June 2023

Fondazione Eni Enrico Mattei

Working Paper

013.2023

Social Sustainability in European Banks: A Machine Learning Approach using Interval-Based Composite Indicators

Carlo Drago, Loris Di Nallo, Maria Lucetta Russotto

Social Sustainability in European Banks: A Machine Learning Approach using Interval-Based Composite Indicators

By **Carlo Drago** (University of Niccolò Cusano)
Loris Di Nallo (University of Cassino e del Lazio Meridionale)
Maria Lucetta Russotto (University of Firenze)

Summary

Promoting social information reporting and disclosure can promote sustainable banking. The paper aims to measure banking social sustainability by constructing a new interval-based composite indicator using the Thomson Reuters database. In this work, we propose an approach to constructing interval-based composite indicators that enhance the composite indicator's construction sensibly, allowing us to measure the uncertainty due to the choices in the composite indicator design. The methodological approach employed is based on a Monte-Carlo simulation and allows for improving the information the composite indicators can obtain. So, we measure the value of the social indicator and its subcomponents and the value's uncertainty due to the different possible weights. The results show that the best international ESG practices in European banks relate to French and United Kingdom Banks, primarily than Italian banks. Finally, we analyze innovative perspectives and propose policy recommendations, considering the growing attention to the issue of ESG disclosure and its adherence to reality, to support sustainable banking ecosystems.

JEL Classification: G21; Q5; C02; C15; C43; C63

Keywords: Social Index, Sustainable Banking, ESG, Monte-Carlo Simulation, Machine Learning, Interval-based Composite Indicators

Address for correspondence:
Loris Di Nallo
Adjunct Professor, University of Cassino e del Lazio Meridionale
Viale dell'Università, 03043 Cassino, Italy
email: l.dinallo@unicas.it

Social Sustainability in European Banks: A Machine Learning Approach using Interval-Based Composite Indicators

Carlo Drago

Associate Professor in Economic Statistics

University of Rome N. Cusano, Via Don Carlo Gnocchi 3, 00166 Rome, Italy

Carlo.drago@unicusano.it

Loris Di Nallo*

Adjunct Professor in Accounting and Banking for SMEs

University of Cassino e del Lazio Meridionale, Viale dell'Università, 03043 Cassino, Italy

*Corresponding Author l.dinallo@unicas.it

Maria Lucetta Russotto

Adjunct Professor of Banks and Financial Systems

University of Firenze, Via delle Pandette, 50127 Firenze, Italy

Marialucetta.russotto@unifi.it

Abstract

Promoting social information reporting and disclosure can promote sustainable banking. The paper aims to measure banking social sustainability by constructing a new interval-based composite indicator using the Thomson Reuters database. In this work, we propose an approach to constructing interval-based composite indicators that enhance the composite indicator's construction sensibly, allowing us to measure the uncertainty due to the choices in the composite indicator design. The methodological approach employed is based on a Monte-Carlo simulation and allows for improving the information the composite indicators can obtain. So, we measure the value of the social indicator and its subcomponents and the value's uncertainty due to the different possible weights. The results show that the best international ESG practices in European banks relate to French and United Kingdom Banks, primarily than Italian banks. Finally, we analyze innovative perspectives and propose policy recommendations, considering the growing attention to the issue of ESG disclosure and its adherence to reality, to support sustainable banking ecosystems.

Keywords: social index, sustainable banking, ESG, Monte-Carlo simulation, machine learning, interval-based composite indicators.

Jel: G21; Q5; C02; C15; C43; C63

1. Introduction

The interest in investigating the social area of sustainability of banks arises from the huge impact on society, considering the multitude of functions they perform (Beck et al., 2010; Greenbaum and Thakor, 2007). In the banking world, in recent years, increasing pressure has emerged for banks to be more socially responsible, favoring the adoption of sustainable strategies that ensure responsible investment decisions, sustainability, and transparency, also involving stakeholders in their activities (Danisman, 2022; Chih et al., 2010). A transition in the banking system is required to be economically, socially, and environmentally sustainable (Seyfang & Gilbert-Squires, 2017; Ropke, 2016). Moreover, legislative pressures are present to improve the disclosure of sustainability: EBA guidelines (2021b) and the coming of the Sustainable Finance Disclosure Regulation.

The literature on the effects of Environmental, Social, and Governance (ESG) on accounting performance (La Torre et al., 2021; Ahmad et al., 2021; Brogi & Lagasio, 2018a), market performance (Di Tommaso & Thornton, 2020; Buallay, 2019; Miralles-Quiros et al., 2019), risk and efficiency (Izcan & Bektas, 2022; Neitzert & Petras, 2021; Forgione et al., 2020) in the banking system is deep, while fewer contributions are about ESG index (Bhimavarapu et al., 2022; Chang et al., 2021; Papoutsi & Sodhi, 2020). This research aims to fill this gap, focusing on the social component. Developing initiatives to spread a comprehensive Corporate Social Responsibility (CSR), especially regarding social themes, could mitigate and remedy banks' violation of these principles. However, given that this voluntary disclosure is not consistently implemented and has not prevented some problems, the topic dealt with in this paper assumes a significant relevance from the point of view of protecting social problems.

We consider a quantitative methodology based on the construction of an interval-based composite indicator; this composite indicator is based on a Monte-Carlo simulation obtained by considering the varying factors on the composite indicator as well (the weightings) and obtaining a relevant result also taking into the account the upper and the lower bound of the composite indicator which can indicate some relevant possibility of improvement of the composite indicators as well also analyzing the single specific indicators. Results show strong stability exists in the different positions of the best and the worst institutions regarding ranking. Therefore, the composite indicator seems to be an excellent solution to combine different sub-indicators to measure the social sustainability of European banks.

The paper is organized as follows. After the introduction, Section 2 presents the theoretical background. Section 3 outlines the research model specifying the sample and the methodology.

Section 4 proposes results and discussion. Finally, section 5 provides a conclusion, focusing on implications, limitations, and future research agenda.

2 Theoretical background

2.1 ESG in Banking Industry and its Measurement

In recent years, the increasing pressure for banks to be more socially responsible fostered the adoption of sustainability reporting and disclosure practices (Danisman, 2022; Chiaramonte et al., 2021; Cotugno et al., 2021; Sannino et al., 2021). As the banking industry is characterized by high human-based and reputational-based pillars (Kolk, 2004), the growing use of sustainability reporting and disclosure in the banking sector aims to highlight sustainability, sustainable practices, company's stakeholder engagement, cross-sector partnerships, and community development

Therefore, reporting and disclosure on sustainability represent fundamental tools for the strategy and transparency of sustainable banking activity, careful to meet the expectations of stakeholders who aim for sustainable development (Batae et al., 2021). In addition, environmental and social behaviors are considered among the most essential variables (Toma & Stefanelli, 2022; Adu et al., 2022; Chenet et al., 2021). The academic literature in recent has almost exclusively focused on why CSR is done, with fewer contributions on incorporating it into a formal production framework (Puggioni & Stefanou, 2019), considering the need for a transition in the banking system (Seyfang & Gilbert-Squires, 2017; Ropke, 2016).

ESG criteria represent the metrics used by investors and other stakeholders to evaluate the impact of the companies on these themes (European Parliament, 2020). While the literature on the effects of ESG values in generic companies is pervasive, there are fewer contributions focused on the banking world. The most debated arguments are financial-accounting and market performance, efficiency, and reputation (see, for instance, Izcan & Bektas, 2022; La Torre et al., 2021; Neitzert & Petras, 2021; Ahmad et al., 2021; Birindelli & Intonti, 2018; Brogi & Lagasio, 2018a; Dell'Atti et al., 2017).

In literature about the construction of the index of social variables, there are no specific contributions as far as we know. Most academic work uses an index edited by vendors as a starting point. Some elaboration models are developed if we extend the analysis to the ESG index, not considering only the social component (table 1).

