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Enhancing Firm Value through the Lens of ESG Materiality: Evidence from the Banking Sector in OECD Countries

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Abstract: Momentous developments in the regulatory environment, increasing investor demand, and growing awareness of climate change and societal issues are leading banks to adopt a comprehensive approach beyond the traditional financial lens. Assessing performance towards sustainability issues, including environmental, social, and corporate governance (ESG), and its' relevance in firm value in the banking sector offers a field of continuous interest for researchers. This paper investigates the role of ESG materiality in firm value, based on a sample of banks operating in OECD countries, for the period 2016–2020. Adopting the materiality classification for the banking sector provided by the Sustainability Accounting Standards Board (SASB), the study consists of a multi-layer methodology. In the first stage, a dynamic technique for order preference by similarity to ideal solution (TOPSIS) and entropy methods are utilized to calculate ESG score based on ESG materiality for 1115 bank-year observations while in the second stage, value relevance analyses are applied in order to reveal whether ESG materiality affects firm value. The results depict that ESG performance based on ESG materiality has a positive influence on the firm value for both models, price-to-book value ratio (PBV), and Tobin's Q (TQ). Moreover, collected from the Refinitiv database, ESG combined has a low impact on PBR whereas there is no significant effect on TQ. The implication is that the firm value is influenced by the materiality-adjusted ESG performance than by the extended ESG spectrum.

Keywords: ESG materiality; firm value; dynamic entropy; dynamic TOPSIS; banking sector; OECD

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1. Introduction

Undoubtedly, the drastic change in the global risk profile has a significant impact on both the business environment and the global economy. Companies have faced growing and escalating challenges in recent years against the backdrop of complex environmental, socioeconomic, and governance (ESG) issues in addition to economic ones [1]. The pandemic crisis, the climate crisis, the social justice crisis, and the global economic crisis are significant problems that organizations are currently confronting. They also demonstrate how systemic and interrelated risk is in a society that is really intertwined. It is now more important than ever to consider how growing risks may affect institutions' business strategies and future financial results due to the shifting risk landscape. As a result, ESG risks, which have the largest potential to damage firms, must now be considered in business strategy beyond just compliance. As a result, ESG risks, which have the biggest potential to harm businesses, must now be included in corporate strategy rather than just being something that institutions should think about.

Additionally, a growing number of investors are asking institutions to find efficient strategies to recognize and manage ESG risks and opportunities across the short, medium, and long term. Established in 2006, the United Nations Principles for Responsible Investment (PRI) continues to grow with worldwide responsible investment momentum. The number of institutions that signed the PRI increased by more than 50% in 2021, reaching 4700, compared to the previous year. Finally, as of September 2022, the initiative surpassed 5000 signatories representing US$121 trillion in managed assets (AUM) [2]. At COP26, more

than 450 financial institutions managing more than $130 trillion in assets from 45 countries committed to transforming the economy to net zero over the next three decades through Glasgow Financial Alliance for Net Zero (GFANZ) [3]. As a result, investors scrutinize organizations not just for what they produce now but also for how they do it and what specific efforts they have taken to protect their ability to generate value in the future. Beyond the numbers, the corporate value notion highlights the current profit maximization paradigm's shortcomings. The expanding body of research demonstrating the beneficial effects of ESG materiality on financial performance is one of the primary factors behind the increasing importance of ESG integration among investment firms [4].

One of the main drivers behind the development of the ESG landscape is regulations. To improve stakeholder and investor communication and to promote corporate transparency and accountability, an increasing number of businesses are also using voluntary reporting. A total of 96% of the world's 250 largest companies and 80% of the 5200 companies covering the top 100 companies in 52 countries disclose their sustainability performance [5]. According to theoretical viewpoints including legitimacy, stakeholder, and institutional theories, there are a number of reasons why businesses choose to freely share their sustainability information and implement sustainable policies. In the legitimacy procedures, ESG reporting becomes very important and helps to increase credibility with all stakeholders. A substantial contribution to reaching the goal of legitimacy in the corporate environment is made by engaging in not only the financial elements but also the ESG components and voluntary disclosures [6].

Although voluntary or required adoption and integration of ESG strategies into business models are becoming more common, this does not guarantee that they will meet investors' needs and expectations. Stakeholders are unable to obtain the precise information they require if the relationship and interaction between the revealed environmental, social, and corporate governance indicators and financial performance are not considered. It is "complicated, confusing, and nuanced" how sustainability performance and firm value relate to one another [7]. On the academic front, there has been a great amount of work on the link between ESG and firm value since the 1970s. However, the number of specific studies on the relevance of ESG materiality to investment decision-making is scarce and much more recent. Khan et al. (2016) [8] generated materiality and immateriality ratings by adopting the SASB's notion of materiality and the findings show that superior financial performance is not correlated with a strong performance on immaterial ESG issues [8]. Kotsantonis and Bufalari (2019) [9], working with the top 100 largest worldwide banks, achieved the same results by employing the technique of Khan, Serafeim, and Yoon (2016) [8]. Additionally, materiality is shown to increase the predictability of financial performance in contrast to total ESG or immateriality scores in the study by van Heijningen (2019) [10]. According to Consolandi et al. (2020), the concentration of ESG materiality operates as a concentration risk factor, and the market appears to favor companies that operate in sectors with high levels of ESG materiality concentration [11].

Moreover, due to their considerable power to choose investment projects, manage risks, determine who has access to capital, and determine which activities are financed, banks have always taken an active part in the economic and social development of nations. Banks significantly influence society and, in turn, sustainable development through carrying out this function. However, mostly due to their special characteristics—different accounting rules, reporting incentives, or risk exposures—compared to other institutions, as well as the fact that they operate under particular regulations, banks are frequently left out of samples in empirical research in this area. In this sense, it is necessary and vital to take into account the banking industry in terms of measuring both the value and ESG materiality performance.

Differentiated by the limited number of academic studies mentioned above in terms of the scope and methodology in this study, the relationship between the materiality-oriented ESG performance of the banking sector and firm value is tested with a multiple-layer methodology. In this paper, we generate a unique set of indicators for the ESG performance

assessment which is aligned with SASB's materiality map for the banking sector [12]. We use this indicator set to calculate the ESG materiality score as a measure of the level of ESG performance and concentration of ESG materiality for each bank. We also test the impact of the ESG materiality on firm value based on a sample of banks operating in OECD countries for a period of 5 years (2016–2020) estimating a linear regression model.

The remainder of the paper is organized as follows. In Section 2, we present the literature review and hypotheses development. In Section 3, we introduce the data and sample, and methodology while we discuss the results in Section 4. Finally, Section 5 provides the conclusion.

2. Literature Review and Hypotheses Development

For many years, financial accounting standards gave businesses and investors consistent language to discuss financial performance. However, standard accounting was created at a time when the majority of a company's market valuation was made up of tangible assets. Considering the noteworthy switch in the market value components in almost half a century, the percentage of intangible assets grew from 17% to 90% [13]. As a result, a significant portion of the market value today is made up of intangible assets, such as corporate trust, reputation, business strategy, risk management strategy, human capital, operational legitimacy, and supply chain. The notable change in tangible and intangible assets shows that the worth of the businesses as a whole is not well represented by the financial statements taken on their own. Due to this historic change, businesses are now disclosing information beyond their financial results and supporting the expansion of the reporting framework to include ESG and sustainability disclosures.

Sustainable business practices have an effect on a company's financial health, operational efficiency, and enterprise value in the modern economy. Since demand prices are discounted by potential buyers when there is doubt about the product's quality, according to Brickley et al. (2002) [14]. A company can also distinguish its products and raise demand by credibly pledging to behave ethically. On the other side, a business that develops a bad reputation for unethical behavior would lose both present and potential new clients, as well as the revenue they would have brought in. According to Chami et al. (2002), a corporation should be concerned with ethics because this is a significant intangible asset that will influence the market value of its shares [15]. Companies in the software business place a lot of emphasis on data security, a social concern. A beverage producer must manage water effectively because it is an environmental concern. A governance issue, managing conflicts of interest is crucial for an investment bank. Long-term management of these problems successfully is expected to enhance business performance through lower operational costs, a better reputation, more risk tolerance, the possibility for competitive advantage, and higher long-term enterprise value [16].

According to the cost of capital theory, implementing sustainability measures would entail higher operating costs, which would eventually result in lower capital costs [17]. The findings of El Ghoul et al. (2011) [18], which showed that better sustainability ratings are connected with a lower cost of capital for a large sample of US enterprises, provide evidence in favor of this argument. According to research on the banking sector, improved financial performance and stable revenue would offset the costs associated with implementing ESG regulations. According to Buallay (2019) [17], who conducted a study on 235 European banks and found a favorable correlation between ESG and operational performance, each ESG component needs to be further examined. On the other hand, according to a different study by the same author [19], there is a negative correlation between ESG and the financial, operational, and market performance of 530 banks worldwide. Furthermore, Nguyen et al. (2021) [20] showed that CSR activities tend to offer risk-mitigating benefits in Vietnam however unconstrained banks, on the other hand, are more likely to invest in unnecessary CSR, thus reducing bank performance and increasing bank risk-taking. The reason for the negative results is that banks still need to take extra steps to incorporate sustainability

policies into their operational activities [19] and should be focused on sustainability issues material for the industry.

In addition to ethical considerations, ESG Materiality Performance may be a useful tool for maintaining the reputation and ensuring financial sustainability [21]. Existing research indicates that default risk and bank sustainability performance seem to have a negative or insignificant relationship [22,23]. Bolton (2013) [24] discovers data pointing to the possibility that enhancing corporate sustainability quality could significantly boost bank performance and lower risk for US banks. As a result, it is reasonable to assume that banks' ESG Materiality Performance will help them adjust to their new operating environment. However, there is scant evidence on the relationship between ESG and firm value in the banking industry; this research gap is what the current study will attempt to fill.

ESG data is available to investors from a variety of sources, including stock exchanges, data and index providers, and rating agencies. However, experts urge businesses to pay more attention to material ESG concerns that have the potential to significantly impact their bottom line [25]. Moreover, Madison and Schiehll (2021) revealed that financial materiality has an impact on how meaningful ESG scores and rankings are, allowing investment opportunities in companies with strong ESG ratings on business-critical issues to be identified [26]. Despite the fact that more and more rating agencies are evaluating the ESG performance of companies, studies have revealed that each agency uses a different assessment methodology [27]. Furthermore, to our knowledge, no rating agency has used a methodology designed particularly to take into account the financial materiality of ESG risks and opportunities, with the exception of Factset Truvalue Insight [28].

In order to assist companies and investors in establishing a common vocabulary regarding the financial effects of sustainability, SASB was established as a nonprofit organization in 2011. The corporate sustainability disclosure landscape becomes increasingly complicated over time. Clarity and simplification were demanded in this market by several multinational corporations and investors. In response, the Value Reporting Foundation (VRF), which was formally established in June 2021, was created by the merger of the International Integrated Reporting Council (IIRC) and SASB in November 2020 [29]. The merger represented a significant step toward simplification by joining two organizations that were committed to generating enterprise value. On 1 August 2022, the VRF formally merged with the IFRS Foundation [30].

