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## SPECIALTY SECTION

This article was submitted to  
Quantitative Sustainability Assessment,  
a section of the journal  
Frontiers in Sustainability

RECEIVED 15 April 2022

ACCEPTED 30 August 2022

PUBLISHED 21 September 2022

## CITATION

Keeley AR, Chapman AJ, Yoshida K,  
Xie J, Imbulana J, Takeda S and  
Managi S (2022) ESG metrics and  
social equity: Investigating  
commensurability.  
*Front. Sustain.* 3:920955.  
doi: 10.3389/frsus.2022.920955

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# ESG metrics and social equity: Investigating commensurability

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During the past two decades, the world has seen exponential growth in the number of companies reporting environmental, social, and governance (ESG) data, and various ESG metrics have been proposed and are now in use. ESG metrics play a crucial role as an enabler of investment strategies that consider ESG factors, which are often referred to as “ESG investments”. The ESG metrics and investment market are evolving rapidly, as investors, corporations, and the public are giving more priority to the “S” in ESG, including social equity issues, such as diversity, income inequality, worker safety, systemic racism, and companies’ broader role in society. In this critical, systematic review, utilizing in-depth assessments, we investigate and compare the approaches employed in major ESG metrics and studies, then, we shed light on the “S” aspect by reviewing existing approaches used to assess social equity to clarify commensurability with ESG. Through the systematic review, this paper confirms that ESG investments can be expected to provide stable and high returns especially over the long term. This paper also clarifies how elements considered in social equity studies are largely reflected in major ESG metrics.

## KEYWORDS

ESG metrics, social equity, systematic review, sustainability index, sustainable investment

## Introduction

Environmental, social, and governance (ESG) investment has become an opportunity for businesses to tap into the growing social demand for lasting change and the emerging ESG market. According to a report by the Global Sustainable Investment Alliance ([Global Sustainable Investment Alliance, 2021](#)), total global ESG investments in 2020 reached \$35.3 trillion, which is an increase of 15% from 2018 and 55% from 2016. The \$35.3 trillion figure represents 35.9% of the \$98.4 trillion in assets managed by all of the institutional investors surveyed<sup>1</sup>. A comprehensive literature review by [Camilleri \(2020\)](#) confirms that the providers of financial capital are increasingly allocating funds toward positive impact and sustainable investments. Because of the growth in environmental and ethical consciousness, both consumers and investors want companies to consider these values. And the growth in such demand

<sup>1</sup> GSIA has surveyed institutional investors in the five regions: Europe; the US; Canada; Australia; NZ; and Japan.

increases the importance of developing sound ESG metrics to evaluate ESG activities. As shown by the recent adoption of a proposal for a Directive on corporate sustainability due diligence by the European Commission on February 23, 2022 that aims to foster not just environmentally but also socially responsible corporate behavior throughout global value chains, investors, corporations, and the public are giving more priority to the “S” in ESG, including social equity issues, such as diversity, income inequality, worker safety, systemic racism, and companies’ broader role in society. Despite the growing importance of ESG metrics and social aspects of ESG, there is a lack of academic scholarship investigating the commensurability of these metrics, and especially how important social elements are reflected in these metrics.

In recent years, there has been a growing awareness of the problem of the disarray of standards for disclosing ESG information, which is important in assessing the ESG initiatives of companies. The main disclosure standards for ESG information vary, depending on the purpose of the disclosure, such as the areas to be disclosed, whether it is principle or detailed based, the assumed stakeholders, disclosure channels, principles to be followed, and disclosure items. There has been a move toward the unification of standards, including a joint statement by standard-setting bodies and a proposal by the International Financial Reporting Standards Foundation to set sustainability reporting standards. Many studies have critiqued the lack of common theorization and commensurability among the ESG metrics mainly used in the market (Chatterji et al., 2016). Some studies have pointed out that the divergence of ESG ratings is mostly due to the differences in the scope, measurement, and weights of the metrics (Berg et al., 2022), but a critical analysis of ESG metrics and studies that have employed the metrics is required to solve the lack of common theorization and commensurability. We conduct this critical analysis in this study through a systematic review and a detailed examination of ESG metrics, and we investigate and compare the assessment approaches employed in the major ESG metrics and studies. Through the systematic review, we also examine the impact of ESG performance on financial performance and how the results differ among studies using different ESG metrics for the analyses. Additionally, to further examine how the major ESG metrics incorporate important social elements, we shed light on the “S” aspect by reviewing existing approaches used to assess social equity and examine how the elements considered in existing approaches are reflected.

Through the systematic review, this paper confirms that ESG investments can be expected to provide stable and high returns especially over the long term. Regarding the commensurability of the metrics, based on accessible methodology descriptions for four leading ESG metrics widely used in academic research, and business, this paper finds that the elements assessed have a significant divergence across the metrics: only four elements are common among all four ESG metrics, with the ratios of exclusive

elements being 37.3, 38.1, 4.4, and 7.1% for the four metrics. This paper also clarifies how the elements considered in the social equity studies are reflected in the major ESG metrics. Some of the common factors that we find in the studies that evaluated social equity quantitatively are the concept of employment, such as relations, unemployment ratios and age groups, as well as income and education, which are also important elements in ESG metrics (e.g., gender balance, salary, and training). This paper also clarifies that access is a factor that can be quantified and used frequently in social equity studies, including access to energy, transportation, and essential facilities, whereas quantifying access is hardly observed in the major ESG metrics. The results of this paper contribute to advancing the research community’s and practitioners’ knowledge by providing a detailed examination of commensurability of the major ESG metrics, and how the ESG metrics capture important social elements.

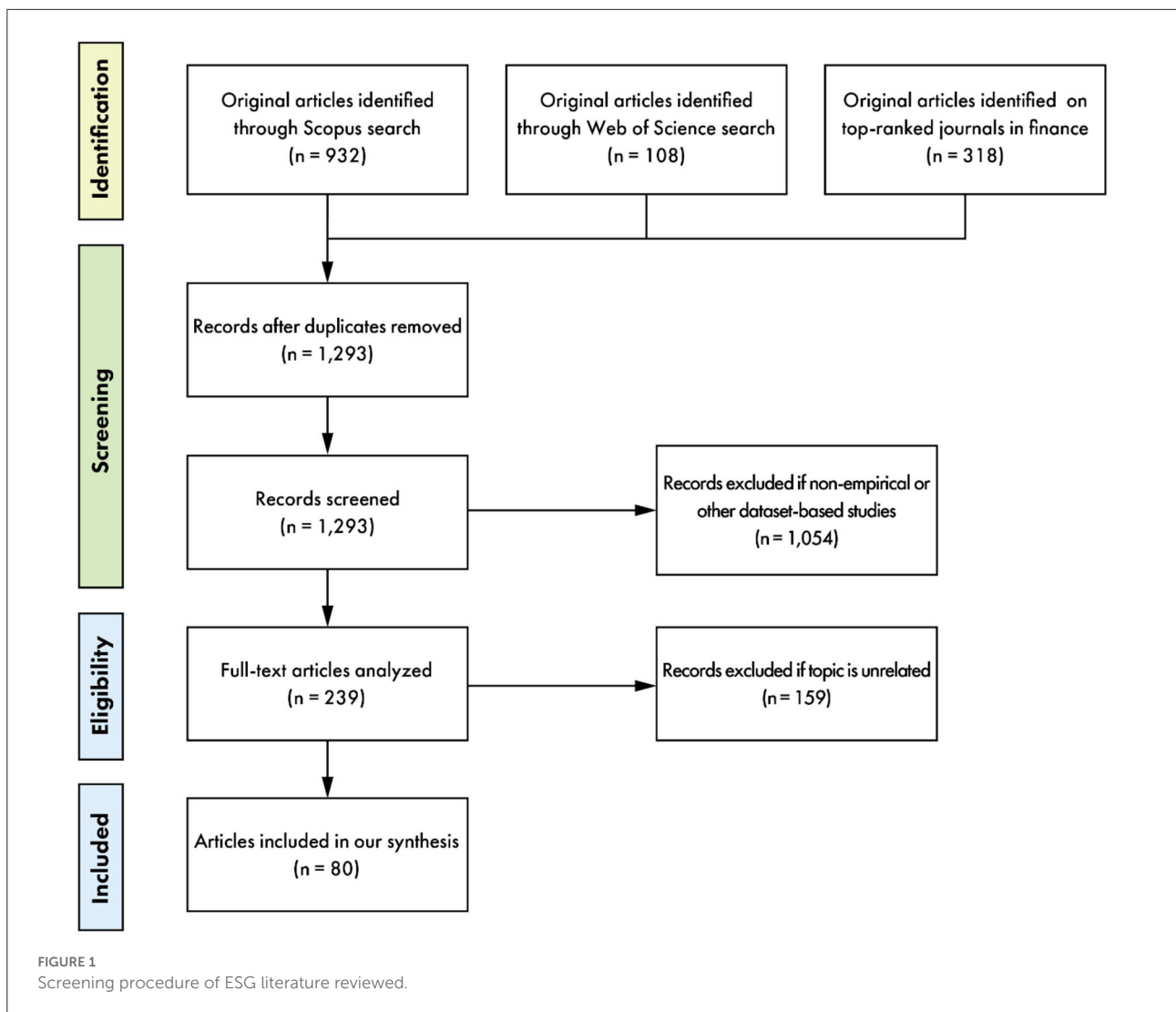
The remainder of this paper is structured as follows. Section Systematic review of the literature that has employed ESG metrics provides the results of the systematic review of the ESG and social equity literature. Section ESG metrics and social equity: A closer look at the methodology and elements assessed provides a closer look at the major ESG metrics and critical elements of social equity studies. The discussion and conclusions, which are based on the systematic review and a detailed examination of the elements assessed, are presented in Section Discussion and conclusion.

## Systematic review of the literature that has employed ESG metrics

This section provides the result of the systematic review of the ESG and social equity literature to capture the trends in the literature, such as investigated issues, geographical region, industries, and research fields.

