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Review

Innovation and environmental, social, and governance factors influencing sustainable business models - Meta-analysis

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ABSTRACT

The article summarizes the state of knowledge in the field of factors affecting sustainable business models of enterprises, with particular emphasis on non-financial factors, ESG (environmental, social, governance) and innovation. Research results published in over 72 articles were analyzed. The article uses meta-analysis, the least absolute shrinkage and selection operator method and logistic regression in order to analyze the results of the research in an international context (Asia, America, Africa, Europe), and finally focuses on an in-depth analysis of the experiences of European countries. We found that innovations affect sustainable business models in an unambiguously positive way generally for every country. In addition, there is moderately strong evidence that cultivating social capital affects sustainable business models in a positive way. The limitation and challenge of this study was to include environmental, social and governance factors in the analysis, in particular their standardization and categorization. The applied research approach and methodology allowed these difficulties to be overcome.

Contents

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1. Introduction

The interest in sustainable business models (SBM) has been gaining importance both from the perspective of sustainable development goals and the business response to changing consumption trends (green consumerism) (Nosratabadi et al., 2019). In searching for the relationship between social and environmental performance and financial performance, the literature provides a mixed picture. Some researchers argue for a positive relationship (Dowell et al., 2000), some confirmed a negative relationship (Walley and Whitehead, 1994), and others detected a neutral relationship (Elsayed and Paton, 2005). The only study that confirmed an unqualified, positive conclusion is the meta-analysis by Orlitzky et al. (2003), which examined the financial benefits of corporate social and environmental responsibility. The positive relationship between sustainability and financial performance is one of the reasons why research in the field of sustainable business models has been carried out and why companies are transforming their business model towards sustainability. There is also considerable pressure to incorporate ESG factors in the decision-making process, especially by capital investors and financial institutions (Sinha, 2016; Finansinspektionen, 2016).

A large amount of literature devoted to business models has been published, and the multidimensional nature of business models makes it difficult to build a theory around these studies (Zott et al., 2011; Spieth et al., 2014), whose definitions and conceptualization differ depending on the purpose of the research and the theoretical approach adopted by the researchers (Lambert and Davidson, 2013). There are some general trends in research on business models, but these trends are not standardized, and the research approach presented in the published papers is not comparable. There is a broad scope of research focused on SBM innovations (Schneider and Spieth, 2013; Boons et al., 2013); the relationship between environmental and social sustainability and companies' business models (Seelos and Mair, 2005; Barber et al., 2012); and SBM and the triple bottom line approach (Lee et al., 2012) or the Triple Layered Business Model Canvas (Joyce and Paquin, 2016). Key drivers of business models towards sustainability include the need to adjust to external stakeholders requirements (Ferreira et al., 2013; Miller et al., 2014), changes in the competitive environment (de Reuver et al., 2009), and the opportunities provided by new information and communication technologies (Wirtz et al., 2010). However, no study has comprehensively examined the impact of non-financial factors (ESG) on companies' business models in a sustainability context. This article introduces a new look at sustainable business models by indicating the role and influence of ESG factors on the building of these models by companies. An innovative approach is to identify the leading ESG factors in this area and to categorize them according to their impact. To date, no study has analyzed the relationship between ESG factors and business models, and no attempt has been made to indicate which factors—environmental, social or managerial—are most important in the study of this phenomenon. Although the role of innovation in the context of business models has been recognized, the novelty in this article is its indication of the importance of innovation in a particular type of model, namely, sustainable business models. The research approach presented in the article involves certain challenges and limitations resulting from the lack of comparable variables for the object of study, the non-uniform and diversified approach to the object of study presented in the analyzed articles, and the lack of research relating directly to the study of the impact of ESG factors on sustainable business models (SBMs). The standardization and unification of the approach posed a challenge and, at the same time, limited the study. The adopted research approach, in particular the combination of keywords in the meta-analysis, allowed for the original orientation of the research.

The aim of this paper is to identify, through a literature examination, the prevailing patterns in key drivers impacting the adaptation of companies' business models to sustainability and consider them according to their relationship with the ESG categories. The main research questions of this paper is what is the relationship and its direction between sustainable business models, innovations, ESG and other factors based on the numerous research undertaken in the last decade. The core research question to be addressed in the scope of the current meta-analysis is whether it is possible to confirm on a wide base of analyzed research results that the general conclusion about the impact of selected ESG and innovation factors on SBM is already valid.

2. Literature review

The term "business model" (BM) has been defined by many authors; however, none of these definitions has been fully accepted by the business community (Shafer et al., 2005). Despite this, in general it can be assumed that a business model presents how a company does business or in other words, it is a way an enterprise operates and uses resources to generate profit (Zott and Amit, 2010). Although there are different definitions of a business model, value creation is at the heart of any of such models (Bocken et al., 2014). As companies have been considered as responsible for negative impacts on the environment and society (Dunphy et al., 2014), they had to integrate sustainability into their operations and contribute to making societies more sustainable (Elkington, 1997). Traditional business models had to be transformed into more sustainable ones to achieve corporate sustainability goals.

Sustainable business models integrate a triple bottom line approach and take into account a wide range of stakeholder interests, including the environment and society (Bocken et al., 2014). In one of the approaches, the concept of SBM extends traditional BM – it describes the rationale of how an organization creates, delivers, and captures value, but in economic, social, cultural, or other contexts and in a sustainable way (Nosratabadi et al., 2019). Geissdoerfer et al. (2018) confirmed in their literature review that SBM is most often seen as a modification of conventional BM with certain characteristics and goals added, and it integrates sustainability into value proposition, value creation and delivery activities. Lozano (2018) provided a different perspective to SBM, combining the value proposition, creation and delivery into one approach in which value is added, based on efficient use of resources and inputs that result in products and services that better contribute to more sustainable societies.

