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Is the circular economy proposed as sustainability in firm mission statements? A semantic analysis

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ABSTRACT

Clean production, the circular economy and eco-innovation aim at supporting global resilience and sustainability. The present work examines the conceptualization of the circular economy in Italy, via publicly available social media data. Specifically, we conducted a mixed-method analysis of the mission statements of Italian firms, as published on LinkedIn. The semantic network analysis underlined three emergent themes within these statements, referring to sustainability, technology, and production and consumption. A cluster analysis identified the most frequently occurring keywords in each of these themes, which included "sustainable development", "technology", "waste", "products", "management" and "materials." The theme of sustainability was further analyzed with respect to its three main pillars (i.e., social, economic, environmental). According to absolute values, approximately 40% of all firms referenced all of these pillars in their mission statements. The results point to the need for interdisciplinarity at the firm level to ensure competitiveness and greater emphasis on the social component of sustainability.

1. Introduction

Interest in the circular economy is increasing among both academics and business professionals, as evidenced by the growing number of articles referring to various aspects of the circular economy model (Arauzo-Carod et al., 2022; Nikolaou and Tsagarakis, 2021). Importantly, research has shown that the circular economy may efficiently contribute to achieving the Sustainable Development Goals (SDGs). Therefore, firms may play a significant role in driving the transition to sustainability through their participation in the circular economy (Heras-Saizarbitoria et al., 2023; Marshall et al., 2023; Ting et al., 2023). More specifically, research has shown that firms' sustainable practices, business model revision and consistent reporting are needed to support the sustainable transition (Kristoffersen et al., 2021). In this vein, previous studies have evaluated the engagement of firms with the circular economy using a variety of methods, including

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comparative literature reviews, qualitative analyses, and general industry/business research (Cheah et al., 2023; Martinho, 2021).

The present study considered narrative data—specifically, written communication about sustainability and the circular economy—as a key driver of sustainability. Shiller (2017) defined narrative economics as a series of contagious stories and opinions orienting individual and social decisions towards specific market directions. In *The Power of Narrative in Environmental Networks*, Lejano et al. (2013) discussed how narratives presented within a social network may facilitate collective action in support of virtuous goals. Thus, the stories that are told within a particular network may define the virtuous quality of that network.

Both individual and collective actions are based on narratives. The greater the emphasis given to specific topics within these narratives, the greater the individual or collective engagement with those topics. For this reason, previous studies have engaged in discourse analysis of policy planning (Damurski and Oleksy, 2018; Elissalde et al., 2014). This is an appropriate research direction for sustainability, which requires the engagement of individual actors. Firms are strictly linked to society (McMahon, 1986), and their business practices and ethics influence the economic and moral values of their local communities (Guidi et al., 2008). Furthermore, inter-firm/industrial networks promote industrial symbiosis (Agudo et al., 2022), which may lead to sustainable innovation (Long and Liao, 2022).

In the present era of information and communications technology, economic narratives may be formed though online communication. According to the literature, firms use online social networks to communicate their sustainable values, share information with stakeholders and present their long-term strategies (Giacomini et al., 2020; Manetti and Bellucci, 2016; Patuelli and Saracco, 2022). This communication may contribute to shaping the values of their customers and communities. Additionally, firms' green orientation may shape the green attitudes of their workers, thereby increasing the number of "green" job calls (Kouri and Clarke, 2014; Ning et al., 2021; Pejic-Bach et al., 2020). For this reason, the present study considered firms' mission statements as a synthetic measure of the corporate vision shared by all stakeholders.

While previous works have analyzed general narratives that support the circular economy (Dettori and Floris, 2019; Guo et al., 2017; Xiong et al., 2022), the narratives provided by firms remain underexplored, especially considering firms' essential contribution to the sustainable transition. Moreover, previous studies have tended to emphasize the contribution of research to identifying the issues that characterize sustainable development, while failing to deeply investigate content from all stakeholders, including firms (Bhatt et al., 2020; Guleria and Kaur, 2021; Pimenta et al., 2021). Across all sectors, firms are promoting the circular economy in an attempt to achieve competitive advantage (Appolloni et al., 2021; Kusumo et al., 2022). The commitment of these firms to promoting the sustainable benefits of the circular economy might contribute to removing barriers (Ghisellini et al., 2016) and fostering the social support needed for proper governance (Cramer, 2022). Narratives supporting the circular economy may convey future expectations (Lazarevic and Valve, 2017), and such expectations may be particularly evident in firm mission statements (Mion et al., 2021). Accordingly, the present study aimed at mapping Italian firms' understanding of the circular economy by exploring their approaches to sustainability, as communicated in their mission statements. In line with recent studies, the analysis drew on LinkedIn data (Knäble and Tsagarakis, 2023; Tsironis et al., 2022; Tsironis and Tsagarakis, 2023), which is relatively accessible and much more impactful (from a communication perspective) than non-financial reports (as examined in, e.g., Opferkuch et al. (2022)).

The remainder of the paper is structured as follows: Section 2 reports the results of a literature review and outlines the research context; Section 3 describes the methodology used for the research; Section 4 presents and discusses the results of the analyses; and Section 5 provides concluding remarks.