The Sustainability Accounting Standards Board (SASB) aims to establish a connection between investors and institutions by considering the financial effects of sustainability. In this direction, SASB standards have been developed based on the feedback of market participants, especially investors. SASB's mission is to help businesses worldwide identify, manage and report on the sustainability issues most material to their investors. In addition, SASB standards are industry-specific, allowing investors and companies to compare the performance of companies in an industry (Guidelines for 11 Sectors, 77 Industries have been published) [12]. The SASB notion of materiality, which highlights sustainability issues that are material from an investor's standpoint, is the one we use in this paper.

The Impetus for our study stems from the mismatch of ESG scores and lack of materiality perspective for ESG performance assessment in the banking industry, which raises the following questions: Would ESG scores change if the Sustainability Accounting Standard Board's (SASB's) ESG financial materiality framework is taken into account? If so, how do the adjusted scores affect firm value?

Finally, we propose the following hypothesis in light of the more substantial empirical evidence and the applicability of the arguments in favor of a positive relationship between ESG Materiality and firm value:

Hypothesis 1. *ESG Materiality performance exerts positive effects on firm value.*

Hypothesis 1a. *ESG Materiality performance exerts positive effects on PBV.*

Hypothesis 1b. *ESG Materiality performance exerts positive effects on Tobin's Q.*

This study clarifies if the consideration of financial materiality as per the SASB's materiality map has a substantial impact on the ESG performance scores of banks as reported by the data provider Refinitiv in its Eikon database. The importance of our analysis stems from the fact that investors, who are the main consumers of these ratings, do not exactly match the financial materiality standards used by the major ESG data providers and rating agencies.

3. Research Design and Methodology

3.1. Data and Sample

The Refinitiv ESG database served as the foundation for our sample. To select the sample, we use the following criteria. First, we select banks, operating in OECD countries for the 10-year period (2011–2020) according to Refinitiv industry classification, the GICS system. Second, we match the GICS with the industry classification proposed by the SASB's financial materiality framework, the SICS system in order to apply the targeted SASB Materiality Map to our sample, representing the commercial bank industry. With this procedure, the sample includes 8050 bank-year observations. Third, given the availability of the data needed to calculate the ESG materiality scores, the time frame for 2016 to 2020 was selected. Fourth, the banks in the sample are those for which Refinitiv Eikon provides data regarding not only required ESG indicators but also required financial indicators. As a consequence, the intended sample, the number of banks that meet our criteria, includes 1115 bank-year observations. The balanced sample composition by country distribution can be seen in Table 1.

Table 1. The sample composition by country distribution.

Valid	Frequency	Percent	Cumulative Percent
Australia	30	2.7	2.7
Austria	10	0.9	3.6
Belgium	5	0.4	4.0
Canada	45	4.0	8.1
Chile	15	1.3	9.4
Colombia	15	1.3	10.8
Czech Republic	5	0.4	11.2
Denmark	15	1.3	12.6
France	20	1.8	14.3
Germany	5	0.4	14.8
Greece	10	0.9	15.7
Hungary	5	0.4	16.1
Ireland; Republic of	10	0.9	17.0
Israel	20	1.8	18.8
Italy	15	1.3	20.2
Japan	120	10.8	30.9
Korea; Republic (S. Korea)	25	2.2	33.2
Mexico	15	1.3	34.5
Netherlands	10	0.9	35.4
Norway	5	0.4	35.9
Poland	40	3.6	39.5
Portugal	5	0.4	39.9
Russia	10	0.9	40.8
Spain	25	2.2	43.0
Sweden	20	1.8	44.8
Switzerland	10	0.9	45.7
Turkey	35	3.1	48.9
United Kingdom	30	2.7	51.6
United States of America	540	48.4	100.0
Total	1115	100.0	

3.2. Methodology

In the paper, we use a multi-stage methodology, adopting the Sustainability Accounting Standards Board's (SASB) materiality classification for the banking industry. In the first step, we match Refinitiv ESG indicators with SASB's General Issue Categories for the commercial banking industry. In the second step, we utilize a dynamic technique for order preference by similarity to ideal solutions (TOPSIS) and entropy methods to calculate materiality-adjusted ESG scores, namely the ESG Materiality score. Finally, in the third step, we apply value relevance analyses to reveal whether ESG materiality affects firm value.

3.2.1. Matching Refinitiv ESG Indicators Using SASB Materiality Map

One of the market's ESG databases, provided by Refinitiv, has information dating back to 2002 and covers more than 630 different ESG criteria. In order to reformulate the three pillar scores and the ultimate ESG scores (ESG score, ESG controversies score, and ESG combined score), which is a representation of the company's ESG performance, commitment, and effectiveness based on publicly-reported information. Based on the reported data related to the ESG pillars, Refinitiv provides ESG Combined (ESGC) scores aiming at a balanced and thorough rating of a company's ESG performance. The ESG controversies overlay is taken from international media sources. This score's primary goal is to undervalue the ESG performance score in light of unfavorable media coverage. To achieve this, it adjusts the total ESGC score to account for the effects of big, material ESG controversies [31].

In this stage, we establish the relevance map for financial material issues detected by SASB and the ESG data items, categories, and pillars provided by the Refinitiv Eikon ESG database. For the commercial banking industry identified by SASB as "business ethics", "systematic risk management", "financial inclusion and capacity building", "data security", and "incorporation of ESG factor in credit analysis", five material topics are our reference point for the mapping [12]. Followed by, presented in detail in Appendix A, 76 data points from the Refinitiv ESG database are selected for the material indicators pool relevance with the five material topics. Consequently, to select the indicators to be used in ESG materiality performance measurement we identify five exclusion criteria as follows: (i). Datagap for observations >90% and datagap for indicators >90%, (ii). Datagap for observations >60% and then datagap for indicators >30%, (iii). Criterion has been deleted due to alternative criterion included, (iv). Excluded due to value of observations being mostly the same (which means that it does not provide qualified information), (v). Excluded due to many outliers observed for the criterion. After meeting this procedure, we determine the final ESG indicator with 34 indicators, presented in Table 2, for ESG materiality performance measurement. Moreover, in terms of the final ESG data set, the sample includes 1260 bank observations. The details of the selection process can also be followed in Appendix B.

Table 2. Descriptive statistics of the final ESG indicator set for ESG materiality performance measurement. Note. #bank = 252; 5 year; 1260 observations.

SASB GIC		ESG Indicators	Type	Mean	Mod	Median	Std Dev
Disclosure Topic: Business Ethics	BE_1	Policy Business Ethics Score	Score	51.75	60.19	59.95	21.37
	BE_2	Improvement Tools Business Ethics Score	Score	47.67	0.00	67.15	31.24
	BE_3	Policy Bribery and Corruption Score	Score	49.84	0.00	64.70	27.98
	BE_4	Bribery, Corruption and Fraud Controversies Score	Score	51.63	60.84	60.70	21.76
	BE_5	Policy Fair Competition Score	Score	43.47	0.00	74.06	36.81
	BE_6	Anti-Competition Controversies Score	Score	52.66	58.45	58.44	17.65
	BE_7	Policy Responsible Marketing	Binary/Boolean	0.02	0.00	0.00	0.12

Table 2. *Cont.*

SASB GIC		ESG Indicators	Type	Mean	Mod	Median	Std Dev
Disclosure Topic: Business Ethics	BE_8	Product Responsibility Monitoring	Binary/Boolean	0.08	0.00	0.00	0.26
	BE_9	Human Rights Policy Score	Score	41.90	18.53	18.53	33.19
	BE_10	Board Functions Policy Score	Score	31.69	0.00	0.00	34.59
	BE_11	Corporate Governance Board Committee	Binary/Boolean	0.61	1.00	1.00	0.49
	BE_12	Audit Board Committee	Binary/Boolean	0.92	1.00	1.00	0.27
	BE_13	Audit Committee Independence Score	Score	50.30	54.76	54.76	19.13
	BE_14	Shareholder Rights Policy Score	Score	49.40	50.25	50.25	12.86
	BE_15	Policy Shareholder Engagement	Binary/Boolean	0.86	1.00	1.00	0.35
Disclosure Topic: Systemic Risk Management	SRM_1	Crisis Management Systems	Binary/Boolean	0.68	1.00	1.00	0.47
	SRM_2	Climate Change Commercial Risks Opportunities Score	Score	31.53	0.00	0.00	42.03
	SRM_3	Policy Emissions	Binary/Boolean	0.55	1.00	1.00	0.50
	SRM_4	Target Emissions	Binary/Boolean	0.35	0.00	0.00	0.48
	SRM_5	Resource Reduction Policy Score	Score	45.98	74.08	74.08	33.67
	SRM_6	Policy Environmental Supply Chain Score	Score	29.58	0.00	0.00	40.74
	SRM_7	Environmental Supply Chain Management Score	Score	25.22	0.00	0.00	39.14
Disclosure Topic: Financial Inclusion and Capacity Building	FICB_1	Policy Community Involvement Score	Score	51.46	59.30	58.85	18.94
	FICB_2	Product Sales at Discount to Emerging Markets	Binary/Boolean	0.02	0.00	0.00	0.12
	FICB_3	Product Access Low Price Score	Score	27.57	0.00	0.00	40.56
	FICB_4	Training and Development Policy Score	Score	54.13	63.18	63.18	23.91
	FICB_5	Policy Skills Training	Binary/Boolean	0.77	1.00	1.00	0.42
	FICB_6	Net Employment Creation Score	Score	45.47	8.44	41.39	26.57
Disclosure Topic: Data Security	DS_1	Policy Data Privacy Score	Score	50.03	56.77	56.77	18.76
Disclosure Topic: Incorporation of ESG Factors in Credit Analysis	IESG_1	Environmental Products Score	Score	38.48	0.00	0.00	40.63
	IESG_2	Environmental Assets Under Mgt Score	Score	20.84	0.00	0.00	38.99
	IESG_3	Equator Principles or Env Project Financing Score	Score	40.33	0.00	0.00	41.97
	IESG_4	Environmental Project Financing	Binary/Boolean	0.42	0.00	0.00	0.49
	IESG_5	Supplier ESG training	Binary/Boolean	0.09	0.00	0.00	0.29

3.2.2. Calculating Materiality-Adjusted ESG Score

In this section, we describe the steps in calculating the materiality-adjusted scores for the sample banks. To calculate ESG Materiality Score for each bank-year observation, we utilize dynamic TOPSIS and entropy methods as shown in Figure 1, where the key methods are depicted in the following subsections.

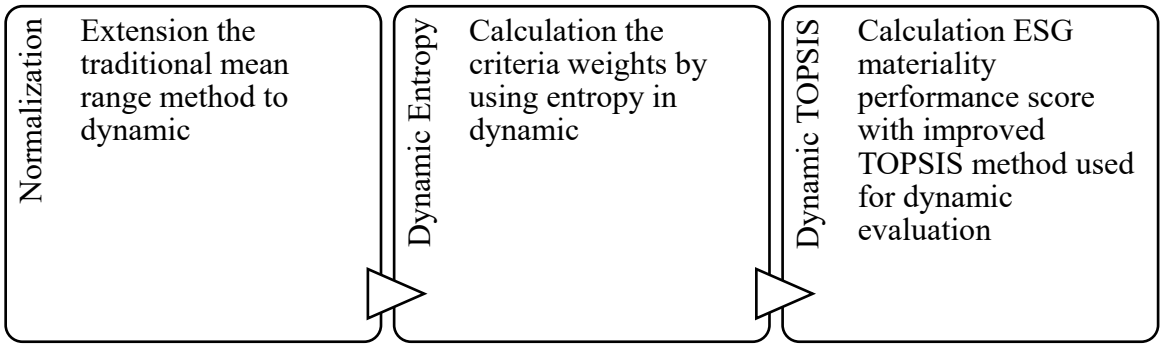


Figure 1. The framework of ESG Materiality performance measurement.

