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## **Environmental and socio-technical transitions in IBEX 35 companies: fsQCA analysis of the media representation of innovation and sustainability**

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**Abstract:** Socio-technical transitions and environmental transformation have an important reflection on the decisions of companies. The analysis of the reality refracted in public opinion is a proxy to the change in the management styles of large companies. This paper analysed the sustainability strategies of companies indexed in the IBEX 35. First, a semantic and contextual analysis of 424 news items published in the press for the 35 main Spanish companies during 2019 was carried out using T-LAB software. The Factiva® database, owned by Dow Jones and Company®, was used. Second, an fuzzy set qualitative comparative analysis (fsQCA) analysis was carried out to analyse the dissemination blueprints in international media of the green strategies of the IBEX 35 companies. Economic and media attributes were used to analyse the causal relationship. The results suggest the design and implementation of different strategies for the international media representation of business sustainability.

**Keywords:** socio-technical transitions; strategy; fuzzy set; QCA; qualitative comparative analysis; fsQCA; fuzzy set qualitative comparative analysis; factiva; IBEX; IBEX 35; green strategies; media representation; fsQCA robustness; fsQCA robustness coefficient.

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## **1 Introduction**

The Brundtland Report (WCED, 1987) represented a turning point in the analysis of the environment. Over the last 50 years, social and business concerns have evolved in appreciating economic, social and environmental sustainability as an important challenge that drives change and strategic innovation (Fichter and Paech, 2004; Van Kleef and Roome, 2007; Wüstenhagen, 2008; Kuhlman and Farrington, 2020; Fernandes et al., 2019).

Social transformation has been constant in recent decades. The long-term vision is that responsibility in the consumption of resources makes it possible for consumers to demand decisive action from companies to change the market. The environmental approach guides strategic change (Aragón-Correa et al., 2008), new business models (Joyce and Paquin, 2016), the design of innovation strategies (Noci and Verganti, 1999; Orlitzky et al., 2011), and sustainability-oriented innovations (SOIs) (Fichter and Paech, 2004; Fernandes et al., 2019).

In recent decades, sustainable transition (Markard et al., 2012) has featured in important public debates. The collective imagination of socio-technical transitions (Rosenbloom et al., 2016) configures generalised public opinion in citizens. In this sense, large companies contribute to shaping public discourse using different narratives over time. Their stories connect with all stakeholders and create a possible story that acts as a driving force behind corporate strategy.

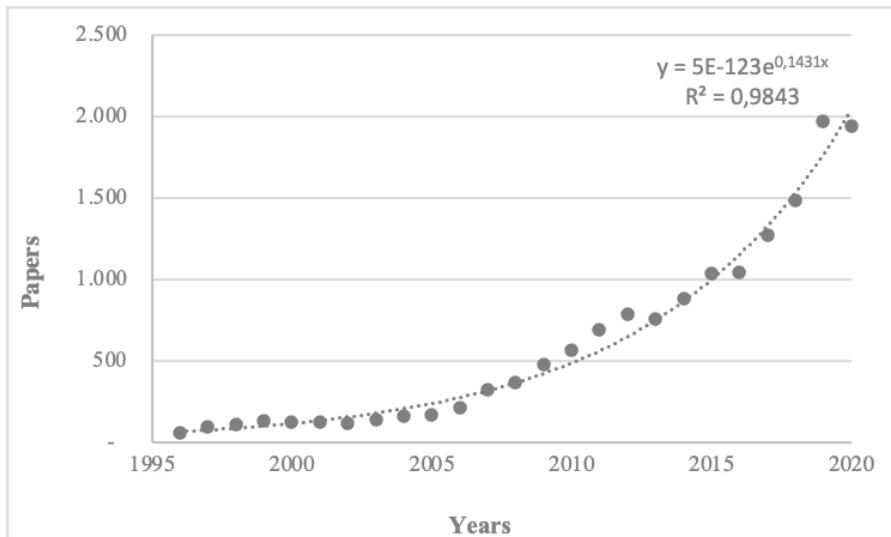
Companies make decisions that affect their leadership styles, driving directions of their strategy. The course of action and strategic implementation is reflected in the press as media representation. Their analysis allows identifying the versions of reality that companies internalise and project, configuring a refracted reality (Lippmann, 2003). Society takes this reflection projected by the media to build, structure and alter public opinion (Mcquail, 2000).

In this sense, the media contribute to the dissemination of new sustainability models, calibrating their level of relative importance (Entman, 1993) and building a public image (Fernández Reyes, 2004) of the socio-technical transition process and the evolution of green business models. These new frames of reference allow citizens to interpret issues of public interest such as the type of sustainable relationships that companies create and the way in which their activity affects all stakeholders (Scheufele, 1999).

The narrative on environmental and socio-technical transitions determines the economic behaviour of the agents, in addition to modifying the international projection and the positioning of the companies. Taking into consideration agenda-setting as a contingent factor (Aruguete, 2017; Anderson et al., 2020), the discourse observed in the press is a proxy of the reality refracted by the media (Lippmann, 2003).

The narrative constructed by the media affects the general vision that society obtains on an issue and, consequently, the behaviour of stakeholders is affected by the state of opinion existing in the public discourse on that issue, similar to how the media and the stock markets interact (Tetlock, 2007).

In recent years, academic interest in sustainability and its impact on the economy and management systems has increased. The Web of Science core collection query shows 15,303 results.<sup>1</sup> A strong intensification has been observed in recent years (Figure 1).

**Figure 1** Trend of published scientific papers on socio-technical transitions, sustainability and sustainability-oriented innovations

The impact of this field of knowledge is increasingly relevant for companies and their performance. The global decarbonisation strategy poses great challenges to society (Stripple and Bulkeley, 2019; Geels, 2018; Geels et al., 2017a; 2017b) and its replacement by renewable energies represents a great political opportunity (Langhelle et al., 2019; Bulkeley et al., 2014) of economic development and business administration (Upham et al., 2020; Papachristos, 2017; Rosenbloom et al., 2016; Bulkeley et al., 2014).

In this sense, the integration of financial information and non-financial information of companies is an important subject of study (Ibáñez, 2021), especially in the verification of sustainability reports and their impact on stock prices (Quirós et al., 2021) and how sustainability could be related to governance (Andreu-Pinillos et al., 2020). Thus, the interest of researchers has been consolidated in studying how companies can enhance adherence with stakeholders (Neessen et al., 2021) at the same time that they impact on the innovation of business models (Goni et al., 2021; Shakeel et al., 2020).