2. The circular economy narrative

Previous studies have evaluated firms' transitions to the circular economy in Italy, identifying the most common practices as "recycling", followed by "reuse" (which has become increasingly widespread over the past 5 years) (Ghisellini and Ulgiati, 2020). Many researchers have also studied the interaction between sustainability and the circular economy, with the aim of clarifying the extent to which circular economy strategies improve social, economic and environmental performance. Additionally, some practical studies have focused on firm-related data. As an example, Bocken et al. (2022) analyzed 150 firms to determine how firm strategies support sufficiency and the transition to the circular economy.

The circular economy has had a significant influence on the waste management sector, in particular (Maliha et al., 2023). Camana et al. (2021) performed a systematic analysis of 609 scientific papers on waste management in Italy, evaluating current tools and the environmental gains associated with certain strategies. Previous research on the circular economy and sustainability has also focused on plastics and the blockchain (Nallapaneni and Chopra, 2023).

A further sector that is directly related to the circular economy is that of construction. Previous research has monitored the use of recycled materials and recyclable prime materials within an Italian region (Ginevra et al., 2021). Circular economy frameworks have also been widely developed in the agriculture sector. Accordingly, a survey conducted by Crovella et al. (2021) mapped the lack of data and proposed a set of replicable sustainability indicators. Research has also outlined the crucial contribution of higher education to the transition to the circular economy (De Medici et al., 2018). Finally, country-based studies have illustrated the implementation of the circular economy in specific industry sectors. For example, Diemer et al. (2022) conducted a literature review to identify the conditions required to improve circularity in French construction firms.

Text mining is a commonly used technique for data analysis, and it can be applied to various platforms and data structures. Some studies have applied text mining analysis to circular economy topics. For instance, Tang and Liao (2021) mined the public preference information of experts using a natural language processing technique, and subsequently clustered those experts into subgroups. Additionally, Mahanty et al. (2021) proposed a mixed-method analysis of the circular economy, integrating topic modeling of the literature and a Delphi study, and identifying a significant rise in the number of circular economy studies beginning in the years 2014–2015. After this time, circular economy research topics became more differentiated, focusing on practical concepts with long-term impacts. A further study proposed a methodology for retrieving knowledge on the recycling and reuse of waste through the classification of data related to a sample patents pool (Spreafico and Spreafico, 2021). Moreover, a literature analysis proposed a data mining–based methodology and constructed a one-dimensional discrete dynamic model on sustainable development and the circular economy in the agriculture sector (Zhenjian et al., 2021). The literature shows that Italy is an excellent case study for assessing the contribution of circular models to achieving the SDGs, because this country ranks fourth behind the Netherlands, Belgium and Germany (Anselmi et al., 2023).

The circular economy is a trending topic in both the academic and the business spheres. Despite the plethora of academic literature and business reports on this subject, there have been few data-based analyses, especially considering data from social media platforms. However, some co-word analysis, word clustering, and keyword frequency studies have been deployed to study circular economy trends in relation to Italian firms.

Following these studies, the present research aimed at investigating firms' sustainable and circular economy discourse through an analysis of their mission statements, as published on social media. The analysis further aimed at identifying the central themes of this discourse, and their relative levels of emphasis. As social values are influenced by the communication of ideals, we analyzed all three pillars of sustainable development. The results showed the prevalence of each of the identified themes, underlining that some were given greater relevance, while others merited further emphasis.

3. Data and methodology

The present study employed a mixed-methods approach to analyze firm mission statements, as regards the circular economy. Mixed-methods approaches are appropriate for complex fields, such as that defined by the intersection of the social sciences and sustainability science (Sovacool et al., 2018). To complement this hybrid field of study, the present research investigated the relationship between firms and sustainability and the circular economy semantically, identifying useful subcategories (Schöggl et al., 2020).

The literature shows that, among online social networks, LinkedIn is particularly useful for gathering business data (Kumar et al., 2019; Pinheiro et al., 2022; Ullah et al., 2021). For this reason, recent studies have used LinkedIn data to investigate emerging business patterns and trends related to the circular economy (Knäble and Tsagarakis, 2023; Tsironis et al., 2022). Following the approach proposed by Tsironis et al. (2022), in the present study, we mined firm mission statements, as published on LinkedIn. We considered these mission statements a synthetic measure of the common vision of all stakeholders. To identify the relevant firms, we applied the following criteria: (i) Italian and (ii) working towards the circular economy. Relative to other online social media platforms, LinkedIn imposes fewer restrictions on word count, thereby allowing more detailed descriptions and, in the present case, mission statements. In addition, LinkedIn users may direct discussions to specific socio-economic issues, thereby generating pre-filtered data (in contrast to general social network data, which address a variety of topics).

Our search queried the tag "circular economy" and selected firms with headquarters based in Italy. This resulted in a sample of 452 firms with data updated to April 10th, 2022. In the first step of the mining process, we identified every firm that included the term "circular economy" in its LinkedIn profile. Second, we extracted the information from each section of these firms' profiles in comma-separated values (CSV) files. Each column of the resulting dataset represented a profile section (e.g., "industry sector", "headquarters location", "year of foundation", "specialties", etc.). These files were then loaded into Excel sheets for further analysis. Fig. 1 summarizes the empirical strategy.