## Data

The ESG articles reviewed in this study are collected from Scopus, Thomson Reuters’ Web of Science, and the top-ranked journals in finance. Considering the fact that ESG studies have been increasingly undertaken in the past decades, we set the search period from January 1, 2000 to December 31, 2021. Following the keywords in previous systematic reviews, the keywords of the ESG topic include “CSR,” “corporate social responsibility,” “ESG,” and “environmental social\* governance” (Kong et al., 2020; Widyawati, 2020), where the \* stands for any other patterns of the word. The keywords of the ESG database include “MSCI,” “KLD,” “Kinder Lydenberg Domini,” “Refinitiv,” “Thomson Reuters Asset4,” “Bloomberg,” “FTSE Russell,” and “Arabesque S-Ray,” which are the major ESG data providers

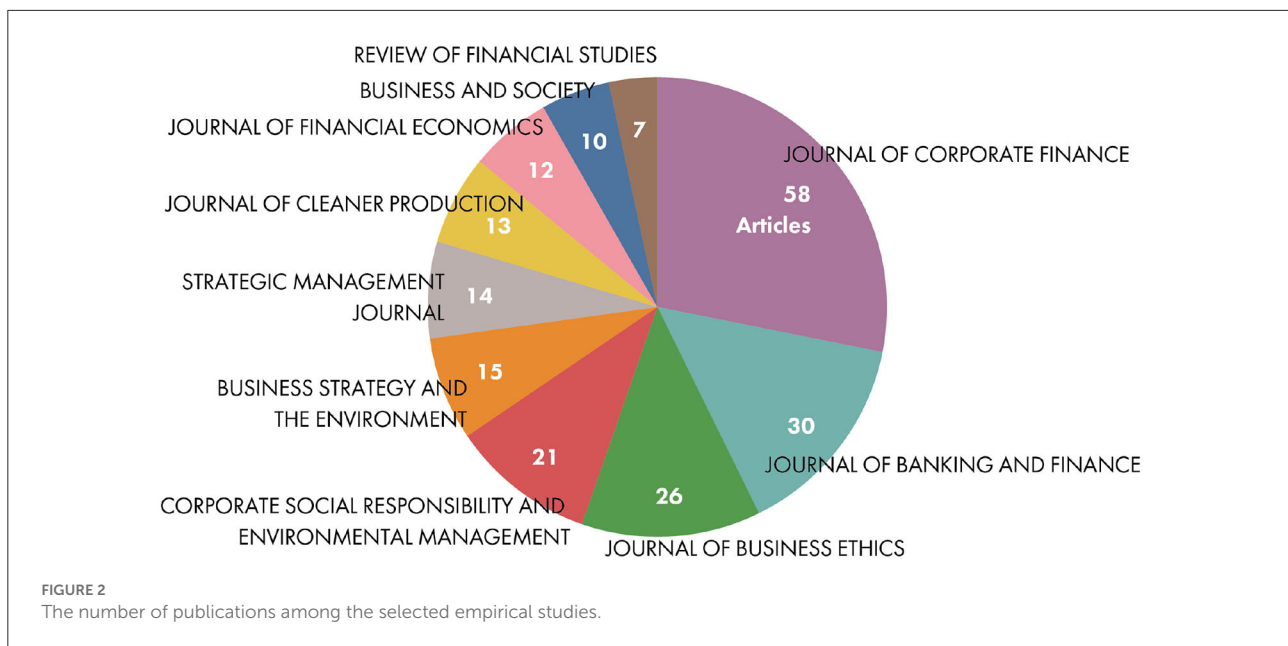


in the global market (Escrig-Olmedo et al., 2019). Keywords of financial performance that usually appear in the literature include “CFP,” “financial performance,” “stock return,” “ROA,” “ROE,” and “Tobin’s Q.” We perform two search strategies in both Scopus and Web of Science<sup>2</sup>. Strategy 1 is keywords of ESG topic and financial performance, and Strategy 2 is keywords of ESG topic and ESG database. After filtering research articles in English and highly cited or hot papers on the Web of Science, Strategy 1 found 90 results, and Strategy 2 found 18 results. Moreover, after combining Strategies 1 and 2, 932 results were found on Scopus. We then searched for papers in the top-ranked journals in finance (Journal of Banking and Finance, Journal of Corporate Finance, Journal of Finance, Journal of Financial Economics, and Review of Financial Studies) to supplement the

results from Scopus and Web of Science. This screening process was conducted by one author and verified by another author.

Figure 1 presents the screening procedure, starting from original articles in Scopus, Web of Science, and top-ranked journals in finance. After removing duplicated articles, we identified 1,293 articles. We manually checked all articles to filter out empirical studies that used the ESG database we are focusing on, and we had 239 articles. Figure 2 presents the number of publications in the selected empirical studies. Most of the studies that used ESG metrics were in the field of corporate finance, followed by specialized CSR journals. We then listed studies that discussed the impact of ESG activities on corporate financial performance. ESG activities are proxied by ESG scores or any specific ESG indicators in the ESG databases. Corporate financial performance is proxied by ROA, ROE, Tobin’s Q, and other indicators of market return. After excluding studies that are not our focus, the final sample is 80 articles.

<sup>2</sup> The search date is January 6<sup>th</sup> 2022.



Regarding the social equity literature, following the review process for the ESG literature, the articles reviewed are from Scopus and Thomson Reuters' Web of Science, with the search period set from January 1, 2000 to December 31, 2021. As one of the main objectives of this study is to investigate how the elements considered in social equity evaluation studies are reflected in major ESG metrics, the keywords for this systematic review are "social equity," "assessment/evaluation," and "quantitative." The screening procedure is presented in Figure 3. Initially, there were 29 papers from the Web of Science and 170 papers from Scopus. After dropping duplicates, we obtained 172 articles. To identify papers with high impact, we employed a selection strategy where the databases were grouped by publication year—Group 1 ends in 2015; Group 2 is from 2016 to 2020, and Group 3 is 2021. In Group 1, papers whose citation count is less than the 50% average level are excluded. In Group 2, papers whose citation count is less than the 25% level are excluded. Regarding papers in 2021, all articles reflected the time-function nature of citations. After filtering out using our citation count quota approach, 128 articles were left. Finally, after excluding studies that did not focus on social equity evaluation, we had 24 articles and 26 case studies for the review.

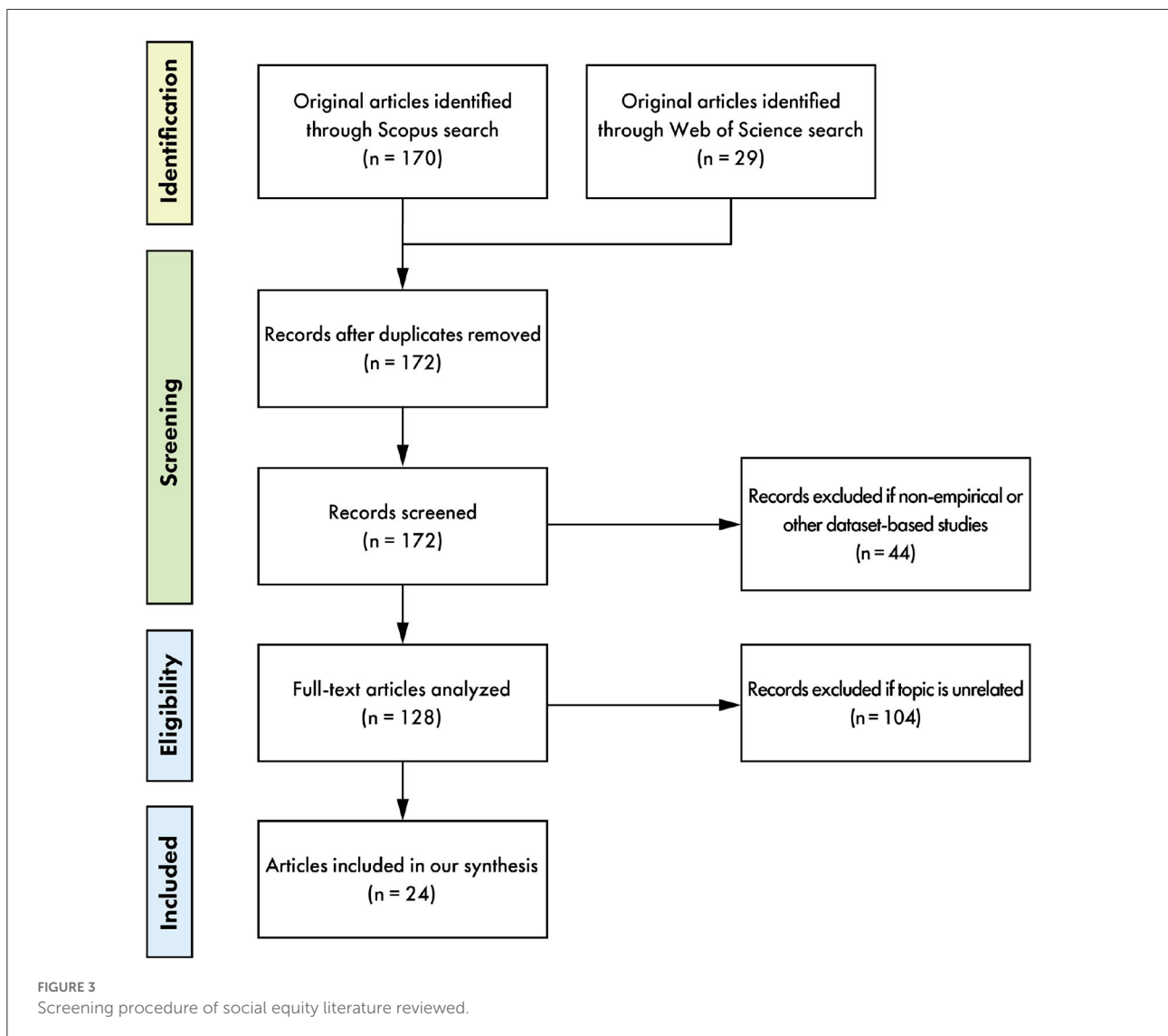
## Analysis and discussion

Based on the final articles selected from 2014 to 2021, we review how the conclusions and implications change across different topics and databases. Figure 1 depicts how the frequency of using ESG metrics increased in the reviewed period. Three databases that are mostly used in the literature are MSCI,

Bloomberg, and Refinitiv. The number of publications increased in 2014 after MSCI's ESG database became available and kept growing in subsequent years. Initially, MSCI's ESG database was the most used. However, the number of studies that use Refinitiv's ESG database surged in 2021, becoming comparable to that of MSCI's ESG database. The use of Bloomberg's ESG database had a steady growth in the past 5 years (Figure 4).

Table 1 presents four panels that focus on different topics about the effect of ESG factors on corporate performance. In all panels, ESG factors (overall or each factor) are used as independent variables. Table 1A summarizes studies that used accounting measures, such as ROA, ROE, and EBITDA, as dependent variables; Table 1B summarizes studies that used market evaluation Tobin's Q, that is, firm value as dependent variables; Table 1C summarizes studies that used stock return as dependent variables; Table 1D summarizes studies that used the cost of capital and risk indicators as dependent variables.

We now discuss the systematic review results. Table 1 uses the notation "positive (negative)," "mostly positive (negative)," "partially positive (negative)," "mixed," or "not significant" for the conclusion of each study. Most of the studies considered in this systematic review estimated the relationship between dependent and independent variables multiple times under various models, with minor changes, to test for robustness. In Table 2, positive (negative) means that a "positive (negative)" coefficient value is observed in all the estimation models in each of the papers. In addition, "mostly" indicates a case in which most of the estimation models are positive (negative), whereas "partially" indicates a case in which positive (negative) results are reported in a few of the estimation models. However, "mixed" refers to cases where the study had different trends



(positive and negative) depending on the estimation model. The square frames in Table 2 mean that the enclosed variables are estimated using the same formulas, and the variables enclosed in this square frame contain interaction terms. In this study, to simplify the discussion, the results are considered “mixed” even when the variables in the framework lack consistent trends (positive and negative) due to the influence of specific elements. In addition, for independent variables, most of the studies employed variables in which the greater the value, the higher the degree of ESG management. In contrast, some studies used non-ESG management variables (e.g., CSR concern, negative CSR, toxic firm dummy, and SIN stock), where the greater the value, the lower the degree of ESG management. Finally, the following discussion captures the whole trend of individual papers. If the same study reports both positive and negative trends, we count it as mixed. For studies that report both positive (negative) and

non-significant trends, we count them as positive (negative). However, studies that employ more than two ESG metrics are excluded from the count. We also present the results of the reviewed studies on selected dependent variables in the form of heatmaps in Figure 5 (ROA, ROE, and EBITDA), Figure 6 (Stock Return), and Figure 7 (Tobin’s Q). To show the trend in more simple way, “mostly positive” and “partially positive” results are presented as positive in the heatmaps and “mostly negative” and “partially negative” are presented as negative, while in the case of “mixed”, one count is added to both positive and negative. The heatmaps presents the breakdown of the results by showing the count for ESG, E, S, G (and the combinations) as explanatory variables.