The study of the discourse created in the media has important advantages:

- 1 understanding the configuration of public opinion;
- 2 knowing the topics of interest that have been set by the agenda-setting;
- 3 studying the impact of this story on international public opinion; and
- 4 analysing the dissemination strategies of innovation and sustainability policies.

This paper follows this structure: first, it raises the research question and purpose; second, the materials and methods used are described, focusing on aspects such as the sample, the contextual analysis or the fuzzy set qualitative comparative analysis (fsQCA) methodology; third, the results and discussion are described; fourth, it addresses the conclusions and the references used.

## 2 Research question and purpose

As mentioned above, public opinion on innovation and sustainability is formed through the messages introduced in the media agenda, fundamentally through the promotion of individual company narratives. This study focuses its analysis on the main Spanish companies indexed in the IBEX 35 and evaluates the discourse configured by these companies in world public opinion in 2019. Taking this context, two research questions were developed:

- 1 What is the discourse on innovation and sustainability constructed in 2019 by the main Spanish companies?
- 2 What were the strategies designed by the IBEX 35 companies for the internationalisation of their innovation and sustainability narratives?

An important novelty of this study lies in using the semantic and contextual analysis of published opinion to analyse the discourse of the main Spanish companies for the international dissemination of their narratives on innovation and sustainability. The semantic analysis allows us to know the most frequent slogans appearing in the press and their association by pairs of words. In addition, the comparison by pairs of words shows the core topics of interest that characterise the discourse constructed by large Spanish companies on innovation and sustainability.

Another contribution of this paper to management literature is the performance of an fsQCA analysis to identify the main attributes that allow the design of different strategies aimed at increasing innovation and sustainability in the positioning of companies.

This methodology offers a valid option to understand the complexity of the factors that influence the increase in the international media of IBEX 35 companies. fsQCA analysis focuses on the theoretical logic of sets and allows to examine multiple equifinal alternatives that lead to the same result and to identify the conditions that may be necessary or sufficient for the said result. The methodology used is suitable for small samples and allows examination of multiple equifinal alternatives, distinguishing between necessary and sufficient attributes.

This study has important implications for management teams and CEOs. The findings and methodology used in this paper are useful to analysts of corporate strategy, social responsibility and brand value management. The analysis of the conclusions allows to orient and guide the business strategy in the socio-technical transition process. Thus, this study is aimed at generating long-term value for the stakeholders of a company based on the green strategy. Additionally, this research offers important insights for investors in efficient portfolio management.

## 3 Materials and methods

### 3.1 Sample

We searched for news published in the press, using the Factiva® database, owned by Down Jones & Company ©. This tool provides access to more than 32,000 media outlets around the world and 265 Spanish media and news agencies. The period of analysis is 1 January, 2019 to 31 December, 2019.

Four types of searches were carried out. The first search aimed to extract all the news published in the Spanish press and in the Spanish language, which included the name of the companies indexed in the IBEX 35. The companies were listed by full name and acronym, adding the terms 'sustainability and innovation' using the Boolean AND operator.

The trading acronyms were analysed in Factiva © to avoid the risk of a false positive (type I error). The use of an acronym was discarded when at least one result other than the analysed company appeared in the first 100 search results. In such cases only the company name was used.

When the search did not reveal any errors among the first 100 results, the full name of the company and its acronym were used. Otherwise, when at least one organisation matching the acronym of the analysed companies was found in the first 100 results, only the full name of the company was used.

The 2019 news sample ( $N = 424$ ) was used for the semantic analysis of public opinion built on innovation and sustainability by IBEX 35 companies.

The second search followed a protocol similar to the previous search (news in Spanish language published in Spanish media, applying controls to avoid type I error). However, this search found the number of news published individually, for each company, as long as the headline or abstract included the company name and the terms innovation and sustainability. The news found comprised all the news that included in the headline or summary the name of the company and the disclosure of its innovation and sustainability strategy. The variable obtained was called innovation and sustainability news (ISN).

The third search followed the same protocol, broadening its search and extending it to all the news published about the company under study in Spanish and in Spain. The variable obtained was called total national news (TNN).

The fourth search followed the same protocol and, furthermore, extended its analysis in an international perspective, including all countries and all languages. The variable obtained was called total international news (TIN).

Next, the variables non-national news (NNN), news internationalisation rate (NIR) and sustainability and innovation rate (SIR) were obtained, through the following calculations:

- $SIR = (ISN/TNN) * 100$
- $NNN = TIN - TNN$
- $NIR = (NNN/TIN) * 100$

In addition, the following financial variables were downloaded for 2019:

- PER (Price Earnings Ratio)
- EPS (Earnings per share)
- EV/EBITDA (Enterprise value/earnings before interest, taxes, depreciation, and amortisation).

The information was provided by Bolsas y Mercados Españoles (BME), to SIX Group Company. BME is the operator of all stock markets and financial systems in Spain and provides global market access systems to issuers, intermediaries and investors in Europe,

America and Africa (BME, 2020). Table 1 includes the financial and media variables obtained for the IBEX 35 companies.