Table 1. Literature on ESG index

Authors	Paper	Journal, year	ESG index
Gaganis et al.	CISEF: A composite index of social, environmental, and financial performance	European Journal of Operational Research, 2021	Authors elaborate on a composite indicator of social, environmental, and financial performance.
Papoutsi & Sodhi	Does disclosure in sustainability reports indicate actual sustainability performance?	Journal of Cleaner Production, 2020	ESG index comes from content analysis used on sustainability reports
Bhimavarapu et al.	Makes the Impact of Transparency and Disclosure on the Firm's Valuation Depends on the ESG?	Journal of Risk and Financial Management, 2022	ESG index is calculated using dichotomous scoring

So many academics refer to ESG data processed by vendors, also in order to create their rankings and aggregate index solutions (Eccles & Stroehle, 2018). Mainstream data vendors are Bloomberg and Thomson Reuters. The current studies consider the most comprehensive ESG (Bhimavarapu et al., 2022; Rajesh et al., 2022; Gasser et al., 2017; Utz et al., 2015; Utz et al., 2014). Nevertheless, there are some problems: the ESG rating criteria used by prominent agencies show a lack of commonality in the definition and measuring of ESG (Malesios et al., 2022; Billio et al., 2020), and a new ESG paradigm is desirable (Gallucci et al., 2022). Consequentially it emerges the need to understand better the social construction which underlies analyses with non-financial indicators (Eccles et al., 2019), especially in the banking industry where ESG factors have a more substantial impact (Kumar et al., 2016)

The issue of implementation of ESG in the banking world is discussed in academia (Dikau & Voltz, 2021), and a deeper analysis of its measurement and on the social component are requested, considering the functions of the banks (Beck et al., 2010; Greenbaum & Thakor, 2007).

2.2 The S component of the ESG

Regarding the ESG combined score analysis, there are no significant differences between Developed and Emerging Europe, while the Social Score of Southern European banks is significantly higher than Northern (Batae et al., 2020).

Starting from the standard definition, in the social area, we include Workforce freedom of association, Child labor, Forced and compulsory labor, Workplace health and safety, Customer health and safety, Discrimination, diversity, and equal opportunity, Poverty and community impact, Supply chain management, Training and education, Customer privacy, Community impacts (EBA, 2021a). One of the most used measures in literature comes from ASSET4 of Thomson Reuters: Social Pillar Score, composed of the Human Rights score, Workforce score, Product Responsibility score and Community score.

Regarding financial-economic performance, it emerges that social score has a positive and significant impact on the earnings per share of a firm (Ahmad et al., 2021), ROE (Simsek & Cankaya, 2021; Shakil et al., 2019), and ROA (Simsek & Cankaya, 2021). Deepening into the subcomponents, product responsibility influences ROA (Batae et al., 2021). In line with the findings of the ESG combined score, Social Score is negatively and significantly associated with stock market values (Mirallas-Quiros et al., 2019).

Relatively to risk, the literature confirms a risk-reducing effect of the social dimension for the banks (Di Tommaso & Thornton, 2020). However, there is only a statistically significant risk-reducing effect on default risk, not portfolio risk (Neitzart & Petras, 2021). On the other hand, product responsibility, investments in social and human rights, or workforce training significantly enhance resiliency; the responsibility score significantly reduces exposure and contribution risk; and the workforce score reduces exposure to risk and insolvency risk (Gehrig et al., 2021). In addition, bank fragility is analyzed: composite ESG score lower bank fragility, with an higher impact of the social dimension and a different impact that depends on banks' characteristics and operating environments. Fair workforce treatment, product responsibility, and equal treatment of shareholders are the most significant variables (Chiaramonte et al., 2021). Finally, idiosyncratic bank risk: differently from the Environmental and Governance dimension, there is no significant association (Izcan & Bektas, 2022). As for the composite ESG score, there is a U-shaped relationship between Social Score and efficiency (Lopez-Penabad et al., 2022).

Lastly, it is possible to discuss the reputation theme. The social aspect of ESG directly impacts reputation. The social variable has an influence on positive community engagement, product

responsibility and good employee relations (Izcan & Bektas, 2022). Therefore, employee relations form an essential part of the social dimension, and previous research has concluded that good employment practices and policies minimize firm-specific risks (Lopez-Penabad et al., 2022). This positive relationship between reputation and Social Score is confirmed in other works (Dell'Atti et al., 2017; Bouslah et al., 2013).

Therefore, the potential impact of the social variable of banks emerges from the literature, with effects also on performance. Thus, the research question concerns the importance of measuring this variable. This paper aims to extend the literature about the elaboration of bank ranking, focusing on social disclosure variable. Other contributions focus on drawing up rankings for banking efficiency (Zimkova, 2014), branch efficiency (Mavi, 2015), systemic risk (Moratis & Sakellaris, 2021), and productivity (Dmitrovic et al., 2016).

3 Research design

3.1 The Data

The banks included in the STOXX Europe 600 Banks represent the object of analysis of this work. The STOXX Sector indices are available for global markets, Europe, the Eurozone, and Eastern Europe, and use the market standard Industry Classification Benchmark (ICB). We refer to 2020 to have the data for all 40 banks listed in STOXX Europe 600 banks. Therefore, we analyzed 40 banks listed in European banks. The critical assumption is that this index is representative of the most-capitalized and largest banks in Europe (Jung, 2023). Specifically, the index covers more than 70% of the assets of all European banks subject to the Single Supervisory Mechanism (Brogi & Lagasio, 2018b), expressing a proxy of the entire European market and a good level of information (Serrasqueiro & Oliveira, 2022). This type of index of listed companies is used in other scientific works in which the companies present represent, as a proxy, their country of origin (see, for example, Brida et al., 2016).

Relatively to the variables analyzed, we extract them Thomson Reuters database. We consider Environmental, Social, and Governance Scores from Refinitiv, Social Pillar Score, and its sub-component (Workforce; Human Rights; Community; Product Responsibility). Thomson Reuters calculates these scores using The Refinitiv Business Classification as the benchmark, considering that different sectors have different weights. In particular, for the banking sector's social pillar score, we have the following weights: Workforce 38,7%; Human Rights 19,4%; Community 24,2%; Product

Responsibility 17,7%. The methodology adopted enables Thomson Reuters to produce a score between 0 and 100 (Refinitiv, 2022).

This paper aims to develop a ranking of banks at a geographical level concerning the issue of social sustainability and its sub-components. In this sense, we have used an interval-based composite indicator based on different factors of variation. This factor allows measuring the composite indicator as an interval, so we can also measure the variability of our results and the uncertainty implied by the different choices (in this sense, we consider the results not only the center but also the upper and the lower bound of the composite indicator).

3.2 Methodology

In this work, we will construct an innovative composite indicator on the ESG for European Banks to identify the best practices in Europe and rank the different banks. In policymaking and academic research, composite indicators are increasingly used to summarize complex phenomena by combining multiple individual indicators into one metric (Joint Research Centre-European Commission 2008).

An indicator that combines multiple measures into one is referred to as a composite indicator, as it provides a more comprehensive view of a phenomenon or constructs than individual measures alone (see Joint Research Centre-European Commission 2008, Saltelli 2007). Composite indicators can be applied to various topics, such as economic performance, sustainability, social well-being, gender equality, environmental quality, sustainable cities, energy, and corporate governance (Black et al., 2017; Zanella et al., 2015). A composite indicator can be constructed in various ways, and the specific methodology used may depend on the purpose and availability of the data. In this respect, a typical composite indicator. An indicator considered composite is a measurement that combines several sub-indicators, which are weighted and normalized to create a single result. It is based on a definition presented by Saisana et al. (2005) and Aiello & Attanasio (2006). A relevant problem in composite indicators is their subjectivity. Composite indicators have several limitations, including the subjectivity involved in selecting the indicators, the structure of the composite indicator, and the weighting. Various researchers can have different choices in composite indicator selection, the structure of the composite constructed or the weighting (for instance), which may affect the final results. Compounding composite indicators across studies or contexts can be more challenging due to this subjectivity (Joint Research Centre-European Commission 2008, Dobbie & Dail 2013, Greco et al. 2019, Correa Machado et al. 2022). In order to overcome this problem, a proposal was made to consider a Monte-Carlo simulation based on the different sources of variation and choices on the different factors related to the construction of the composite indicator to cover all the situations which can be based on subjectivity choices. In this respect, it is possible to consider the different indicators

on which the composite indicator is constructed and the weighting applied to the different indicators. In this context, the different results obtained from the Monte-Carlo Simulations are not aggregated, but they have all considered interval observations (interval data). There are many advantages in this context related to the fact that it is possible to consider the center of the interval (which corresponds) to the final value of the composite interval and the lower and upper bound. In this case, these parameters are important because they allow comparing the extreme results that can occur on the Monte-Carlo simulations and the variation (which can be interpreted as vulnerability factors in the general system of indicators considered) as a measure of uncertainty.