The TOPSIS method, created by Hwang and Yoon in its original form, is one of the best-known and most widely applied Multi-Criteria Decision Making (MCDM) techniques. It is based on the idea that the selected alternative should be the furthest away from the negative-ideal solution and the closest to the ideal solution. While the negative-ideal solution optimizes the cost criteria and minimizes the benefit criteria, the positive-ideal solution minimizes both the cost and benefit criteria. Since the TOPSIS technique does not presume that each criterion has equal weight, the decision-maker must assign a set

of weights [32]. When there are a lot of criteria, there are several drawbacks to the direct assessment of weights. Additionally, this type of weighing procedure may be unstable, inefficient, and arbitrarily chosen [33]. Additionally, because many of the sustainability aspects' requirements clash with one another, it can be challenging to meet all of them at once. From this point on, the weights of the criteria are assessed using the entropy approach. This makes it possible to calculate each criterion's relative weight in an objective manner. In information theory, entropy assesses the anticipated information content of a particular message [34]. Entropy can be viewed as a measurement of actual or observational diversity. Entropy considers that messages or categories of events may occur with unequal frequency or probabilities, unlike the measure of selective information. Entropy is a nonparametric measure of diversity since it makes no assumptions about the nature of the frequency distribution or the probability distribution [35].

Entropy and TOPSIS methods are widely used Multi-Criteria Decision Making (MCDM) Techniques in the field of sustainability [36–39]. The majority of research, however, did not take into account an object's total performance on a certain criterion over time. For instance, the criteria weights were often determined within a single year and varied between years. The comparability of the evaluation outcomes across years may be hampered as a result. Li et al. (2018) devised a dynamic TOPSIS-entropy technique to address this issue by extending the mean range normalization, entropy weighting method, and TOPSIS to dynamic situations [40]. This study follows a similar methodology in this step.

Dynamic Entropy Method for Weighting

The entropy weighting approach is chosen for its clarity, simplicity, and objectivity of the data provided. The fundamental step in the strategy is to calculate the weights for each criterion over all alternatives using the entropy sum. Smaller changes in the linked criterion values are indicated by larger entropy sums. This means that the criterion will be assigned little weight because it contributes little to the end result of the evaluation, and vice versa. The following formula is used to determine the entropy of the criterion c_j:

$$E_j = -k \sum_{i=1}^{n} p_{ij} \ln p_{ij},\ j = 1, 2, \ldots, m \tag{1}$$

$E_j \in [0,1]$ is guaranteed by the constant $k = 1/\ln n$, and $p_{ij} = x_{ij} / \sum_{i=1}^{n} x_{ij}$ is the normalization value of the original criterion values x_{ij} and $p_{ij} = 0$, let $p_{ij} \ln j = 0$.

The entropy total needs to account for changes in criterion values over time because the entropy weight is employed in the paper's dynamic evaluation of banks' ESG materiality performance. To do this, we expand the application of the entropy weighting technique to dynamic assessment issues as proposed by Li et al. (2018) [40], such as:

$$E_j = -k \sum_{h=1}^{L} \sum_{i=1}^{n} p_{ij}(t_h) \ln p_{ij}(t_h)\ ,\ j = 1, 2, \ldots, m \tag{2}$$

where $k = 1/\ln(Lxn)$, $p_{ij}\ (t_h) = x_{ij}(t_h) / \sum_{h=1}^{L} \sum_{i=1}^{n} x_{ij}(t_h)$ and $x_{ij}(t_h)$ represent the actual performance value of alternative (bank) with respect to criterion c_j in the year t_h.

In order to determine the entropy weight of criterion c_j:

$$w_j = \frac{1 - E_j}{\sum_{j=1}^{m} (1 - E_j)} \tag{3}$$

where $w_j \in [0,1]$ and $\sum_{i=1}^{n} w_j = 1$.

Dynamic TOPSIS

The fundamental steps of TOPSIS for involving dynamic evaluation are summarized as follows.

1st Step: Scaling the actual values of the criteria into a consistent range

$$\begin{cases} y_{ij\ (t_h)} = \frac{x_{ij\ (t_h)} - x_{\min(j)}}{x_{\max(j)} - x_{\min(j)}}, \ if\ c_j\ is\ a\ benefit\ criterion \\ y_{ij\ (t_h)} = \frac{x_{\max(j)} - x_{ij\ (t_h)}}{x_{\max(j)} - x_{\min(j)}}, \ if\ c_j\ is\ a\ cost\ criterion \end{cases} \quad (4)$$

where, respectively, $x_{\max(j)}$ and $x_{\min(j)}$ indicate the highest and lowest values of criterion c_j across all assessment years while $x_{\max(j)} = \max\{x_{1j}(t_1), \ldots, x_{nj}(t_1), \ldots, x_{1j}(t_L), \ldots, x_{nj}(t_L)\}$ and $x_{\min(j)} = \min\{x_{1j}(t_1), \ldots, x_{nj}(t_1), \ldots, x_{1j}(t_L), \ldots, x_{nj}(t_L)\}$.

2nd Step: Applying the related dynamic entropy weights to the normalized criterion values

$$u_{ij}(t_h) = w_i y_{ij}(t_h),\ i = 1, 2, \ldots, n,\ j = 1, 2, \ldots, m,\ h = 1, 2, \ldots, L \quad (5)$$

where w_i calculated by Equations (2) and (3).

3rd Step: Ascertaining the best and worst answers for each criterion

$$u_j^+ = max\{u_{ij}(t_h),\ \ i = 1, 2, \ldots, n; h = 1, 2, \ \ldots, L\} \quad (6)$$

$$u_j^- = min\{u_{ij}(t_h),\ \ i = 1, 2, \ldots, n; h = 1, 2, \ \ldots, L\} \quad (7)$$

4th Step: Calculating the distance ($d_i^+(t_h)$ *and* $d_i^-(t_h)$) between the evaluation values of alternatives and the best and the worst solutions.

$$d_i^+(t_h) = \sqrt{\sum_{j=1}^{m} \left(u_{ij}(t_h) - u_j^+\right)^2} \quad (8)$$

$$d_i^-(t_h) = \sqrt{\sum_{j=1}^{m} \left(u_{ij}(t_h) - u_j^-\right)^2} \quad (9)$$

5th Step: Evaluating the distance between the associated evaluation values and the two ideal solutions to determine the relative performance level of alternatives.

$$c_i(t_h) = \frac{d_i^-(t_h)}{d_i^+(t_h) + d_i^-(t_h)} \quad (10)$$

where $c_i(t_h) \in [0, 1]$ and better sustainable performance of alternative (bank) is indicated when $c_i(t_h)$ trends toward 1.

3.2.3. Evaluating Value Relevance of ESG Materiality

In order to examine the relationship between ESG materiality performance and the values it generates, our dependent variables are specifically defined as firms' value from a financial standpoint. The future profitability of a company is typically used by the financial market to determine its value. Assuming a perfect capital market, the security's price represents the most accurate and impartial estimate of the firm's present value [41]. We evaluate firm value in this study using the Price to Book Value Ratio (PBV) and Tobin's Q (TQ), which take price information into account and, as a result, take into account investors' forward-looking estimates. In terms of evaluating the ESG materiality performance (ESG_Materiality) as an explanatory variable for firm value, we also investigate the relationship between the ESG Combined (ESG_Combined) score provided by the Refinitiv database. Thus, it guides us to make a more meaningful conclusion about the results.

We include three types of control variables (bank, industry and macro-specific) that may have an impact on the relation between ESG performance and value in line with the previous literature. Bank-specific control variables are included in four categories: profitability, measured by return on equity (ROE); size measured by logarithm of the total

assets (Size); the Tier 1 Capital Ratio (T1C), which includes both market risk and operational risk components; and the Capital Adequacy Ratio (CAR). Profitability and company value are related, and this link is explained by the signaling theory. Investors and creditors pay great attention to profitability as a key performance metric. According to Wu et al. [42], it also predicts future revenues for the first group and indicates the potential to pay dividends (signaling theory). For the latter group, this displays the firm's capacity to pay off debt and interest (signaling theory). Therefore, it is presumable that profitability affects business value. Furthermore, there are many studies have found a significant positive impact of profitability on firm value [43–45]. For this variable, we use return on equity (ROE) in the model.

We also include control for firm size, calculated as the natural log of total assets (Size). Most previous literature has found the firm size to be negatively related to firm value [43–50] which supports the predictions of agency theory. According to Jensen [51], managers are compelled to develop their companies above the ideal size since doing so gives them more power over the resources under their control. As a result, agency costs develop, which could negatively affect a firm's value. On the other hand, fewer studies have revealed an insignificant relation for size and firm value [52,53].

As mentioned by Hafez (2015) [54], the capital adequacy ratio (CAR) is a specialized bank indicator that demonstrates compliance with regulatory capital requirements and calculates the financial risk associated with the responsibilities that banks have to their lenders and clients. Prior research in the banking industry employed capital adequacy as a control variable [55]. According to Siueia et al. (2019) [56], the capital adequacy ratio can be used to determine a bank's capacity to support its current capital structure as well as a measure of the invisible risk of default. Furthermore, the Tier 1 capital ratio (T1C) as the proxy of balance sheet strength, is also crucial for bank value in terms of representing the bank's core equity capital against its total risk-weighted-assets [57]. It has also been adopted as a crucial indicator of a bank's financial stability as part of the Basel III Accord on bank regulation. In that regard, CAR and T1C are included as the remaining two bank-specific control variables in our study.

In line with the literature, for the industry-specific variable, representing assets of the five largest banks as a share of total commercial banking assets, the Concentration variable is included as a control for industry concentration [58,59].

Finally, we consider six macro and global-specific control variables: GDP per capita (GDPcap), GDP growth (GDPgr), inflation (Inf), country governance score (CGS), protecting minority investors score (PMIS) and global risk score (GEPU) as control to address the endogeneity problems that frequently manifest in economics-based sustainability research as correlated variables, reverse causality, and simultaneity [60,61]. In line with previous literature focused on the banking sector [55,61–63], we use the GDPcap, GDPgr and Inf as a sign of macroeconomic trends. Besides, as mentioned by Demirgüç-Kunt and Huizinga (1999) [61], lower profitability is associated with greater contract enforcement, a lack of corruption, and an effective legal system. Thus, in our study, in line with previous research [62,63], we also include country governance score (CGS) which consists of six sub-dimensions: "voice and accountability", "rule of law", "regulatory quality", "political stability and absence of violence", "government effectiveness", and "control of corruption". Moreover, as several studies [64,65] arguing that the institutional settings impact firms' risk-taking behavior and firm's managers are more probable to involve in risk-taking behaviour in countries having a low shareholder protection level, we also include the protecting minority investor score (PMIS) to measure the regulatory settings, in line with previous research [66]. Finally, in terms of affecting corporate performance, GEPU index, calculated by Davis (2016) [66], is used as a proxy of economic policy uncertainty is also taken into account in our study, as in Athari (2021) [63]. Table 3 presents definitions and data sources of variables included in our study.

Table 3. Definitions, abbreviations and sources of variables.