**Table 1** Media and financial variables of the IBEX 35 companies in 2019

<i>Companies</i>		<i>Media variables</i>						<i>Financial variables</i>		
<i>Name</i>	<i>Ticker</i>	<i>ISN</i>	<i>TNN</i>	<i>TIN</i>	<i>NNN</i>	<i>NIR</i>	<i>SIR</i>	<i>PER</i>	<i>EPS</i>	<i>EV/EBITDA</i>
Acciona	ANA	337	3378	3642	264	7.25%	9.98%	17.39	4.25	7.73
Acerinox	ACX	22	4450	4730	280	5.92%	0.49%	10.07	0.86	5.26
ACS	ACS	94	2904	3166	262	8.28%	3.24%	11.63	2.91	3.14
Aena	AENA	171	2860	3024	164	5.42%	5.98%	15.34	8.85	9.31
Almirall	ALM	13	635	652	17	2.61%	2.05%	27.68	0.48	10.94
Amadeus	AMS	58	3038	3283	245	7.46%	1.91%	23.31	2.61	12.86
Arcelor Mittal	MTS	119	6267	6988	721	10.32%	1.90%	0	-2.40	0
Banco Sabadell	SAB	215	2440	2665	225	8.44%	8.81%	20.01	0.05	0
Banco Santander	SAN	471	2623	2964	341	11.50%	17.96%	8.54	0.47	0
Bankia	BKIA	320	8345	8915	570	6.39%	3.83%	11.13	0.23	0
BBVA	BBVA	714	9540	10346	806	7.79%	7.48%	6.59	0.7	0
Bankinter	BKT	108	6363	6788	425	6.26%	1.70%	12.31	0.57	0
CaixaBank	CABK	630	7836	8483	647	7.63%	8.04%	9.89	0.32	0
Cellnex Telecom	CLNX	50	4540	4969	429	8.63%	1.10%	284.68	0.06	47.91
Cie Automotive	CIE	75	3731	4024	293	7.28%	2.01%	14.49	1.48	5.79
Colonial	COL	49	2591	2784	193	6.93%	1.89%	36.98	0.22	30.02
Enagas	ENG	147	4199	4430	231	5.21%	3.50%	12.76	1.85	8.87
Endesa	ELE	573	4042	4314	272	6.31%	14.18%	14.14	1.42	8.40
Ferrovial	FER	266	3289	3563	274	7.69%	8.09%	-29.01	-0.61	39.74
Siemens Gamesa	GAM	77	3883	4299	416	9.68%	1.98%	17.34	0.61	17.21
Naturgy	GAS	357	3937	4196	259	6.17%	9.07%	-7.89	-2.82	7.72
Grifols	GRF	23	3525	3819	294	7.70%	0.65%	23.08	0.99	16.51
IAG	IAG	1008	5554	6044	490	8.11%	18.15%	6.28	0.75	1.54
Iberdrola	IBE	861	7196	7665	469	6.12%	11.96%	14.93	0.47	11.04
Indra	IDR	265	3402	3646	244	6.69%	7.79%	11.93	0.69	5.42
Inditex	ITX	416	6230	6750	520	7.70%	6.68%	20.21	1.11	12.63
Mapfre	MAP	292	2534	2761	227	8.22%	11.52%	13.65	0.17	0
Más Móvil	ICOM	96	2889	3086	197	6.38%	3.32%	28.74	0.71	7.42
Meliá	MEL	192	2825	3036	211	6.95%	6.80%	13.47	0.61	4.19
Merlin Properties	MRL	161	2828	3051	223	7.31%	5.69%	17.68	0.61	23.22
Pharmamar	PHM	8	586	617	31	5.02%	1.37%	0	-0.04	47.99
Red Eléctrica	REE	412	3739	3907	168	4.30%	11.02%	14.97	1.3	8.61
Repsol	REP	550	5709	6216	507	8.16%	9.63%	9.66	1.46	2.29
Telefónica	TEF	841	7184	7947	763	9.60%	11.71%	9.06	0.81	3.77
Viscofan	VIS	25	2388	2542	154	6.06%	1.05%	18.16	2.65	14.30

### 3.2 *Contextual analysis*

The perspective of socio-technical transitions in media representation emphasises the refracted reality (Lippmann, 2003) and the social construction of sustainability. The news were processed with T-LAB Plus 2020, a data analysis software that offers statistical, graphical, and content analysis applications, by identifying word patterns (T-LAB, 2020). Next, the vocabulary was built by performing an analysis based on two types of textual units: elementary contexts and lexical units.

On the one hand, elementary contexts facilitate the segmentation of the linguistic corpus in the evaluation of cooccurrences. These syntagmatic units include one or more sentences. On the other hand, lexical units contain two types of information: words and slogans. Words are numbered as they appear in the corpus. Lemmas represent labels attributed to lexical units once they have been grouped and classified according to specific and custom dictionaries. Ultimately, the lemmas represent unified semantic categories for research, according to the linguistic criterion of lemmatisation applied by the researcher.

The T-LAB software has been used in social sciences (Banaji et al., 2018; Bosoni, and Mazzucchelli, 2019) and in management sciences management (Benevene et al., 2017; Iaia et al., 2019; Greco and Polli, 2020). T-LAB facilitates the processes of message analysis, the implications of their semantic representation, and the understanding of long-term communication trends.

### 3.3 *fsQCA analysis*

This paper classifies the strategies according to two typologies, based on their importance with respect to the total news generated by a company, and according to the intensity and impact made on public opinion:

- hard strategies for socio-technical and environmental transitions
- soft strategies for socio-technical and environmental transitions.

The fsQCA methodology was used to learn about the strategies designed by IBEX 35 companies. This methodology is focused on the analysis of the different causal configurations (Ragin, 2008; 1987), and is based on the use of Boolean algebra, and allows us to capture the ideas of asymmetry (Fiss, 2011) and equifinality (Fiss, 2007).

fsQCA is used to identify the recipes followed to generate the analysed result. This methodology has been used in studies on management performance (Garcia-Castro and Aguilera, 2014; González-Cruz and Cruz-Ros, 2016; Ide, 2018; Lestari and Faturohman, 2019; Bhankaraully and Goyer, 2020) and innovation (Pustovrh and Jaklic, 2014; Huang and Huarng, 2015; Rabadán et al., 2020; Berné-Martínez et al., 2020).

This methodology is suitable for investigations with small samples (Cezar, 2020; McLevey, 2014) and allows to overcome the limitations of other inferential statistical techniques (Woodside, 2013).

The use of fsQCA permits empirical studies of the necessary and sufficient conditions that configure the outcome analysed to be conducted. This is especially useful when investigations have complex, contradictory, or little explored theoretical frameworks. The research design process guarantees methodological control (Rihoux, 2017) and was based

on previous in-depth knowledge of IBEX 35 companies, as well as the most relevant academic theory on strategy and socio-technical and environmental transitions.

Following Ragin and Pennings (2005), we know that fuzzy sets retain almost all the essential mathematical properties of sharp sets and thus allow researchers to model complex and diverse constellations of case aspects and evaluate theoretical relationships of sets (p.425). fsQCA allows the creation of models based on the concept of cyclical causality (Fiss, 2011) and, consequently, helps to understand how the combination of several causal conditions can determine the communication of socio-technical and environmental transitions

According to Ragin (2008), it is possible to deconstruct a single symmetric analysis into two asymmetric set theory analyses, one focused on sufficiency and the other on necessity (p.7). In this way, fsQCA allows for the development and profiling of the theory scheme (Redding and Viterna, 1999). Unlike other techniques, fsQCA does not compare individual variables but, instead, analyses complete combinations of simultaneous conditions.