So following Gioia (2016) and Gioia & Lauro (2005), each composite indicator $\boldsymbol{Y}^{I}$ interval-based is characterized by

$$\boldsymbol{Y}^{I} = \left(Y_i = \left[\underline{y}_i, \bar{y}_i\right]\right) \qquad i = 1, \cdots, n \qquad [1]$$

Where $\underline{y}_i$ is a lower bound and the $\bar{y}_i$ is an upper bound for the considered i as scenario or simulated composite indicators based on a set of assumptions (weighting schemes, for instance).

At the same time, we have the center of the interval

$$y_i^c = \left(\underline{y_i} + \bar{y}_i\right)/2 \qquad [2]$$

and also the radius

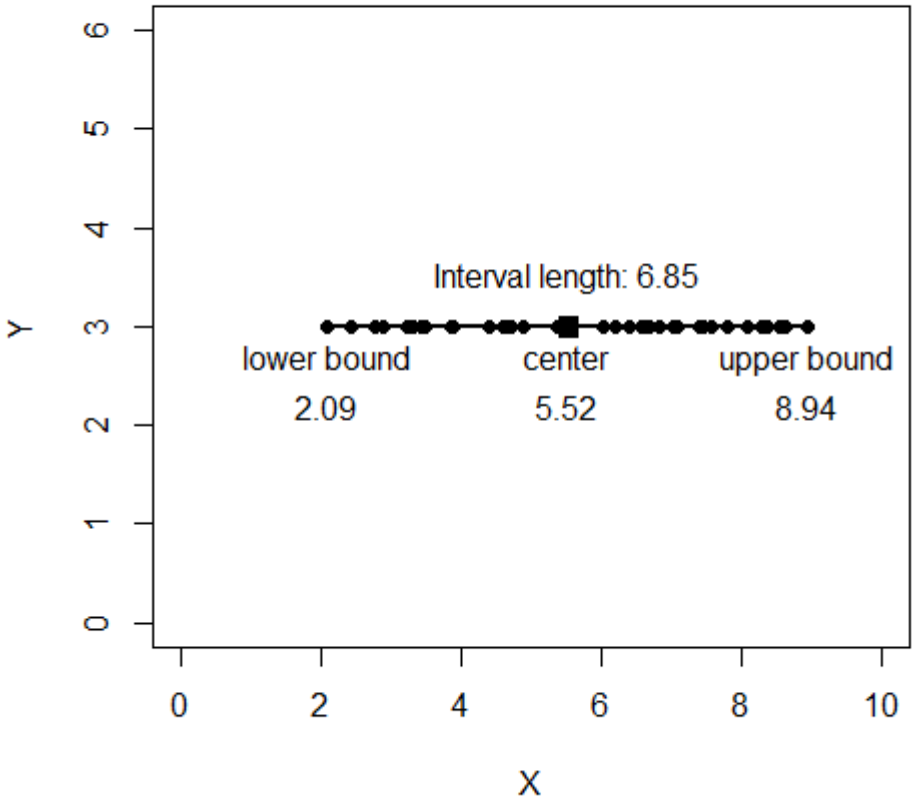
$$y_i^r = \left(\overline{y_i} - \underline{y}_i\right)/2 \qquad [3]$$

which also allows us to consider the length of the interval simply by:

$$y_i^l = \left(\bar{y}_i - \underline{y}_i\right) \qquad [4]$$

We can observe Figure 1 to visualize the structure of an interval-based composite indicator. In the figure, we have simulated a parameterization of the composite indicator computing their parameters: the upper and the lower bound, the center, and the length.

Figure 1: Interval-Based Composite Indicators



So, it is possible to compare the different centers, the different upper and lower bounds, but also the range (or length) for each interval data as a way to better understand the general composite indicators, which in this case are not a single number but an interval (see in this respect Drago & Gatto 2022, Drago 2021, Gatto & Drago 2020).

In this sense, we can also have a relevant interpretation of the parameters of the interval: the center represents the "value" symmetric to the outcome of the composite indicator, where the upper and the lower bounds can be extreme values, and so show that some variables or a single variable are performing very poorly, and so there is a clear indicator of weakness (for the lower bound), for the upper bound it could be an indicator for the variables involved of strength (for some variables not necessarily all). In this sense, comparisons with the center can help observe the different results and

structures of the underlying indicators. Finally, the different values of interval length are relevant because they allow us to measure the level of uncertainty of the indicator and the economic level of vulnerability, considering that some indicators are excellent and others are particularly bad. In this sense, from the intervals, various taxonomies can be considered. Two relevant taxonomies can be countries showing low interval length with high centers showing a good general level of the indicator and at the contrary showing low interval length with low centers showing a bad static situation (see Drago and Gatto 2023).

At this point, it is considered a clustering procedure to identify better the different categories about their characteristics and parameters of the intervals obtained. In this way, we consider a clustering algorithm as the K-means (Hartigan & Wong 1979) identify the general groups of intervals and, in this sense, social A procedure of validation based on the Elbow method (Thorndike 1996) is used to identify and validate the optimal number of clusters it is possible to obtain. In relation to this theme, for each aggregated group we compute the archetypes, using an average of the different interval values (following in this sense Gioia & Lauro 2005).At the same time, following Gioia & Lauro (2005), we can calculate the average interval to compare the different countries.

4 Discussion of results

4.1 Empirical results

In order to compare the different results, we can consider the various parameterizations of the interval obtained from the Monte Carlo simulation. These results are obtained as the center of the interval, representing the most likely value of the composite indicator. In this case, it is possible to observe the banks that show the best results for the center of the composite-based interval (table 2): BNP Paribas SA, Standard Chartered PLC, Barclays PLC, Intesa San Paolo, and finally, Societe Generale SA. That means that the best practice at the international level is for two French institutions (BNP Paribas S.A. and Societe Generale SA) but also two English institutions (Standard Chartered PLC and Barclays PLC) and finally, an Italian institution (Intesa San Paolo). Close Brothers Group PLC, Avanza Bank Holding AB, Jyske Bank A/S, Virgin Money UK PLC, Ringkjoebing Landbobank A/S are severely performed at the center.

Table 2. Interval-based composite indicator ranking by center

rank	Bank	center	mean
1	BNP Paribas SA	1.155	1.13
2	Standard Chartered PLC	0.895	1.01

3	Barclays PLC	0.78	0.73
4	Intesa San Paolo	0.775	0.97
5	Societe Generale SA	0.755	0.65
6	Banco Santander SA	0.745	0.81
7	FinecoBank Banca Fineco SpA	0.68	0.5
8	Caixabank SA	0.65	0.7
9	UniCredit SpA	0.595	0.6
10	Raiffeisen Bank International AG	0.565	0.65
11	Deutsche Bank AG	0.5	0.58
12	Natwest Group PLC	0.495	0.53
13	Banco Bilbao Vizcaya Argentaria SA	0.335	0.34
14	DNB Bank ASA	0.305	0.39
15	Investec PLC	0.25	0.33
16	Banco BPM SpA	0.2	0.21
17	Erste Group Bank AG	0.135	0.27
18	Bankinter SA	0.03	-0.05
19	Lloyds Banking Group PLC	0.025	0.38
20	Banco de Sabadell SA	0.01	0.1
21	Kbc Groep NV	-0.04	0.19
22	Credit Agricole SA	-0.065	0.09
23	Skandinaviska Enskilda Banken AB	-0.07	0.1
24	Bank Polska Kasa Opieki SA	-0.12	-0.27
25	Svenska Handelsbanken AB	-0.135	0.05
26	HSBC Holdings PLC	-0.15	-0.09
27	Powszechna Kasa Oszczednosci Bank Polski SA	-0.195	0
28	ING Groep NV	-0.215	-0.11
29	Danske Bank A/S	-0.255	-0.44
30	BAWAG Group AG	-0.255	-0.17
31	Bank of Ireland Group PLC	-0.295	-0.29
32	Swedbank AB	-0.335	-0.26
33	Commerzbank AG	-0.385	-0.18
34	Nordea Bank Abp	-0.44	-0.41
35	ABN Amro Bank NV	-0.46	-0.46
36	Close Brothers Group PLC	-0.735	-0.88
37	Avanza Bank Holding AB	-1.075	-1.71
38	Jyske Bank A/S	-1.65	-1.63
39	Virgin Money UK PLC	-1.715	-1.77
40	Ringkjoebing Landbobank A/S	-2.42	-2.58

The results do not seem to change much if we consider the lower and upper bounds. In this case, we are observing the best practices for the lower bound (table 3) and the best practices for the upper

bound (table 4). We have the best institutions for the lower bound: BNP Paribas S.A., Barclays PLC, Standard Chartered PLC, Natwest Group PLC, and Intesa San Paolo. The worst performances, in this case, are Nordea Bank Abp, Jyske Bank A/S, Virgin Money UK PLC, Avanza Bank Holding AB, Ringkjoebing Landbobank A/S. Finally, the results do not change so much for the upper bound. So we have: BNP Paribas SA, Standard Chartered PLC, Banco BPM SpA, Societe Generale SA and finally Intesa San Paolo. At the same time, the worst performances are from ABN Amro Bank NV, Close Brothers Group PLC, Jyske Bank A/S, Virgin Money UK PLC, and Ringkjoebing Landbobank A/S.