Regarding the relationship between ESG and profitability (see Table 1A; Figure 5), the results are mixed. We find that seven studies used Bloomberg as ESG metrics, among which

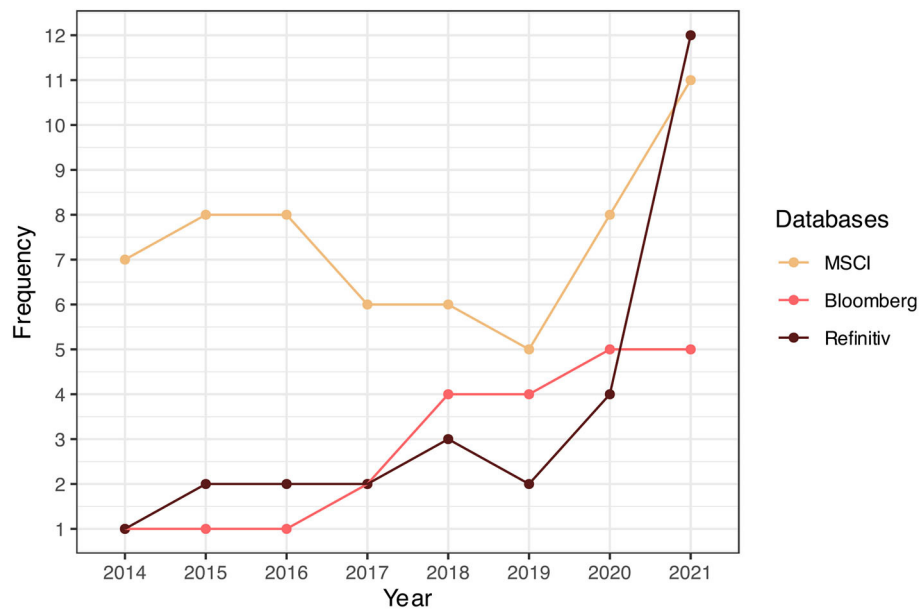


FIGURE 4

The frequency of using ESG metrics in reviewed papers. This figure shows the frequency of using ESG databases from 2014 to 2021. There are several studies using multiple databases.

three studies reported a positive relationship; one study found a non-significant relationship; two studies reported a mixed relationship, and one study reported a negative relationship. Similarly, seven studies used Refinitiv or Asset4 as ESG metrics, among which four studies reported a positive and significant trend, two mixed, and one negative. However, 17 studies used MSCI or KLD as ESG metrics, among which four studies suggested a negative relationship; nine studies suggested a positive relationship, and the remaining four studies found a mixed relationship. From the heatmap, we can observe that for ROA, ROE, and EBITDA “Positive”  $\geq$  “Negative” holds in all of the cases except for EBITDA with overall ESG score as explanatory variable. However, there are still statistically non-significant results and negative results that cannot be neglected. Thus, in the short term, it is hard to prove the positive effects of ESG factors on profitability.

Regarding Tobin’s Q (see Table 1B; Figure 6), the studies revealed that ESG factors have a positive effect on firm value. Among the 20 studies that used MSCI and KLD as ESG metrics, all reported positive trends, except for six studies that reported a mixed result. This trend is also similar for studies that used Bloomberg, Refinitiv, and Thomson Reuters’ Asset4 as ESG metrics, which generally confirms a positive direction, except for two studies that did not find statistical significance and five studies that reported a mixed trend. Figure 6 shows that “Positive”  $>$  “Negative” holds in all of the cases. Therefore, regardless of the type of ESG metrics for Tobin’s Q, it is confirmed that the most recent studies report a

positive direction. In summary, ESG factors are found to have robust and positive effects on corporate performance in the long term.

Table 1C summarizes the effect of ESG factors on stock return. Refinitiv’s Thomson Reuters Asset4 was used in five studies, among which three reported a positive direction; one suggested a mixed trend, and one did not find any significant result. However, 12 studies used MSCI and KLD as ESG metrics, among which seven reported positive effects; two reported a negative result; two suggested a mixed trend, and the remaining one reported a non-significant relationship. Based on these results, studies that used Refinitiv’s Thomson Reuters Asset4 tend to have positive results, whereas those that used MSCI and KLD found more complicated results. From the heatmap, as shown in Figure 7, “Positive”  $\geq$  “Negative” holds in most of the cases. However, the impact of ESG factors on stock returns naturally depends on the research period, samples, and other environmental factors. In Table 1C, studies that used interaction models mostly had complicated results, indicating the external contingency of ESG factors. Some studies focused on the time trend of negative shocks to the stock prices of many firms, but it is not necessary to compare this in an analysis that focuses on normal stock returns. We recognize these limitations, but we do not generalize and make comparisons for discussion.

Regarding the cost of equity and other risks (see Table 1D), the studies revealed a negative trend, which means that ESG factors are effective in reducing financial risk and cost. In the 12 studies that used MSCI and KLD as ESG metrics,



TABLE 1 List of studies using ESG metrics reviewed.

References	Dependent variable	ESG metrics	Independent variable		Conclusion (Positive; Negative; Mixed)
			Overall, E, S, G	Variable name	
<b>(A) Dependent variable: ROA, ROE, EBITDA</b>					
Duque-Grisales and Aguilera-Caracuel (2021)	ROA	Thomson Reuters	Overall	ESG score	(Mostly) Negative
[−4mm]		Asset4	Overall	ESG score × slack	(Mostly) Positive
Griffin et al. (2021)	ROA	Thomson Reuters	E, S	E/S	(Mostly) Positive
Bátae et al. (2021)	ROA	Refinitiv	E	Env_RU ( <i>resource use efficiency</i> )	Not significant
			E	Env_EM ( <i>emission and waste reductions</i> )	Positive
			E	Env_IN ( <i>environmental innovation</i> )	Not significant
			S	Soc_WF ( <i>workforce</i> )	Not significant
			S	Soc_HRights ( <i>human rights</i> )	Not significant
			S	Soc_COM ( <i>community</i> )	Not significant
			S	Soc_PRD ( <i>product responsibility</i> )	Not significant
			G	Gov_MN ( <i>management and oversight</i> )	Negative
			G	Gov_SH ( <i>shareholder rights</i> )	Not significant
			G	Gov_CSR ( <i>CSR strategy</i> )	Not significant
			E	Env_RU	Not significant
			E	Env_EM	Positive
			E	Env_IN	Not significant
			S	Soc_WF	Not significant
			S	Soc_HRights	Not significant
			Kuzey et al. (2021)	ROA	Refinitiv
Overall	ΔESGs	Not significant			
Overall	CSRcom ( <i>CSR committee</i> )	(Partially) Negative			
Overall	ESGs × CSRcom	Not significant			
Overall	ΔESGs × CSRcom	Not significant			
ROE	Refinitiv	Overall		ESGs	Not significant
		Overall		ΔESGs	Not significant
		Overall		CSRcom	Not significant
		Overall		ESGs × CSRcom	Not significant
		Overall		ΔESGs × CSRcom	Not significant
Atif et al. (2021)	ROA	Bloomberg	G	WOBP ( <i>% of women on the board</i> )	Positive
			G	WOBP × REN/TC ( <i>Total renewable energy consumption as a percentage of total energy use</i> )	Positive
Naseem et al. (2020)	ROE	Bloomberg	G	WOBP × REN/TC	Positive
	ROA	Thomson Reuters	Overall	CSR	Positive
		Asset4	Overall	PCSRhat ( <i>predicted value of CSR</i> )	Positive
	ROE	Thomson Reuters	Overall	CSR	Positive
Cai et al. (2020)	ROA Low = 1, ROA High = 2 ( <i>multinomial probit regressions</i> )	Asset4	Overall	PCSRhat ( <i>predicted value of CSR</i> )	(Partially) Positive
		MSCI, KLD	Overall	Net adjusted CSR score	Positive

(Continued)

TABLE 1 (Continued)

References	Dependent variable	ESG metrics	Independent variable		Conclusion (Positive; Negative; Mixed)
			Overall, E, S, G	Variable name	
Liu et al. (2020)	ROA	MSCI, KLD	Overall	CSR	Positive
	ROE	MSCI, KLD	Overall	CSR	Not significant
Nguyen et al. (2020)	ln (1 + profitability)	MSCI, KLD	Overall	CSR proxy	Positive
			Overall	Long-term investor ownership × CSR proxy	Not significant
Devie et al. (2020)	CFP ( <i>corporate financial performance</i> )	Bloomberg, other reliable sources	Overall	CSR	(Mostly) Positive
Alareeni and Hamdan (2020)	ROA	Bloomberg	Overall	ESG index	Positive
			E	EVN index	Negative
			Overall	CSR index	Negative
			G	CG index	Positive
	ROE	Bloomberg	Overall	ESG index	Positive
			E	EVN index	Negative
			Overall	CSR index	Negative
			G	CG index	Negative
Hoang et al. (2020)	ROA	Bloomberg	E	EDS ( <i>environmental disclosure score</i> )	(Mostly) Positive
			E	GHG ( <i>greenhouse gas emissions per unit of revenue</i> )	(Mostly) Positive
			E	WATER ( <i>total water uses per unit of revenue</i> )	Not significant
			E	WASTE ( <i>total waste per unit of revenue</i> )	Not significant
Saleem et al. (2021)	ROA	Bloomberg	G	GDev-index-index ( <i>the governance deviance index</i> )	Negative
Albuquerque et al. (2019)	Change in ROA	MSCI, KLD	Overall	CSR1 variable	Not significant
			Overall	CSR1 × GDP growth	Negative
			Overall	CSR2 variable	Not significant
			Overall	CSR2 × GDP growth	Negative
Luffarelli et al. (2019)	EBITDA	MSCI, KLD	Overall	CSP	Not significant
			Overall	CSP × PMP ( <i>product-market profile</i> )	Negative
Xie et al. (2019)	ROA	Bloomberg	E	Verification type	Not significant
			E	Green building policy	Positive
			E	Sustainable packaging	Positive
			E	Environmental quality management policy	Not significant
			E	Environmental supply chain management	Not significant
			E	Climate change policy	Not significant
			E	Climate change opportunities discussed	Not significant
			E	Risks of climate change discussed	Not significant
			E	Emissions reduction initiatives	Not significant
			E	New products climate change	Not significant
			E	Energy efficiency policy	Not significant
			S	Equal opportunity policy	Not significant
			S	Human rights policy	Not significant
			S	Training policy	Not significant
S	Employee CSR training	Negative			

(Continued)



TABLE 1 (Continued)