Variable	Abbreviation	Explanation	Source
Dependent variables			
Price to Book Value	PBV	Measures the excess of a company's book value of equity over the market value of its shares, or share price.	Refinitiv
Tobin's Q	TQ	The proportion of total book value of assets to total book value of (total market value of equity plus total book value of liabilities). The number of outstanding common shares multiplied by the closing price at the end of the year yields the total market value of equity.	Computed by the authors with data from Refinitiv
Independent variables			
ESG Materiality Score	ESG_M	Calculated by authors based on SASB Materiality Map, materiality-adjusted ESG performance score aggregates indicators for the commercial banking industry of five material topics, including "business ethics", "systematic risk management", "financial inclusion and capacity building", "data security", and "incorporation of ESG factor in credit analysis".	Computed by authors with Dynamic Entropy and TOPSIS methodology with data from Refinitiv
ESG Combined Score	ESG_C	Based on the reported data related to the ESG pillars, combined ESG scores offer a balanced and thorough rating of a company's ESG performance. The ESG controversies overlay is taken from international media sources.	Refinitiv
Bank-specific control variables			
Return on Equity	ROE	Defines as net income after taxes divided by total equity, and it illustrates the profitability of the invested equity from the accounting standpoint.	Refinitiv
Size	Size	The natural logarithm of total assets	Refinitiv
Tier 1 Capital Ratio	T1C	The Tier 1 capital ratio is the ratio of a bank's core equity capital to its total risk-weighted assets	Refinitiv
Capital Adequacy Ratio	CAR	Measures the capacity of a bank to absorb losses using specified equity components. Total own funds minus total risk-weighted assets equals the calculation.	Computed by the authors with data from Refinitiv
Industry-specific control variables			
Concentration	Conc	Five largest commercial banks' assets as a percentage of all commercial banks' assets.	World Bank- Global Financial Development Database
Country-specific control variables			
GDP per capita	GDPcap	GDP is calculated as the total gross value added by all producers who are residents of the economy, plus any applicable product taxes, minus any unaccounted-for subsidies.	World Bank- World Development Indicators Database
GDP growth	GDPgr	It displays the GDP's yearly percentage growth rate at market prices calculated using constant local currency.	World Bank- World Development Indicators Database
Inflation	Inf	The rate of price change in the economy as a whole is shown by inflation as calculated by the yearly growth rate of the GDP implicit deflator. The difference between GDP in current local currency and GDP in constant local currency is known as the GDP implicit deflator.	World Bank- World Development Indicators Database

Table 3. *Cont.*

Variable	Abbreviation	Explanation	Source
Country Governance Score	CGS	The Worldwide Governance Indicators (WGI) creates aggregate indicators of six country governance (CG) dimensions, including voice and accountability, political stability and the absence of terrorism or acts of violence, government effectiveness, regulatory quality, rule of law, and corruption control.	World Bank- Worldwide Governance Indicators Database
Protecting Minority Investors Score	PMIS	The extent of disclosure index, extent of director liability index, extent of shareholder rights index, extent of shareholder claims index, extent of ownership and control index, and extent of corporate transparency index are used to calculate the annual score of protecting minority investors.	World Bank- Doing Business Database
Global Economic Policy Uncertainty	GEPU	Index of Global Economic Policy Uncertainty	www.policyuncertainity.com, (accessed on 17 October 2022)

In line with our research questions, specifically, the structural regression equations are as follows:

$$\begin{aligned} Firm\ value(PBV)_{it} &= \beta_0 + \beta_1 ESG_{Materiality_{it}} + \beta_2 ROE_{it} + \beta_3 Size_{it} + \beta_4 T1C_{it} \\ &+ \beta_5 CAR_{it} + \beta_6 Conc_{tg} + \beta_7 GDPcap_{tg} + \beta_8 GDPgr_{tg} \\ &+ \beta_9 Inf_{tg} + \beta_{10} CGS_{tg} + \beta_{11} PMIS_{tg} + \beta_{12} GEPU_t + u_{it} \end{aligned} \quad (11)$$

$$\begin{aligned} Firm\ value(TQ)_{it} &= \beta_0 + \beta_1 ESG_{Materiality_{it}} + \beta_2 ROE_{it} + \beta_3 Size_{it} \\ &+ \beta_4 T1C_{it} + \beta_5 CAR_{it} + \beta_6 Conc_{tg} + \beta_7 GDPcap_{tg} \\ &+ \beta_8 GDPgr_{tg} + \beta_9 Inf_{tg} + \beta_{10} CGS_{tg} + \beta_{11} PMIS_{tg} \\ &+ \beta_{12} GEPU_t + u_{it} \end{aligned} \quad (12)$$

$$\begin{aligned} Firm\ value(PBV)_{it} &= \beta_0 + \beta_1 ESG_{Combined_{it}} + \beta_2 ROE_{it} + \beta_3 Size_{it} \\ &+ \beta_4 T1C_{it} + \beta_5 CAR_{it} + \beta_6 Conc_{tg} + \beta_7 GDPcap_{tg} \\ &+ \beta_8 GDPgr_{tg} + \beta_9 Inf_{tg} + \beta_{10} CGS_{tg} + \beta_{11} PMIS_{tg} \\ &+ \beta_{12} GEPU_t + u_{it} \end{aligned} \quad (13)$$

$$\begin{aligned} Firm\ value(TQ)_{it} &= \beta_0 + \beta_1 ESG_{Combined_{it}} + \beta_2 ROE_{it} + \beta_3 Size_{it} \\ &+ \beta_4 T1C_{it} + \beta_5 CAR_{it} + \beta_6 Conc_{tg} + \beta_7 GDPcap_{tg} \\ &+ \beta_8 GDPgr_{tg} + \beta_9 Inf_{tg} + \beta_{10} CGS_{tg} + \beta_{11} PMIS_{tg} \\ &+ \beta_{12} GEPU_t + u_{it} \end{aligned} \quad (14)$$

In the models above, *PBV* and *TQ* represents the banks' value, measured by *ESG* Materiality or *ESG* _Combined scores, four bank-specific (*ROE*, Size, *T1C*, and *CAR*) for the bank (*i*), in year (*t*), one industry-specific (Concentration), and six macro and global-specific control variables (*GDPcap*, *GDPgr*, *Inf*, *CGS*, *PMIS*, and *GEPU*) in year (*t*) for the country (*g*); β_0 indicates the constant; β_{1-12} are the coefficients of the predicotrs and control variables; and u_{it} represents the estimation error.

Descriptive Statistics

The descriptive statistics of variables used in the analyses are provided in Table 4. For our sample, 1115 bank-observations, the mean value (standard deviation-std dev) of PBV is 1.19 (0.59), with the range of 3.77. The mean (std dev) value of TQ is 1.02 (1.16), with the range of 5.18. For the ESG Combined score, the average of our sample is 44.82 out of 100, while the ESG Materiality score is 42.36 out of 100. Our sample banks have an average ROE of 9%. Finally, the average (median) values of our control variables also appear to be reasonable, with natural log of size (Size) at around 24.71, concentration at 65.39, GDP

capita at 48,353.63, GDP growth at 0.42, inflation at 1.97, country governance score at 1.07, protecting minority investors score at 70.62, and global economic policy uncertainty at 239.44.

Table 4. Descriptive Statistics.

Variable	Mean	Std. Deviation	Range	Minimum	Maximum
PBV	1.1913	0.5963	3.7699	0.1591	3.9290
TQ	1.0295	0.1635	5.1813	0.8727	6.0540
ESG_M	0.4236	0.1423	0.7181	0.1376	0.8557
ESG_C	44.8168	18.0931	85.1513	2.7865	87.9379
ROE	0.0933	0.0472	0.7847	−0.5108	0.2739
Size	24.7097	1.7556	7.5367	21.2859	28.8226
T1C	0.1331	0.0270	0.2270	0.0600	0.2870
CAR	0.0991	0.0380	0.3490	0.0043	0.3533
Conc	65.1972	14.4937	48.5472	51.4528	100.0000
GDPcap	48,353.6291	18,071.2588	81,788.2163	5312.1986	87,100.4148
GDPgr	0.4204	2.8659	19.0137	−11.2533	7.7604
Inf	1.9737	2.3684	20.0804	−3.6046	16.4758
CGS	1.0737	0.4860	2.5576	−0.7410	1.8166
PMIS	70.6278	5.8888	34.0000	50.0000	84.0000
GEPU	239.4484	51.2611	146.4095	148.6246	295.0341

4. Empirical Results and Discussion

We structure this section into four parts. In the first three subsections, we convey our empirical results for dynamic entropy, dynamic TOPSIS, and regression, respectively. Finally, in the last subsection, we discuss the results by relating them to the previous literature and the theoretical framework.

4.1. Dynamic Entropy Results

Before employing the dynamic TOPSIS method, the dynamic entropy method was used for evaluating the weights of the criteria, objectively. Based on the dynamic entropy method results, the main indicators of ESG materiality for the banking sector can be determined, as well as the superior aspects and differences of the bank's ESG materiality were demonstrated.

On that basis, as shown in Table 5, for ESG materiality, "IESG_2: Environmental Assets Under Management Score", "FICB_3: Product Access Low Price Score", "SRM_6: Policy Environmental Supply Chain Score", "SRM_2: Climate Change Commercial Risks Opportunities Score", and "SRM_7: Environmental Supply Chain Management Score" were five leading indicators having weight range between 0.13 and 0.08. On the other hand, "BE_8: Product Responsibility Monitoring", "BE_15: Policy Shareholder Engagement", "BE_12: Audit Board Committee", "FICB_2: Product Sales at Discount to Emerging Markets", and "BE_7: Policy Responsible Marketing" were the least weighted five indicators with the weight range between (0.0022–0.0005). Table 5 also indicates the general and category order for all indicators.

4.2. Dynamic TOPSIS Results

To evaluate the ESG materiality performance of the 1115 bank-year observations during the 2016–2020 period, we employed the dynamic TOPSIS method using objective weights calculated by the dynamic entropy method in order to avoid subjective judgments. In line with results obtained from the dynamic TOPSIS method, a performance score that lies between 0 and 1 was obtained for each observation. In order to examine the performance trend of banks over the years, we calculated the average score by year by filtering the scores. Also, to investigate the differentiation between the ESG Combined score calculated by Refinitiv and including an extended spectrum of ESG topics [31], and the ESG Materiality score calculated by us, we normalized ESG Materiality scores into 0–100. Figure 2 gives that the ESG performance of the sample tends to be increased over

the years according to both scoring systems, while the ESG Materiality score is lower than ESG Combined score in all years and overall.

Table 5. Entropy weights.