In the first step, we utilized a co-word semantic network to identify discourse patterns. Co-word analysis (CWA) (Callon et al., 1991; Topalli and Ivanaj, 2016) measures the strength of the links between concepts by calculating their co-occurrence, and reveals patterns of associations (Coulter et al., 1998). The result of this analysis was a bipartite network in which firms were connected through words; words, in turn, were connected within and between firms, evidencing (apparently) hidden, shared topics. While this approach has been applied to map trends in economic (Topalli and Ivanaj, 2016), political (Shao et al., 2021) and social spheres (Irfan et al., 2015), to the best of our knowledge, the present study was the first to apply this technique to reconstruct firms' "circular puzzle". As will be discussed in the results, the analysis successfully identified three relevant themes: (i) sustainability, (ii) technology and (iii) production and consumption.

Sustainability and sustainable practices are relevant to firms' corporate social responsibility (CSR) strategies (Camilleri, 2020; Nguyen et al., 2023; Sanchez-Planelles et al., 2022), which include economic, environmental and social aspects (Epstein et al., 2018). However, the technological aspects of sustainable progress are also crucial (Dantas et al., 2021; Vu et al., 2023), and the emergence of a technological theme is therefore worthy of attention. Finally, the third theme refers to the need to redesign production and consumption models to support the circular economy (Nikolaou and Tsagarakis, 2021).

The first step of the analysis determined the prevalence of these themes across firms and industries. The second step proposed an interesting disentanglement of the three pillars of sustainability (i.e., social, economic, environmental), based

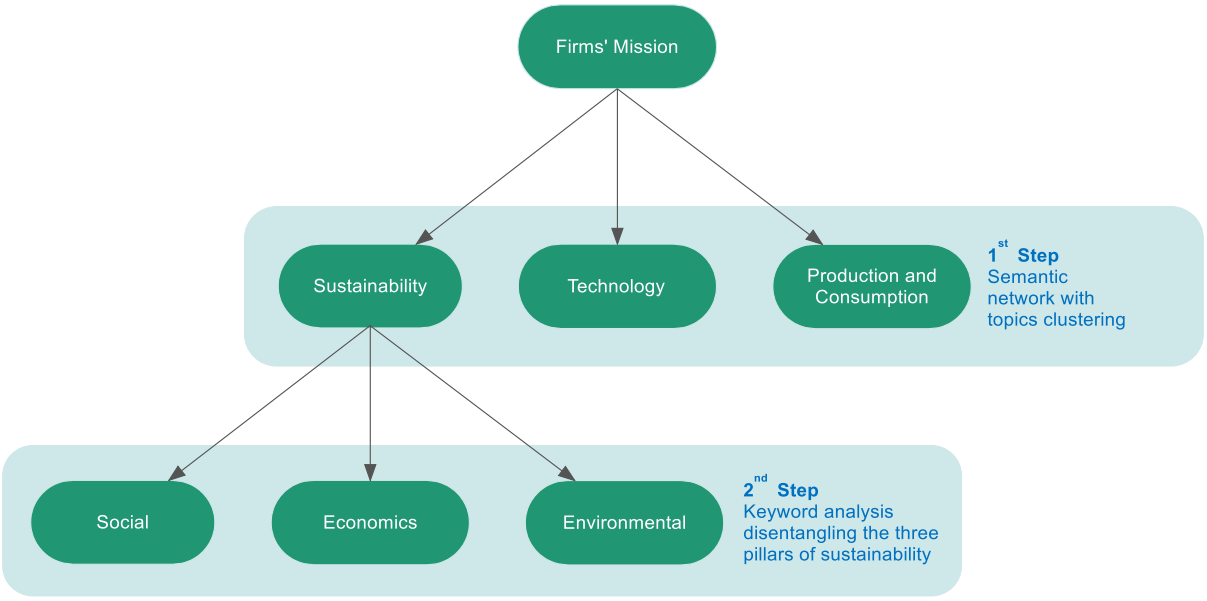

Fig. 1. Summary of the empirical strategy.

on a keyword analysis. This aimed at the greater integration of social aspects into the circular economy and sustainability discourse, as recommended by previous research (see D'Adamo et al. (2021) and Mies and Gold (2021)).

Overall, the analysis aimed at investigating Italian firms' vision of the circular economy, mapping emergent themes and identifying their relative degrees of emphasis. The findings shed light on which topics are currently being given more priority, as well as which topics are currently being treated more peripherally and may be fostered to facilitate the sustainable transition.

4. Results

In what follows, we present the main results of the analysis. Specifically, Section 4.1 provides a descriptive analysis of the firms; and Section 4.2 outlines the results of the semantic network analysis, showing the emergence of the three themes (i.e., sustainability, technology, production and consumption). Section 4.2also analyzes the three pillars of sustainability, showing the weight given to environmental, economic, and social aspects in firms' circular economy discourse.