References	Dependent variable	ESG metrics	Independent variable		Conclusion (Positive; Negative; Mixed)
			Overall, E, S, G	Variable name	
Fauver et al. (2018)	ROA	Thomson Reuters Asset4	S	Health and safety policy	Not significant
			S	Fair remuneration policy	Not significant
			S	EF Index	Positive
Brogi and Lagasio (2019)	ROA	MSCI, KLD	Overall	ESGSCORE	Not significant
			E	ESCORE	Not significant
			S	SSCORE	Not significant
			G	GSCORE	(Partially) Positive
Byun and Oh (2018)	ΔROA	MSCI, KLD	S	Net CSR coverage ( <i>positive CSR-related news articles minus negative CSR-related news articles, its articles covering topics in community, diversity, and employee relations</i> )	Positive
Hoi et al. (2018)	ROA	MSCI, KLD	Overall	KLD index	Not significant
			Overall	CSP	(Partially) Positive
			Overall	CSP × high social capital	Positive
			Overall	Positive CSR	Positive
			Overall	Positive CSR × high social capital	Positive
			Overall	Negative CSR	Not significant
Bhandari and Javakhadze (2017)	ROA	MSCI, KLD	Overall	KLD	Negative
			Overall	KLD	Negative
Wang and Sarkis (2017)	ROA	Bloomberg	G	CSRGOV	Not significant
Cornett et al. (2016)	ROA	MSCI, KLD	E	CSRENV	Not significant
			Overall	ESG index	Positive
			Overall	ESG index × small	(Partially) Positive
			Overall	ESG index	Positive
			Overall	ESG index × small	(Partially) Positive
Harrison and Berman (2016)	ROA	MSCI, KLD	Overall	CSP ( <i>total strengths</i> )	Negative
			Overall	CSP ( <i>total concerns</i> )	(Partially) Negative
Tebini et al. (2016)	ROA	MSCI, KLD	E	Envt	Not significant
			E	Envt (-1)	Positive
			E	Envt (-2)	Positive
			E	Envt (-3)	Positive
			E	Envt × size	Positive
			E	Envt × invest	Negative
			E	Envt × beta ( <i>systematic risk</i> )	Negative
Lys et al. (2015)	ΔROA	Thomson Reuters Asset4	Overall	CSR	Positive
			E	ENV_COMP	Not significant
			S	SOC_COMP	Positive
			G	CORPGOV	Not significant
Nguyen and Nguyen (2015)	ROA	MSCI, KLD	Overall	Aggregate strengths	Positive
			Overall	Aggregate concerns	Positive
Boesso et al. (2015)	EBITDA	MSCI, KLD	S	Community	(Mostly) Positive
			G	Governance	(Mostly) Positive

(Continued)

TABLE 1 (Continued)

References	Dependent variable	ESG metrics	Independent variable		Conclusion (Positive; Negative; Mixed)
			Overall, E, S, G	Variable name	
			S	Diversity	(Mostly) Positive
			S	Employee	(Mostly) Positive
			E	Environment	(Mostly) Negative
			S	Human rights	Negative
			S	Product	Negative
Di Giuli and Kostovetsky (2014)	ROA $\Delta$ next 3 years	MSCI, KLD	Overall	KLD strengths	Negative
			Overall	KLD concerns	Not significant
Kumar et al. (2016)	EBITDA	MSCI, KLD	E	Employee weakness	Not significant
			E	Employee strengths	Positive
			S	Customer weakness	Not significant
			S	Customer strengths	Not significant
			S	Community weakness	Not significant
			S	Community strengths	Not significant
			G	Governance weakness	Not significant
			G	Governance strengths	Positive
			E	Environment weakness	Not significant
			E	Environment strengths	Not significant
			S	Diversity weakness	Negative
			S	Diversity strengths	Positive
			S	Human rights weakness	Negative
			S	Human rights strengths	Positive
Moura-Leite et al. (2014)	ROA	MSCI, KLD	E, S	Primary stakeholder management	Positive
<b>(B) Dependent variable: Tobin's Q</b>					
Griffin et al. (2021)	Tobin's Q	Thomson Reuters Asset4	E, S	E/S	Positive
Bátae et al. (2021)	TQ	Refinitiv	E	Env_RU ( <i>resource use efficiency</i> )	Not significant
			E	Env_EM ( <i>emission and waste reductions</i> )	Not significant
			E	Env_IN ( <i>environmental innovation</i> )	Not significant
			S	Soc_WF ( <i>workforce</i> )	Not significant
			S	Soc_HRights ( <i>human rights</i> )	Not significant
			S	Soc_COM ( <i>community</i> )	Not significant
			S	Soc_PRD ( <i>product responsibility</i> )	Not significant
			G	Gov_MN ( <i>management and oversight</i> )	Not significant
			G	Gov_SH ( <i>shareholder rights</i> )	Not significant
			G	Gov_CSR ( <i>CSR strategy</i> )	Not significant
Kuzey et al. (2021)	Tobin's Q	Refinitiv	Overall	ESGs	Mixed
			Overall	$\Delta$ ESGs	Not significant
			Overall	CSRcom ( <i>CSR committee</i> )	(Partially) Negative
			Overall	ESGs $\times$ CSRcom	(Partially) Positive
			Overall	$\Delta$ ESGs $\times$ CSRcom	Not significant
Dai et al. (2021)	Market-to-book	MSCI, KLD, Thomson Reuters Asset4	Overall	CSR <sup>c</sup> $\times$ CSR <sup>s</sup> _Supplier controls	Positive
			Overall	CSR <sup>s</sup> _Supplier controls	Positive
			Overall	CSR <sup>c</sup> _Supplier controls	Negative

(Continued)

TABLE 1 (Continued)

References	Dependent variable	ESG metrics	Independent variable		Conclusion (Positive; Negative; Mixed)
			Overall, E, S, G	Variable name	
Bu et al. (2021)	Tobin's Q	MSCI, KLD	Overall	CSR <sup>c</sup> × CSR <sup>s</sup> _Customer controls	Positive
			Overall	CSR <sup>s</sup> _Customer controls	Negative
			Overall	CSR <sup>c</sup> _Customer controls	Not significant
			Overall	CSR_PRE ( <i>a variable denoting the optimal level of CSR activities</i> )	Positive
			Overall	TID ( <i>talented inside directors</i> ) × CSR_PRE	Positive
			Overall	CSR_RES ( <i>excessive level of CSR activities, calculated as CSR minus CSR_PRE</i> )	Negative
			Overall	TID × CSR_RES	(Partially) Positive
			Overall	CSR	Positive
Ertugrul and Marciukaityte (2021)	log (Tobin's q)	MSCI, KLD	Overall	CSR net ( <i>CSR strengths – CSR concerns</i> )	(Partially) Positive
			Overall	Unionization × CSR net	Negative
Lu et al. (2021)	Tobin's Q	MSCI, KLD	Overall	CSR	Not significant
			Overall	CSR × financial risk	Positive
			Overall, E	CSR × environmental risk	Positive
			Overall	CSR × earnings stability	Positive
			Overall	CSR × sales growth	Not significant
Hannah et al. (2021)	Tobin's Q	KLD, MSCI, Bloomberg	Overall	CSR	Positive
			Overall	CSR <sup>2</sup>	(Partially) Positive
			Overall	CSR	Positive
			Overall	CSR <sup>2</sup>	(Partially) Positive
			Overall	CSR × SalesGR	(Partially) Positive
Atif et al. (2021)	Tobin's q	Bloomberg	Overall	CSR × AssetGR	(Partially) Positive
			G	WOBP ( <i>% of women on the board</i> ) × REN/TC ( <i>Total renewable energy consumption as a percentage of total energy use</i> )	Positive
Jia and Li (2020)	TobinsQ	Thomson Reuters Asset4	Overall	CSPD ( <i>above the sample median of sustainability performance</i> )	Positive
			Overall	ECC ( <i>exposure to climate change</i> ) × CSPD	Positive
			Overall	CSPD	(Partially) Positive
			Overall	EPU ( <i>economic policy uncertainty</i> ) × CSPD	Positive
			Overall	CSPD	(Partially) Positive
Bardos et al. (2020)	Tobin's Q	MSCI, KLD	E, S	Community/environmental CSR	(Partially) Positive
Brower and Dacin (2020)	Tobin's Q	MSCI, KLD	Overall	Overall CSR activities (lag)	Positive
			Overall	Primary CSR activities (lag) ( <i>primary CSP level is calculated as the sum of the firm's CSP strength scores for governance, employee relations, and product strengths for each firm-year observation in the data</i> )	Positive
			Overall	Secondary CSR activities (lag) ( <i>secondary CSP level is calculated as the sum of each firm's CSP strength scores for environmental impact, community involvement, and diversity strengths for each firm year observation in the data</i> )	Positive

(Continued)

TABLE 1 (Continued)

References	Dependent variable	ESG metrics	Independent variable		Conclusion (Positive; Negative; Mixed)
			Overall, E, S, G	Variable name	
Liu et al. (2020)	Tobin's Q	MSCI, KLD	Overall	CSR	Positive
Nguyen et al. (2020)	ln (market-to-book)	MSCI, KLD	Overall	CSR proxy	Positive
			Overall	Long-term investor ownership × CSR proxy	Positive
			Overall	ESG index	Positive
Alareeni and Hamdan (2020)	Tobin's Q	Bloomberg	E	EVN index	Positive
			Overall	CSR index	Positive
			G	CG index	Positive
			G	Gdev-index-index ( <i>the governance deviance index</i> )	Positive
Saleem et al. (2021)	Tobin's-Q	Bloomberg	G	Gdev-index-index ( <i>the governance deviance index</i> )	Positive
Boubakri et al. (2019)	Tobin's Q	Thomson Reuters Asset4	Overall	PCSR ( <i>predicted CSR intensity</i> )	(Mostly) Positive
			Overall	STATE ( <i>percentage of shares held by a government</i> ) × PCRSR	Positive
Albuquerque et al. (2019)	Tobin's Q	MSCI, KLD	Overall	lagged CSR1 variable	Positive
			Overall	lagged CSR2 variable	Positive
Luffarelli et al. (2019)	Tobin's q	MSCI, KLD	Overall	CSP	Not significant
			Overall	CSP × PMP ( <i>product-market profile</i> )	Positive
Zolotoy et al. (2019)	Tobin's Q	MSCI, KLD	Overall	CSR	(Mostly) Positive
			Overall	CSR × religious adherence	(Mostly) Negative
Xie et al. (2019)	Market value (Tobin's Q)	Bloomberg	E	Verification type	Positive
			E	Green building policy	Not significant
			E	Sustainable packaging	Positive
			E	Environmental quality management policy	Negative
			E	Environmental supply chain management	Not significant
			E	Climate change policy	Not significant
			E	Climate change opportunities discussed	Not significant
			E	Risks of climate change discussed	Not significant
			E	Emissions reduction initiatives	Not significant
			E	New products climate change	Not significant
			E	Energy efficiency policy	Not significant
			S	Equal opportunity policy	Positive
			S	Human rights policy	Positive
			S	Training policy	Positive
			S	Employee CSR training	Not significant
S	Health and safety policy	Not significant			
S	Fair remuneration policy	Not significant			
Fauver et al. (2018)	Tobin's Q	Thomson Reuters Asset4	S	EF ( <i>employee-friendliness</i> ) index	(Mostly) Positive
Byun and Oh (2018)	log (Tobin's q)	MSCI, KLD	S	Net CSR coverage ( <i>positive CSR-related news articles minus negative CSR-related news articles. its articles covering topics in community, diversity, and employee relations</i> )	Positive
			Overall	KLD index	(Partially) Positive