Table 3: Lower bound

Rank	**bank**	**Lower Bound**
1	BNP Paribas SA	0.93
2	Barclays PLC	0.55
3	Standard Chartered PLC	0.45
4	Natwest Group PLC	0.37
5	Intesa San Paolo	0.34
6	Banco Santander SA	0.32
7	Caixabank SA	0.28
8	Raiffeisen Bank International AG	0.27
9	UniCredit SpA	0.26
10	Societe Generale SA	0.24
11	FinecoBank Banca Fineco SpA	0.18
12	Banco Bilbao Vizcaya Argentaria SA	0.13
13	DNB Bank ASA	0.08
14	Deutsche Bank AG	0.05
15	Erste Group Bank AG	-0.35
16	Investec PLC	-0.42
17	Credit Agricole SA	-0.65
18	Bank Polska Kasa Opieki SA	-0.66
19	Lloyds Banking Group PLC	-0.84
20	Banco BPM SpA	-0.88
21	Svenska Handelsbanken AB	-0.88
22	Kbc Groep NV	-0.89
23	Banco de Sabadell SA	-0.9

24	Skandinaviska Enskilda Banken AB	-0.9
25	Powszechna Kasa Oszczednosci Bank Polski SA	-0.91
26	Bankinter SA	-0.93
27	BAWAG Group AG	-0.93
28	Commerzbank AG	-0.93
29	HSBC Holdings PLC	-0.97
30	Swedbank AB	-0.98
31	ABN Amro Bank NV	-1
32	Danske Bank A/S	-1.16
33	ING Groep NV	-1.19
34	Bank of Ireland Group PLC	-1.23
35	Close Brothers Group PLC	-1.35
36	Nordea Bank Abp	-1.36
37	Jyske Bank A/S	-2.17
38	Virgin Money UK PLC	-2.25
39	Avanza Bank Holding AB	-2.85
40	Ringkjoebing Landbobank A/S	-3.61

Table 4: Upper bound

rank	**bank**	**Upper Bound**
1	BNP Paribas SA	1.38
2	Standard Chartered PLC	1.34
3	Banco BPM SpA	1.28
4	Societe Generale SA	1.27
5	Intesa San Paolo	1.21
6	FinecoBank Banca Fineco SpA	1.18
7	Banco Santander SA	1.17
8	Caixabank SA	1.02
9	Barclays PLC	1.01
10	Bankinter SA	0.99
11	Deutsche Bank AG	0.95
12	UniCredit SpA	0.93

13	Investec PLC	0.92
14	Banco de Sabadell SA	0.92
15	Lloyds Banking Group PLC	0.89
16	Raiffeisen Bank International AG	0.86
17	Kbc Groep NV	0.81
18	Skandinaviska Enskilda Banken AB	0.76
19	ING Groep NV	0.76
20	Avanza Bank Holding AB	0.7
21	HSBC Holdings PLC	0.67
22	Danske Bank A/S	0.65
23	Bank of Ireland Group PLC	0.64
24	Natwest Group PLC	0.62
25	Erste Group Bank AG	0.62
26	Svenska Handelsbanken AB	0.61
27	Banco Bilbao Vizcaya Argentaria SA	0.54
28	DNB Bank ASA	0.53
29	Credit Agricole SA	0.52
30	Powszechna Kasa Oszczednosci Bank Polski SA	0.52
31	Nordea Bank Abp	0.48
32	Bank Polska Kasa Opieki SA	0.42
33	BAWAG Group AG	0.42
34	Swedbank AB	0.31
35	Commerzbank AG	0.16
36	ABN Amro Bank NV	0.08
37	Close Brothers Group PLC	-0.12
38	Jyske Bank A/S	-1.13
39	Virgin Money UK PLC	-1.18
40	Ringkjoebing Landbobank A/S	-1.23

Table 5: Range

rank	**id**	**Range**
1	Avanza Bank Holding AB	3.55

2	Ringkjoebing Landbobank A/S	2.38
3	Banco BPM SpA	2.16
4	ING Groep NV	1.95
5	Bankinter SA	1.92
6	Bank of Ireland Group PLC	1.87
7	Nordea Bank Abp	1.84
8	Banco de Sabadell SA	1.82
9	Danske Bank A/S	1.81
10	Lloyds Banking Group PLC	1.73
11	Kbc Groep NV	1.7
12	Skandinaviska Enskilda Banken AB	1.66
13	HSBC Holdings PLC	1.64
14	Svenska Handelsbanken AB	1.49
15	Powszechna Kasa Oszczednosci Bank Polski SA	1.43
16	BAWAG Group AG	1.35
17	Investec PLC	1.34
18	Swedbank AB	1.29
19	Close Brothers Group PLC	1.23
20	Credit Agricole SA	1.17
21	Commerzbank AG	1.09
22	ABN Amro Bank NV	1.08
23	Bank Polska Kasa Opieki SA	1.08
24	Virgin Money UK PLC	1.07
25	Jyske Bank A/S	1.04
26	Societe Generale SA	1.03
27	FinecoBank Banca Fineco SpA	1
28	Erste Group Bank AG	0.97
29	Deutsche Bank AG	0.9
30	Standard Chartered PLC	0.89
31	Intesa San Paolo	0.87
32	Banco Santander SA	0.85
33	Caixabank SA	0.74
34	UniCredit SpA	0.67

35	Raiffeisen Bank International AG	0.59
36	Barclays PLC	0.46
37	DNB Bank ASA	0.45
38	BNP Paribas SA	0.45
39	Banco Bilbao Vizcaya Argentaria SA	0.41
40	Natwest Group PLC	0.25

From this analysis, we can observe substantial stability in the different positions which occur on the best and the worst institutions in terms of ranking. These results are significant to understand the reason for these ranks by observing the ranks of the single values, which are sub-indicator of the composite indicator. This way can observe the relevant elements in determining an international best or worst practice. The ranking from the Thomson Reuters database are in table 6.

Table 6: Ranks for each single sub-indicator

Name	*Ranking Social Pillar Score*	*Ranking Workforce Score*	*Ranking Human Rights Score*	*Ranking Community Score*	*Ranking Product Responsibility Score*
Intesa San Paolo	3	1	17	2	7
UniCredit SpA	8	14	17	5	11
Kbc Groep NV	20	10	1	24	24
Skandinaviska Enskilda Banken AB	21	16	1	25	24
Svenska Handelsbanken AB	22	26	11	12	24
Commerzbank AG	29	23	17	28	24
Banco Bilbao Vizcaya Argentaria SA	15	24	17	16	11
Bankinter SA	26	2	33	19	24
Societe Generale SA	12	7	17	20	2
Bank of Ireland Group PLC	31	35	36	10	11
Barclays PLC	5	12	11	3	11
Close Brothers Group PLC	36	25	34	36	24
Natwest Group PLC	10	13	11	18	11
Standard Chartered PLC	2	18	1	1	2