4.1. Descriptive findings

A preliminary statistical analysis, framing the main research, was conducted to capture firms' distribution across the following sectors: "renewables and environment" (59 firms), "environmental services" (47 firms), "research" (27 firms), "management consulting" (24 firms), and "apparel and fashion" (22 firms). Additionally, the "specialties" section of the dataset conveyed valuable information regarding firms' circular economy activities, with the most frequently occurring keywords including "sustainability" (68), "green economy" (34), "innovation" (32), "recycling" (24), and "design" (19). Of note, literal references to the "circular economy" and words in languages other than English were excluded from the analysis. Fig. 2 displays the geographical distribution of the sample. A gap between the north and the south is evident, with the vast majority of firms located in the north and most regions in the north (i.e., approximately 72%) demonstrating a per capita GDP of approximately twice that of the southern regions (where only 10% of firms were based).

4.1.1. semantic network and topic clustering

We focused our analysis on the "description" section of firms' mission statements. Employing a "bag of word" approach, we tokenized the words in each statement, generating 32,723 words. We disregarded all references to the "circular economy", since these were included in all statements by design and they might bias the thematic clustering (i.e., creating a systematic connection between potentially different concepts). We also removed typical "stop words", such as articles and symbols. Finally, we removed low-frequency words, such as numbers and firm-specific terms that were useless for the purpose of clustering.

On the basis of the resulting semantic network, we clustered co-occurring words to identify topics (similar to Topalli and Ivanaj (2016)). We used the weighted modularity clustering method to account for the intensity (i.e., link weight) of

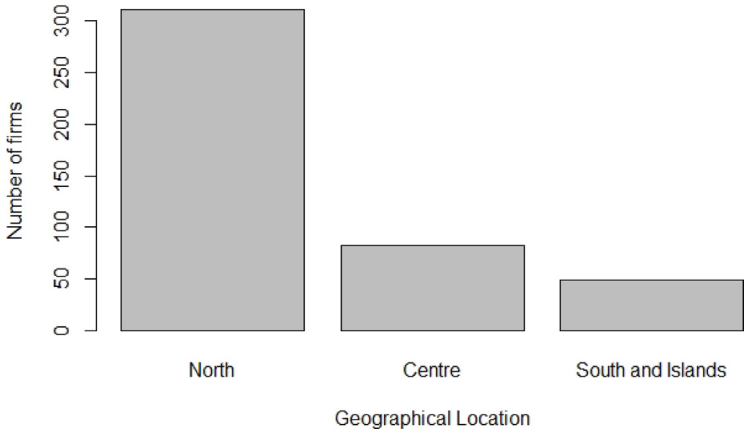

Fig. 2. Geographical distribution of Italian firms operating in the circular economy.

Fig. 3. Topics emerging from the cluster analysis: (i) sustainability, (ii) technology and (iii) production and consumption.

Table 1
Example firm mission statements for each theme.

Firm	Description	Theme
Firm 1	"*Our products are premium upcycled denim quality, handmade, vegan and eco-friendly materials. All phases of production are transparent and made by sustainable production and circular economy.*"	Production and consumption
Firm 2	"*CarboREM is an innovative start-up that develops treatment plants for waste water sludges, converting them in energy (biogas) and potentially recovering all the nutrients content before creating useful biochar.*"	Technology
Firm 3	"*We help legacy leaders in achieving radical business evolution, through human inspiration and powerful tools. Our aim is to accelerate the positive transformation of economic and cultural paradigms, by designing actions today so that humanity and the biosphere can benefit tomorrow.*"	Sustainability

connection between words, in line with the conventional method for text clustering proposed by some authors (Blondel et al., 2008; Leydesdorff and Nerghes, 2017). Fig. 3 depicts the results. The size of each word was weighted on the basis of vertex strength (i.e. connection intensity), and therefore network centrality.

As anticipated in Section 2, three themes emerged: (i) sustainability, (ii) technology and (iii) production and consumption. Specifically, the three pillars of sustainability (i.e., social, economic, environmental) were reflected in the (key)words "social", "people", "environmental", "green", "business", and "economic". Furthermore, "research", "technology", and "management" identified technological topics. Finally, production and consumption were characterized by the keywords "production", "supply" and "products", as well as topics related to supply chain management.

Table 1 reports a sample of firms' mission statements in relation to each theme, in order to outline the coherence of the thematic classification of firm narratives.

Thus, the analysis identified three relevant themes, in line with the literature.