(Continued)

TABLE 1 (Continued)

References	Dependent variable	ESG metrics	Independent variable		Conclusion (Positive; Negative; Mixed)
			Overall, E, S, G	Variable name	
Buchanan et al. (2018)	Tobin's Q	Bloomberg	Overall	CSR	Positive
			Overall	CSR × crisis (2008Q3 - 2009Q1)	Negative
Taylor et al. (2018)	Tobin's Q	Bloomberg	Overall	ESG, social, environmental, governance disclosure	(Partially) Positive
			Overall	ADSALE ( <i>advertising expenditures to sales</i> ) × ESG, social, environmental, governance	(Partially) Positive
			Overall	CSR firm	Negative
Yu et al. (2018)	Industry-adjusted	Bloomberg	Overall	ESG disclosure (industry-adjusted)	(Partially) Negative
	Tobin's Q		Overall	(ESG disclosure) <sup>2</sup>	(Partially) Positive
Shahzad and Sharfman (2017)	Tobin's q	MSCI, KLD	Overall	CSP	Mixed
Wang and Sarkis (2017)	Tobin's Q	Bloomberg	G	CSRGOV	Not significant
			E	CSRENV	Not significant
Hawn and Ioannou (2016)	Log Tobin's q	Thomson Reuters	Overall	Internal (CSR) <sub>t-1</sub> /assets	Not significant
		Asset4	Overall	External (CSR) <sub>t</sub> /assets	Positive
Cornett et al. (2016)	Tobin's Q	MSCI, KLD	Overall	ESG index	(Partially) Positive
			Overall	ESG index × small	(Partially) Positive
Ferrell et al. (2016)	Tobin's Q	MSCI, KLD	Overall	CSR	(Partially) Positive
			Overall	CSR × entrenchment index	Positive
Cahan et al. (2015)	Tobin's Q	MSCI, KLD	Overall	CSR	Not significant
			Overall	CSR × media	Not significant
			Overall	CSR × H-H	Positive
			Overall	CSR × media × H-H	Positive
Gao and Zhang (2015)	Tobin's Q	MSCI, KLD	Overall	CSR score	Not significant
			Overall	CSR × DAS ( <i>discretionary accrual smoothing</i> )	Positive
Jha and Cox (2015)	Tobin's Q	MSCI, KLD	Overall	CSR_S ( <i>it is the sum of CSR_STRENGTHS and CSR_CONCERNS. the detailed descriptions of how CSR_STRENGTHS and CSR_CONCERNS are calculated are described later in this table. a higher number indicates greater social responsibility</i> )	Positive
			Overall	CSR_S	Positive
			Overall	CSR_S × HIGH SOCIAL CAPITAL	Not significant
Nguyen and Nguyen (2015)	Tobin's Q	MSCI, KLD	Overall	Aggregate strengths	Positive
			Overall	Aggregate concerns	Positive
Vomberg et al. (2015)	Tobin's Q	MSCI, KLD	S	Human capital	Not significant
			S	Brand equity × human capital	Positive
			S	Human capital × FMCG ( <i>fast moving consumer goods</i> )	Negative
			S	Human capital × consumer durables	Negative
			S	Human capital × retail	Negative
Moura-Leite et al. (2014)	Tobin's Q	MSCI, KLD	E, S	Primary stakeholder management	Positive

(Continued)

TABLE 1 (Continued)

References	Dependent variable	ESG metrics	Independent variable		Conclusion (Positive; Negative; Mixed)
			Overall, E, S, G	Variable name	
<b>(C) Dependent variable: Stock return, contains CAR, AR</b>					
Ding et al. (2021)	Weekly stock return	Thomson Reuters	Overall	CSR score × COVID19	Positive
	Abnormal return	Asset4	Overall	CSR score × COVID19	Positive
Garel and Petit-Romec (2021)	Stock returns (Feb. 20–Mar. 20)	Thomson Reuters Asset4	E	Environmental score	(Mostly) Positive
Bose et al. (2021)	CAR	Refinitiv	Overall E, Overall	HIGH_CSR LNEMISSION × HIGH_CSR	(Mostly) Positive (Mostly) Negative
Bolton and Kacperczyk (2021)	Stock returns (RET)	MSCI, KLD, Thomson Reuters Asset4, Bloomberg	E E	SCOPE 1 SCOPE 2 SCOPE 3	(Partially) Positive (Partially) Positive (Partially) Positive
Bae et al. (2021)	Raw_firm-level stock returns	MSCI, KLD Refinitiv, Thomson Reuters Asset4	Overall Overall	CSR_MSCI CSR_REFINITIV	Not significant Not significant
	Mkt-adj_firm-level stock returns	MSCI, KLD Refinitiv, Thomson Reuters Asset4	Overall Overall	CSR_MSCI CSR_REFINITIV	Not significant (Partially) Positive
Avramov et al. (2021)	Excess return	MSCI, KLD, MSCI IVA, Bloomberg, Asset4 (Refinitiv), Sustainalytics, and RobecoSAM	Overall Overall	ESG ESG × low ESG uncertainty Low ESG uncertainty	Not significant Negative (Partially) Positive
	CAPM-adjusted return		Overall Overall Overall	ESG ESG × low ESG uncertainty Low ESG uncertainty	Not significant Negative (Partially) Positive
Doukas and Zhang (2021)	CAR (-3, +3)	MSCI, KLD	Overall	Adjusted CSR (compute the total strengths and total concerns for each category and then divide the scores for each category by the respective maximum numbers of strength and concern scores to obtain adjusted strength and concern scores for each dimension. Finally, take the net difference between the total adjusted strength and total adjusted concern scores)	(Partially) Negative
	One-year BHAR		Overall Overall Overall	Adjusted CSR × MA (managerial ability) -Score Adjusted CSR Adjusted CSR × MA-score	Positive Negative Positive
Liang et al. (2020)	Acquirer CAR [-1, +1]	Thomson Reuters Asset4	S	Acquirer employment quality (domestic)	Positive
			S	Acquirer employment quality (cross-border)	Negative
Boone and Uysal (2020)	CAR (-5, +5)	MSCI, KLD	E E	Different reputation dummy (takes a value of one if an acquirer and its target do not fall into the same environmental grouping) Green firm dummy	Negative Not significant

(Continued)

TABLE 1 (Continued)

References	Dependent variable	ESG metrics	Independent variable		Conclusion (Positive; Negative; Mixed)
			Overall, E, S, G	Variable name	
P.-A. Nguyen et al. (2020)	Excess stock returns	MSCI, KLD	E	Ratio of green firms	Not significant
			E	Toxic firm dummy	Negative
			E	Green firm dummy	Not significant
Tong et al. (2020)	Acquirer announcement return	MSCI, KLD	Overall	CSR proxy	Not significant
			Overall	Long-term investor ownership × CSR proxy	(Partially) Negative
Zolotoy et al. (2019)	Market model AR_during 2008–2009	MSCI, KLD	Overall	Target CSR	(Mostly) Positive
			Overall	CSR	Positive
Dutordoir et al. (2018)	Fama–French–Carhart model AR_during 2008–2009	MSCI, KLD	Overall	CSR × religious adherence	Negative
			Overall	CSR	Positive
			Overall	CSR × religious adherence	Negative
Feng et al. (2018)	CAR: SEOs (seasoned equity offerings) announcements	MSCI, KLD	Overall	AdjCSR (sum of yearly adjusted community activities, diversity, employee relations, environmental record, human rights, and product quality and safety scores from KLD)	Positive
			Overall	CSR	Positive
Choy et al. (2017)	CAR	Thomson Reuters Asset4	Overall	Corporate social responsibility	Not significant
Lins et al. (2017)	Raw return	MSCI, KLD	Overall	CSR	(Mostly) Positive
			Overall	CSR	(Partially) Positive
Shiu and Yang (2017)	Abnormal returns	MSCI, KLD	Overall	Short-term CSR engagement	(Partially) Positive
			Overall	Long-term CSR engagement	Positive
			Overall	Short-term CSR engagement	Not significant
Gao and Zhang (2015)	Cumulative abnormal returns	MSCI, KLD	Overall	Long-term CSR engagement	Positive
			Overall	CSR × DAS	Positive
Borghesi et al. (2014)	Rett (ex-dividend stock return during fiscal year <i>t</i> )	MSCI, KLD	Overall	CSR	Not significant
			Overall	Industry adjusted CSR	Not significant
Di Giuli and Kostovetsky (2014)	Annual stock return premiums (1992 to 2006)	MSCI, KLD	Overall	KLD strengths	(Partially) Negative
			Overall	KLD concerns	Not significant
			Overall	KLD strengths	(Partially) Negative
			Overall	KLD concerns	Not significant
(D) Dependent variable: Cost of equity, Other Risks					

(Continued)



TABLE 1 (Continued)

References	Dependent variable	ESG metrics	Independent variable		Conclusion (Positive; Negative; Mixed)
			Overall, E, S, G	Variable name	
Tsang et al. (2021)	ROA_Volatility	Thomson Reuters Asset4	Overall	CSRContracting (an indicator variable that equals 1 if senior executives' compensation is linked to CSR/H&S (Health and Safety)/sustainability targets (CSR contracting) in the year and 0 otherwise)	Positive
			S, E	CSRPerf (the average of Social performance score and Environmental performance score)	Negative
	Overall	CSRContracting	Positive		
Chen et al. (2021)	NSKEW (the negative skewness of firm-specific weekly returns over the fiscal year period)	MSCI, KLD	S, E	CSRPerf	Negative
			Overall	CSR	Not significant
	DUVOL (the natural logarithm of the ratio of the standard deviation in the "down" weeks to the standard deviation in the "up" weeks)	Overall	CSR	Not significant	
Devie et al. (2020)	RISK	Bloomberg, other reliable sources	Overall	CSR	Negative
Boubakri et al. (2019)	Cost of equity capital	Thomson Reuters Asset4	Overall	PCSR (predicted CSR intensity)	Not significant
			Overall	STATE (percentage of shares held by a government) × PCSR	Negative
Albuquerque et al. (2019)	Firm Beta	MSCI, KLD	Overall	lagged CSR1 variable	Negative
			Overall	lagged CSR2 variable	Negative
Chang et al. (2019)	BETA (systematic risk)	MSCI, KLD	Overall	SD_CSR (the standardized CSR score, which is equal to the sum of standardized CSR scores over six categories: environment, community, human rights, diversity, employee relations, and product)	Negative
Albarrak et al. (2019)	Cost of equity	Bloomberg	E	ENV_COMMITTEE (environmental committee)	(Partially) Negative
			E	ENV_SCORE	Not significant
			E	iCarbon × ENV_SCORE	Not significant
Lueg et al. (2019)	TRSK (Total Risk)	Bloomberg	Overall	ESG	Not significant
	BETA (Systematic Risk)		Overall	ESG	Negative
	IDIO (Idiosyncratic Risk)		Overall	ESG	Not significant
Breuer et al. (2018)	Implied cost of equity	Thomson Reuters	Overall	CSR	(Partially) Negative
	BETA	Asset4	Overall	CSR	Not significant
	SIGMA		Overall	CSR	Not significant