SASB GIC	Ind_Code	ESG Indicators	Weight	Materiality Order	
				General	Category
Business Ethics	BE_1	Policy Business Ethics Score	0.0139	17	7
	BE_2	Improvement Tools Business Ethics Score	0.0316	10	3
	BE_3	Policy Bribery and Corruption Score	0.0242	13	5
	BE_4	Bribery, Corruption and Fraud Controversies Score	0.0144	16	6
	BE_5	Policy Fair Competition Score	0.0479	9	2
	BE_6	Anti-Competition Controversies Score	0.0094	20	8
	BE_7	Policy Responsible Marketing	0.0005	34	15
	BE_8	Product Responsibility Monitoring	0.0022	30	12
	BE_9	Human Rights Policy Score	0.0278	12	4
	BE_10	Board Functions Policy Score	0.0675	6	1
	BE_11	Corporate Governance Board Committee	0.0044	25	11
	BE_12	Audit Board Committee	0.0010	32	14
	BE_13	Audit Committee Independence Score	0.0075	21	9
	BE_14	Shareholder Rights Policy Score	0.0054	22	10
	BE_15	Policy Shareholder Engagement	0.0018	31	13
Systemic Risk Management	SRM_1	Crisis Management Systems	0.0038	27	7
	SRM_2	Climate Change Commercial Risks Opportunities Score	0.0904	4	2
	SRM_3	Policy Emissions	0.0039	26	6
	SRM_4	Target Emissions	0.0049	24	5
	SRM_5	Resource Reduction Policy Score	0.0294	11	4
	SRM_6	Policy Environmental Supply Chain Score	0.0942	3	1
	SRM_7	Environmental Supply Chain Management Score	0.0836	5	3
Financial Inclusion and Capacity Building	FICB_1	Policy Community Involvement Score	0.0112	19	4
	FICB_2	Product Sales at Discount to Emerging Markets	0.0005	33	6
	FICB_3	Product Access Low Price Score	0.1012	2	1
	FICB_4	Training and Development Policy Score	0.0157	14	2
	FICB_5	Policy Skills Training	0.0028	28	5
	FICB_6	Net Employment Creation Score	0.0150	15	3
Data Security	DS_1	Policy Data Privacy Score	0.0116	18	1
Incorporation of ESG Factors in Credit Analysis	IESG_1	Environmental Products Score	0.0663	7	2
	IESG_2	Environmental Assets Under Mgt Score	0.1332	1	1
	IESG_3	Equator Principles or Env Project Financing Score	0.0650	8	3
	IESG_4	Environmental Project Financing	0.0053	23	4
	IESG_5	Supplier ESG training	0.0025	29	5

Figure 3 depicts the country-based average ESG performance scores of the sample. In terms of ESG Materiality performance, France (69.88), Netherlands (65.19), Spain (62.31), Australia (60.99) and Austria (60.48) are the five top countries (performance score) leading the banking sector, while United States (34.76), Japan (34.99), Czech Republic (40.44), Russia (41.44) and Mexico (41.70) are the five bottoms. From the Refinitiv point, country-based results differ substantially. Spain (69.63), Norway (69.36), Korean Republic (68.42), Portugal (68.21), and Greece (66.83) are the best performer countries (performance score) in terms of ESG Combined score, whereas Japan (33.89), United States (34.76), Denmark (41.52), Switzerland (44.05) and Mexico (44.69) are the five countries having the worst performance.

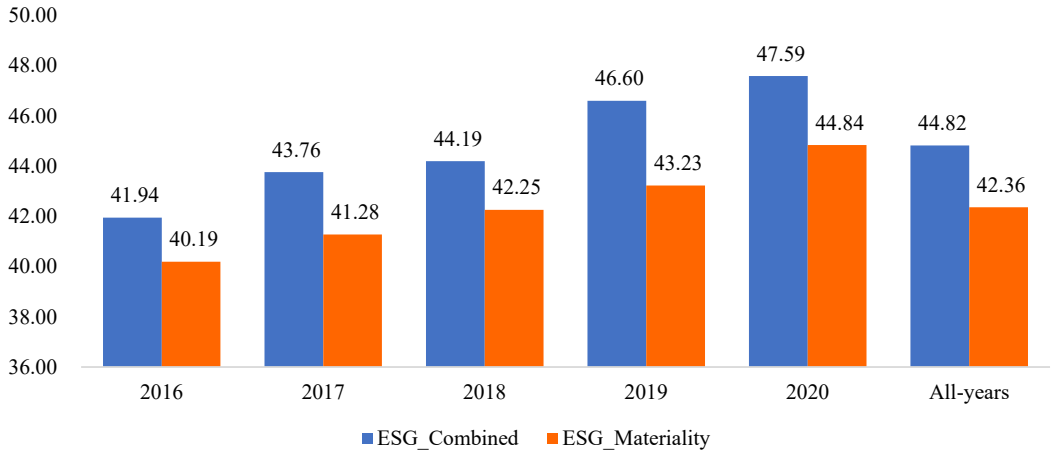


Figure 2. Dynamic TOPSIS results (ESG_Materiality) by years and its comparison with ESG Combined Scores.

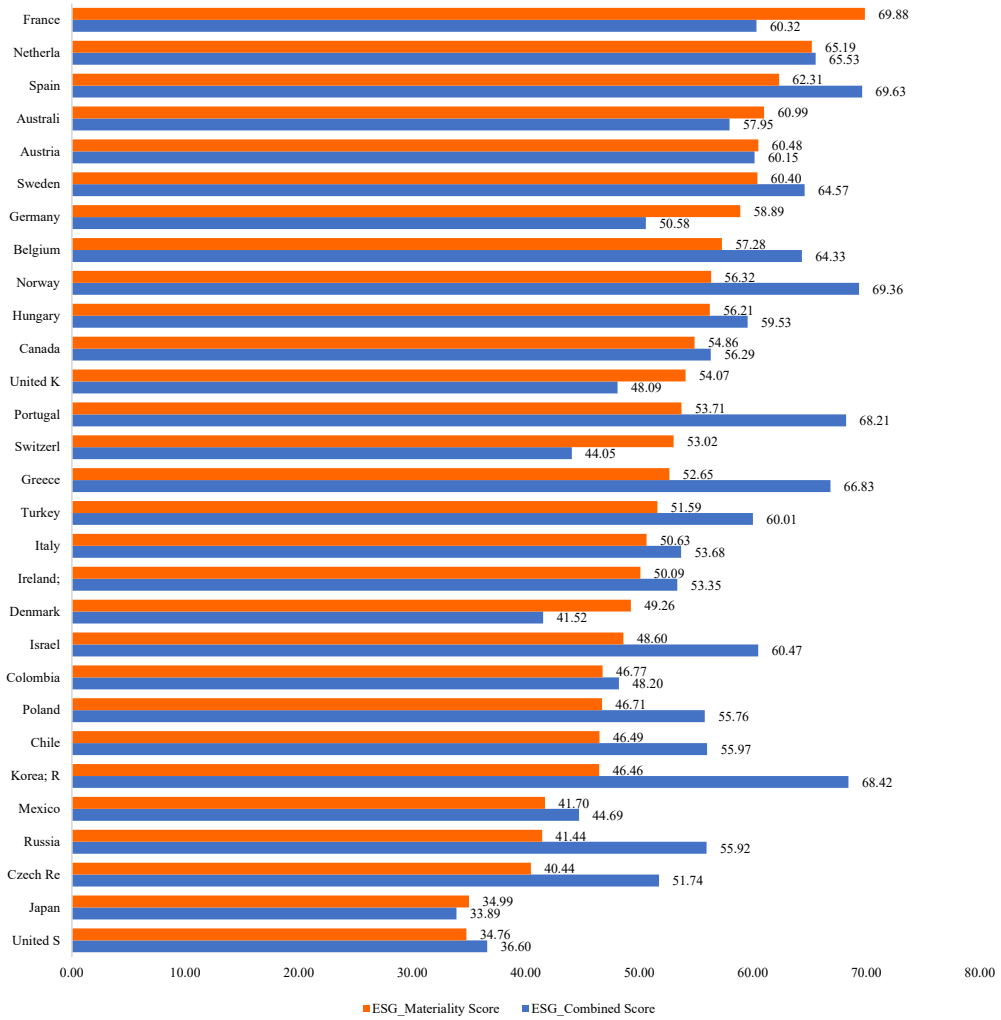


Figure 3. Dynamic TOPSIS results (ESG_Materiality) by countries and its comparison with ESG Combined Scores.

4.3. Correlations

The correlations between the dependent variables and the main predictors are presented in Table 6. The highest correlation is between the independent variables for different models, ESG_Materiality and ESG_Combined, with a 0.748 correlation coefficient (r). There

are significant, but small negative correlations between the ESG_Materiality and T1C, CAR, Cons, GDPcap, GDPgr, Inf, and GEPU (r = −0.236, −0.428, 0.594, −0.293, −0.087, 0.135, and 0.081, respectively). On the other hand, the accounting-based measure of financial performance, ROE is significantly correlated with T1C (r = −0.067), and CAR (r = 0.107). The ESG_Combined score is also negatively but weakly correlated with CAR, GDPcap, GDPgr, and CGS (r = −0,311, −0.350, −0.038, and −0.191 respectively), while positively correlated with ROE, Conc, Inf, PMIS and GEPU. In general, the Correlation matrix reveals that there is no high correlation between the explanatory variables and shows that there is no serious multicollinearity problem in this study.

Table 6. Pearson correlations between the independent variables.

	ESG_M	***ROE***	***T1C***	***CAR***	***Conc***	***GDPcap***	***GDPgr***	***Inf***	***CGS***	***PMIS***	***GEPU***
ESG_C	0.748 **	0.108 **	0.098 **	−0.311 **	0.524 **	−0.350 **	−0.038	0.175 **	−0.191 **	0.059 *	0.071 *
ESG_M		0.034	0.236 **	−0.428 **	0.594 **	−0.293 **	−0.087 **	0.135 **	−0.049	0.047	0.081 **
ROE			−0.067 *	0.107 **	−0.021	−0.051	0.229 **	0.255 **	−0.124 **	0.202 **	−0.100 **
T1C				−0.115 **	0.297 **	−0.097 **	−0.062 *	−0.013	0.109 **	−0.139 **	0.049
CAR					−0.493 **	0.197 **	0.078 **	0.106 **	−0.157 **	0.066 *	−0.020
Conc						−0.425 **	−0.006	−0.015	0.022	−0.018	−0.035
GDPcap							−0.008	−0.421 **	0.672 **	0.130 **	0.059 *
GDPgr								0.064 *	0.025	−0.021	−0.482 **
Inf									−0.633 **	0.162 **	0.032
CGS										0.040	−0.086 **
PMIS											0.005

Signif. Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1.

4.4. Regression Results

We processed the data by using SPSS software and R Studio. After testing the classical assumptions on the initial 1260 bank-year observations, we carried out data-gap and outlier analyses on the data. After the data preprocessing, 1115 bank-year observations remained for our sample. We performed multiple linear regression to investigate whether ESG Materiality enhances the firm value based on four models, formulated specifically in Equations (11)–(14). The results of the regression analyses were shown in Tables 7 and 8.

As highlighted in Table 7, the overall results for all regression models were significant (Significance = 0.000). In Tables 7 and 8, according to the adjusted R square value, in Model 1 and Model 3, the independent variables explained the variance in PBV (dependent variable) as of 53.1% and 52.6% respectively. Moreover, in Model 2 and Model 4, the variance of TQ (dependent variable) was explained by independent variables of 12.7% and 12.3%, respectively. Our results also show that the ESG_Materiality (in the same period) is a significant predictor of PBV and TQ at a significance level of 0.000 (B = 0.684, p = 0.000, fixed effects) and 0.01 (β = 0.127, p = 0.01, fixed effects), respectively. (Table 7). On the other hand, the ESG_Combined is also a significant predictor of PBV although having a lower impact relative to ESG Materiality. Moreover, Model 4 also shows that the ESG_Combined score did not contribute significantly to TQ (Table 8).