The technique is based on the configuration and calibration of the variables studied, differentiating the outcome against the attributes that can contribute, in their causal configurations, to explain the expected result. The procedure follows four sequential steps (Fiss, 2011): First, calibrate the variables, so that they can be analysed based on set theory. Second, construct a data matrix (in QCA terminology, 'truth table'), with  $2^k$  rows ( $k$  is the number of causal conditions proposed by the model). Third, reduce the rows. For this, two criteria are applied: on the one hand, that there are cases in a causal combination (factual approach) and, simultaneously, that the level of consistency is equal to or greater than 0.75 (Ragin, 2008). Fourth, reduce the rows of the truth table again. In this last step, using the algorithm based on Boolean algebra proposed by Ragin (2008).

Given that most cases do not conform to the ideal typologies, following the usual methodology in fsQCA, the calibration process fixes the values in the continuous [0–1] and establishes three cut-off points that delimit the fully inside, maximum ambiguity and fully outside, so that they allow for the capture of variations in terms of sets (Ragin, 2009b). In this study, the Quine-McCluskey algorithm was run with the fs/QCA 3.0 software. The logarithmic function that allows calibrating the original values in logarithmic group scores according to values from 0 to 1 (Ragin et al., 2006).

Regarding the calibration of the conditions, the percentile method has been followed (Misangyi and Acharya, 2014). Table 2 shows the cut-off values for the outcome and for all the analysed attributes. The cut-off point has been calculated as a delimitation of three sets: fully inside (75% percentile), maximum ambiguity (50% percentile) and fully outside (25% percentile).

Therefore, the minimisation process is carried out through algorithms that allow a reduction in the frequency and accepted threshold of consistency (Chang and Cheng, 2014). The frequency thresholds can be higher than 1, although the consistency thresholds must be, at least, 0.75 (Ragin, 2009). In this process, the methodology allows characterising the simultaneous presence of elements that are important to generate the outcome (Meuer, 2014).

According to Ragin (2008), it is possible to deconstruct a single symmetric analysis into two asymmetric set theory analyses, one focused on sufficiency and the other on necessity (p.7). Thus, this study assesses the necessary and sufficient conditions that configure the hard and Soft Strategies in the dissemination of the socio-technical and environmental transitions of IBEX 35 companies, according to the 2019 analysis.



Following Ragin (2008), we know that with fuzzy sets, there is no mathematical reason to expect that the consistency scores calculated for the negation of a result are perfectly negatively correlated with the consistency scores of the original result (p.137).

**Table 2** Attributes used in the fsQCA analysis. Descriptive statistics and calibration points

<i>Atributes</i>		<i>Statistics</i>				<i>Calibration<sup>(1)</sup></i>		
<i>Type</i>	<i>Atributes</i>	<i>Max</i>	<i>Min</i>	<i>Median</i>	<i>Standard deviation</i>	<i>Fully inside</i>	<i>Maximum ambiguity</i>	<i>Fully outside</i>
<i>Outcome</i>	ISN <sup>(2)</sup>	0.1815	0.0049	0.0598	0.0488	0.0935	0.0598	0.0195
Condition	EPS	8.8500	-2.8200	0.6900	1.8662	1.3600	0.6900	0.2750
Condition	PER	284.68	-29.0100	13.6500	47.2678	17.9200	13.6500	9.7750
Condition	EV/ EBITDA	47.99	0	7.7200	12.8214	12.7450	7.7200	1.9150
Condition	ISN	1008	8	192	270.9259	414	192	76
Condition	NIR <sup>(2)</sup>	0.1150	0.0261	0.0728	0.0171	0.0813	0.0728	0.0622

<sup>(1)</sup>Following Misangyi and Acharya (2014).

<sup>(2)</sup>NIR and SIR attributes are expressed in times one.

Therefore, the analysis of presence and absence identifies the asymmetry of the causes (EPS, PER, EV/EBITDA, ISN, NIR) of the outcome (SIR), both in the presence and in its denial (Ragin, 2008). In my study, the presence of the outcome corresponds to the Hard Strategies designed by the IBEX 35 companies. The absence of the outcome corresponds to the Soft Strategies designed by the IBEX 35 companies.

The analysis identifies the different pathways for IBEX 35 companies to increase (or decrease) the SIR, proposing the following model:

$$SIR = f(\text{EPS, PER, EV/EBITDA, NIS, NIR})$$

## 4 Results and discussion

### 4.1 Contextual analysis

The extraction of information through T-LAB is based on elementary contexts and lexical units. As indicated, elementary contexts are proportions of the corpus text that correspond to syntagmatic units of one or more sentences, while lexical units are records that contain two pieces of information: word and lemma. Each word is shown and numbered exactly as it appears in the corpus, while the lemma constitutes the label attributed to the lexical units. Finally, Table 3 shows the 38 main lexical units (lemmas or keywords).

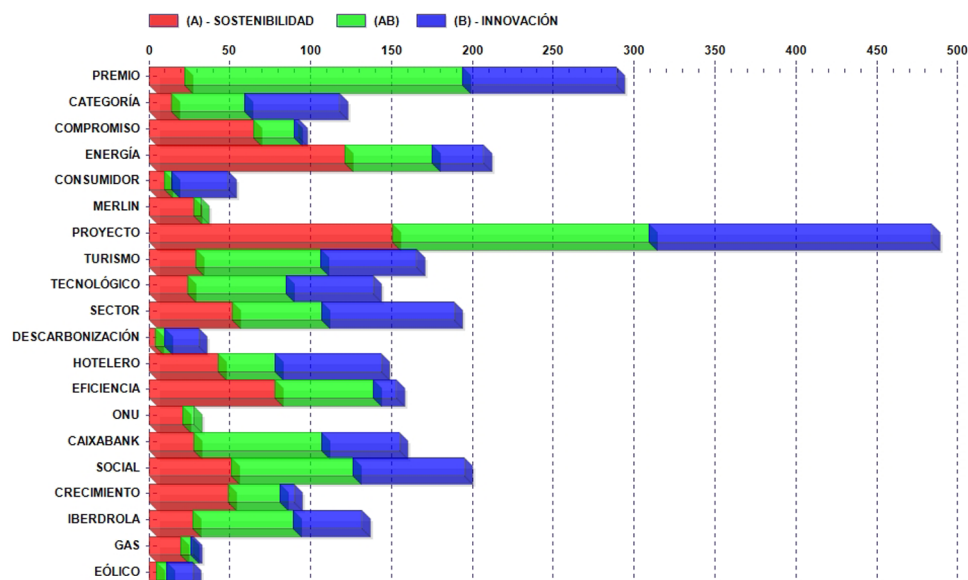
The cooccurrence analysis focused on the comparison between pairs of keywords comparing elementary contexts in which two specific lemmas are present. The comparison analysis of the pairs of slogans sustainability – innovation has been developed. The lexical units derived from the study make it possible to develop a cooccurrence analysis focused on word associations, which identify the number of times two or more lemmas appear in identical elementary contexts. In this way, it is possible to examine the relationship between lemmas. Figure 2 shows the relationship between the lemmas' sustainability and innovation.