(Continued)

TABLE 1 (Continued)

References	Dependent variable	ESG metrics	Independent variable		Conclusion (Positive; Negative; Mixed)
			Overall, E, S, G	Variable name	
Bhandari and Javakhadze (2017)	Alpha 3factor	MSCI, KLD	Overall	KLD	Negative
	Alpha 4factor		Overall	KLD	Negative
El Ghoul and Karoui (2017)	Alpha	MSCI, KLD	Overall	CSR (CSR score)	Negative
			Overall	CSR (Strengths)	Negative
			Overall	CSR (Concerns)	Not significant
Oh et al. (2017)	Idiosyncratic risk	MSCI, KLD	Overall	ADV (CSR)	Not significant
			Overall	ADV (CSR) × SIN stock	Positive
			Overall	Probability of KLD report	Not significant
L. Cai et al. (2016)	CAPM_BETA	MSCI, KLD	E	ENV	Negative
	FF_MKT_BETA		E	ENV	Negative
	DEVRET		E	ENV	Negative
Cheung (2016)	idio ( <i>idiosyncratic risk</i> )	MSCI, KLD	Overall	CSR	Negative
	beta ( <i>systematic risk</i> )		Overall	CSR	Negative
Becchetti et al. (2015)	Idiosyncratic volatility	MSCI, KLD	E, S	Stakeholder risk ( <i>stakeholder risk as the relative sum of weaknesses (concerns) in corporate responsibility in the domains of community, diversity, employee relations, environment, human rights, and product quality according to official ratings of a primary (KLD) CSR rating agency</i> )	Negative
Cahan et al. (2015)	Cost of capital	MSCI, KLD	Overall	CSR	Not significant
			Overall	CSR × media	Not significant
			Overall	CSR × H-H	Not significant
			Overall	CSR × media × H-H	Negative
Ng and Rezaee (2015)	Cost of equity_IndEP	MSCI, KLD	E	ENV	Negative
			S	SOC	(Partially) Negative
			G	GOV	Negative
			Overall	KLD	Negative
	Cost of equity_GORDON	MSCI, KLD	E	ENV	Negative
			S	SOC	(Partially) Negative
Kim et al. (2014)	NCSKEW ( <i>the negative conditional skewness of firm-specific weekly returns over the fiscal year</i> )	MSCI, KLD	Overall	KLD	Negative
			Overall	CSR_SCORE	Negative
			Overall	CSR_SCORE	Negative
			Overall	CSR_SCORE	Negative
	DUVOL ( <i>the natural logarithm of the ratio of the standard deviation in the “down” weeks to the standard deviation in the “up” weeks</i> )	MSCI, KLD	Overall	CSR_SCORE	Negative
			Overall	CSR_SCORE	Negative

The frame means that the enclosed variables are estimated using the same formula.

TABLE 2 Comparison of ESG score rating structure.

	Refinitiv	MSCI	Arabesque S-ray
Environmental	Resource use Emissions Innovation	Natural resources Climate change Environmental opportunities Pollution and waste	Resource use Emissions Environmental solutions Waste Water Environmental stewardship Environmental management
Social	Workforce Community Product responsibility Human rights	Human capital Social opportunities Product liability  Stakeholder opposition	Employment quality Community relations Product quality and safety Human rights  Diversity Occupational health and safety Training and development Product access Labor rights Compensation
Corporate governance	Management Shareholders CSR strategy	Corporate governance  Corporate behavior	Corporate governance  Business ethics

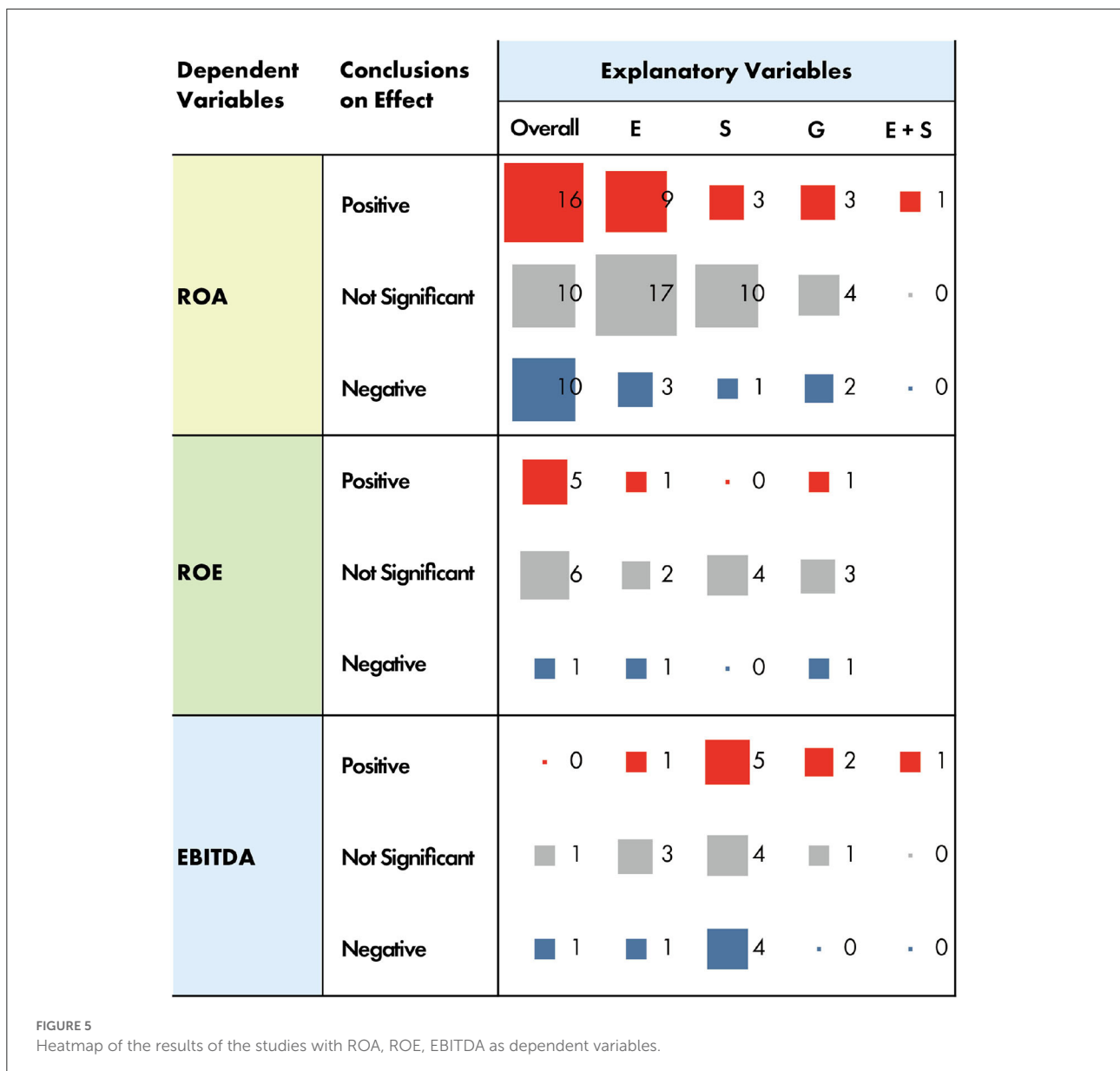
Here, the Bloomberg ESG database is omitted, since there are no ESG categorical topics.

almost all of them reported negative trends, except one study that reported a positive trend and another study that did not find statistical significance. This trend is also similar in the case of studies that used Bloomberg, Refinitiv, and Thomson Reuters Asset4 as ESG metrics, which generally found a negative direction, except one study that reported a mixed trend. Therefore, regardless of the type of ESG metrics employed, most recent studies have reported a negative effect, implying that engaging in ESG activities leads to robust and favorable results. If other conditions, such as free cash flow, are constant, the lower the value of the cost of capital, the greater the firm's value. Therefore, the robust trends observed in Tables 1B,D can be interpreted as an improvement in the firm's value assessment as a result of risk reduction due to ESG management.

Regarding social equity studies, based on articles selected from 2013 to 2021, we review the investigated issues, critical factors, geographical regions, and research fields, as presented in Table 3. Compared with qualitative theoretical analysis, quantitative analysis of social equity is a relatively new research area. The reviewed articles mostly appeared in the last 5 years. Social equity issues have been discussed worldwide,

and quantitative analysis has been applied to a number of case studies in both developed and developing countries and regions.

In terms of the research field, social equity issues in transportation are the most studied topics. Accessibility of horizontal and vertical equity was used as an indicator to assess the extent to which residents can access the job market (El-Geneidy et al., 2016) and facilities (Yuan et al., 2017; Chen et al., 2018; Guo et al., 2020), as well as to discuss transportation design problems (Caggiani et al., 2017; Ruiz et al., 2017; Camporeale et al., 2019; Henke et al., 2020). Regarding transdisciplinary fields, social equity estimation is an essential part of the social sustainability index (Shaker and Sirodoev, 2016; Silva et al., 2018; Larimian and Sadeghi, 2021). Income gap has also been used as an indicator of social equity (Kangmennaang et al., 2017; Su et al., 2017). Regarding environmental issues, some studies have investigated the dissimilarity in costs or benefits and natural resources among different entities or protected areas (Halpern et al., 2013; Gurney et al., 2015) and constructed a social equity score that integrates energy issues (Chapman et al., 2021). Section Social equity will discuss the critical factors used in social equity evaluation in detail.