Regardless of the model approach chosen, most authors agree that sustainable business models are critical components to meet the demands of changing environment and society (Neumeyer and Santos, 2018). Bocken et al. (2014) explained, that eco-design and eco-efficiency improvements are not enough to offset to the increasing resource use and impact of a growing developing global

population on environment. To coordinate technological and social innovations with system-level sustainability, a business model can be used (Bocken et al., 2014). Such a model also creates competitive advantage through higher customer value and contributes to sustainable development of the company and society (Lüdeke-Freund, 2010). Similar conclusions were presented by Evans et al. (2017a). They pointed that SBM is one of the key concepts for sustainable value creation, which is demanded by the changing business environment, wider range of stakeholders engaged in debate over industry, limited resources, and emphasizing social responsibilities of firms. A study on a selected group of small and medium enterprises (SME) from Italy suggests that sustainability can create value by achieving innovation in BMs in the long run (Broccardo and Zicari, 2020). According to Schaltegger et al. (2012) one of the key challenges in designing SBM is to do it in a way that allows the company to capture economic value for itself through delivering benefits to society and environment.

Building and employing a proper SBM is one of the keys to running a successful business, but it is worth considering what the impact of financial institutions on this model and on corporate sustainability overall is. Through their activities, financial institutions and financial markets have a strong impact on the economy, society, and sustainable development (Weber, 2014; Helleiner, 2011).

Many studies describe the benefit of integrating environmental and sustainability indicators into credit risk management (Bauer and Hann, 2010). Weber et al. (2010) showed that sustainability criteria can be used to predict the financial performance of a debtor and improve the predictive validity of the credit rating process. They concluded that sustainability influences company creditworthiness as part of its financial performance. Goss and Roberts (2011) revealed that lenders are more sensitive to CSR concerns in the absence of collateral.

Evidence that sustainable performance can affect the finance of a company is provided by investigating lending institutions in 15 EU countries (Eliwa et al., 2019). The researchers found that firms with stronger ESG performance have a lower cost of debt. Baranes (2009) and Egede and Lee (2007) verified that the financial sector is able to influence the environmental and sustainability impacts of their clients, such as projects or borrowers and their investors.

The vast literature is focused on the impact of innovations and non-financial factors on companies' business models. In "Theory of economic development" Schumpeter pointed out that development is driven by innovations. The importance of innovation in sustainable development was highlighted, among others, by Rennings (2000), Rammel (2003) and Silvestre and Ţîrcă (2019). According to Amit and Zott (2012), only the implementation of innovations in the entire business model can ensure constant development of the enterprise. In our study we put special stress on the impact of ESG factors and innovations on corporate business models taking into account the geographic context.

3. Research methodology and results

Meta-analyses are widely used techniques to formally assess the results of previous research. Through qualitative or quantitative research procedures they allow to derive generalized conclusions based on the existing literature. The studies devoted to ESG factors, business performance and innovation processes already witnessed several valuable examinations with the use of meta-analyses. A recent industry-wide analysis depicting the relationship between sustainability innovations and competitiveness and other contextual factors was presented by Hermundsdottir and Aspelund (2020). The authors, using a systematic literature search, article review process, and qualitative grouping of recommendations demonstrated the existence of a positive impact of sustainability innovation in the areas of product, processes and managerial practices on developing competitive advantage, though moderated with national, market, industry and firm context.

Kuzma et al. (2020) focused on factors exerting an impact on sustainability performance of organizations. Using meta-analysis of formal modelling procedures and subsequent weighted average correlation measures, i.e. Fisher's Z, they presented several vital conclusions. Namely, innovation exerts a positive impact on performance in organizational economic sustainability, social sustainability, and environmental sustainability. A similar modelling approach was adopted by Zubeltzu-Jaka et al. (2018), with the study devoted to eco-innovations. Despite mixed findings in individual pieces of research literature, the authors were able to identify the main clusters of determinants of eco-innovations, of which "market pull" and "technology push" clusters were more likely to produce green innovations. In addition, eco-innovations are more likely to be provided by firms with collaborative networks in conjunction with such entities as research institutes and public agencies.

Several meta-analyses are dedicated to supply chain management processes. Fang and Zhang (2018) analyze the extension of the internal green activities on the whole supply chain and external environmental actions as well as operational and economic performance of companies. The results show a strong positive impact of green supply chain management on all kinds of company performance. And the successful implementation of external environmental management needs cooperation with internal sustainability strategies. In a similar area of study, a meta-analysis by Govindan et al. (2020) confirmed a positive link between all forms of sustainability practices in supply chain management and firm performance. In particular, the adoption of social and environmental sustainability actions has a positive impact on both the operational and financial performance of the firms across all economies and industry types.

A related meta-analysis study concerning sustainable supply chain management practices was performed by Rashidi et al. (2020). Using a different methodological approach, namely a quantitative bibliometric and network analysis, the authors showed that several views on the positive relationship between supply chain management performance and sustainability, corporate social responsibility, environment, and the innovation capability of suppliers need further consideration. The gap between knowledge on industry business drivers and academic research needs to be bridged in this area.

Mardani et al. (2017) analyzed publications applying the structural equation modelling in environmental sustainability problems. In this meta-analysis, based mainly on a literature review and frequency statistics, the authors judged that nowadays, manufacturing industries have more focus on environmental sustainability compared to other sectors. According to the authors, the resource-based view theory contributed the most in the field of environmental sustainability, followed by stakeholder theory. Less established literature contributions are recognized, among others, from social capital theory and transaction cost theory.

A recent meta-analysis study concerning the concept of sustainable business models was conducted by Marczewska and Kostrzewski (2020). Using article review techniques, frequencies ratios and citation influence indices the authors concluded that the topics of corporate and business model sustainability are strongly linked to research on entrepreneurship, innovation and value creation. However, as it was a bibliometric analysis, they did not enhance their study with a formal modelling approach allowing for the extraction of the magnitude and significance of the presented relationships.