**Table 3** Lemmas and frequency. IBEX 35 companies in 2019

<i>Lemma</i>	<i>Original lemma<sup>(3)</sup></i>	<i>Frequency</i>	<i>Lemma</i>	<i>Original lemma<sup>1</sup></i>	<i>Frequency</i>
sustainability	sostenibilidad	1400	customer	cliente	306
innovation	innovación	1155	group	grupo	306
company	empresa	1124	euros	euros	292
project	proyecto	1010	system	sistema	287
prize	premio	634	director	director	286
company	compañía	470	efficiency	eficiencia	285
sector	sector	438	category	categoría	283
energy	energía	434	model	modelo	275
energetic	energético	409	objective	objetivo	267
caixabank	caixabank	408	iberdrola	iberdrola	267
service	servicio	394	renewable	renovable	264
digitalisation	digitalización	390	network	red	260
hotelier	hotelero	381	corporate	corporativo	247
social	social	370	responsibility	responsabilidad	238
electric	eléctrico	368	technological	tecnológico	222
development	desarrollo	362	change	cambio	217
tourism	turismo	358	mobility	movilidad	209
business	negocio	321	transformation	transformación	204
bbva	bbva	308	training	formación	204

<sup>1</sup>Original lemma in Spanish.

**Figure 2** Cooccurrence analysis. IBEX 35 companies in 2019 (see online version for colours)





**Figure 4** Radial diagram of the lemma innovation (see online version for colours)

The intensity of the relationship between lemmas A and B shows some listed companies on the IBEX 35, as well as important terms that assign meaning to the discourse on sustainability created in the media by the main Spanish companies.

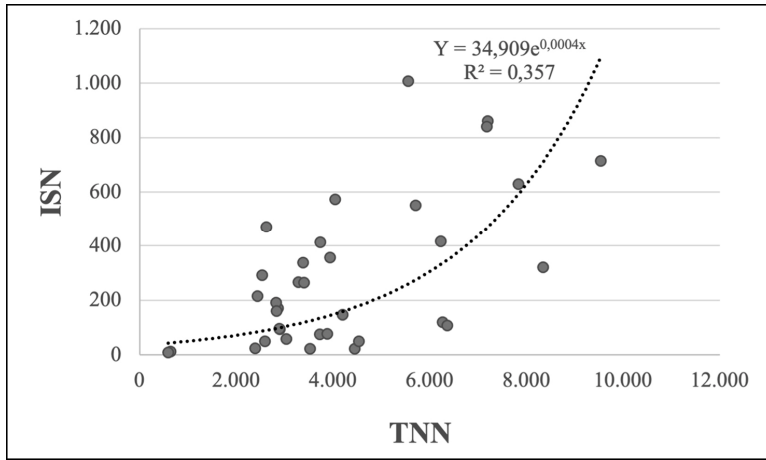
Similarly, the lemma A (innovation) is displayed in the centre, and the statistically significant comparison lemmas (B) ( $p < 0.001$ ) are displayed around it. Its distance from slogan A indicates a lower degree of association, following this sequence: Sustainability → Award → Project → Company → Technological → Digitisation → Social → Tourism → Transformation → Corporate → Sector → Business → Iberdrola → Responsibility → Caixabank → Category → BBVA → Creation → Group → Renewable → Meliá → Opportunity → Training → Investment → Challenge → Collaboration → Consumer → Inditex → Decarbonisation → Mapfre → Environmental → Employment → Talent → Creativity.

In addition to some companies listed on the IBEX 35, there are lemmas such as opportunity, consumer, environment, renewable energy, investment, training and talent among the main slogans with which the discourse on innovation created in public opinion is associated. These terms help to identify the radiography of the discourse and the state of opinion created in the press by the main Spanish companies during 2019 around socio-technical and environmental transitions.