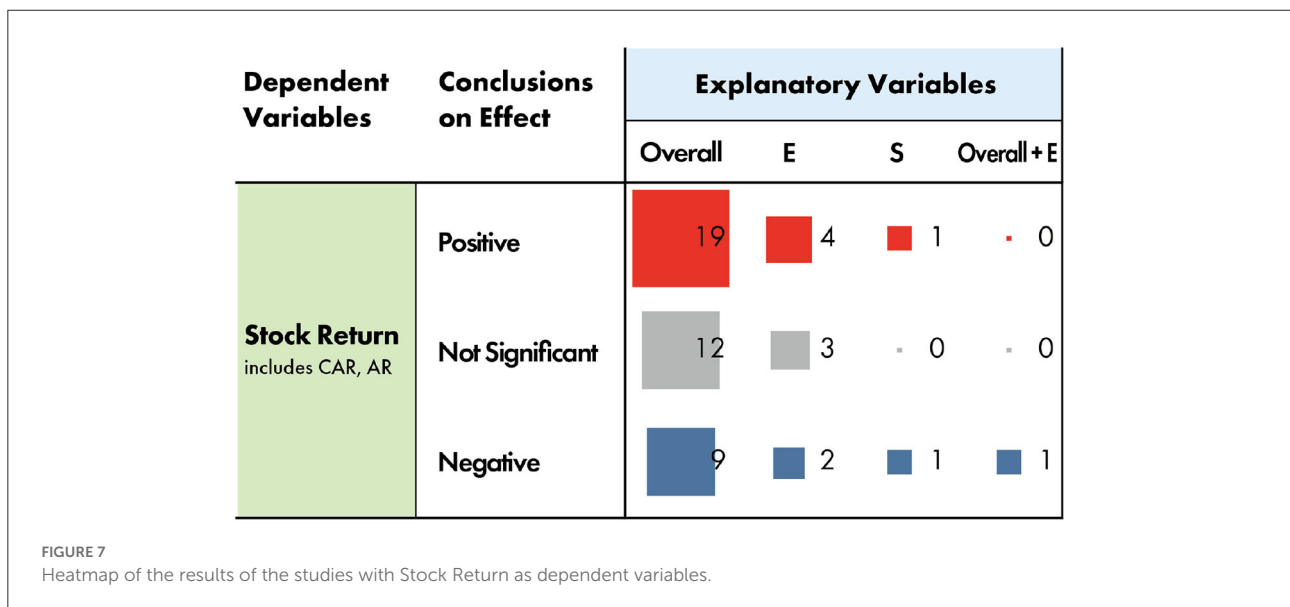
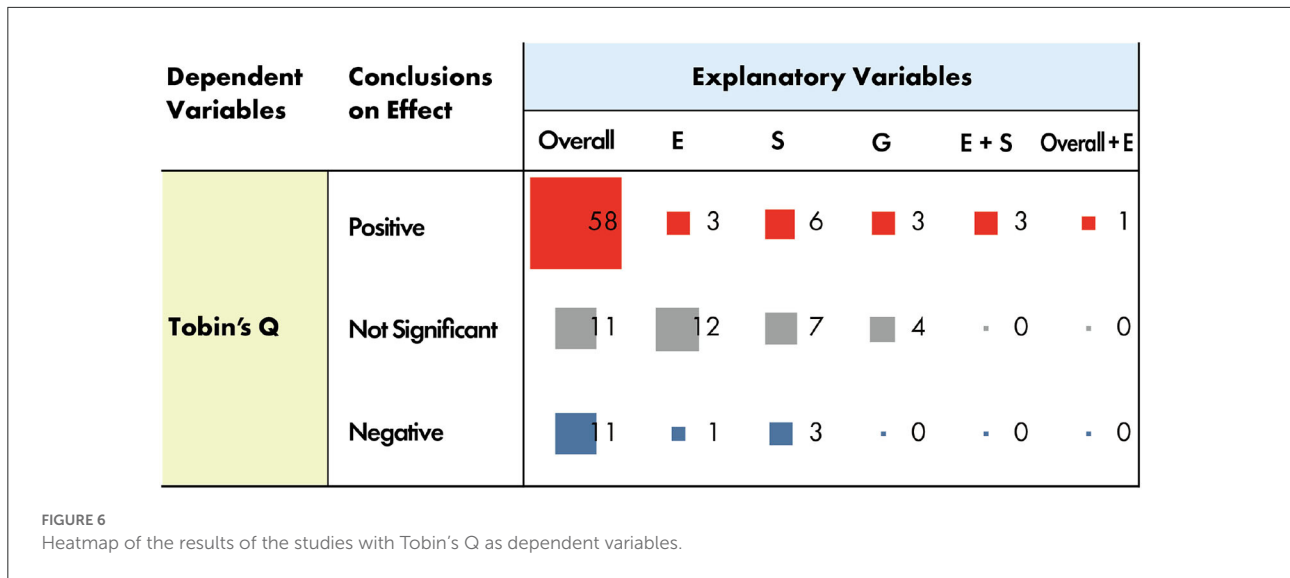
### ESG metrics and social equity: A closer look at the methodology and elements assessed

This section first provides the details of the ESG metrics, with a brief background, methodology, and composition of the elements assessed. Then, the details of social equity evaluation studies are presented using the same procedure.

#### ESG metrics

Corporate sustainability reporting and rating, which are expected to impact individual corporations' behavior, surged

in the last two decades (Scalet and Kelly, 2010). However, compared with financial reporting, which has a long history of evolution, it is still in its infancy (Tschopp and Huefner, 2015). Marlin and Marlin (2003) noted that the first phase of the corporate sustainability report in the 1970s and 1980s only focused on environmental management. Since then, CSR reporting has developed to involve multiple stakeholders and provide verifiable materials from the social auditor (the second phase is the 1990s) and has met third-party global reporting standards (the third phase is the 2000s) (Marlin and Marlin, 2003). Since then, various corporate sustainability reporting tools, such as frameworks (principles, initiatives, or guidelines) and standards, have been widely applied to evaluate corporations' efforts to achieve sustainability (Siew, 2015). Many



ESG rating agencies assess corporate sustainability based on the disclosed CSR reports and provide rating reports for multiple stakeholders. In the last 10 years, new criteria have been added to the assessment models, remarkably enhancing the accuracy and robustness of ESG ratings (Escrig-Olmedo et al., 2019).

Many studies have critiqued the low convergence of ESG ratings and called for being cautious about drawing conclusions based on these ratings (Siew, 2015; Chatterji et al., 2016; Berg et al., 2022). The main problems are the lack of common theorization (different definitions of good CSR) and commensurability (different measurements) (Chatterji et al., 2016). The scope, measurement, and weights contribute to the divergence of ESG ratings (Berg et al., 2022). Moreover,

only a few ESG rating agencies disclose the details of their evaluating criteria and methods, leaving a black box in the ratings. Therefore, a universal ESG accounting standard with “dynamic materiality” is needed (Eccles and Mirchandani, 2022). Based on the accessible information about the rating methods and the elements assessed, we investigate four leading ESG databases widely used in academic research, investment, and business—Thomson Reuters’ Refinitiv, MSCI, Bloomberg, and Arabesque S-Ray.

We first looked at how the ESG rating results correlate across the four databases and discuss the similarities and differences in the methodology and elements assessed in detail. Figure 8 depicts the distribution of ESG scores in each database and the correlation of scores based on the dataset in 2019. The ESG

TABLE 3 Summary of methodology across ESG metrics.

	Refinitiv	Bloomberg	MSCI	S-ray
Score range	0–100	0–100	0–10	0–100
Grade range	D- to A+ (12 grades)		CCC to AAA (7 grades)	
Other measures	Controversies		Controversies	Global compact score Preferences filter
Data sources	Company disclosure Media sources	Company disclosure	Company disclosure Media sources Specialized datasets (government databases, NGO, academic, etc.)	Company disclosure Media sources NGO
Coverage*	Around 9,000 firms	Around 12,000 firms	Around 8,500 firms	Around 8,000 firms
Update frequency	Monthly	Yearly	Monthly	Daily
Object of the Evaluation	Disclosure and performance	Disclosure	Performance (management capability) given both risks and opportunities	Performance given long and short-term risks and opportunities
Rating method	Full data-driven evaluation	Disclosure-based evaluation	Analysts' review	Semi data-driven evaluation and human oversight
Weight calculation	Data-based inner- and inter- industry adjustment	Industry adjustment	Industry adjustment Risk and opportunity exposure adjustment	Static review and data-based adjustment (sector- and industry-level, equal- and market cap-weighted monthly index returns)
Industry classification	TRBC	GICS	GICS	FactSet definition

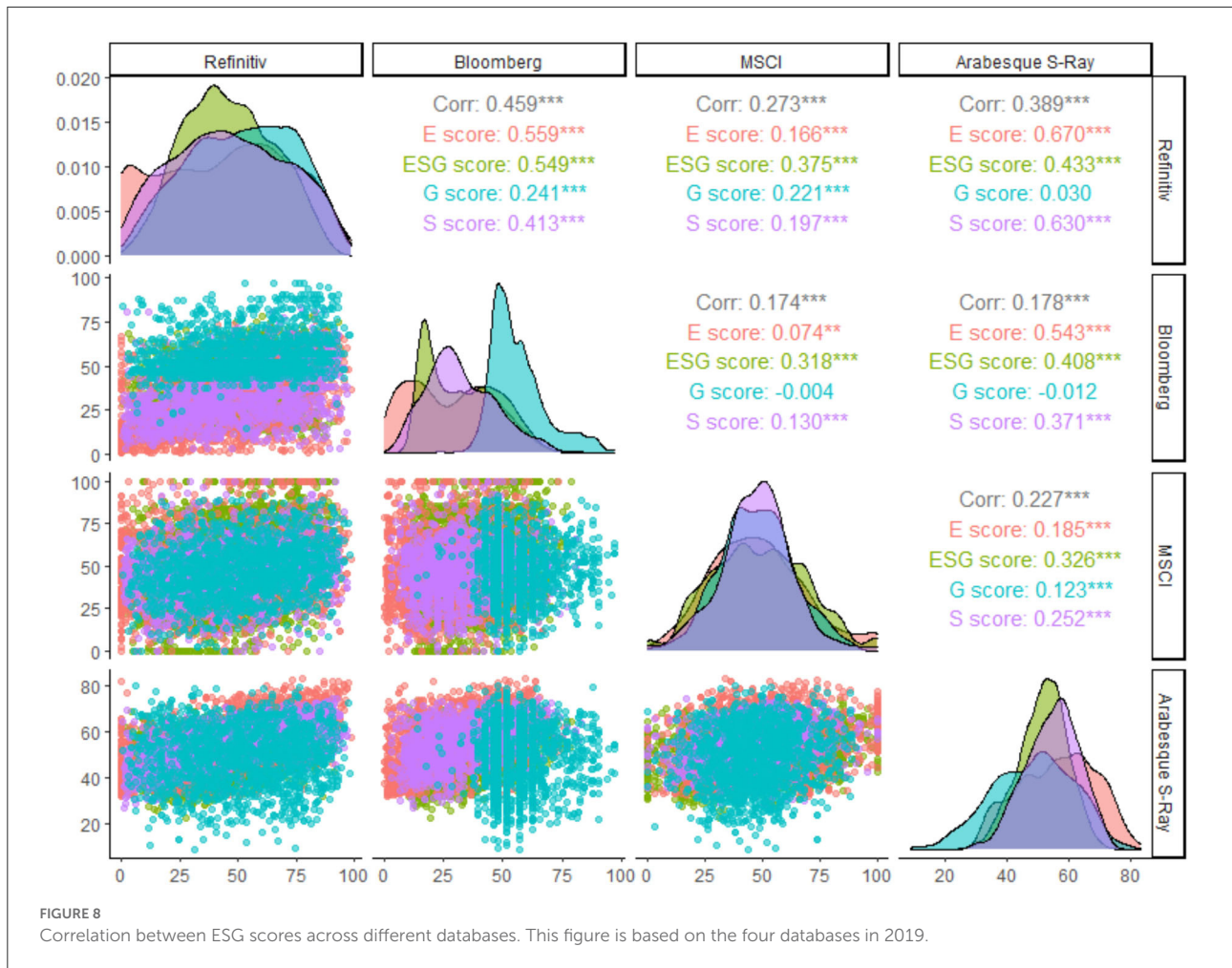
\* The number of firms assessed was counted in 2019.

scores and the scores of the components (E, S, and G) in the MSCI database have similar distributions, which are close to a normal distribution. However, the distribution in Bloomberg's ESG database varies, with a higher average G score and a lower average E score. As for Refinitiv's ESG ratings, the G score has a right-skewed distribution, whereas the others skew to the left to different extents. The scores of ESG components in S-Ray have right-skewed distributions. As noted in previous studies, the four investigated databases have low correlations. Most of the correlation coefficients are <0.5, ranging from  $-0.012$  to  $0.670$ . The correlations of integrated ESG scores range from  $0.318$  (MSCI and Bloomberg) to  $0.549$  (Refinitiv and Bloomberg). Regarding the ratings of ESG components, it is hard to find strong correlations between these databases. Regarding the E and S scores, MSCI ratings have the lowest correlation with the other three databases. Compared with those of E and S scores, the correlations of G scores are weaker and even insignificant between MSCI and Bloomberg, S-Ray and Refinitiv, as well as S-Ray and Bloomberg. We assume that the inconsistency between these ratings is due to the different methodologies and elements assessed, which will be discussed in the following parts.