The research on sustainable business models and their drivers

still lacks a recent quantitative, cross industry meta-analysis, which summarizes the current state of knowledge in this field. In this paper, we undertake such a comprehensive literature analysis. From the methodological perspective, we decided not to use a purely qualitative and descriptive approach, which has obvious limitations, such as a lack of formulation of a formal statistical relationship as well as no information on the significance of specific factors. However, the quantitative meta-analysis methodologies used in some of the above-mentioned papers, may also suffer from some drawbacks. Typically, the studies encounter high I^2 statistics proposed by Higgins et al. (2003), which measure the heterogeneity in the sample. If it is large (above 80%), it indicates a selection of a random-effect model to perform the meta-analysis. However, the further procedure might be questionable in this situation, as the source of the heterogeneity should have been investigated. As Esterhuizen and Thabane (2016) notice, "if heterogeneity is substantial, the focus should be on exploring and understanding the sources of variation, and pooling of the data in a meta-analysis may not be appropriate."

In our method, we use a novel approach by eliminating the set of possible interactions using a least absolute shrinkage and selection operator method. Then we construct logit models, which allow both to identify the single pairwise correlations and also to identify the complex dependencies between variables. In addition, we are able to capture not only the significance of specific relationships but also to test the combined probability of model correct predictions as well.

The first stage of our study uses meta-analysis in order to identify the factors impacting enterprises' sustainable business models. The meta-analysis was conducted on the basis of a database of scientific articles, compiled from a review of publications in the area of interest. The ScienceDirect database of Elsevier was used as the source of publications. This database was chosen as it contains high-quality articles from journals with rigorous publishing requirements. Other reasons were: easy direct access to a rich library of publications, the ability to limit the results to the desired type of publication, and up-to-date content. In the authors' opinion, using a different database or including sources from additional databases would not significantly improve the quality of the meta-analysis.

The first step was defining the keywords for searching through the database. The following keywords were selected: business model, financial market, financial institutions, company/corporate/firm value, banks + sustainability, sustainable development. Then, the publication database was searched for each of these keywords. At this stage, additional criteria were applied to limit the search results to the most relevant ones:

- only research papers were searched as the type of publication,
- the date of publication was 2010 or later, due to the fact that the issue of sustainable development has recently been studied more widely.

The next task was to browse through the titles, keywords, and abstracts of the articles found. In this way, publications relevant to our research were selected. There were several papers that we found using different keywords, so duplicate results were removed. The outcome of this stage was the initial database of articles containing 112 items.

Once the initial database was created, we proceeded to the next step, in which all the articles were read through to verify if they actually present studies on the impact of any factors on the business models of enterprises. After verification, there were 99 articles left, which next were carefully analyzed to determine factors that had an impact on the business models. When carrying out the analysis, the papers that referred only to business models, and not to SBMs, and those that did not describe the relationship between the examined factors and SBM were rejected. The final database of articles contains 72 items. Altogether, the analysis consisted of seven steps as depicted in Fig. 1.

The articles were analyzed to identify factors relating to the business models of enterprises. Taking into account the character of these factors, they were assigned to at least one of the following categories for further research, i.e. Environmental, Social, Governance, Innovations, Corporate sustainability, Stakeholders, Social capital. Then, the relationship between the identified factors and the sustainable business model in individual articles was described. The relationships could be unidirectional (=>), bidirectional (<=>) or no influence (≠>). The variables and their description are provided in Table 1. The review of articles as well as classified dependencies are presented in Table 2.

In our research, we aim to capture the impact exerted by numerous variables (see Table 1). To obtain this goal we use two modelling procedures. The first one is a two stage process, which consists of the least absolute shrinkage and selection operator (Lasso) method and logistic regression. The second approach is based on several logistics regressions run in a 'from-general-to-specific' mode supported by information criteria values. Logit models are a dedicated and widely used tool for modelling the discrete dependent variables (see e.g. Greene, 2000, chap. 19), which is the case of this study. A short description of applied methods is presented below.

The Lasso method selects a subset of variables that are relatively well correlated with the outcome and are useful for prediction. The method was originally proposed by Tibshirani (1996) and is broadly described in Hastie et al. (2015). In Lasso's linear variant we look for a solution for equation (1):

$$y = \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_p x_p + \varepsilon \tag{1}$$

by minimizing both the in-sample prediction error and penalty resulting from model complexity (i.e. the $\lambda \sum_{j=1}^{p} |\beta_j|$ term) described by equation (2):

$$\frac{1}{2N}(y - \boldsymbol{X}\beta')'(y - \boldsymbol{X}\beta') + \lambda \sum_{j=1}^{p} |\beta_j| \tag{2}$$

where:

y – dependent variable indicating whether a study refers to 'Europe'
x_i – independent variables,
β_i – coefficients for independent variables,
p – number of independent variables,
λ – penalty term which tunes the coefficients so that if lambda increases, shrinkage occurs, so variables that are at zero are penalized – they can be thrown away.

Final econometric modelling in our research (in the both above-mentioned approaches) is conducted with the use of the logistic regression (logit) model. The modelled variable is:

$$Y_i = \begin{cases} 1, & \textit{if a given research refers to Europe} \\ 0, & \textit{otherwise} \end{cases} \tag{3}$$

The logistic function has the following form:

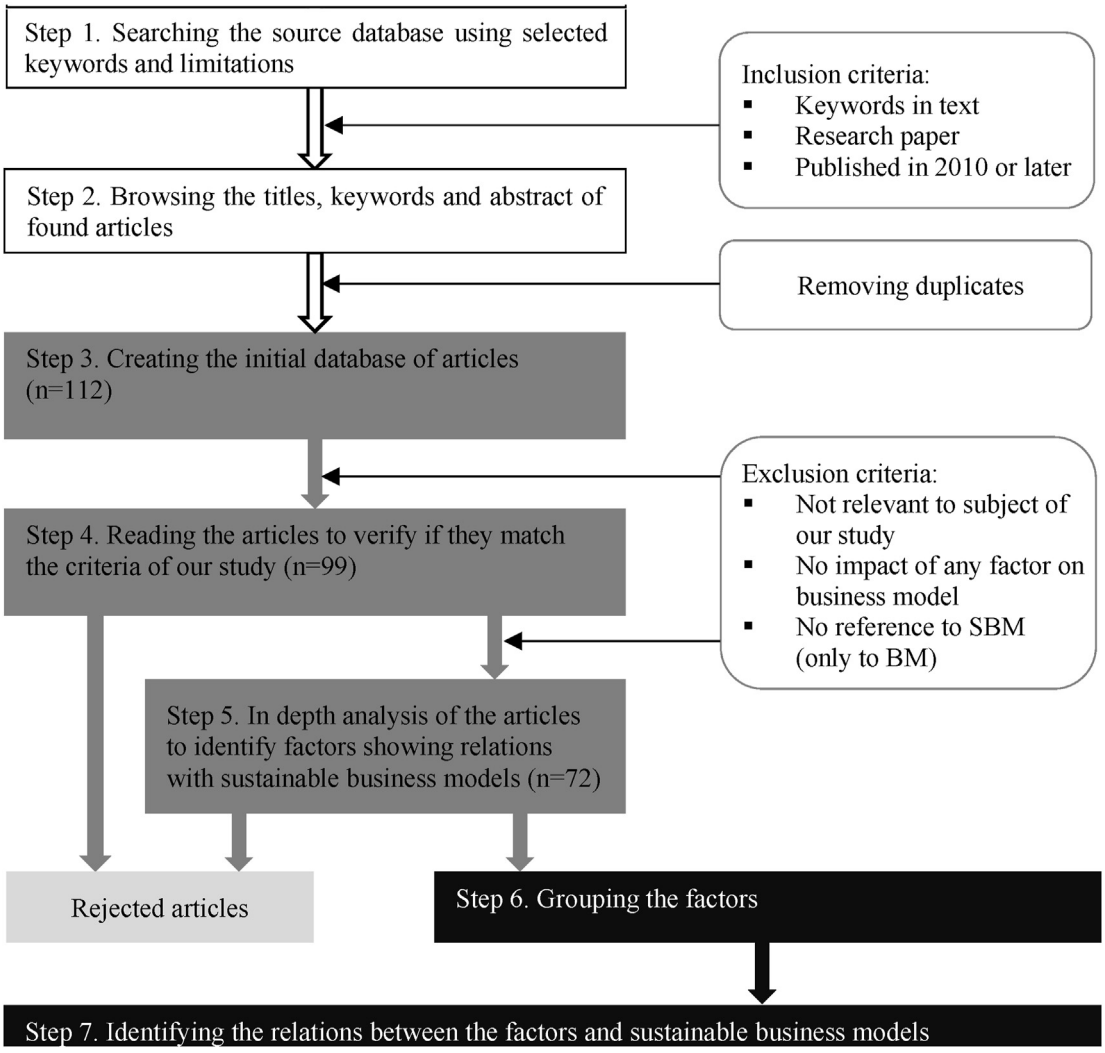

Fig. 1. Meta-analysis steps. Source: own elaboration.

Table 1
Description of independent variables used in econometric modelling.

Variable name	Short description	Explanation
Environmental	E	Environmental factors understood as ways of operation that lead to reducing waste and pollution, saving resources (water, energy, electricity), reducing greenhouse gas emissions
Social	S	Social factors understood as activities taken by the company to preserve human rights, reduce gender and racial inequity, provide good working conditions (health and safety), keep good relations with local communities, support charity, complying with CSR
Governance	G	Governance factors understood as elements of the company's policy focused on tax policy, corruption and bribery, executive remuneration, board diversity and structure
Innovation	IN	Innovations defined as the implementation of a new or significantly improved product or process
SMEsector	SME	Variable describing whether the research was devoted to small and medium enterprises
INSBM	IN=>SBM	Influence of innovations on creating and developing SBM
CSSBM	CS=>SBM	Corporate sustainability influence on creating and developing SBM
ESBM	E=>SBM	Environmental factors influence on creating and developing SBM
SSBM	S=>SBM	Social factors influence on creating and developing SBM
GSBM	G=>SBM	Governance factors influence creating and developing SBM
INnoSBM	INno≠>SBM	No impact of innovations on SBM
SE&SBM	S,E<=>SBM and SBM=>S,E	The social and environmental factors and SBM show a bidirectional relation, and SBM also had an impact on environmental and social factors
SCSBM	SC=>SBM	Social capital factors influence on creating and developing SBM
SHSBM	SH=>SBM	Stakeholders influence on creating and developing SBM
RMSBM	RM=>SBM	Risk management affects the creation and development of SBM

Source: own elaboration.
Note: S,E=>SBM relationship was decomposed and allocated to variables representing S=>SBM and E=>SBM.

Table 2
Summary of the literature on innovation, ESG and sustainable business model nexus.