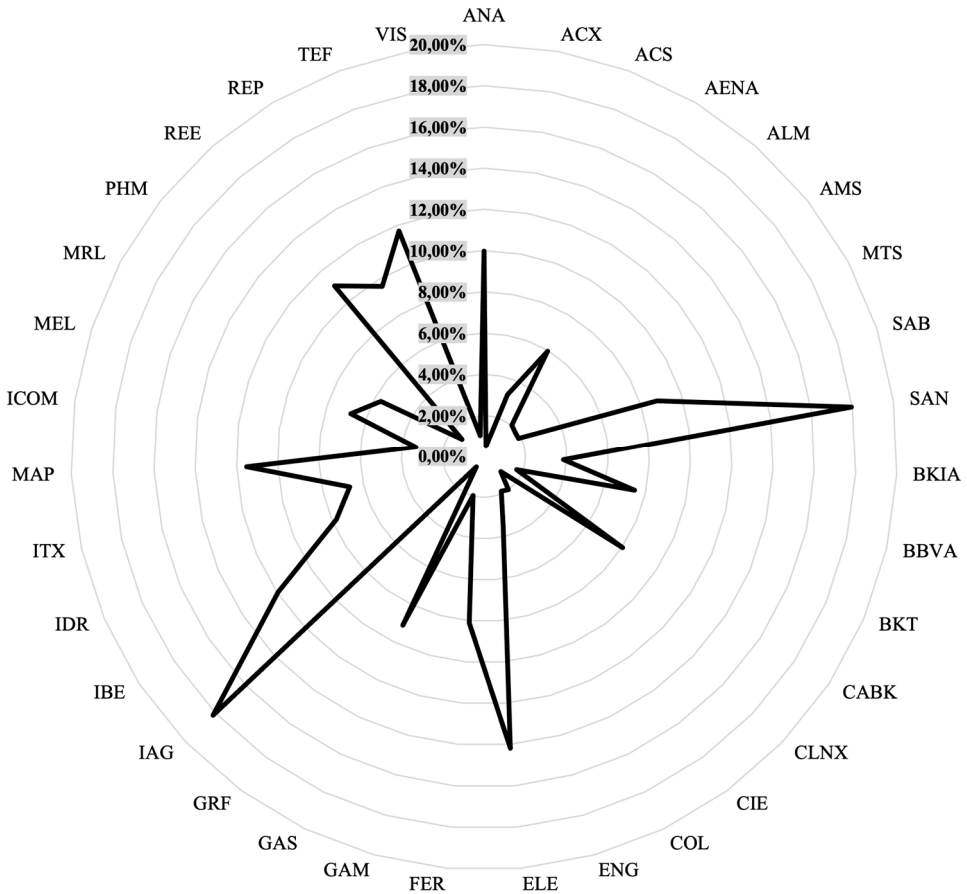
#### 4.2 *fsQCA analysis*

The first output of my analysis offers information on the link between TNN and ISN. There is a relevant link ( $R^2 = 0.357$ ) between the TNN and the news published on innovation and sustainability (ISN). Statistical adherence weakens as TNN increases, following a non-linear progression (Figure 5).

**Figure 5** Exponential regression for the innovation and sustainability news (ISN)



**Figure 6** Radial analysis for the sustainability and innovation rate (SIR)



A second result allows us to verify that the diffusion strategies of the socio-technical and environmental transitions of the IBEX 35 companies are not homogeneous among companies. When calculating the SIR variable, important differences are detected between the companies analysed (Figure 5). Figure 6 reports radial analysis for the Sustainability and Innovation Rate (SIR). The fsQCA analysis helps in understanding the different recipes that explain the causal configuration of the strategies designed by the IBEX 35 companies in 2019. Thus, the causal analysis shows the strategic pathways used by the main Spanish companies to articulate their strategies of socio-technical and environmental transition, as well as its dissemination in public opinion.

The analysis of necessary conditions (Tables 4 and 5) offers relevant information on what causal conditions are necessary for the investigated outcome to occur. Ragin (2008) accepts that a condition is necessary if it exceeds the threshold of 0.9. The presence (and absence) analysis suggests that for SIR to be generated (or not generated), it is necessary for companies to project content in the media (or not to project it) on changes in their business models and new green strategies.

**Table 4** Analysis of the necessary conditions. High strategies

<i>Conditions</i> <sup>1</sup>	<i>Consistency</i>	<i>Coverage</i>
EPS	0.5236	0.5360
~EPS	0.5764	0.5562
PER	0.4404	0.4390
~PER	0.6465	0.6401
EV/EBITDA	0.4031	0.4119
~EV/EBITDA	0.6794	0.6565
ISN	0.9054	0.9069
~ISN	0.2266	0.2233
NIR	0.6301	0.6385
~NIR	0.4884	0.4759

<sup>1</sup>In QCA terminology, the symbol ~ indicates the absence of a condition.

**Table 5** Analysis of the necessary conditions. Soft strategies

<i>Conditions</i>	<i>Consistency</i>	<i>Coverage</i>
EPS	0.5461	0.5665
~EPS	0.5527	0.5404
PER	0.6413	0.6477
~PER	0.4446	0.4460
EV/EBITDA	0.6492	0.6723
~EV/EBITDA	0.4321	0.4232
ISN	0.2220	0.2253
~ISN	0.9083	0.9068
NIR	0.4691	0.4817
~NIR	0.6479	0.6397

Although SIR is a necessary condition, the sufficiency analysis allows multiple paths (Ragin, 2008). Causal complexity (Ragin, 1987) and equifinality (Fiss, 2011; Katz and Kahn, 1978) are at the base of the existence of different routes and initial conditions for strategies of diffusion of the socio-technical and environmental transformations of the IBEX 35 companies.

**Table 6** Analysis of sufficiency for the outcome

<i>Conditions and coefficients</i>	<i>Hard strategies<sup>1,2</sup></i>						<i>Soft strategies<sup>1,2</sup></i>				
	1a	1b	1c	1d	1e	1f	2a	2b	2c	2d	2e
EPS	○		○	○		●		●			
PER	○	○		○	●	●	○		●	○	
EV/EBITDA	○	○	○		●	●	○		●	○	●
ISN	●	●	●	●	●	●	○	○	○	○	○
NIR		●	●	●	○			○			○
Number of companies	3	5	4	2	4	4	4	5	9	4	6
Raw coverage	0.3198	0.3916	0.2986	0.2902	0.2402	0.2436	0.2808	0.3416	0.5309	0.2808	0.4174
Unique coverage	0.0661	0.1369	0.0491	0.0421	0.0311	0.0269	0.0913	0.0171	0.2044	0.0091	0
Consistency	0.8603	0.9764	0.9812	0.9807	0.9763	0.9301	0.8887	0.9340	0.9482	0.9069	0.9402
Intermediate solution											
Coverage	0.7775						0.8387				
Consistency	0.9131						0.9332				
Cutoff											
Frequency	1						1				
Consistency	0.7697						0.8242				
Directional expectations	(-, -, -, -, -)						(-, -, -, -, -)				
Parsimonious solution											
Coverage	0.9054						0.9083				
Consistency	0.9069						0.9067				

<sup>1</sup>Compiled by the author using the software program fsQCA 3.0. More detailed results are available upon author request.

<sup>2</sup>Black circles indicate the presence of a condition, and white circles indicate its absence. Blank spaces indicate 'don't care'.

Table 6 displays the solutions to the proposed model, both for the Hard Strategies for socio-technical and environmental transitions (SIR presence), and for Soft Strategies for

socio-technical and environmental transitions (SIR absence) of the IBEX 35 companies. In both cases, the results of the intermediate solution are offered, indicating the number of companies that follow each empirically identified pathway.

The consistency of the intermediate and parsimonious solutions is satisfactory (Hard Strategies, 0.9131; Soft Strategies, 0.9332). In both cases, they exceed the most demanding criterion (0.8) proposed by Ragin (2008). The different strategies followed by the IBEX 35 companies demonstrate adequate gross coverage for the different routes and, considering the type of research, are completely acceptable.