Lloyds Banking Group PLC	13	9	1	7	24
Danske Bank A/S	35	29	1	34	24
Jyske Bank A/S	37	36	37	38	24
Ringkjoebing Landbobank A/S	40	40	40	37	24
Banco Santander SA	4	5	17	11	6
DNB Bank ASA	14	17	11	14	22
HSBC Holdings PLC	27	8	10	30	24
Swedbank AB	18	33	30	23	24
BNP Paribas SA	1	4	1	6	2
Erste Group Bank AG	17	21	31	13	11
Nordea Bank Abp	33	37	11	14	24
Banco de Sabadell SA	24	19	17	33	9
Credit Agricole SA	23	15	17	32	11
Banco BPM SpA	19	22	35	21	1
Raiffeisen Bank International AG	7	6	17	9	11
Caixabank SA	6	3	17	8	11
ING Groep NV	30	32	1	35	11
FinecoBank Banca Fineco SpA	11	20	17	26	5
BAWAG Group AG	28	30	11	27	24
ABN Amro Bank NV	34	34	17	29	24
Virgin Money UK PLC	39	38	38	39	24
Powszechna Kasa Oszczednosci Bank Polski SA	25	11	17	22	24
Investec PLC	16	27	9	4	23
Deutsche Bank AG	9	28	1	17	10
Bank Polska Kasa Opieki SA	32	31	31	31	11
Avanza Bank Holding AB	38	39	39	40	8

From the cluster analysis (table 7-8), we can observe that we can obtain four groups of the cluster. We can observe that cluster 4 shows the best performances for the parameters considered by the interval-based composite indicator. In the end, we found 14 banks with the best social sustainability indicator. The results in figure 2 show that the best results for the interval composite indicators using

a mean for the different banks considered in each country are France, Italy, Spain, and Norway. Lower results are for the Netherlands, Sweden, Finland, and Denmark.

Table 7 K-Means clustering for the interval features

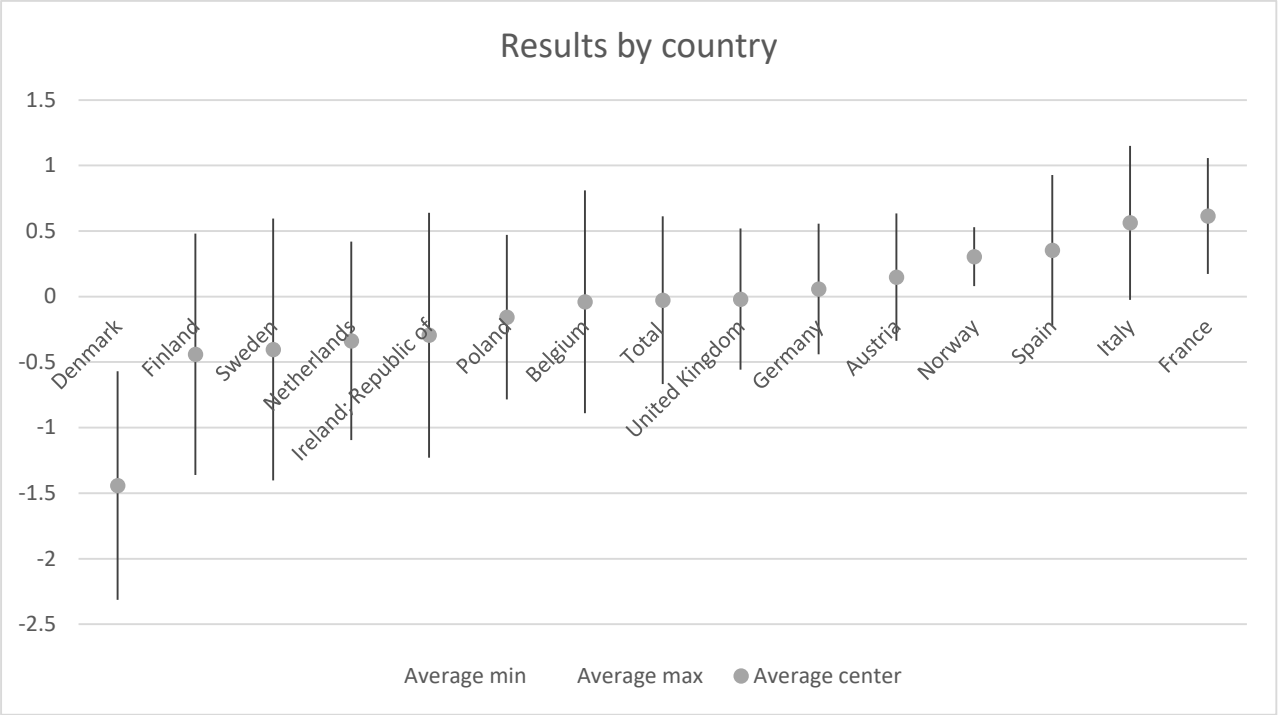
id	Bank	min	max	mean	cluster
1	BNP Paribas SA	0.93	1.38	1.13	4
2	Standard Chartered PLC	0.45	1.34	1.01	4
3	Barclays PLC	0.55	1.01	0.73	4
4	Intesa San Paolo	0.34	1.21	0.97	4
5	Societe Generale SA	0.24	1.27	0.65	4
6	Banco Santander SA	0.32	1.17	0.81	4
7	FinecoBank Banca Fineco SpA	0.18	1.18	0.5	4
8	Caixabank SA	0.28	1.02	0.7	4
9	UniCredit SpA	0.26	0.93	0.6	4
10	Raiffeisen Bank International AG	0.27	0.86	0.65	4
11	Deutsche Bank AG	0.05	0.95	0.58	4
12	Natwest Group PLC	0.37	0.62	0.53	4
13	Banco Bilbao Vizcaya Argentaria SA	0.13	0.54	0.34	4
14	DNB Bank ASA	0.08	0.53	0.39	4
24	Bank Polska Kasa Opieki SA	-0.66	0.42	-0.27	3
29	Danske Bank A/S	-1.16	0.65	-0.44	3
30	BAWAG Group AG	-0.93	0.42	-0.17	3
31	Bank of Ireland Group PLC	-1.23	0.64	-0.29	3
32	Swedbank AB	-0.98	0.31	-0.26	3
33	Commerzbank AG	-0.93	0.16	-0.18	3
34	Nordea Bank Abp	-1.36	0.48	-0.41	3
35	ABN Amro Bank NV	-1	0.08	-0.46	3
36	Close Brothers Group PLC	-1.35	-0.12	-0.88	3
37	Avanza Bank Holding AB	-2.85	0.7	-1.71	2
38	Jyske Bank A/S	-2.17	-1.13	-1.63	2
39	Virgin Money UK PLC	-2.25	-1.18	-1.77	2
40	Ringkjoebing Landbobank A/S	-3.61	-1.23	-2.58	2
15	Investec PLC	-0.42	0.92	0.33	1

16	Banco BPM SpA	-0.88	1.28	0.21	1
17	Erste Group Bank AG	-0.35	0.62	0.27	1
18	Bankinter SA	-0.93	0.99	-0.05	1
19	Lloyds Banking Group PLC	-0.84	0.89	0.38	1
20	Banco de Sabadell SA	-0.9	0.92	0.1	1
21	Kbc Groep NV	-0.89	0.81	0.19	1
22	Credit Agricole SA	-0.65	0.52	0.09	1
23	Skandinaviska Enskilda Banken AB	-0.9	0.76	0.1	1
25	Svenska Handelsbanken AB	-0.88	0.61	0.05	1
26	HSBC Holdings PLC	-0.97	0.67	-0.09	1
27	Powszechna Kasa Oszczednosci Bank Polski SA	-0.91	0.52	0	1
28	ING Groep NV	-1.19	0.76	-0.11	1

Table 8: K-Means archetypes for the interval features

Group.1	min	max	mean	cluster
1	-0.82385	0.79	0.113077	1
2	-2.72	-0.71	-1.9225	2
3	-1.06667	0.337778	-0.37333	3
4	0.317857	1.000714	0.685	4

Figure 2: Interval-Based Composite Indicators averages aggregated by country



4.2 Applicability to rating

Much of the literature mainly aims to investigate ESG ratings' effects on corporate performance (both financial and non-financial). A second strand of the literature analyzes and evaluates the particularities of the ESG rating and the adopted methodologies highlighting their disagreement (Billio et al., 2020). Finally, the rating agencies have decided to develop their own valuation methodologies in order to evaluate the ESG phenomenon. Our empirical results show how this methodology can represent a first tool for developing ESG ratings, particularly for social issues.

This topic is interesting because rating evaluates the quality, performance, and outcomes of entities, individuals, and organizations (Drago et al., 2019). ESG ratings can indicate whether the company falls into the category of socially responsible companies, and they can influence stakeholders' reactions (Cheng et al., 2014; Sen and Bhattacharya, 2001), identifying an opportunity for the firm's social assets, such as reputation or status.