	Study	Publication year	Region	Examined period	Methodology	Conclusions
1	Shakeel et al.	2020	–	1960–2019	Literature analysis	IN=>SBM
2	Gao & Li	2020	Europe	2018–2019	Case study, interview, data analysis	S,E=>SBM
3	Cosenz & Bivona	2020	Europe	2017–2018	Case study	IN=>SBM
4	Chasin et al.	2020	Europe, North America	2018–2019	Content analysis	IN=>SBM
5	Curtis & Mont	2020	Europe, North America	2019	Structured approach to business modelling, morphological analysis, literature review	IN=>SBM
6	Leviäkangas & Öörni	2020	Europe	2019	Meta-model tested with a case study	IN=>SBM
7	Brillinger et al.	2020	–	2010–2019	Literature review, in-depth expert group interview, data analysis	Other
8	Broccardo & Zicari	2020	Europe	2014–2016	Interview, data analysis	IN=>SBM
9	Baldassarre et al.	2020	Europe	2019	Design science research (DSR)	S,E=>SBM
10	Laukkanen & Tura	2020	–	2017–2018	Literature review, empirical review	IN≠>SBM
11	Gamble et al.	2020	Europe, North America, South America, Asia, Africa	1959–2019	Data analysis	SH=>SBM
12	To et al.	2020	North America	2013–2018	Cox modelling, temporal qualitative comparative analysis	IN=>SBM
13	Reficco et al.	2020	Europe	1987–2019	Case study	S=>SBM
14	Zufall et al.	2020	Europe	2018	Multiple case study	S,E=>SBM
15	Bocken & Geradts	2019	Europe	2016–2018	Qualitative research approach	IN=>SBM
16	Madsen	2019	Europe	2016–2018	Case study	S,E<=>SBM
17	Bradley et al.	2019	Asia	2015	Case study	S,E=>SBM
18	Gasparin et al.	2020	Europe	2017–2019	Case study	S,E=>SBM
19	Press et al.	2019	–	2014–2018	Case study	IN=>SBM
20	Bocken et al.	2018	Europe	2014–2018	Case study	E=>SBM
21	Velter et al.	2019	Europe	2017	Case study	IN≠>SBM
22	Karlsson	2019	Europe, North America	2002–2017	Exploratory research design	CS=>SBM
23	Rotondo et al.	2019	Europe	2008–2016	Case study	S=>SBM
24	Joyce & Paquin	2016	Europe, North America, Asia	2008–2012	Multiple case study	E=>SBM
25	Yang et al.	2016	Europe	2016	Case study	S,E=>SBM
26	Karkowska	2019	Asia	1998–2015	Panel data analysis	IN=>SBM
27	Fernando et al.	2018	–	2013–2014	Data analysis	IN=>SBM
28	Dyllick & Muff	2015	Europe	1970–2015	Literature analysis	ESG=>SBM
29	Rantala et al.	2018	North America	2017	Data analysis	other
30	Lloret	2015	Europe	2015	Data analysis	ESG=>SBM
31	Battistella et al.	2018	Europe	2017–2018	Case study	S,E=>SBM
32	Piscicelli et al.	2018	Europe	2016	Case study	other
33	Pedersen et al.	2016	Europe	2012	Data analysis	CS=>SBM
34	Aluchna & Rok	2018	Europe	2018	Case study	S,E=>SBM
35	Gauthier & Gilomen	2015	–	2012–2013	Case study	IN=>SBM
36	Nosratabadi et al.	2019	Europe, North America, South America, Asia, Africa	1999–2018	Literature analysis	S,E<=>SBM
37	Clinton & Whisnant	2019	Europe	2018	Literature analysis	S,E<=>SBM
38	Peralta et al.	2019	Europe	2019	Empirical analysis	IN=>SBM
39	Bashir et al.	2020	Europe, North America, Asia	2018	Data analysis	S,E=>SBM
40	Han	2019	Europe, North America, South America, Africa, Asia	2012–2017	Fractal Analysis, RP and RQA analysis of daily closing prices of Brent Crude Oil, Dow Jones Industrial Average, Shenzhen Component Index	E=>SBM
41	Al Mamun et al.	2018	–	1980–2015	Panel unit roots and estimation techniques	IN=>SBM
42	Busch et al.	2015	–	1978–2014	Literature review	ESG=>SBM

Table 2 (*continued*)

	Study	Publication year	Region	Examined period	Methodology	Conclusions
43	McKillop et al.	2020	North America	2017 −2018	Research review	IN=>SBM
44	Zagorchev & Gao	2015	Asia	2002 −2009	Multivariate panel models	other
45	Darus et al.	2014	Europe	2008 −2011	Content analysis, regression model	SH=>SBM
46	Andrikopoulos et al.	2014	Asia	2009	Content analysis	S=>SBM
47	Wang et al.	2020	Asia	2013 −2017	Data analysis	E=>SBM
48	Ferdousi	2015	Europe	2012	Data analysis	IN=>SBM
49	Dagilienė	2013	–	2012	Content analysis	S=>SBM
50	Berzkalne & Zelgalve	2014	Europe	2005 −2011	Empirical analysis using correlation method	SC=>SBM
51	Amara et al.	2016	North America	2009 −2010	Data analysis	SC=>SBM
52	Zhang et al.	2019	Asia	2010 −2017	Panel data analysis, empirical model testing	E=>SBM
53	Rjiba et al.	2020	Europe, North America, South America, Asia, Africa	2002 −2016	Data analysis	SC=>SBM
54	Bardos et al.	2020	North America	1997 −2013	Data analysis	S=>SBM
55	Weiling & Xin	2017	Asia	2011 −2015	Data analysis	S=>SBM
56	Buchanan et al.	2018	Europe, Asia	2006 −2010	Empirical analysis	S=>SBM
57	Chiu et al.	2019	North America	2007 −2014	Empirical analysis	SC=>SBM
58	Sheikh	2018	–	2003 −2015	Empirical analysis	S=>SBM
59	Chang et al.	2019	Europe, North America, South America, Asia, Africa	2002 −2014	Empirical analysis	S=>SBM
60	Fatemi et al.	2018	North America	2006 −2011	Empirical analysis	ESG=>SBM
61	Lee & Kim	2016	Europe, North America, South America, Asia, Africa	2002 −2012	Empirical analysis	S=>SBM
62	López-Pérez et al.	2017	Europe	2016	Data analysis PLS	S=>SBM
63	Liang et al.	2018	Europe, North America, South America, Asia, Africa	2006 −2015	Empirical analysis - stochastic frontier analysis (SFA), stochastic metafrontier approach (SMF)	CS=>SBM
64	Yip & Bocken	2018	Europe, North America, Asia	2015	Data analysis	CS=>SBM
65	Nizam et al.	2019	Europe, North America, South America, Asia, Africa	2013 −2015	Empirical analysis - cross-sectional linear regressions, non-linear threshold regressions	S,E=>SBM
66	Spatareanu et al.	2019	Europe	2006 −2014	Econometric methodology, developed model testing	IN=>SBM
67	Liu et al.	2019	Asia	1990 −2017	Empirical study	IN=>SBM
68	Brömer et al.	2019	Europe	2018	Case study	CS=>SBM
69	Pinter et al.	2010	–	2003	Data analysis	E=>SBM
70	Secundo et al.	2020	Europe, North America, South America, Asia, Africa	2003 −2018	Structured literature review (slr)	SC=>SBM
71	Jinjiang et al.	2020	Europe, North America, South America, Asia, Africa	2015 −2017	Descriptive statistical analysis	IN=>SBM
72	Ganescu	2012	Europe	2010	Data analysis	S=>SBM