As seen in Table 7, ESG Materiality contributed significantly to the firm value represented by PBV (significant value = 0.033, <0.05) in Model 1 and TQ (significant value = 0.01, <0.05) as we expected. Moreover, the coefficient on the ESG Materiality is significantly positive at 0.684 and 0.127, implying a positive valuation effect of ESG materiality for the banking sector in OECD countries. In the Model 1, ROE, Size, T1C, Conc, GDPcap, Inf, and GEPU also contributed significantly to PBV. The results of the coefficient values revealed that ROE was the most prominent variable contributing to PBV with a positive value (6.073) and followed by T1C at 1.695. In Model 2, coefficient on the ESG Materiality is also positive at 0.127 (significant value = 0.01, <0.05). On the other hand, as shown in Table 8, Models 3 and 4 show that the ESG Combined scores contributed significantly to PBV, but not to TQ. Considering Models 1 and 3, the results depicted that the ESG Materiality score contributed higher than the ESG Combine score in terms of explaining PBV.

Table 7. Regression results for ESG_Materiality as a predictor.

	PBV(Model 1) Coefficients (*p*-Value)	**TQ(Model 2) Coefficients (*p*-Value)**
ESG_Materiality	0.684 *** (0.000)	0.127 * (0.01)
ROE	6.073 *** (0.000)	0.332 ** (0.001)
Size	−0.141 *** (0.000)	−0.004 (0.370)
Tier1 Capital	1.695 *** (0.001)	0.353. (0.056)
Capital Adequacy Ratio	0.809. (0.051)	1.482 *** (0.000)
Concentration	−0.005 *** (0.000)	−0.001. (0.077)
GDPcap	0.000 * (0.014)	0.000 ** (0.004)
GDPgr	−0.016. (0.002)	0.001 (0.613)
Inflation	−0.031 * (0.002)	−0.003 (0.206)
Country Governance Score	0.058 (0.215)	0.058 *** (0.001)
Protect Minority Investors Score	0.002 (0.484)	0.001 * (0.016)
Global Risk Score-GEPU	−0.003 *** (0.000)	0.000 (0.312)
Constant	4.339 *** (0.000)	0.792 *** (0.000)
Bank fixed effects	Yes	Yes
Time fixed effects	Yes	Yes
Breusch-Pagan LM	415.45 ***	36,955 ***
Hausman Chi-square	172.17 **	688.63 ***
Adjusted R-square	0.531	0.127
F (*p* value)	106.040 ***	14.510 ***
N	1115	1115
Banks	223	223

Signif. Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1.

Table 8. Regression results for ESG_Combined as a predictor.

	PBV(Model 3) Coefficients (*p*-Value)	**TQ(Model 4) Coefficients (*p*-Value)**
ESG_Combined	0.003 ** (0.001)	0.000 (0.463)
ROE	6.088 *** (0.000)	0.350 ** (0.001)
Size	−0.120 *** (0.000)	0.001 (0.707)
Tier1 Capital	1.946 *** (0.000)	0.386 * (0.037)
Capital Adequacy Ratio	0.804 (0.054)	1.485 *** (0.000)
Concentration	−0.004 ** (0.001)	−0.001 (0.236)
GDPcap	0.000 * (0.005)	0.000 ** (0.009)
GDPgr	0.044. (0.055)	0.001 (0.666)
Inflation	−0.017 *** (0.000)	−0.003 (0.339)
Country Governance Score	0.068 (0.151)	0.057 ** (0.001)
Protect Minority Investors Score	0.002 (0.386)	0.002 * (0.010)
Global Risk Score	−0.003 *** (0.000)	0.000 (0.361)
Constant	3.824 *** (0.000)	0.660 *** (0.000)
Bank fixed effects	Yes	Yes
Time fixed effects	Yes	No
Breusch-Pagan LM	394.58 ***	36,502 ***
Hausman Chi-square	518.94 ***	720.99 ***
Adjusted R-square	0.526 ***	0.123 ***
F (*p* value)	104.186 ***	14.025 ***
N	1115	1115
Banks	223	223

Signif. Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1.

4.5. Discussion

This study first sheds light on whether the ESG performance scores of banks as provided by the data provider Refinitiv in its Eikon database are significantly impacted by the consideration of financial materiality as per the SASB's materiality map. Our study's relevance arises from the fact that investors, who are the primary consumers of such ratings,

do not precisely correspond to the financial materiality criteria employed by the major ESG data suppliers and rating agencies. We showed that for the banking industry, incorporating financial materiality in the evaluation of ESG performance leads to appreciable score differences and makes it possible to differentiate between banks that address significant ESG issues and those that focus on issues that are mostly immaterial to the industry, though a broad spectrum of ESG relevance. As a result, we demonstrated how the inclusion of financial materiality can enhance the informative value of ESG scores, which could lead to more precise investment assessments and wiser investment choices, in alignment with the previous studies focused on ESG materiality.

A recent study by Madison and Schiehll (2021) [16] revealed that financial materiality has an impact on how relevant ESG scores and rankings are, making it possible to identify investment opportunities in companies that score highly on business-critical ESG concerns. Similarly, Consolandi et al. (2020) [11] also demonstrated that ESG materiality had a greater impact on stock performance when it came to financially significant concerns. In its analysis of investment strategies, Kaiser [67] found that adding ESG risk materiality investors to a portfolio improved its risk-adjusted performance. Moreover, align with the other studies [8,15,25,68], our study bolsters the notion that using SASB mapping to evaluate companies' ESG materiality performance can greatly enhance the usefulness of ESG scores and rankings.

Our findings also revealed that the SASB-adjusted score "ESG materiality score" diverged significantly from the initial Refinitiv ESG Combined score for all years and nations included in our sample (ESGC). For all years and nations, it is noteworthy that the ESG materiality scores—as calculated by us using the dynamic entropy and TOPSIS methods—were lower than the ESGC. Our findings support Madison and Schiehll's [16] findings in that the SASB-adjusted scores for their sample firms were also lower than the MSCI initial scores. According to the results of our entropy analysis, the topics of "systemic risk management", "financial inclusion and capacity building", and "incorporating ESG factors in credit analysis" and their key ESG indicators 'environmental assets under management', 'product access at a low price', 'climate change commercial risks opportunities', and 'environmental supply chain management' were primarily responsible for this difference.

Another notable finding relying on regression results in this study concerned that ESG Materiality had a positive valuation effect of ESG materiality for the banking sector in OECD countries. ESG Materiality score contributed significantly to the firm value represented by PBV and TQ while the ESG Combined score did merely for PBV with a lower contribution. This finding supports the value-enhancing theory, pointing to a positive ESG–value relationship. However, we would like to also point out that the results of the study assume that there is a linear relationship between ESG scores and dependent variables. We examined the relationship between ESG scores and dependent variables in our sample using scatter plots. Since there is no significant difference in the R-square values of linear and non-linear (quadratic, cubic, etc.) fitted lines, we studied linear models within the scope of this study as a starting point. In this regard, investigating the nonlinear relationship is pointing out the direction for further research.

5. Conclusions

The literature has yet to address the connection between ESG performance and firm value. However, a rising body of research suggests that a firm's ESG performance, particularly when materiality is taken into account, has a beneficial impact on its market value. The value-enhancing theory contends that corporate sustainability initiatives can increase a firm's market value, both directly and indirectly. However, this idea has not been put to the test yet using financial materiality-adjusted ESG ratings, but rather original ESG scores. Furthermore, research looking at ESG materiality has not focused on the banking sector. Thus, the dearth of thorough research on the value relevance of ESG Materiality in the banking industry served as the driving force behind our effort.

In addition, the banking sector is dealing with growing investor demand and business challenges associated with legislation such as EU Taxonomy, Sustainable Finance Disclosure Regulation (SFDR), and Corporate Sustainability Due Diligence (CSDD) Directive. These new issues offer a special circumstance that enables us to test an intriguing study hypothesis: the applicability of ESG Materiality-valuation impacts in the sector. We looked into the relationship between the ESG Materiality performance and the market value of banks doing business in OECD nations.

This study contributes to the literature on the evaluation of ESG materiality performance and its impact on valuation. Since stakeholders are requesting greater information about ESG risks and management practices, banks are increasingly sharing ESG-related data. Focusing on the informational requirements of investors, we demonstrate how SASB-oriented ESG rankings and scores differ from the original ESG scores and are therefore more likely to deliver pertinent data to investors. Investors want to be aware of the financial materiality of ESG concerns before making investment decisions since responsible investment is fundamentally based on the financial logic of profit maximization. We also contributed methodologically in terms of calculating ESG materiality performance by integrating deeper techniques, unlike previous studies.

We have two limitations in our study, as with any empirical investigation. First, and related to the scope of our analysis, the focus was narrowed to banks included in the Refinitiv Eikon ESG database. The creation of a map on ESG material issues between SASB and Refinitiv is another potential drawback. Although the descriptions of each business and the major ESG issues were thoroughly examined to create these equivalences, there is still some subjectivity at play.

Finally, we conclude by pointing out the direction for further research. Future research could pursue this direction by (1) extending our methodology to other industries, (2) examining the contribution of SASB-identified materiality in the relationship between ESG performance and financial performance, and (3) estimating firm value enhanced by ESG materiality using machine learning techniques, considering both linear and non-linear modeling. Finally, we hope that our findings would support additional studies into how ESG Materiality affects business value.

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Data Availability Statement: The data that support the findings of this study are available from Refinitiv Eikon but restrictions apply to the availability of these data, which were used under license from Yildiz Technical University and so are not publicly available. Data sharing is not applicable.

Conflicts of Interest: We declare no conflict of interest in this work.

Appendix A

Table A1. Pool of ESG Indicators Mapped with GICs.

SASB Material Topics for Commercial Banking Industry	Refinitiv Indicators	Refinitiv Categories	Refinitiv Pillars
Disclosure Topic: Business Ethics	Policy Business Ethics	Community	Social
	Policy Business Ethics Score	Community	Social
	Business Ethics Controversies	Community-Controversies	Controversies
	Improvement Tools Business Ethics	Community	Social
	Improvement Tools Business Ethics Score	Community	Social
	Policy Bribery and Corruption	Community	Social
	Policy Bribery and Corruption Score	Community	Social
	Bribery, Corruption and Fraud Controversies	Community-Controversies	Controversies
	Bribery, Corruption and Fraud Controversies Score	Community-Controversies	Controversies
	Policy Fair Competition	Community	Social
	Policy Fair Competition Score	Community	Social
	Anti-competition Controversies	Community-Controversies	Controversies
	Anti-Competition Controversies Count	Community-Controversies	Controversies
	Anti-Competition Controversies Score	Community-Controversies	Controversies
	Whistleblower Protection	Community	Social
	Whistleblower Protection Score	Community	Social
	Tax Fraud Controversies	Community-Controversies	Controversies
	Policy Fair Trade	Product Responsibility	Social
	Policy Fair Trade Score	Product Responsibility	Social
	Policy Responsible Marketing	Product Responsibility	Social
	Policy Responsible Marketing Score	Product Responsibility	Social
	Controversies Responsible Marketing	Product Responsibility-Controversies	Controversies
	Responsible Marketing Controversies	Product Responsibility-Controversies	Controversies
	Product Responsibility Monitoring	Product Responsibility	Social
	Product Responsibility Monitoring Score	Product Responsibility	Social
	Human Rights Policy Score	Human rights	Social
	Ethical Trading Initiative ETI	Human rights	Social
	Ethical Trading Initiative ETI Score	Human rights	Social
	Board Functions Policy	Management	Governance
	Board Functions Policy Score	Management	Governance
	Corporate Governance Board Committee	Management	Governance
	Audit Board Committee	Management	Governance
	Audit Committee Independence Score	Management	Governance
	Shareholder Rights Policy	Shareholder	Governance
	Shareholder Rights Policy Score	Shareholder	Governance
	Policy Shareholder Engagement	Shareholder	Governance
Disclosure Topic: Systemic Risk Management	Crisis Management Systems	Community	Social
	Climate Change Commercial Risks Opportunities Score	Emissions	Environmental
	Policy Emissions	Emissions	Environmental
	Targets Emissions	Emissions	Environmental
	Emission Reduction Target Percentage	Emissions	Environmental
	Resource Reduction Policy	Resource use	Environmental
	Policy Water Efficiency Score	Resource use	Environmental
	Policy Energy Efficiency Score	Resource use	Environmental
	Policy Environmental Supply Chain Score	Resource use	Environmental
	Environmental Supply Chain Management Score	Resource use	Environmental
	Environmental Supply Chain Monitoring Score	Resource use	Environmental
Disclosure Topic: Financial Inclusion & Capacity Building	Policy Community Involvement	Community	Social
	Policy Community Involvement Score	Community	Social
	Community Lending and Investments	Community	Social
	Community Lending and Investments Score	Community	Social
	Donations / Million in Revenue $	Community	Social
	Product Sales at Discount to Emerging Markets	Community	Social
	Product Sales at Discount to Emerging Markets Score	Community	Social
	Product Access Low Price	Product Responsibility	Social
	Product Access Low Price Score	Product Responsibility	Social
	Controversies Product Access	Product Responsibility-Controversies	Controversies