The issue of rating agencies is relevant. In particular, an emerging ESG rating agency may not immediately receive sufficient media and business attention due to low public awareness of sustainable development and limited visibility of the rating agency (Zeng & Xu, 2019), leaving the market to the big players. Generally, ESG ratings are elaborated by different vendors to assess the ESG performance of companies by considering several criteria, measurements, and quantitative and qualitative methods; ESG scores typically range between 0 and 100; these scores are typically associated with a rating class using thresholds or quartiles of the ESG score values (Bax et al., 2022).

In this context, our work's methodology can be applied to assess the reliability of ESG values. Furthermore, the results are central to understanding the reason for these ranks by observing the ranks of the single sub-indicator of the composite indicator. This way can observe the relevant elements in determining an international best or worst practice. Moreover, it can represent a starting point for elaborating specific ratings.

5. Conclusions

5.1 Practical and theoretical implication

Businesses exhibit a growing sensitivity to social and environmental issues as they engage in corporate social responsibility (Attanasio et al., 2021; Lozano, 2018; Eweje & Sakaki, 2015). Therefore, the adoption of sustainable strategies becomes necessary for banks to be more socially responsible.

This study aim to propose a first analysis on the reporting and disclosure of social information in the sustainable banking sector, with the aim of improving this area, developing dissemination initiatives and proposing an overall CSR. Thus, the increasing attention to ESG (in particular to the social component) in organizations and especially in the banking sector is confirmed by our results and statistics contributing to existing literature (Lopez-Penabad et al., 2022; Batae et al., 2021; Ahmad et al., 2021; Simsek & Cankaya, 2021; Neitzart & Petras, 2021; Gehrig et al., 2021; Di Tommaso & Thornton, 2020; Shakil et al., 2019; Mirallas-Quiros et al., 2019).

This paper has several theoretical and practical implications. First of all:

- Considering that the financial system is linked to many and different stakeholders, who require ever greater non-financial information, a particular attention to the issue emerges. Banks are central because they significantly impact society, considering the functions they perform (Beck et al., 2010; Greenbaum & Thakor, 2007).
- Developing initiatives to spread a comprehensive ESG model, especially about social themes, could mitigate and remedy banks' violation of these principles. However, given that this voluntary disclosure is not consistently implemented and has not prevented some problems, the topic dealt with in this paper assumes a significant relevance from the point of view of the protection of social problems.

The first findings show that:

- The best international practices in Social issues are primarily found in French and U.K. banks, with an Italian bank coming in second.

Regarding the non-excellent disclosure performance of banks in the Scandinavian area, our results are supported by the work of Paulet & Relano (2012), who assert that the Scandinavian banks that present substantial disclosure on sustainability issues are only the so-called ethical ones. Furthermore, focusing on Denmark, the literature detects a lack of disclosure of social issues, despite good legislative pressure (Atan et al., 2016), with a resulting gap between legislation and disclosure expectations (Rose, 2015). Finally, regarding the Netherlands, the Monitoring Committee Corporate Governance Code (2022) highlights how companies could report this information more meaningfully, better explaining the actions are taken, the problems that emerged, the consequent considerations, the consequent results, and the impact on the companies. These interpretations of the results must be considered in the light of the primary hypotheses presented in the data paragraph: as in Brida et al. (2016), we consider the Eurostoxx as a representative index of the European banking world and of the individual countries to which the banks belong.

We consider a quantitative methodology based on constructing an interval-based composite indicator. We use composite indicators, one of the most popular means used by academics, practitioners, and policymakers, to consolidate a multidimensional aspect of interest into a single metric (Gaganis et al., 2021). Where constructing a composite indicator seems to be an excellent solution to combine different sub-indicators to measure the social sustainability of the European banks, the problem of subjectivity is a known issue for the composite. It can be overcome by considering a Monte-Carlo simulation on the different varying factors (weighting and structure of the composite indicator, for instance), allowing using interval data an improved measure of the final result of the composite indicator and the uncertainty-related the different composite indicator. In order to support sustainable banking ecosystems.

This is a valuable baseline for academics, practitioners, policymakers, and regulators to understand the actions to take. We analyze innovative perspectives and propose policy recommendations, considering the growing focus on the issue of ESG disclosure (Dikau & Voltz, 2021). We propose that bank managers must be continuously aware of the information needs of all stakeholders, which is a vital source to better compete in the market. This study is the first attempt to fill the gap by elaborating on a specific index and best practices. We posit a framework that banks can use to evaluate social areas from a multidimensional point of view.

5.2 Limitations and future research agenda

Like any research, this paper has several limitations. First, as data are collected from a sample of European listed banks, the generalization of the findings is limited due to the characteristics of banks and geographic restrictions. Moreover, the sample includes both commercial and investment banks. Therefore, future research should investigate the social index using different samples. For example, samples are composed only of commercial (Badunenko et al., 2021) or investment banks or extending the geographical analysis. Unlisted banks are more complex because these banks are not always required to publish sustainability reports.

Regarding the methodology, composite indicators have several limitations, including the subjectivity involved in selecting the indicators, the structure of the composite indicator, and the weighting. In order to overcome this problem, a proposal is made to consider a Monte-Carlo simulation based on the different sources of variation and choices on the different factors related to the construction of the composite indicator to cover all the situations which can be based on subjectivity choices.

In the future, scholars could focus on this methodological approach by expanding it to other ESG variables. Furthermore, the composite indicator could be used as a starting point for testing the hypothesis of a relationship between ESG and performance already analyzed in the literature (La Torre et al., 2021; Ahmad et al., 2021; Di Tommaso & Thornton, 2020; Buallay, 2019; Miralles-Quiros et al., 2019 Brogi & Lagasio, 2018a)

References

Adu, D.A., Al Najjar, B., & Sittipongpanich, T. (2022). Executive compensation, environmental performance, and sustainable banking: The moderating effect of governance mechanisms. *Business Strategy and the Environment*.

Ahmad, N., Mobarek, A., & Roni, N.N. (2021). Revisiting the impact of ESG on financial performance of FTSE350 UK firms: Static and dynamic panel data analysis. *Cogent Business & Management*, 8:1. https://doi.org/10.1080/23311975.2021.1900500

Aiello, F., & Attanasio, M. (2006, September). Some issues in constructing composite indicators. In *VIII international meeting on quantitative methods for applied sciences*, Certosa di Pontignano (pp. 11-13).

Ashwin Kumar, N.C., Smith C., Badis, L., Wang, N, Ambrosy, P. & Tavares, R. (2016). ESG factors and risk-adjusted performance: a new quantitative model. *Journal of Sustainable Finance & Investment*.

Atan, R., Razali, F. A., Said, J., & Zainun, S. (2016). Environmental, social and governance (ESG) disclosure and its effect on firm's performance: A comparative study. *International Journal of Economics and Management*, 10(2), 355-375.

Attanasio, G., Preghenella, N., De Toni, A. F., & Battistella, C. (2021). Stakeholder engagement in business models for sustainability: The stakeholder value flow model for sustainable development. *Business Strategy and the Environment*

Badunenko, O., Kumbhakar, S. C., & Lozano-Vivas, A. (2021). Achieving a sustainable cost-efficient business model in banking: The case of European commercial banks. *European Journal of Operational Research*, 293(2), 773-785.

Batae, O.A., Dragomir, V.D., & Feleaga, L. (2020). Environmental, social, governance (ESG), and financial performance of European banks. *Accounting and Management Information Systems*, Vol. 19, No. 3, 480-501. http://dx.doi.org/10.24818/jamis.2020.03003

Batae, O.A., Dragomir, V.D., & Feleaga L. (2021). The relationship between environmental, social, and financial performance in the banking sector: A European study. *Journal of Cleaner Production*

Bax, K., Bonaccolto, G., & Paterlini, S. (2022). Do lower environmental, social, and governance (ESG) rated companies have higher systemic impact? Empirical evidence from Europe and the United States. *Corporate Social Responsibility and Environmental Management*.

Beck, T., Demirgüç-Kunt, A., & Levine, R. (2010). Financial institutions and markets across countries and over time: The updated financial development and structure database. *The World Bank Economic Review*, 24 (1), 77–92.