Source: own elaboration.
Note: Abbreviations are explained in Table 1.

$$p_i = P(Y_i = 1|X_i; a) = \frac{1}{1+e^{-Z_i}} = \frac{e^{Z_i}}{1+e^{Z_i}} \quad (4)$$

where:

Z – a linear function such that $Z_i = a_0 + a_1X_{1i} + a_2X_{2i} + \ \ldots + a_kX_{ki} + \varepsilon_i$
i – number of observations
X_k – independent variables
$k = 1, 2, \ldots, n$– number of variables
a_k – coefficients.

Logit is the logarithm of the odds ratio $\frac{p_i}{1-p_i} = e^{Z_i}$ i.e.:

$$ln\frac{p_i}{1-p_i} = lne^{Z_i} = Z_i = \quad (5)$$

$$a_0 + a_1X_{1i} + a_2X_{2i} + \ldots + a_kX_{ki} + \varepsilon_i$$

To check the prediction properties of a model, the accuracy ratio R_P^2 (the ratio of correct predictions to all predictions) is measured, where theoretical $\hat{p}$ values are calculated as:

$$\widehat{p_i} = \frac{e^{\widehat{Z_i}}}{1 + e^{\widehat{Z_i}}} \quad (6)$$

For the unbalanced samples, where the share of $Y_i = 1$ in the sample is not equal to 0.5, which is the case of this research, it is important to calculate the adjusted accuracy ratio with $\widehat{Y_i} = 1$ *when* $\widehat{p_i} > \gamma$ where γ is the share $Y = 1$ in the sample.

For the econometric analysis, we employed the variables which described the scope and results of the research papers presented in Table 2. All data were converted into the binary variables. Firstly we used the linear Lasso approach and performed variable selection based on the lowest cross-validation mean prediction error (min_cv) as well as the lowest Bayes information criterion (min_-BIC). This selection would not be affected by using an alternative measures of regression fitness since the out-of sample R-squared is low and comparable for all feasible variants and overall R^2 points to the model with lowest mean prediction error. These results are presented in Table 3. As a result, the variables selected based on the lowest cross-validation (cv) mean prediction error were chosen for further analysis due to their better fitness (lower mean square error (MSE) and higher R^2). These were: Social, INSBM, Innovation and ESBM variables.

In the second step we ran logistic regressions using the selected variables obtained with the Lasso method. After elimination of the variables with insignificant coefficients we obtained a well-fitted Model 1 with two independent variables: INSBM and Social. Model 1 is characterized by an adjusted accuracy ratio of 66.67% and favourable tests' statistics – LR Chi^2 for the whole model as well as significant coefficients (see Table 4).

The Hosmer–Lemeshow goodness-of-fit test also delivered favourable results. However, since all independent variables in Model 1 are categorical and are not numerous, the Pearson goodness-of-fit test was conducted as well. This test also delivered a satisfactory outcome. Table 4 illustrates the final results for the first modelling approach employed.

The alternative approach was based solely on the logistic regression with a 'from-general-to-specific' procedure. It delivered Model 2, presented in Table 5. This approach also provided meaningful results. In addition, Model 2 showed even better prognostic properties (adjusted accuracy ratio of 70.83%) than Model 1 and is characterized by appropriate model specification and goodness-of-fit statistics, although not all variables are statistically significant in Model 2. Some variables are significant with p values between 5% and 10%, namely CSSBM, SE&SBM and SSBM.

To verify whether Model 2 is superior to Model 1 we conducted the likelihood-ratio test, with the assumption that Model 1 is nested in Model 2. It delivered the 7.72 test value, which means that the zero hypothesis has to be rejected (Prob > $Chi^2 = 0.1724$). Thus the results from Model 1 are stronger than from Model 2. However, Model 2 may still be considered as a moderately strong extension of Model 1. It is worth noting that all the findings from Model 1 are confirmed by Model 2.

The modelling allowed to separate some meaningful common relationships between the SBM and other variables analyzed in the numerous research articles (see Table 2). The obtained results can be split into strong, moderate and weak categories. The strong results are those which were confirmed by both models. For this group, we found that innovations affect SBMs in an unambiguously positive way for the research regarding Europe. In addition, European research focuses on social factors, which distinguishes it from other approaches. Moderately strong results are those which are significant for at least one model and are not rejected by the second one. This is the case for the social capital variable. As Model 2 shows, cultivating social capital, similarly to innovations, positively affects the sustainability of the company's business model.

The analysis also provided some additional useful outcomes from Model 2, although on the verge of statistical significance. For the p-values in the range between 0.05 and 0.1, the model revealed a positive impact between corporate sustainability, as well as the social factors and the SBM. It also showed an existence of a bidirectional relationship between the joint occurrence of social and environmental factors and the SBM.