Table A1. *Cont.*

SASB Material Topics for Commercial Banking Industry	Refinitiv Indicators	Refinitiv Categories	Refinitiv Pillars
	Training and Development Policy	Workforce	Social
	Training and Development Policy Score	Workforce	Social
	Policy Skills Training	Workforce	Social
	Net Employment Creation	Workforce	Social
	Net Employment Creation Score	Workforce	Social
Disclosure Topic: Data Security	Policy Data Privacy	Product Responsibility	Social
	Policy Data Privacy Score	Product Responsibility	Social
	Controversies Privacy	Product Responsibility-Controversies	Social
	Policy Cyber Security	Product Responsibility	Social
Disclosure Topic: Incorporation of ESG Factors in Credit Analysis	Environmental Products Score	Innovation	Environmental
	Eco-Design Products	Innovation	Environmental
	Revenue from Environmental Products	Innovation	Environmental
	Percentage of green products	Innovation	Environmental
	Environmental Assets Under Mgt	Innovation	Environmental
	Environmental Assets Under Mgt Score	Innovation	Environmental
	ESG Assets Under Management	Innovation	Environmental
	Equator Principles or Env Project Financing	Innovation	Environmental
	Equator Principles or Env Project Financing Score	Innovation	Environmental
	Environmental Project Financing	Innovation	Environmental
	Integrated Strategy in MD&A	CSR Strategy	Governance
	Supplier ESG training	Workforce	Social
	Supplier ESG training Score	Workforce	Social

Appendix B

Table A2. ESG Indicator Selection Process and Data Gap Ratios by Year and Indicators.

	#Observation = 8050; #Bank = 805										#Bank = 451	#Bank = 451	#Bank = 147	#Bank = 252	
	2020	2019	2018	2017	2016	2015	2014	2013	2012	2011	Panel10yr_1	Panel5yr_1	Panel10yr_2	Panel5yr_2	Inc/Exc
Policy Business Ethics	44%	53%	60%	62%	69%	78%	80%	80%	81%	82%	44%	24%	0%	0%	Exc-alt
Policy Business Ethics Score	44%	53%	60%	62%	69%	78%	80%	80%	81%	82%	44%	24%	0%	0%	Inc
Business Ethics Controversies	97%	97%	97%	97%	97%	97%	96%	96%	97%	97%	exc1	exc1	-	-	Exc-1
Improvement Tools Business Ethics	44%	53%	60%	62%	69%	78%	80%	80%	81%	82%	44%	24%	0%	0%	Exc-alt
Improvement Tools Business Ethics Score	44%	53%	60%	62%	69%	78%	80%	80%	81%	82%	44%	24%	0%	0%	Inc
Policy Bribery and Corruption	44%	53%	60%	62%	69%	78%	80%	80%	81%	82%	44%	24%	0%	0%	Exc-alt
Policy Bribery and Corruption Score	44%	53%	60%	62%	69%	78%	80%	80%	81%	82%	44%	24%	0%	0%	Inc
Bribery, Corruption and Fraud Controversies	44%	53%	60%	62%	69%	78%	80%	80%	81%	82%	44%	24%	0%	0%	Exc-alt
Bribery, Corruption and Fraud Controversies Score	44%	53%	60%	62%	69%	78%	80%	80%	81%	82%	44%	24%	0%	0%	Inc
Policy Fair Competition	44%	53%	60%	62%	69%	78%	80%	80%	81%	82%	44%	24%	0%	0%	Exc-alt
Policy Fair Competition Score	44%	53%	60%	62%	69%	78%	80%	80%	81%	82%	44%	24%	0%	0%	Inc
Anti-Competition Controversies	44%	53%	60%	62%	69%	78%	80%	80%	81%	82%	44%	24%	0%	0%	Exc-alt
Anti-Competition Controversies Count	96%	96%	97%	97%	98%	99%	97%	98%	99%	100%	exc1	exc1	-	-	Exc-1

Table A2. *Cont.*

	#Observation = 8050; #Bank = 805										#Bank = 451	#Bank = 451	#Bank = 147	#Bank = 252	
	2020	**2019**	**2018**	**2017**	**2016**	**2015**	**2014**	**2013**	**2012**	**2011**	**Panel10yr_1**	**Panel5yr_1**	**Panel10yr_2**	**Panel5yr_2**	**Inc/Exc**
Anti-Competition Controversies Score	44%	53%	60%	62%	69%	78%	80%	80%	81%	82%	44%	24%	0%	0%	Inc
Whistleblower Protection	55%	62%	68%	71%	78%	86%	89%	89%	90%	90%	61%	41%	exc2	23%	Exc-alt
Whistleblower Protection Score	55%	62%	68%	71%	78%	86%	89%	89%	90%	90%	61%	41%	exc2	23%	Exc-5
Tax Fraud Controversies	97%	97%	99%	99%	100%	100%	100%	100%	100%	100%	exc1	exc1	-	-	Exc-1
Policy Fair Trade	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	0%	0%	0%	0%	Exc-4
Policy Fair Trade Score	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	exc1	exc1	-	-	Exc-1
Policy Responsible Marketing	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	0%	0%	0%	0%	Inc
Policy Responsible Marketing Score	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	exc1	exc1	-	-	Exc-1
Responsible Marketing Controversies	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	0%	0%	0%	0%	Exc-alt
Responsible Marketing Controversies Score	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	0%	0%	0%	0%	Exc-5
Product Responsibility Monitoring	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	0%	0%	0%	0%	Inc
Product Responsibility Monitoring Score	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	exc1	exc1	-	-	Exc-1
Human Rights Policy Score	44%	53%	60%	62%	69%	78%	80%	80%	81%	82%	44%	24%	0%	0%	Inc
Ethical Trading Initiative ETI	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	0%	0%	0%	0%	Exc-4
Ethical Trading Initiative ETI Score	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	exc1	exc1	-	-	Exc-1
Board Functions Policy	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	0%	0%	0%	0%	Exc-alt
Board Functions Policy Score	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	0%	0%	0%	0%	Inc
Corporate Governance Board Committee	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	0%	0%	0%	0%	Inc
Audit Board Committee	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	0%	0%	0%	0%	Inc
Audit Committee Independence Score	48%	48%	48%	48%	48%	48%	48%	48%	48%	48%	6%	6%	11%	8%	Inc
Shareholder Rights Policy	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	0%	0%	0%	0%	Exc-alt
Shareholder Rights Policy Score	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	0%	0%	0%	0%	Inc
Policy Shareholder Engagement	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	0%	0%	0%	0%	Inc
Crisis Management Systems	44%	53%	60%	62%	69%	78%	80%	80%	81%	82%	44%	24%	0%	0%	Inc
Climate Change Commercial Risks Opportunities Score	44%	53%	60%	62%	69%	78%	80%	80%	81%	82%	44%	24%	0%	0%	Inc
Policy Emissions	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	30%	30%	24%	26%	Inc

Table A2. *Cont.*

	#Observation = 8050; #Bank = 805										#Bank = 451	#Bank = 451	#Bank = 147	#Bank = 252	
	2020	**2019**	**2018**	**2017**	**2016**	**2015**	**2014**	**2013**	**2012**	**2011**	**Panel10yr_1**	**Panel5yr_1**	**Panel10yr_2**	**Panel5yr_2**	**Inc/Exc**
Target Emissions	45%	45%	45%	45%	45%	45%	45%	45%	45%	45%	30%	30%	24%	26%	Inc
Emission Reduction Target Percentage	88%	88%	88%	88%	88%	88%	88%	88%	88%	88%	83%	83%	exc2	exc2	Exc-2
Resource Reduction Policy Score	44%	53%	60%	62%	69%	78%	80%	80%	81%	82%	44%	24%	0%	0%	Inc
Policy Environmental Supply Chain Score	44%	53%	60%	62%	69%	78%	80%	80%	81%	82%	44%	24%	0%	0%	Inc
Environmental Supply Chain Management Score	45%	52%	61%	63%	68%	77%	80%	80%	81%	81%	53%	36%	31%	23%	Inc
Environmental Supply Chain Monitoring Score	91%	92%	93%	94%	95%	94%	95%	95%	96%	97%	exc1	exc1	-	-	Exc-1
Policy Community Involvement	44%	53%	60%	62%	69%	78%	80%	80%	81%	82%	44%	24%	0%	0%	Exc-alt
Policy Community Involvement Score	44%	53%	60%	62%	69%	78%	80%	80%	81%	82%	44%	24%	0%	0%	Inc
Community Lending and Investments (USD)	95%	95%	96%	96%	96%	97%	96%	97%	97%	98%	exc1	exc1	-	-	Exc-1
Community Lending and Investments Score	95%	95%	96%	96%	96%	97%	96%	97%	97%	98%	exc1	exc1	-	-	Exc-1
Total Donations To Revenues in million	80%	82%	86%	87%	88%	89%	89%	89%	90%	91%	77%	73%	exc2	exc2	Exc-2
Product Sales at Discount to Emerging Markets	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	0%	0%	0%	0%	Inc
Product Sales at Discount to Emerging Markets Score	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	exc1	exc1	-	-	Exc-1
Product Access Low Price	44%	53%	60%	62%	69%	78%	80%	80%	81%	82%	44%	24%	0%	0%	Exc-alt
Product Access Low Price Score	44%	53%	60%	62%	69%	78%	81%	81%	81%	82%	45%	25%	1%	1%	Inc
Controversies Product Access	100%	100%	100%	100%	100%	99%	99%	100%	100%	100%	exc1	exc1	-	-	Exc-1
Training and Development Policy	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	0%	0%	0%	0%	Exc-alt
Training and Development Policy Score	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	0%	0%	0%	0%	Inc
Policy Skills Training	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	0%	0%	0%	0%	Inc
Net Employment Creation	49%	49%	49%	49%	49%	49%	49%	49%	49%	49%	9%	9%	7%	9%	Exc-alt
Net Employment Creation Score	49%	49%	49%	49%	49%	49%	49%	49%	49%	49%	9%	9%	7%	9%	Inc
Policy Data Privacy	44%	53%	60%	62%	69%	78%	80%	80%	81%	82%	44%	24%	0%	0%	Exc-alt
Policy Data Privacy Score	44%	53%	60%	62%	69%	78%	80%	80%	81%	82%	44%	24%	0%	0%	Inc
Controversies Privacy	100%	98%	98%	99%	99%	99%	100%	99%	100%	100%	exc1	exc1	-	-	Exc-1
Policy Cyber Security	44%	62%	79%	84%	88%	91%	92%	92%	93%	94%	68%	49%	exc2	exc2	Exc-2
Environmental Products Score	44%	51%	60%	62%	67%	76%	80%	80%	81%	82%	43%	23%	0%	0%	Inc