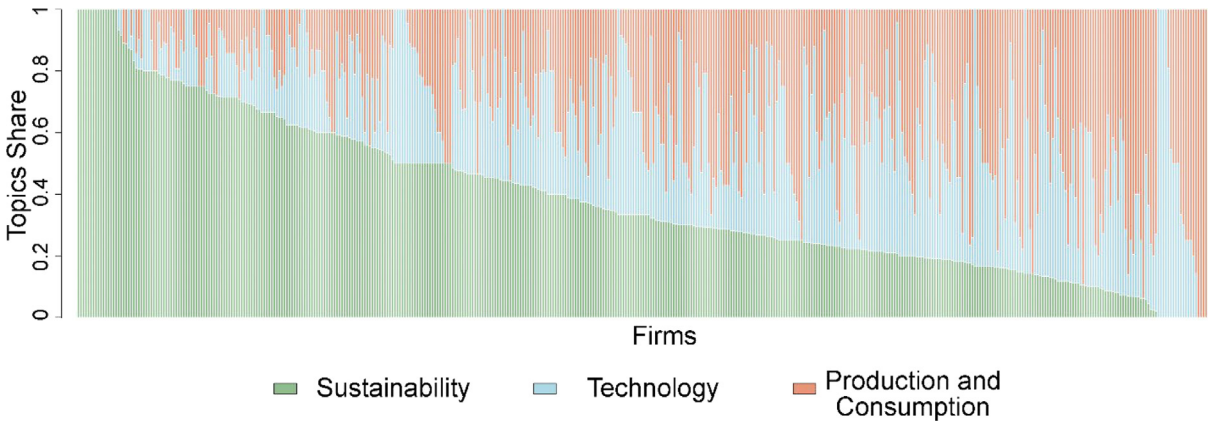

Fig. 4. Prevalence of each theme across firms.

The circular economy implies the extraction of value from waste. In this perspective, use of the "3Rs" (i.e., reduce, reuse, recycle) may lead to a competitive advantage (Sharma et al., 2021). A theoretical framework composed of mindsets, values, behaviors, skills and competencies may create a circularity-oriented culture, which is likely to support business sustainability (Bertassini et al., 2021). However, circular benefits should be distributed between primary and secondary products (Corona et al., 2019; Morone et al., 2021), to prevent a circular economy rebound effect (Laurenti et al., 2018).

A wide variety of technologies are closely related to the circular economy (Chiappetta Jabbour et al., 2019), including big data analytics, the blockchain, the cloud, artificial intelligence, the Internet of Things, industrial simulation and additive manufacturing (Dalenogare et al., 2018). Such sustainable innovations have altered the traditional business models of manufacturing firms (Agarwal and Brem, 2017), forcing them to consider challenges related to flexibility (Sassanelli and Terzi, 2022) and reshoring (Fernández-Miguel et al., 2022).

Sustainability is crucial to the transition to the circular economy (Di Vaio et al., 2023), and firms are under pressure to attend closely to the SDGs (Calabrese et al., 2021). SDG 12, aimed at ensuring responsible production and consumption, calls on businesses to practice dynamic demand and manage the depletion of certain resources (Kostakis and Tsagarakis, 2021). However, a firm's ecological footprint can only be changed through the participation of all economic agents involved in the supply chain (Pineiro-Villaverde and García-Álvarez, 2020). This requires the support of numerical assessments that simultaneously address both business and consumer concerns, to identify possible synergies, codifying benefits and critical factors. Thus, business and consumer engagement is needed to support the sustainable transition (Camacho-Otero et al., 2020; de Oliveira Neto et al., 2022). Specifically, greater attention must be paid to resources, driven by either sustainability concerns (Velenturf and Purnell, 2021) or the need to identify suitable policies (Camilleri, 2020).

To explore differences in the prevalence of certain themes across firms, we conducted a distribution analysis. As a normalized composite index, we considered the share of words related to a specific theme relative to the total number of words in each statement. Fig. 4 displays the resulting distribution. This analysis conferred quantitative information and supported a deeper analysis of the initial results. In quantitative terms, we observed a higher prevalence of the sustainability theme (41%), followed by production and consumption (32%) and technology (25%). A Kolmogorov–Smirnov test (Tampakoudis and Anagnostopoulou, 2020) confirmed these results (see Fig. 5, which presents the topic decumulative distribution). As is evident, as the number of firms grew (x-axis), the prevalence of sustainable topics (y-axis) rose.

Subsequently, we analyzed the coexistence of different themes in individual firm statements, identifying specific distribution patterns. According to the equal distribution hypothesis, if the three themes were equally distributed within each firm, then the prevalence of each would be approximately 33%. We performed a frequency test to detect distinct cases, checking for cases in which the empirical frequency was not statistically different from the expected frequency. When the prevalence of a particular theme exceeded the theoretical prediction, then that theme was considered relevant to the firm. Otherwise, the null hypothesis of equal balance was considered verified. This did not exclude the possibility that firms could have two relevant themes (as shown in Fig. 6). Of interest, all three themes were relevant to the sample, but the sustainability theme emerged more frequently than the others (confirming the previous results). The absolute values showed that 190 firms referred to all three themes, suggesting that interdisciplinarity is the new frontier of not only academic research, but also business practice. Indeed, the sustainability challenge is complex, and new digital and sustainable skills may require both training courses and cooperation with new professional figures. Firms that did not present all three themes together typically focused on only one: (sustainability, 93 firms; production and consumption, 62 firms; technology, 38 firms). However, 30 firms focused on two themes (in different combinations).