4. Discussion

In literature, innovation is considered the center of economic growth (Schumpeter, 1939; Galindo and Méndez-Picazo, 2013) and an important element of competitive advantages of enterprises (Chatzoglou and Chatzoudes, 2018; Distanont and Khongmalai,

Table 3
Results of variable selection with the Lasso method (linear model).

Selection: Cross-validation; No. of obs. = 72, No. of covariates = 14, No. of CV folds = 10					
ID	Description	lambda	No. of nonzero coef.	Out-of sample R-squared	CV mean prediction error
1	first lambda	.1178511	0	0.0360	.2518079
6	lambda before	.0740139	4	−0.0122	.2460195
7[a]	selected lambda	.0674387	4	−0.0114	.2458273
8	lambda after	.0614477	5	−0.0125	.2460876
10	last lambda	.0510149	5	−0.0241	.2489244

Independent variable selection (min_cv represents variables for ID = 7):		
	min_cv	min_BIC
Social	x	x
INSBM	x	
Innovation	x	x
ESBM	x	
Constant	x	x

Penalized coefficients:			
Name	MSE	R-squared	Obs.
min_cv	.2191776	0.0982	72
min_BIC	.2380098	0.0208	72

[a] variables selected for further analysis (ID = 7).
Source: own calculations using Stata 16 software.

Table 4
Model 1 – Logistic regression and selected tests results.

Dependent variable: 'Europe'; Number of obs. = 72						
Variable	Coef.	Std. Err.	Z	P>|z|	95% Conf.	Interval
Social	1.584671	.6346695	2.50	0.013**	.3407416	2.8286
INSBM	1.696156	.6915092	2.45	0.014**	.3408224	3.051489
Constant	−1.198497	.595059	−2.01	0.044**	−2.364792	-.0322032
Log likelihood		−43.277394		Hosmer-Lemeshow chi2 (2)		0.09
LR chi2 (2)		11.26		Prob > chi2		0.9549
Prob > chi2		0.0036		Pearson chi2 (1)		0.09
Pseudo R2		0.1150		Prob > chi2		0.7613

Classified	True		Total
	D	~D	
+	39	21	60
–	3	9	12
Total	42	30	72

Classified + if predicted Pr(D) ≥ 0.583.
Correctly classified = 66.67%.
Source: own calculations using Stata 16 software.

Table 5
Model 2 – Logistic regression and selected tests results.

Dependent variable: 'Europe'; Number of obs. = 72						
Variable	Coef.	Std. Err.	z	P>|z|	95% Conf.	Interval
INSBM	3.68799	1.271915	2.90	0.004***	1.195083	6.180897
CSSBM	2.741796	1.470095	1.87	0.062*	-.1395366	5.623128
INnoSBM	1.613265	1.785689	0.90	0.366	−1.886621	5.11315
SE&SBM	2.711877	1.588086	1.71	0.088*	-.4007145	5.824469
SSBM	2.110121	1.155671	1.83	0.068*	-.1549525	4.375194
SCSBM	3.097023	1.510229	2.05	0.040**	.1370286	6.057018
Social	1.657903	.7572692	2.19	0.029**	.1736825	3.142123
constant	−3.271167	1.242889	−2.63	0.008***	−5.707185	-.83515
Log likelihood		−39.417915		Hosmer-Lemeshow chi2 (5)		0.23
LR chi2 (7)		18.97		Prob > chi2		0.9988
Prob > chi2		0.0083		Pearson chi2 (6)		1.29
Pseudo R2		0.1939		Prob > chi2		0.9721

Classified	True		Total
	D	~D	
+	37	16	53
–	5	14	19
Total	42	30	72

Classified + if predicted Pr(D) ≥ 0.583.
Correctly classified = 70.83%.
Source: own calculations using Stata 16 software.

2018). For this reason, innovations have become a permanent component of the business models of contemporary enterprises. Strong pressure to include environmental, social, and governance (ESG) factors in business models (Bocken and Bogart, 2016) means that innovations introduced by companies should be sustainable (Boons and Lüdeke-Freund, 2013). A sustainable business model built thanks to such innovations may itself constitute the source of the company's competitive advantage (Porter and Kramer, 2011).

Our results show that innovations positively affect sustainable business models. This research is in line with the scope of study on relationships between business model and innovation (Schneider and Spieth, 2013; Euchner and Ganguly, 2014) and business model innovation for sustainability (Inigo et al., 2017; Inigo and Albareda, 2016; Franceschelli et al., 2018; Evans et al., 2017b).

While studying the impact of innovation on SBM, it is worth noticing that not only innovation in technology, products, and services can lead to SBM, but also innovations of the business model itself (Girotra and Netessine, 2013). Such innovation implies changes in the conceptualization of business models regarding their exchanges and relations with stakeholders and the environment. The relationship between innovations and SBM revealed by our study is particularly visible for eco-innovations. This is confirmed by Barbieri and Santos (2020), who, based on a case-study of a Brazilian pharmaceutical company, showed that eco-innovations bring environmental benefits. Cagno et al. (2015) revealed that environmental performance is positively affected by open innovations.

Chesbrough (2008) emphasizes that both the company and external entities benefit from open innovations (outside-in process and inside-out process). In the inside-out process, the ideas, knowledge, and know-how, coming from the internal innovation processes of the company may be adopted by external entities, while the opposite action characterizes the outside-in process. Based on a literature review, Rauter et al. (2017) identified five

categories of open innovation: innovation process, companies' internal innovation system, companies' external innovation systems, cooperative aspects, and open innovation methods for sustainability purposes.

The relationship between sustainable innovation and open innovation is the subject of research in the last years (Costa, 2020; Curley, 2017). Arcese et al. (2015) described open sustainable innovation, as a combination of innovation and sustainability concept. The aim of implementation of such innovation is a development of processes, products, and services, but they also stimulate the transformation of the business model into a sustainable business model. Based on research in the food industry, he showed that the implementation of the open sustainable innovation approach contributes to achieving business and sustainable goals, such as reduced impact on the environment, healthier and safer food, and reduced company's costs. On the other hand, Rauter et al. (2017), on the basis of an analysis of 19 papers published in the period from 2003 to 2015, showed that the impact of open innovation on sustainable innovation is still debatable.