Table A2. *Cont.*

	#Observation = 8050; #Bank = 805										#Bank = 451	#Bank = 451	#Bank = 147	#Bank = 252	
	2020	**2019**	**2018**	**2017**	**2016**	**2015**	**2014**	**2013**	**2012**	**2011**	**Panel10yr_1**	**Panel5yr_1**	**Panel10yr_2**	**Panel5yr_2**	**Inc/Exc**
Eco-Design Products	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	0%	0%	0%	0%	Exc-4
Revenue from Environmental Products	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	exc1	exc1	-	-	Exc-1
Percentage of green products	98%	98%	98%	98%	98%	98%	98%	98%	98%	98%	exc1	exc1	-	-	Exc-1
Environment Assets Under Mgt	44%	53%	60%	62%	69%	78%	80%	80%	81%	82%	44%	24%	0%	0%	Exc-alt
Environmental Assets Under Mgt Score	44%	53%	60%	62%	69%	78%	80%	80%	81%	82%	44%	24%	0%	0%	Inc
ESG Assets Under Management(USD)	95%	98%	100%	100%	100%	100%	100%	100%	100%	100%	exc1	exc1	-	-	Exc-1
Equator Principles or Env Project Financing	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	0%	0%	0%	0%	Exc-alt
Equator Principles or Env Project Financing Score	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	0%	0%	0%	0%	Inc
Environmental Project Financing	44%	53%	60%	62%	69%	78%	80%	80%	81%	82%	44%	24%	0%	0%	Inc
Integrated Strategy in MD&A	57%	66%	71%	72%	79%	88%	91%	91%	91%	91%	64%	45%	exc2	31%	Exc-4
Supplier ESG training	44%	44%	44%	44%	44%	44%	44%	44%	44%	44%	0%	0%	0%	0%	Inc
Supplier ESG training Score	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	exc1	exc1	-	-	Exc-1

Note: "#Bank" stands for number of banks. "Inc" stands for the indicators included in the study. "Exc-1", "Exc-2", "Exc-alt", "Exc-4" and "Exc-5" stand for excluded indicators as described below: Iteration1: "Exc-1"; datagap for observations > 90% and datagap for criteria >90%; Iteration2: "Exc-2"; datagap for observations > 60% and then datagap for criteria > 30%; Iteration3: "Exc-alt"; Criterion has been deleted due to alternative criterion included; Iteration4: "Exc-4": Excluded due to value of observations is mostly same; Iteration5: "Exc-5": Excluded due to many outliers observed for the criterion.

Appendix C

Table A3. ESG Combined and ESG Materiality Scores by Country-Descriptives.

Country	**Measure**	**ESG_Combined Score**		**ESG_Materiality Score**	
		Statistic	**Std. Error**	**Statistic**	**Std. Error**
Australia	Mean	57.95	2.13	0.61	0.02
	Median	56.19		0.62	
	Std. Deviation	11.65		0.12	
Austria	Mean	60.15	4.54	0.60	0.03
	Median	54.29		0.60	
	Std. Deviation	14.35		0.10	
Belgium	Mean	64.33	0.78	0.57	0.02
	Median	64.63		0.57	
	Std. Deviation	1.75		0.04	
Canada	Mean	56.29	2.36	0.55	0.02
	Median	56.77		0.61	
	Std. Deviation	15.84		0.14	
Chile	Mean	55.97	4.06	0.46	0.04
	Median	49.48		0.45	
	Std. Deviation	15.74		0.17	

Table A3. *Cont.*

Country	Measure	ESG_Combined Score		ESG_Materiality Score	
		Statistic	Std. Error	Statistic	Std. Error
Colombia	Mean	48.20	3.86	0.47	0.02
	Median	48.35		0.49	
	Std. Deviation	14.96		0.07	
Czech Re	Mean	51.74	1.17	0.40	0.01
	Median	51.65		0.40	
	Std. Deviation	2.61		0.02	
Denmark	Mean	41.52	2.82	0.49	0.01
	Median	41.38		0.49	
	Std. Deviation	10.92		0.05	
France	Mean	60.32	2.74	0.70	0.01
	Median	56.52		0.70	
	Std. Deviation	12.27		0.05	
Germany	Mean	50.58	4.89	0.59	0.01
	Median	47.71		0.59	
	Std. Deviation	10.93		0.02	
Greece	Mean	66.83	3.74	0.53	0.02
	Median	67.02		0.50	
	Std. Deviation	11.82		0.06	
Hungary	Mean	59.53	3.97	0.56	0.04
	Median	57.43		0.54	
	Std. Deviation	8.87		0.08	
Ireland;	Mean	53.35	3.66	0.50	0.02
	Median	56.66		0.51	
	Std. Deviation	11.56		0.07	
Israel	Mean	60.47	2.45	0.49	0.01
	Median	57.83		0.48	
	Std. Deviation	10.94		0.06	
Italy	Mean	53.68	4.07	0.51	0.03
	Variance	248.75		0.02	
	Std. Deviation	15.77		0.14	
Japan	Mean	33.89	1.91	0.35	0.01
	Median	26.09		0.32	
	Std. Deviation	20.87		0.14	
Korea; R	Mean	68.42	3.36	0.46	0.01
	Median	69.84		0.46	
	Std. Deviation	16.80		0.06	
Mexico	Mean	44.69	8.47	0.42	0.04
	Median	58.14		0.51	
	Std. Deviation	32.81		0.16	
Netherlandd	Mean	65.53	3.97	0.65	0.03
	Median	68.17		0.65	
	Std. Deviation	12.55		0.09	
Norway	Mean	69.36	5.55	0.56	0.02
	Median	71.05		0.57	
	Std. Deviation	12.40		0.04	
Poland	Mean	55.76	2.29	0.47	0.02
	Median	57.23		0.48	
	Std. Deviation	14.51		0.10	
Portugal	Mean	68.21	4.86	0.54	0.01
	Median	69.48		0.54	
	Std. Deviation	10.86		0.01	

Table A3. *Cont.*

Country	Measure	ESG_Combined Score		ESG_Materiality Score	
		Statistic	Std. Error	Statistic	Std. Error
Russia	Mean	55.92	2.22	0.41	0.02
	Median	55.23		0.43	
	Std. Deviation	7.03		0.06	
Spain	Mean	69.63	2.11	0.62	0.01
	Median	70.96		0.63	
	Std. Deviation	10.56		0.07	
Sweden	Mean	64.57	2.56	0.60	0.01
	Median	65.10		0.60	
	Std. Deviation	11.46		0.05	
Switzerland	Mean	44.05	0.69	0.53	0.06
	Median	43.39		0.54	
	Std. Deviation	2.18		0.18	
Turkey	Mean	60.01	1.50	0.52	0.01
	Median	59.69		0.49	
	Std. Deviation	8.87		0.09	
United K	Mean	48.09	2.25	0.54	0.02
	Median	45.51		0.57	
	Std. Deviation	12.32		0.12	
United S	Mean	36.60	0.53	0.35	0.00
	Median	35.32		0.33	
	Std. Deviation	12.38		0.09	

Appendix D

Table A4. ESG Combined and ESG Materiality Scores by Year-Descriptive.

Year			ESG_Combined		ESG_Materiality	
			Statistic	Std. Error	Statistic	Std. Error
2016	Mean		41.94	1.23	0.40	0.01
	95% Confidence Interval for Mean	Lower Bound	39.52		0.38	
		Upper Bound	44.37		0.42	
	5% Trimmed Mean		41.54		0.39	
	Median		39.72		0.36	
	Variance		338.51		0.02	
	Std. Deviation		18.40		0.14	
	Minimum		5.62		0.14	
	Maximum		87.30		0.78	
	Range		81.67		0.65	
	Interquartile Range		26.93		0.20	
	Skewness		0.37	0.16	0.80	0.16
	Kurtosis		−0.49	0.32	−0.35	0.32
2017	Mean		43.76	1.22	0.41	0.01
	95% Confidence Interval for Mean	Lower Bound	41.36		0.39	
		Upper Bound	46.17		0.43	
	5% Trimmed Mean		43.47		0.41	
	Median		41.39		0.38	
	Variance		332.06		0.02	
	Std. Deviation		18.22		0.14	
	Minimum		3.90		0.16	
	Maximum		87.94		0.77	

Table A4. *Cont.*

Year			ESG_Combined		ESG_Materiality	
			Statistic	Std. Error	Statistic	Std. Error
	Range		84.03		0.61	
	Interquartile Range		26.40		0.23	
	Skewness		0.31	0.16	0.61	0.16
	Kurtosis		−0.49	0.32	−0.61	0.32
2018	Mean		44.19	1.24	0.42	0.01
	95% Confidence Interval for Mean	Lower Bound	41.76		0.40	
		Upper Bound	46.63		0.44	
	5% Trimmed Mean		43.92		0.42	
	Median		42.02		0.38	
	Variance		341.21		0.02	
	Std. Deviation		18.47		0.14	
	Minimum		3.92		0.21	
	Maximum		87.59		0.86	
	Range		83.67		0.64	
	Interquartile Range		25.38		0.23	
	Skewness		0.30	0.16	0.62	0.16
	Kurtosis		−0.55	0.32	−0.50	0.32
2019	Mean		46.60	1.20	0.43	0.01
	95% Confidence Interval for Mean	Lower Bound	44.23		0.41	
		Upper Bound	48.96		0.45	
	5% Trimmed Mean		46.54		0.43	
	Median		46.14		0.41	
	Variance		321.22		0.02	
	Std. Deviation		17.92		0.14	
	Minimum		3.48		0.19	
	Maximum		86.46		0.78	
	Range		82.97		0.58	
	Interquartile Range		28.25		0.23	
	Skewness		0.07	0.16	0.45	0.16
	Kurtosis		−0.69	0.32	−0.79	0.32
2020	Mean		47.59	1.14	0.45	0.01
	95% Confidence Interval for Mean	Lower Bound	45.34		0.43	
		Upper Bound	49.83		0.47	
	5% Trimmed Mean		47.58		0.45	
	Median		46.37		0.42	
	Variance		289.01		0.02	
	Std. Deviation		17.00		0.14	
	Minimum		2.79		0.19	
	Maximum		86.02		0.77	
	Range		83.24		0.58	
	Interquartile Range		23.57		0.23	
	Skewness		0.03	0.16	0.37	0.16
	Kurtosis		−0.32	0.32	−0.89	0.32

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