Bhimavarapu, V.M., Rastogi, S., Gupte, R., Pinto, G., & Shingade, S. (2022). Does the Impact of Transparency and Disclosure on the Firm's Valuation Depend on the ESG?, 15(9), 410. https://doi.org/10.3390/jrfm15090410

Billio, M., Costola, M., Hristova, I., Latino, C., & Pelizzon, L. (2020). Inside the ESG ratings: (Dis)agreement and performance. *Corporate Social Responsibility and Environmental Management*. DOI: 10.1002/csr.2177

Birindelli, G., & Intonti, M. (2018). The role of corporate social responsibility in the international banking sector in Corporate Social Responsibility. Nova Science Publishers

Black, B., De Carvalho, A. G., Khanna, V., Kim, W., & Yurtoglu, B. (2017). Corporate governance indices and construct validity. *Corporate Governance: An International Review*, 25(6), 397-410.

Bouslah, K., Kryzanowski, L., & M'zali, B. (2013). The impact of the dimensions of social performance on firm risk. *Journal of Banking & Finance*, Volume 37, Issue 4, 1258–1273. https://doi.org/10.1016/j.jbankfin.2012.12.004

Brida, J. G., Matesanz, D., & Seijas, M. N. (2016). Network analysis of returns and volume trading in stock markets: The Euro Stoxx case. *Physica A: Statistical Mechanics and its Applications*, 444, 751-764.

Brogi, M., & Lagasio, V. (2018). Environmental, social, and governance and company profitability: Are financial intermediaries different?, *Corporate Social Responsibility and Environmental Management*, 26, 576–587

Brogi, M., & Lagasio, V. (2018). Is the market swayed by press releases on corporate governance? Event study on the Eurostoxx banks. *Corporate Ownership & Control*, 15(3), 23-31.

Buallay, A. (2019). Is sustainability reporting (ESG) associated with performance? Evidence from the European banking sector. *Management Environmental Quality International Journal*, 30, 98–115.

Chiaramonte, L., Dreassi, A., Girardone, C., & Piserà, S. (2021). Do ESG strategies enhance bank stability during financial turmoil? Evidence from Europe. *The European Journal of Finance*, 1-39

Chang, R., Chu, L., Zhang, B., Zhou, G., & Tu, J. (2021). ESG and the Market Return. *Research Collection Lee Kong Chian School Of Business*.

Cheng, B. T., Ioannou, I., & Serafeim, G. (2014). Corporate social responsibility and access to finance. *Strategic Management Journal*, 35(1), 1–23. http://doi.org/10.1002/smj.2131

Chenet, H., Ryan-Collins, J., & Van Lerven, F. (2021). Finance, climate-change and radical uncertainty: Towards a precautionary approach to financial policy. *Ecological Economics*, 183, 106957.

Chih, H.L., Chih, H.H., & Chen, T.Y. (2010). On the determinants of corporate social responsibility: international evidence on the financial industry. *Journal of Business Ethics*, 119(2), 219-234

Goal-based participatory weighting scheme: balancing objectivity and subjectivity in the construction of composite indicators. *Quality & Quantity*, 1-21.

Cotugno, M., Galletta, S., & Mazzù, S. (2021). Shareholder value in European banks after the global financial crisis: an empirical analysis. *International Journal of Applied Decision Sciences*, 14(5), 477-497.

Danisman, G. O. (2022). ESG Scores and Bank Performance During COVID-19, In Handbook of Research on Global Aspects of Sustainable Finance in Times of Crises (pp. 241-260), IGI Global.

Dell'Atti, S., Trotta, A., Iannuzzi, A.P., & Demaria, F. (2017). Corporate Social Responsibility Engagement as a Determinant of Bank Reputation: An Empirical Analysis. *Corporate Social Responsibility and Environmental Management*, Volume 24, Issue 6. https://doi.org/10.1002/csr.1430

Di Tommaso, C., & Thornton, J. (2020). Do ESG scores effect bank risk taking and value? Evidence from European banks. *Corporate Social Responsibility Environmental Management*, 27, 2286–2298

Dikau, S., & Volz, U. (2021). Central bank mandates, sustainability objectives and the promotion of green finance. *Ecological Economics*, 184, 107022.

Dmitrovic, V., Dobrota, M., & Knezevic, S. (2016). A Statistical Approach to Evaluating Bank Productivity. *Management*, 2016/75. DOI: 10.7595/management.fon.2015.0010

Dobbie, M. J., & Dail, D. (2013). Robustness and sensitivity of weighting and aggregation in constructing composite indices. *Ecological Indicators*, 29, 270-277.

Drago, C. (2021). The analysis and the measurement of poverty: An interval-based composite indicator approach. *Economies*, 9(4), 145.

Drago, C., & Gatto, A. (2022). An interval-valued composite indicator for energy efficiency and green entrepreneurship. *Business Strategy and the Environment*. Volume 31, Issue 5, July 2022, Pages 2107-2126

Drago, C., & Gatto, A. (2023). Gauging energy poverty in developing countries with a composite metric of electricity access. Utilities Policy, 81, 101486.

Drago, D., Carnevale, C., & Gallo, R. (2019). Do corporate social responsibility ratings affect credit default swap spreads? *Corporate Social Responsibility and Environmental Management*, 26(3), 644–652. https:// doi.org/10.1002/csr.1709

EBA, (2021). EBA Report on management and supervision of ESG risks for crediti institutions and investment firms

EBA (2021). Guidelines on Loan Origination and Monitoring.

Eccles, R.G., Lee, L., & Stroehle J.C. (2019). The Social Origins of ESG: An Analysis of Innovest and KLD. *Organization and Environment*, Vol. 33, Issue 4. https://doi.org/10.1177/1086026619888994

Eccles, R.G., & Stroehle J.C. (2018). Exploring Social Origins in the Construction of ESG Measures, SSRN. http://dx.doi.org/10.2139/ssrn.3212685

European Parliament (2020). Corporate social responsibility (CSR) and its implementation into E.U. Company law

Eweje, G., & Sakaki, M. (2015). CSR in Japanese companies: Perspectives from managers. *Business Strategy and the Environment*, 24(7), 678-687

Forgione, A.F., Laguir, I., & Stagliano, R. (2020). Effect of corporate social responsibility scores on bank efficiency: The moderating role of institutional context. *Corporate Social Responsibility and Environmental Management*. DOI: 10.1002/csr.1950

Gaganis, C., Pasiouras, F., Tasiou, M., & Zopounidis, C. (2021). CISEF: A composite index of social, environmental and financial performance. *European Journal of Operational Research*, 291(1), 394-409.

Gallucci, C., Santulli, R., & Lagasio, V. (2022). The conceptualization of environmental, social and governance risks in portfolio studies A systematic literature review. *Socio-Economic Planning Sciences*, 101382.

Gasser, S. M., Rammerstorfer, M., & Weinmayer, K. (2017). Markowitz revisited: Social portfolio engineering. *European Journal of Operational Research*, 258(3), 1181-1190.

Gatto, A., & Drago, C. (2020). Measuring and modeling energy resilience. *Ecological Economics*, 172, 106527.

Gehrig, T., Iannino, M.C., & Unger S. (2021). Social Responsibility and Bank Resiliency. *ECGI Working Paper Series in Finance*, Working Paper N° 755/2021

Gioia, F. (2016). Capital Asset Pricing Model Using Regression Methods for Interval-Valued Variables. *Reliable Computing*, 21:53, 73

Gioia, F., & Lauro, C. N. (2005). Basic statistical methods for interval data. *Statistica applicata*, 17(1), 75-104.

Greco, S., Ishizaka, A., Tasiou, M., & Torrisi, G. (2019). On the methodological framework of composite indices: A review of the issues of weighting, aggregation, and robustness. *Social indicators research*, 141, 61-94.

Greenbaum, S.I., Thakor, A.V. (2007). Contemporary Financial Intermediation. Elsevier Academic Press

Hartigan, J. A.; Wong, M. A. (1979). "Algorithm AS 136: A k-Means Clustering Algorithm". *Journal of the Royal Statistical Society, Series C*. 28 (1): 100–108. JSTOR 2346830.

Izcan, D., & Bektas, E. (2022). The Relationship between ESG Scores and Firm-Specific Risk of Eurozone Banks. *Sustainability*, 14, 8619. https://doi.org/10.3390/su14148619

Kolk, A. (2004). A decade of sustainability reporting: developments and significance. *International Journal of Environment and Sustainable Development*, Nº 3 (1), p. 51-64

Joint Research Centre-European Commission. (2008). *Handbook on constructing composite indicators: methodology and user guide*. OECD publishing.