Asswad et al. (2015) revealed that open innovation may be a way to overcome barriers to implementing innovations. They argued that open innovation is a way to fill the gap between companies and consumers and that it helps to manage waste management by adopting ideas and technologies by collaboration. An example of employing open innovation that proved the above arguments is the case of Fairphone (Wernink and Strahl, 2015).

Besides its impact on the business model, innovation also affects other aspects related to sustainable development or sustainable performance. The impact of innovations on sustainable development was also confirmed by Omri (2020), who studied the case of 75 countries and revealed that the impact depends on the level of economic development of the country. A relationship between innovation and sustainability has been confirmed by Kuzma et al. (2020), based on a meta-analysis study. They revealed a positive impact of innovation on sustainability performance, regardless of whether it was considered as a whole or broken down into performance in economic, social, and environmental sustainability. The opposite impact was revealed by Kuhl et al. (2016), whose research showed that companies considered to be more sustainable were more likely to introduce innovations than the others. Eliwa et al. (2019) presented the impact of financial institutions on motivating enterprises to change towards SBM. The study showed that increasing the level of ESG performance and disclosure by companies lowered the cost of external financing.

Our study revealed a positive relationship between social factors and SBM. Benn et al. (2006), came to a similar conclusion, showing that the social capital of a company influences its transformation towards sustainability. According to them, intellectual and social capital is also an important factor in innovations in products and services. Velter et al. (2019) point out that the introduction of sustainable business model innovation requires building relationships with multi-stakeholders, e.g. suppliers, business partners, customers, and combining economic, social, and environmental dimensions.

Research conducted by Minoja and Romano (2020) confirms that intellectual capital contributes to the ESG performance when sustainability is integrated with governance and managerial processes in an organization. This is in line with the results of the analysis conducted by Garrigos-Simon et al. (2018), who pointed out the significant role of social capital in a company's sustainability. The importance of social capital was also confirmed by Danchev (2006).

5. Conclusion

The problem of sustainable business models has been widely discussed in the relevant literature. A significant challenge and research problem in this area is the high level of diversity among the obtained research results, their diversified context and scope, and the consequent difficulty in comparing them. There are no publications in the field of an aggregated, summative nature. At the same time, the data are analyzed in different geographic contexts.

Bearing in mind these conditions and the research gap, this article attempts to systematize the results of research on SBMs in two contexts – geographical and the system of factors affecting SBMs according to the ESG groups, i.e. environmental, social, and governance. In this context, we verified how innovations and ESG factors affect SBMs and whether this impact differs geographically. The research involved multiple stages. Firstly, a meta-analysis was used. A total of 72 articles were analyzed. In the next stage, analyses were carried out using the Lasso method. Over 20 variables were investigated, of which 15 ultimately qualified for the analysis. We identified the different relationships between the factors affecting SBMs. The crucial relationships were defined among innovations and the environmental, social, and governance (ESG) factors for Europe. This may be connected with the high concentration of research on sustainability and SBMs in the European area, which has been shown by Marczewska and Kostrzewski (2020).

The paper focuses on the European context due to the actions taken by the European Union in the field of EU taxonomy, which established a list of environmentally sustainable economic activities. Research alternatives are possible for Asia, Africa and America. The intention of the authors is to conduct such research in the future. An alternative study of companies from Asia, America or Africa will provide insights into how the location of the business affects the impact of ESG factors and will create the opportunity to assess which non-financial factors have the strongest and weakest impact on SBM in Asia, America and Africa. This will make it possible to draw conclusions about the various possible factors that determine the impact of ESG factors on SBMs, depending on the studied continent. It is assumed that the economic model and the financial market model will have an impact on the obtained results. The benefit of this approach will be the comprehensiveness of the research results and its ability to take into account the role of the financial market in shaping the construction of SBMs, i.e. the relationship between SBMs of enterprises and financial and economic sustainable development. This is an advantage of such an approach, compared to research focusing only on economic development. Future research based on an analysis of the impact of the financial market and its model on the SBMs of enterprises will allow us to determine to what extent and whether financial institutions and the capital market influence the decisions of enterprises to build SBMs. This knowledge is particularly important from the point of view of implementing innovations that affect SBMs and their financing, which is determined by the availability of capital.

A moderately strong relationship was confirmed for the positive impact of innovations and social factors on SBMs in Europe. This means that the companies adapt their business models towards sustainability using innovations, especially eco innovations. The second conclusion is that the social factor is an important element for the process of building SBMs in Europe. This factor is important because in Europe, the social model of the state and economy is predominant (a welfare state and a redistribution model of the state). A moderate relationship between social capital and SBMs was confirmed for Europe, and the weakest relationship was observed for the positive dependencies of the impact on SBMs from corporate sustainability (CSSBM), social factors (SSBM), and the emerging positive two-way relationship between social factors,

environmental factors, and SBM.

The original contribution of this research to the field includes the identification of non-financial factors influencing the business models of companies and the determination of the strength and direction of the dependence of these factors. It also indicates the conditions that are characteristic of Europe, and presents the paths of adaptation among companies towards sustainable business models under an adaptation scenario based on environmental and social factors, as well as governance.

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Author contributions

Conceptualization: MZ, KK; methodology: KK; software: KK; validation: KK; formal analysis KK, MZ; investigation: MZ; resources: MZ, KK, AS; data curation: KK; writing original draft preparation: KK, MZ, AS; writing review and editing: MZ, KK, AS; visualization: KK, MZ, AS; supervision: KK, MZ; project administration: KK, MZ; funding acquisition: MZ.

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.

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Appendix A. Supplementary data

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