Although some pathways may have unique low coverage levels, they are critically important to theory. Therefore, one of the advantages of fsQCA is to help promote multilevel theory (Lacey and Fiss, 2009). The low unique coverage may correspond to its empirical infrequency, but this must be taken into account because this diverse reality enriches and complements the theory. According to Ragin (2008), fsQCA's importance is empirical, not theoretical. The causal nature of the fuzzy set theory and the foundations of the fsQCA make this an important difference from other statistical and inferential techniques. In fact, this occurs with pathways 1c, 1d, 1e, 1f, 2b, 2d, and 2e.

The analysis of the necessary conditions determined that the presence of ISN was sufficient for the outcome to be noted in the Hard Strategies analysis. Similarly, for the analysis of the Soft Strategies, the absence of ISN is a necessary condition. Consequently, for both cases, it is verified that ISN is part of all the solutions to the proposed model.

The Hard Strategies analysis suggests great diversity (1a, 1b, 1c, 1d) for companies with less robust financial results (EPS, PER, EV/EBITDA). In this sense, there are three recipes (1b, 1c, 1d) that are based on a high NIR, while recipe 1a includes Hard Strategies based on which NIR is not relevant. Companies with robust financial results rely on weak internationalisation rates (1e), or do not use the NIR as a strategic design variable (1f).

Based on the concept of equifinality, it is possible to ascertain if the strategies of an IBEX 35 company are possible at the same time following alternative pathways. The media and financial causal conditions are important to drive strategies for socio-technical and environmental transformation. Table 7 relates each company analysed with the strategic recipes.

During 2019, important companies<sup>4</sup> in the Spanish financial sector used multiple paths to promote their Hard Strategies for sustainability and innovation (SAN: 1a, 1b, 1c, 1d; CABX: 1a, 1c, 1d). Companies related to the energy sector also used causal diversity (REE: 1e and 1f; ACC: 1e, 1f).

Other sectors of the Spanish stock market whose companies designed Hard Strategies in 2019 for their socio-technical and environmental transitions were: financial (BKIA: 1a; BBVA: 1b; SAP: 1c), energy (REP: 1b), textile (ITX: 1f), airlines (IAG: 1b), telecommunications (TEF: 1b) and insurance (MAP: 1c) sectors.

The evaluation of the Soft Strategies for socio-technical and environmental transitions suggests that the main Spanish companies followed different paths. Recipes 2b and 2e are applied by companies that did not promote the internationalisation of their positioning in the media and in public opinion. The 2c companies, with strong PER and EV/EBITDA, have a low presence of news on sustainability and innovation. The 2a, 2d solutions include Soft Strategies of companies with weak financial ratios and low intensity in the number of news about the sustainability and innovation of their business models.

The pharmaceutical sector in the IBEX 35 (Table 7) followed Soft Strategies for the communication of its sustainable innovation, from various configuration routes (ALM:



2c, 2e; PHM: 2d, 2e). They also used different paths in the causal configuration of their Soft Strategies (ACX: 2a, 2b, 2d; ENG: 2b, 2d, 2e; BKT: 2a, 2d).

Viscofan (VIS) designed and implemented Soft Strategies for socio-technical and environmental transitions in 2019, and did so through various paths (2b, 2c, 2e). Viscofan is the world leader in casings for meat products which it distributes in over 100 countries worldwide.

**Table 7** Strategies for socio-technical and environmental transitions of IBEX 35 companies in 2019

<i>Companies</i>		<i>Hard strategies</i>						<i>Soft strategies</i>				
<i>Name</i>	<i>Ticker</i>	<i>1a</i>	<i>1b</i>	<i>1c</i>	<i>1d</i>	<i>1e</i>	<i>1f</i>	<i>2a</i>	<i>2b</i>	<i>2c</i>	<i>2d</i>	<i>2e</i>
Acciona	ANA					✓	✓					
Acerinox	ACX							✓	✓		✓	
ACS	ACS							✓				
Aena	AENA								✓	✓		✓
Almirall	ALM									✓		✓
Amadeus	AMS									✓		
Arcelor Mittal	MTS							✓				
Banco Sabadell	SAB			✓								
Banco Santander	SAN	✓	✓	✓	✓							
Bankia	BKIA	✓										
BBVA	BBVA		✓									
Bankinter	BKT							✓			✓	
CaixaBank	CABK	✓		✓	✓							
Cellnex Telecom	CLNX									✓		
Colonial	COL									✓		✓
Enagas	ENG								✓		✓	✓
Endesa	ELE					✓	✓					
Siemens Gamesa	GAM									✓		
Grifols	GRF									✓		
IAG	IAG		✓									
Iberdrola	IBE					✓						
Inditex	ITX						✓					
Mapfre	MAP			✓								
Más Móvil	ICOM								✓			
Merlin Properties	MRL									✓		
Pharmamar	PHM										✓	✓
Red Eléctrica	REE					✓	✓					
Repsol	REP		✓									
Telefónica	TEF		✓									
Viscofan	VIS								✓	✓		✓

Other IBEX 35 companies that promoted Soft Strategies for green change were the: technological (ICOM: 2b; GAM: 2c; CLNX: 2c; AMS 2c), construction and real estate (ACS: 2a; COL: 2c; MRL: 2c), manufacturing (MTS: 2a), pharmaceutical and chemical (GRF: 2c), and infrastructure (AENA: 2b, 2c, 2e) sectors.

### 4.3 Robustness analysis

Following the epistemological interest raised by Krogslund et al. (2015), a robustness analysis was performed to evaluate the fit of the proposed model. A stress test was performed from the modification of the calibration of the variables according to Skaaning (2011) and Schneider and Wagemann (2012). The 10% variation criterion proposed by Fiss (2011) and Stevens (2016) was improved, applying a higher level (15%) of variation in the percentiles that delimit the cut-off points for fully inside and fully outside. Unlike the approach of Paykani et al. (2018), in our study the central percentile that delimits the maximum ambiguity was maintained (0.5) but two cut-off points were modified: fully inside point increased 0.15 and fully outside decreased 0.15.

Thus, a stress test was performed on the initial calibration points of the model. The new cut-off points were: fully inside (0.9), maximum ambiguity (0.5), fully outside (0.1).