Jung, A. (2023). Are monetary policy shocks causal to bank health? Evidence from the euro area. *Journal of Macroeconomics*, 75, 103494.

La Torre, M., Leo, S., & Panetta, I.C. (2021). Banks and environmental, social and governance drivers: Follow the market or the authorities?, *Corporate Social Responsibility and Environmental Management*, 28, 1620–1634. DOI: 10.1002/csr.2132

Lopez-Penabad, M.C., Iglesias-Casal, A., Neto, J.F.S., & Maside-Sanfiz, J.M. (2022). Does corporate social performance improve bank efficiency? Evidence from European banks. *Review of Managerial Science*. https://doi.org/10.1007/s11846-022-00579-9

Lozano, R. (2018). Sustainable business models: Providing a more holistic perspective. *Business Strategy and the Environment*, 27(8), 1159-1166

Malesios, C., De, D., Moursellas, A., Dey, P. K., & Evangelinos, K. (2021). Sustainability performance analysis of small and medium sized enterprises: Criteria, methods and framework. *Socio-Economic Planning Sciences*, 75, 100993.

Mavi, R.K., Saen, R.F., Mavi, N.K, Taleshi, S.S., & Majd Z.R. (2015). Ranking bank branches using DEA and multivariate regression models. *International Journal of Operational Research*, Vol. 24, No. 3. https://doi.org/10.1504/IJOR.2015.072230

Moratis, G., & Sakellaris, P. (2021). Measuring the systemic importance of banks. *Journal of Financial Stability*, Vol. 54.

Miralles-Quiros, M.M., Miralles-Quiros, M.M., & Redondo-Hernandez, J. (2019). The impact of environmental, social, and governance performance on stock prices: Evidence from the banking industry. *Corporate Social Responsibility and Environmental Management*, 26, 1446–1456.

Monitoring Committee Corporate Governance Code (2022). Monitoring Report for the 2021 financial year

Neitzert, F., & Petras, M. (2021). Corporate social responsibility and bank risk. *Journal of Business Economics*, 92, 397–428.

Papoutsi, A., & Sodhi, M.S. (2020). Does disclosure in sustainability reports indicate actual sustainability performance?, *Journal of Cleaner Production*, Volume 260, 121049.

Paulet, E., & Relano, F. (2012). From CSR rhetoric to real business practice: ethical banking in Scandinavia. *International Journal of Business Governance and Ethics*, 7(4), 350-364.

Puggioni, D., & Stefanou, S. E. (2019). The value of being socially responsible: A primal-dual approach. *European Journal of Operational Research*, 276(3), 1090-1103.

Refinitiv, (2022). Environmental, social and governance scores from Refinitiv

Rajesh, R., Rajeev, A., & Rajendran, C. (2022). Corporate social performances of firms in select developed economies: A comparative study. *Socio-Economic Planning Sciences*, 81, 101194.

Røpke, I. (2016). Complementary system perspectives in ecological macroeconomics—The example of transition investments during the crisis. *Ecological Economics*, 121, 237-245.

Rose, C. (2015). Listed firm's level of stakeholder transparency: The comply or explain evidence from the Danish corporate governance code. *International Journal of Business Science & Applied Management*, 10(2), 1-15.

Saltelli, A. (2007). Composite indicators between analysis and advocacy. *Social indicators research*, 81(1), 65-77.

Serrasqueiro, R., & Oliveira, J. (2022). Risk reporting: do country-level institutional forces really matter?. *Asian Review of Accounting*.

Sen, S., & Bhattacharya, C. B. (2001). Does doing good always lead to doing better? Consumer reactions to corporate social responsibility. *Journal of Marketing Research*, 38(2), 225–243. https://doi.org/10.1509/ jmkr.38.2.225.18838

Seyfang, G., & Gilbert-Squires, A. (2019). Move your money? Sustainability transitions in regimes and practices in the U.K. retail banking sector. *Ecological Economics*, 156, 224-235.

Shakil, M.H., Mahmood, N., Tasnia, M., & Munim, Z.H. (2019). Do environmental, social and governance performance affect the financial performance of banks? A cross-country study of emerging market banks. *Management Environmental Quality International Journal*, 30, 1331–1344

Simsek, O., & Cankaya, S. (2021). Examining the relationship between ESG scores and financial performance in banks: Evidence from G8 countries. *Press Academia Procedia*, 14, 169–170

Sannino, G., Nicolò, G., & Zampone, G. (2021). The impact of intellectual capital on bank performance during and after the NPLs crisis: evidence from Italian banks. *International Journal of Applied Decision Sciences*, *14*(4), 419-442.

Thorndike R., L. (1996). Who Belong in the family. *Psychometrika*, 18, 267-276.

Toma, P., & Stefanelli, V. (2022). What are the banks doing in managing climate risk? Empirical evidence from a position map. *Ecological Economics*, 200, 107530.

Utz, S., Wimmer, M., Hirschberger, M., & Steuer, R. E. (2014). Tri-criterion inverse portfolio optimization with application to socially responsible mutual funds. *European Journal of Operational Research*, 234(2), 491-498.

Utz, S., Wimmer, M., & Steuer, R. E. (2015). Tri-criterion modeling for constructing more-sustainable mutual funds. *European Journal of Operational Research*, 246(1), 331-338.

Zanella, A., Camanho, A. S., & Dias, T. G. (2015). Undesirable outputs and weighting schemes in composite indicators based on data envelopment analysis. *European Journal of Operational Research*, 245(2), 517-530.

Zeng, G., & Xu, Y. (2019). Sustainable development and the rating effects: A strategic categorization approach. *Corporate Social Responsibility and Environmental Management*, 26(6), 1554-1564.

Zimkova E., (2014). Technical Efficiency and Super-Efficiency of the Banking Sector in Slovakia. *Procedia Economics and Finance*, 12, 780-787

FONDAZIONE ENI ENRICO MATTEI WORKING PAPER SERIES

Our Working Papers are available on the Internet at the following address:
https://www.feem.it/pubblicazioni/feem-working-papers/

"NOTE DI LAVORO" PUBLISHED IN 2023

1. 2023, G. Maccarone, M.A. Marini, O. Tarola, Shop Until You Drop: the Unexpected Effects of Anti-consumerism and Environmentalism
2. 2023, F. Andreolli, C. D'Alpaos, P. Kort, Does P2P trading favor investments in PV-Battery Systems?
3. 2023, M. Buso, C. Dosi, M. Moretto, Dynamic Regulation of Public Franchises with Imperfectly Correlated Demand Shocks
4. 2023, A. Ugolini, J. C. Reboredo, J. Ojea-Ferreiro, Is climate transition risk priced into corporate credit risk? Evidence from credit default swaps
5. 2023, F. Cornacchia, A. G. Martínez-Hernández, M. Bidoia, C. Giupponi, Towards a modelling process for simulating socio-ecosystems with a focus on climate change adaptation
6. 2023. S. Zanini, Water challenges in socio-ecological systems: is human decision-making accounted for in the analysis of climate change adaptation options?
7. 2023, L. Cavalli, C. Boeri, Carbon neutral lifestyles and NDCs: advice and policy perspectives
8. 2023, F. Calamunci, F. Frattini, When Crime Tears Communities Apart: Social Capital and Organised Crime
9. 2023, D. Bazzana, M. Rizzati, E. Ciola, E. Turco, S. Vergalli, Warming the MATRIX: a climate assessment under uncertainty and heterogeneity
10. 2023, A. L. Baraldi, E. Papagni, M. Stimolo, Neutralizing the Tentacles of Organised Crime. Assessment of the Impact of an Anti-Crime Measure on Mafia Violence in Italy
11. 2023, A. Bastianin, C. Casoli, M. Galeotti, The connectedness of Energy Transition Metals
12. 2023, C. Drago, F. Fortuna, Investigating the Corporate Governance and Sustainability Relationship A Bibliometric Analysis Using Keyword-Ensemble Community Detection
13. 2023, C. Drago, L. Di Nallo, M. L. Russotto, Social Sustainability in European Banks: A Machine Learning Approach using Interval-Based Composite Indicators

Fondazione Eni Enrico Mattei
Corso Magenta 63, Milano – Italia

Tel. +39 02 403 36934

E-mail: letter@feem.it
www.feem.it

Fondazione Eni Enrico Mattei