We repeated this analysis at an industry level, following Tsironis et al. (2022). For this purpose, we considered the top 15 relevant industries, in accordance with the number of firms in each category. The heat map in Fig. 7 summarizes the results. Data were normalized by the sum of firms within each industry. Once again, we observed a higher prevalence

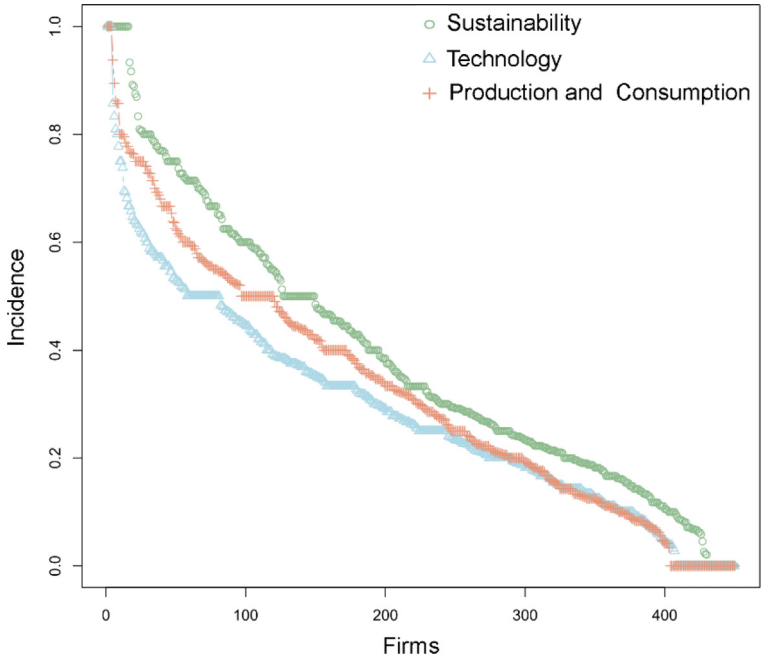

Fig. 5. Decumulative distribution of each theme, across firms.

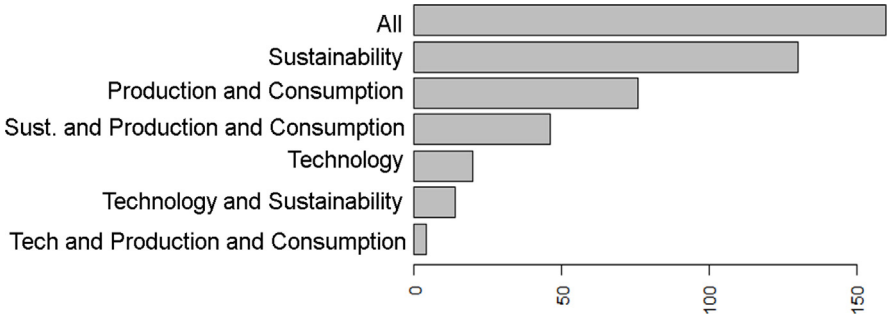

Fig. 6. Relevant themes (y-axis) across firms (x-axis). Data represent frequencies.

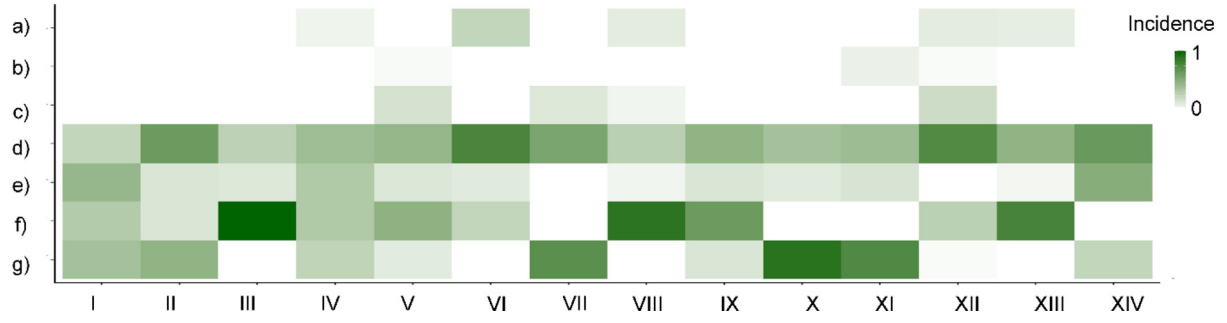

Fig. 7. Theme prevalence across the most significant industries. On the x-axis: (i) apparel and fashion, (ii) chemicals, (iii) civic and social organization, (iv) design, (v) environmental services, (vi) machinery, (vii) management and consulting, (viii) non-profit organizations, (ix) packaging and containers, (x) plastics, (xi) renewables and environment, (xii) research, (xiii) textiles. On the y-axis: (a) sustainability and technology, (b) technology and production and consumption, (c) technology, (d) all, (e) sustainability and production and consumption, (f) sustainability, (g) production and consumption. Incidence is normalized for each sector.

of the sustainability theme, and a higher prevalence of the production and consumption and the technology themes in specific industries, only (i.e., production and consumption in the plastics sector, technology in the research sector).