After carrying out the stress test, the Robustness Coefficient (RC) was calculated. The RC-value allows to evaluate the level of robustness of the model tested with fsQCA. RC-value analyses the impact of the average deviation from the consistency of the proposed model. RC-values close to 1 indicate high robustness. For its calculation, RC considers the consistency of the intermediate solution, for the presence and absence of the outcome, and for all the subsamples used in the validation of the model with fsQCA (e.g., family firms and other SMEs; German companies and French companies). Table 8 reports the components and calculation of the RC-value. RC-value can also be used to analyze the robustness of a model tested with fsQCA even if it has not been calibrated with percentiles. Table 9 reports the acceptable RC-values for the different recalibration scenarios to which it was subjected to the model during the stress test.

**Table 8** RC-value components and calculation

<i>RC components</i>
<i>RC</i> : Robustness Coefficient
<i>CG</i> : Consistency Gap
<i>AC</i> : Average Consistency
<i>MC<sub>i</sub></i> : Model consistency <sup>1</sup>
<i>STC<sub>i</sub></i> : Stress Test Consistency <sup>1</sup>
<i>N</i> : Total number of outcomes and subsamples
<i>RC calculation</i>
$RC = 1 - (CG/AC)$
$AC = \frac{\sum_{i=1}^n MC_i}{N}$
$CG = \frac{\sum_{i=1}^n (MC_i - STC_i)}{N}$

<sup>1</sup>The RC-value calculation includes presence and absence, and all subsamples used to test the model in fsQCA.

A model is robust only if, after the recalibration process, it reports solutions that maintain standards according to Ragin (2008) of consistency and coverage (consistency  $\geq 0.75$ ; coverage  $\geq 0.25$ ), and also simultaneously reports an appropriate RC-value (RC  $\geq 0.9500$ ). The robustness of a model tested in fsQCA is established according to the variation applied in the percentiles and the classification of this robustness can be very strong, strong, moderate and weak.

**Table 9** Robustness analysis of the model in fsQCA using RC-value

<i>Percentile variation</i>	<i>Recalibration</i>			<i>RC-value</i>	<i>Robustness</i>	<i>Symbol<sup>1</sup></i>
	<i>Fully inside</i>	<i>Maximum ambiguity</i>	<i>Fully outside</i>			
± 0.15	+0.15	0	-0.15	0.9900 ≤ RC ≤ 1	Very Strong	***
				0.9500 ≤ RC ≤ 0.9899	Strong	**
± 0.10	+0.10	0	-0.10	0.9900 ≤ RC ≤ 1	Strong	**
				0.9500 ≤ RC ≤ 0.9899	Moderate	*
				0.9000 ≤ RC ≤ 0.9499	Weak	

<sup>1</sup>Weak robustness is pointed out without symbol.

In our study, the calculation of the RC-value was carried out considering two outcomes (hard strategies and soft strategies), a single sample (IBEX35 companies) for the intermediate solution. The analysis of the proposed model report strong robustness (RC = 0.9891\*\*).

## 5 Conclusions

The media projects the refracted reality as a social construction of public opinion. The transformation process promoted by large Spanish companies contributes to understanding the vision that Spanish society has on innovation and sustainability.

The analysis of the debate generated by the main Spanish companies suggests a great diversity of topics discussed in the public sphere. The main semantic nuclei of the discourse are linked to the opportunity, investment and promotion of socio-technical and environmental transitions. The change in the Spanish economic model is influenced by the 2030 Agenda and the Sustainable Development Goals. The sustainability strategy of the main Spanish companies is fundamentally connected with innovation, digitisation projects and new business models. The most prominent driving elements of the green strategy are social responsibility, the opportunities that allow improving efficiency while facing the challenge of decarbonisation. The public discourse is articulated in the vision towards the consumer relying on central sectors of the Spanish economic model (e.g., tourism and mobility) in the management of infrastructures and new business models.

IBEX 35 companies follow different causal recipes to promote their innovation and sustainability strategies. Differences between industries are important. It is a necessary condition that companies intensely direct their communication towards sustainability and innovation. The sufficiency analysis suggests a great importance of the rate of internationalisation of the discourse of companies and the total number of news published on sustainability and innovation.

The versatility of the recipes used in IBEX 35 companies implies that many companies in the financial sector use different ways to disseminate their innovation and sustainability strategies among public opinion. Furthermore, the hard strategies of companies with good financial indicators (PER, EPS and EV/EBITDA) are based on activating a proactive communication of the results of their SOIs strategies. The companies with the worst financial scores that implemented hard strategies of socio-technical transitions rely on a high internationalisation rate. On the other hand, the companies that designed and implemented soft strategies of socio-technical transitions focused their specialisation strategy in Spain, dedicating very few resources to the communication of their green strategies in the international context, whether they registered solid or weak financial scores.

The novelty of this research lies in using the fsQCA analysis to identify the main factors that allow the design of the different strategies aimed at increasing the media representation of the sustainability of companies. Until now, little research has explored the projection of business sustainability and innovation in the press for listed companies. The empirical findings of this study allow to guide and advise the business strategy in the socio-technical transition process, in order to improve its long-term impact. Some managerial implications of this paper are based on the evidence found on the impact of green brands for different stakeholders and for investors based on a value-based portfolio management strategy.

A limitation of this study is based on the heterogeneity of the companies analysed. Future lines of research should delve into the sectoral study and extend its analysis to the comparison between countries. Future studies should delve into the evolution of public discourse on the 2030 Agenda and the SDG. Within this novel line of investigation, the examination of the changes caused by COVID-19 in public opinion and in the discourse of companies based on their SOIs will be of special interest.

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## Notes

<sup>1</sup>Results in Web of Science Core for Boolean search by title, subject or keywords (“socio-technical transitions” OR sustainability OR “sustainability-oriented innovations”). Papers published until 2020 in Social Sciences Citation Index (SSCI) and Science Citation Index Expanded (SCI-EXPANDED). Journals of the Business and Economics, and Operations Research and Management Science categories.

<sup>2</sup>Complementarily, other etymologically derived terms of sustainability and innovation were used, and their plurals in Spanish: sustainable, innovative, innovations, innovative, innovative, and innovative.

<sup>3</sup>The Figure 3 includes lemmas in Spanish, original language from which the semantic analysis of the press was carried out.

<sup>4</sup>Stock ticker acronyms are used. For more information, see Table 7.