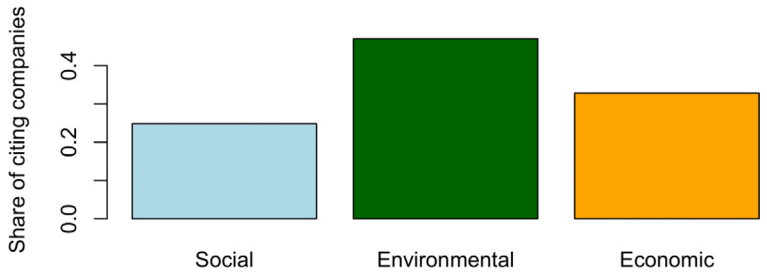

Fig. 8. References to the social, environmental and economic pillars of sustainability across firms. Data are relative frequencies.

The literature shows that the circular economy is primarily about production and packaging, with a specific focus on sourcing strategies and end-of-life activities (Molla et al., 2023; Stewart and Niero, 2018). However, most collaborations are at the firm level, and not the consumer level. Differently, concepts such as green-circular premiums and sustainable certification identify consumer participation as crucial (Appolloni et al., 2022). As a result, business model innovation enables firms to reformulate their value proposition (Chiappetta Jabbour et al., 2020). In fact, the technological transition towards sustainability does not preclude, but rather enhances productivity and profitability (Shakeel et al., 2020). In addition, it is crucial to combine the goals of sustainability with those of resilience (Paul et al., 2023).

The results of this analysis identified that circular and sustainable practices were not operationally equivalent across sectors. However, at the level of communication, several points of shared interest emerged, highlighting the same three themes and determining a number of managerial conclusions: (i) business communication may serve to attract not only consumers, but also investors; therefore, in the present sample, there was a tendency to convey a common message; and (ii) firms may take their cues from others, even across sectors. In fact, the present results suggest that a benchmarking process occurred that placed firms outside the potential market if they did not communicate these topics. Consequently, what emerged was not a set of differentiated elements that might be conducive to potential blue ocean strategies, but a similar narrative strategy across firms. However, the big mistake that firms can make is to expound on sustainability concepts but not apply them. Indeed, phenomena such as greenwashing can reduce the credibility of a brand and result in serious economic losses far greater in value than the potential benefits associated with sustainability.

The results of this analysis may be used to model the circular and green orientation of firms and analyze the long-run trajectories of the green transition (Debref et al., 2022; Pyka et al., 2022).

4.2. Prevalence of the social, environmental and economic pillars of sustainability in firms' circular economy discourse

As emphasized in the previous section, sustainability may be subdivided into three pillars (D'Adamo et al., 2021; Mies and Gold, 2021). Hence, we examined the prevalence of these baseline pillars in firms' circular economy discourse. Since intensive computational methods were not able to further disentangle the theme structure, we conducted a keyword analysis to determine the prevalence of each pillar in the firm descriptions, in line with conventional methods (Giudice et al., 2020). The most frequent words included: "social" and "people", with respect to the social pillar; "environment" and "green", with respect to the environmental pillar; and "business" and "economic", with respect to the economic pillar. For robustness, we repeated the analysis using only one keyword per theme (i.e., "social", "environment", "economic"), obtaining similar results. Fig. 8 reports the prevalence of firms' references to each pillar. We found a predominance of environmental references (44%), and fewer references to economic (32%) and social (approximately 24%) aspects.

This second phase of the analysis was very useful, since the topic of sustainability is typically subdivided into its three components. Initially, the environmental pillar emerged as most crucial, underlining the protection of eco-systems, humans and nature from harmful actions. However, sustainability also extends to economic opportunities. In fact, a long-term vision of sustainability requires economic welfare, with fairly paid workers and distributed income. Thus, while firms should not aim solely at profit, civil economy models show that circular practices may result in greater profit. CSR theory pushes in this direction.

Typically, incentives aim at making sustainable practices competitive with traditional ones. They are most effective when they are accompanied by taxation based on environmental impact. Otherwise, a global process may be triggered whereby firms fail to operate in a model of fair competition. Beyond these economic elements, social aspects are also relevant. There is also an ethical aspect, which is often underestimated because it is not directly associated with any objective result.

The results of the present analysis referred only to firms' theoretical visions, rather than their operational realities (representing a limitation of this work). Thus, it would be useful for future research to explore how the distribution of references to the three pillars of sustainability might change over the different phases of a firm's life.

Previous research has focused predominantly on the economic aspect of sustainability, aimed at proposing new frameworks to reconcile economic growth with environmental protection (Miola and Schiltz, 2019). While it is true that distinctions can be made between the different SDGs (Costanza et al., 2016; Kettunen et al., 2018), new studies are

needed to research the relationships between them (Anselmi et al., 2023; Bali Swain and Ranganathan, 2021). Quantitative analyses tend to make certain processes more objective, but this should not come at the cost of research into aspects that are more difficult to quantify. To this end, the social component should be aggregated with the other components of sustainability.

4.3. Discussion and policy implications

In line with the literature, our working hypothesis assumed that firm values have an influence on societal values (Guidi et al., 2008; McMahon, 1986). Indeed, considering the pivotal role played by communication in shaping ideas and decisions (Lejano et al., 2013; Shiller, 2017), firm messaging may be crucial for determining which principles a society emphasizes. Consequently, we hoped to see firms highlighting the cornerstones of sustainable growth.

The present study contributed to the literature by exploring and quantifying subthemes of the circular economy, as communicated through firm mission statements. Specifically, we analyzed LinkedIn data. Differently from other social media platforms, LinkedIn imposes fewer restrictions on word count. Therefore, LinkedIn data can provide more detail—in this case, on firms' missions.

Methodologically, we introduced a semantic network, combining qualitative and quantitative analyses to identify the topics that were highlighted in firms' circular economy discourse. In line with the literature, these emerged as: (i) sustainability, (ii) technology and (iii) production and consumption. While these results were expected, they also validated the effectiveness of the proposed method of discourse theme mapping. Additionally, the analysis drew on different techniques to provide a quantitative measure of the prevalence of each theme, thereby identifying their relative degrees of centrality. This methodology can be used for further research on larger samples, with the aim of reconstructing the values shared by an entire network, considering all stakeholders.

The results suggest that Italian firms understand the concept of the circular economy and describe it in the correct terms. However, some of the best practices of the circular economy have not yet translated into real results. In particular, where economic prosperity is juxtaposed with sustainable initiatives, correctives may be needed. A proposed solution is contained in the NextGenerationEU scheme, which provides significant funding for green transactions. Importantly, this money should not be used only to improve firms' missions or visions, but it should also be used to help firms implement new business models, make greater use of natural raw materials, expand their reuse of resources and increase their receptivity to the innovative ideas of young people. A country that is lacking in raw materials or dependent on others is destined to be unsuccessful. Thus, resources are needed to strengthen green and circular "Made in Italy" programs and increase Italy's industrial position relative to other countries. At that point, it will be up to consumers to privilege the choices of firms and services that passionately embrace the cause of sustainability, in order to maintain resources and prevent excess debt for future generations.

The present results also highlight some political implications. First, public resources should be used to encourage new entrepreneurial activities in southern Italy. Furthermore, funding should be differentiated between large and small-medium firms, to favor sustainable community models based on industrial symbiosis and shared resources and knowledge. It is therefore necessary that all public funds for the ecological transition be publicized. This may require staff training and the recruitment of new graduates (to benefit from their know-how). Second, a significant proportion of funds should be allocated to startups, to generate sustainable incubators in which to experiment with new businesses and ideas. Finally, action should be taken to support the certification of products and services, in order to prevent greenwashing and circular economy rebound effects, and create a virtuous supply chain with consumers.

5. Conclusions

The circular economy recalls an activity that was often practiced in the past. It holds that nothing should be thrown away, because the purchase of something new incurs a cost and is not always necessary. However, the circular economy rebound effect suggests that the circular economy may not always move towards sustainability.

The global socio-economic crisis brought about by the COVID-19 pandemic and ongoing war in Europe has sharpened the economic distance within nations, as evidenced by a shrinking middle class and the decline of many industries. Added to this, exorbitant energy costs and raw material shortages are placing unstoppable brakes on economic growth. In this context, Italy—a country that is heavily dependent on other nations for raw materials—stands to benefit significantly from the implementation of circular economy models. Such models would not only contribute to environmental protection, but also provide new resources for production cycles at a low cost.

The present work involved a mixed-method analysis of the mission statements of Italian firms, as published on LinkedIn. The results suggest that Italian firms have a clear understanding of the importance of the circular economy.

A significant limitation of the analysis refers to the spatial distribution of the investigated firms. The south was underrepresented, with the number of firms proposing circular actions far less than the number in the north. Of note, the figure for central Italy was slightly higher than that of the south; yet, taken together, these regions failed to make up even 30% of the entire sample. Thus, central and southern Italy may have untapped potential, and the transformation of existing firms or the launch of new industrial activities in these areas should be encouraged. Indeed, a more even spatial distribution would support the principle of sustainability.

Second, considering the results of the text mining analysis, while the level of communication was consistent across all sectors, this might only be valid at the embryonic stage of green production.

In the present sample, firms made significantly more references to sustainability, compared to technology and production and consumption. However, within their references to sustainability, firms gave relatively less space to social concerns. Circular economy models are challenged by the need to invest in technological innovation to both contain production costs and create a virtuous, sustainable, efficient and effective supply chain. Additionally, consumers must recognize the value of "green" products not only through their acts of purchasing, but also in their apprehension of concrete facts. Such apprehension can change cultures and society, encouraging individuals to make more responsible choices and purchases.

Future research might overcome the above-mentioned limitations by exploiting LinkedIn data to reconstruct the "working interactions" between different shareholders and stakeholders, exploring how the ethical (i.e., sustainable) values of a firm are reflected in its operational networks.

The present work attended to the social component of sustainability, and its contribution to determining worker activities and society's overall perception of firms. The circular economy may support the achievement of SDG 12, alongside others. To this end, business actions must consider all three pillars of sustainability to achieve competitive advantage, while also focusing on the themes of technology and production and consumption. The common element across these themes is interdisciplinary innovation.

CRediT authorship contribution statement

Rocco Caferra: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **George Tsironis:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Andrea Morone:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Konstantinos P. Tsagarakis:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Piergiuseppe Morone:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Idiano D'Adamo:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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