In Table 2, we summarize the methodology of the four ESG databases. The final ESG ratings range from 0 to 100 points, except for MSCI, which uses 10 points as the maximum. In addition to ESG scores, Refinitiv and MSCI also provide

concise and explicit ESG grade evaluations. The assessments are usually based on information individual firms disclose. Except Bloomberg, the other raters utilize media sources to construct controversies to adjust the final ESG ratings. All the four databases have a global coverage of at least 8,000 firms. Bloomberg's ESG scores are updated annually. Refinitiv and MSCI's ESG scores are updated monthly, and S-Ray's ESG score is updated daily.

Here, we follow the framework in previous studies to discuss the purpose of the evaluation (the scopes) and the rating procedure (the measures), including the method and weight (Chatterji et al., 2016; Berg et al., 2022). The purpose of the evaluation reflects how the rater defines good CSR, i.e., the theorization or scope of the assessment. In the four databases, there are mainly two directions in determining what is good CSR—information transparency and CSR performance. Bloomberg's disclosure score treats the transparency of ESG information as the most vital factor of CSR. Thus, for Bloomberg's ESG scores, higher information disclosure leads to higher rating results, without accounting for performance. Both MSCI and S-Ray's ESG ratings aim to assess performance in terms of ESG issues but from different perspectives. MSCI's ESG scores tend to evaluate the management's capability in handling both risks and opportunities. S-Ray's ESG scores account for



performance, considering both long-term and short-term risks and opportunities, and the evaluation is conducted daily. Refinitiv’s ESG scores evaluate both disclosure rate and relative performance among peers.

Regarding the rating process, there is no fully disclosed methodology information in these databases. Based on the accessible materials on methodology, we summarize some of the features as follows. Refinitiv has the advantage of a clear and verifiable method, as the assessment is entirely data-driven without any human intervention. Bloomberg’s ESG scores only consider the degree of information disclosure, which makes the rating easy to understand and straightforward. However, MSCI’s ESG scores reflect a more subjective assessment by specialists and analysts, which involves highly professional views, but the assessment is not easily understandable by users. S-Ray’s ratings aim to seek a balance by combining a semi data-driven evaluation and human intervention. Regarding the weights, Refinitiv’s ratings conduct inter- and intra-industry adjustment, which is a fully data-driven process that takes time. The industry classification is based on The Refinitiv Business Classifications.

MSCI and Bloomberg’s ratings are adjusted based on the Global Industry Classification Standard. Notably, MSCI’s ratings are adjusted for risk or opportunities in each element assessed. Thus, the ratings in MSCI are not only a relative peer comparison but also an evaluation of firms’ management capability in handling potential risks and opportunities.

Before comparing the detailed elements assessed, it is essential to note that the structures of ESG scores also vary across each database, as presented in Table 4. The main difference is categorizing the elements under the E, S, and G pillars. In the E pillar, the common categories are resource, emission, and innovation. Although it is given different names, all the three databases have these categories. In addition, pollution and waste are also evaluated in MSCI and S-Ray’s ESG database. S-Ray also provides “environmental stewardship” and “environmental management” scores. In the S pillar, categories of human resource, community, and product responsibility are common among the three databases. Refinitiv and S-Ray have a category of “human rights,” whereas MSCI provides another category of “stakeholder opposition.” S-Ray’s ESG scores provide detailed



TABLE 4 List of quantitative studies of social equity.

References	Indicators out of socioeconomic factors	Social (vulnerability) indicator	Sector or research field	Target area	Country or regions
Valizadeh and Hayati (2021)		Education Economic factors Right to quality of life Capacity development Fair pricing and TRN contracts Employment relations Child labor Non-discrimination and sup. Vuln. People Health cover, access, medic care	Agricultural and biological sciences (miscellaneous)	Fars province	Iran
Larimian and Sadeghi (2021)		Access to essential facilities Access to recreational facilities Access to educational facilities Access to transportation facilities	Urban studies	Dunedin city	New Zealand
A. Chapman et al. (2021)	Ratio of renewable energy to the total electricity Electricity access PM 2.5 exposure Environmental improvement indicator Energy poverty indicator	Income distribution GDP per capita Unemployment ratio	Renewable energy, sustainability and the environment		99 countries
Emrich et al. (2020)		Housing tenure Fianncial capital Race Language proficiency Housing quality Age Employment	Management, monitoring, policy and law	South Carolina floods 2015	United States
Henke et al. (2020)	Travel time	Total number of employees in traffic zone	Transportation	Puglia	Italy
Karakoc et al. (2020)		Population over the age of 65 Population under the age of 5 Population that is Hispanic Single-female based households Households that are in poverty	Urban studies	Shelby County	United States
Bennett et al. (2020)		Recognitional equity (4 items as below) (Rights Livelihoods	Nature and landscape conservation	6 countries on the Mediterranean Sea	6 countries on the Mediterranean Sea

(Continued)

TABLE 4 (Continued)

References	Indicators out of socioeconomic factors	Social (vulnerability) indicator	Sector or research field	Target area	Country or regions
Shigetomi et al. (2020)	GHG emissions Primary PM 2.5 Blue and green water mining risk for neodymium Industrial waste	Traditional Knowledge Culture) Procidural equity (8 items) Distributonal equity (8 items) Household bracket based on cumulative share of consumption	Renewable energy, sustainability and the environment		Japan
Guo et al. (2020)	Park accessibility	Elderly population	Transportation	Harbin city	China
Camporeale et al. (2019)	Number of bus trips	Unemployed population Young (<19 years old) Old (more than 65 years old)	Transportation	Molfetta	Italy
Chen et al. (2018)	Service area ratio Service density Service frequency Route diversity Accessibility within a statistical area Accessibility across statistical area	Percentage of senior population	Transportation	Edmonton	Canada
Silva et al. (2018)		Poverty Households with income below poverty line (%) Population living in extreme poverty (%) Average monthly income (ln) Gender Equality Ratio between average wages for women and men	Social sciences (miscellaneous)	State of Ceara	Brazil
Su et al. (2017)		Urban-rural income gap	Urban studies	Megaregion around Hangzhou Bay	China
Ruiz et al. (2017)	Bus Service Level by districts	Population by districts Dependent population rate Immigrant population rate Female population rate Level of economic activity	Transportation	Palma	Spain
Kangmennaang et al. (2017)	Firm pay gap		Agricultural and biological sciences (miscellaneous)		China

(Continued)

TABLE 4 (Continued)

References	Indicators out of socioeconomic factors	Social (vulnerability) indicator	Sector or research field	Target area	Country or regions
Yuan et al. (2017)	Public parks accessibility	Total population Rate of the Female population Rate of the population aged 0–19 Rate of the population aged 60 and over Rate of ethnic minority population Rate of the illiterate population Rate of the laid-off population Rate of the unemployed population	Transportation	Changting	China
Caggiani et al. (2017)		Residing population Workers Number of employees Residing disadvantaged population Young Unemployed population Low-income population	Transportation	Molfetta	Italy
El-Geneidy et al. (2016)	Travel time Transit fares	Household income Percentage of recent immigrants (since 2006) Percentage of workforce that is unemployed Percentage of residents with education at the level of only a high school diploma (25–64 years old)	Transportation	Montreal	Canada
Shaker and Sirodoev (2016)	Type of cooking fuel Computers, mobile phone, microwave, and DVD/VCR Access to improved water source Access and type of sanitation facility Number of household members outside the country Head of household education level		Social sciences (miscellaneous)		Moldova

(Continued)

TABLE 4 (Continued)

References	Indicators out of socioeconomic factors	Social (vulnerability) indicator	Sector or research field	Target area	Country or regions
Oswald Beiler and Mohammed (2016)	Public transit Access School proximity Network connectivity Mixed land uses Flood hazard Crash rates Truck volume Intermodal facilities	Race Limited English proficiency Age Disability Economic development Vehicles per household Household income Single parent household Cost of living Travel time	Transportation	Sullivan County	United States
Gurney et al. (2015)	Inverse of the Gini coefficient in terms of the percentage of retained catch per unit effort (CPUE)		Nature and landscape conservation	Kubulau	Fiji
Farber et al. (2014)	Ridership percentage Trip generations Distance traveled (miles)	Household income Hispanic Race Age Employment Education Licensed Limited mobility Home ownership Years of residence Place type Residence type	Transportation	Wasatch Front, Utah	United States
Di Ciommo and Lucas (2014)	Travel times Transport costs	Income	Transportation	Madrid	Spain
Halpern et al. (2013)	Fraction of fishing value lost inside marine reserves Fraction of community fishing grounds lost inside marine reserves Fraction of money spent; fraction of area placed into marine reserves		Nature and landscape conservation Nature and landscape conservation Nature and landscape conservation	California Misool, Raja Ampat Coral Triangle	United States Indonesia Southeast Asia

topics in the S pillar, including diversity, occupational health and safety, training and development, product access, labor rights, and compensation. In terms of the G pillar, a similar category among the three databases is corporate governance or management. Moreover, categories of shareholders, CSR strategy, corporate behavior, and business ethics are provided across the databases.

Based on accessible methodology materials of the four ESG ratings, we collect the elements assessed in each ESG database. The total number of elements assessed in all the four databases is 842. The elements assessed have a significant divergence across the four databases. The Venn diagram of Figure 9 compares all the elements assessed, in which only four elements are common among all the four ESG ratings. The ratios of exclusive elements are 37.3% in Refinitiv's ESG scores, 38.1% in MSCI's ESG scores, 4.4% in S-Ray's ESG scores, and 7.1% in Bloomberg's ESG scores. Regarding the social aspect, there are 281 total elements across the four databases, which is 33.4% of all the ESG elements. Surprisingly, there are no common items in all the databases. The number of social elements in Bloomberg and S-Ray is much less than that in Refinitiv and MSCI. The observed significant divergence in the assessed elements across the four databases emphasizes the importance of developing a universal ESG accounting standard with "dynamic materiality", elaborated by Eccles and Mirchandani (2022).

## Social equity

Here, when we refer to social equity, we are referring to a metric used to evaluate the equitability of various energy and environment issues, as well as the social aspects of sustainability. Energy-related social equity has its roots in the energy justice movement, which is based on environmental justice (Pettit, 2004) and climate justice (Bulkeley et al., 2013), focusing on energy issues and environmental benefits (Jenkins, 2018). Energy justice focuses on three key tenets—distributional justice (the distribution of costs and benefits), recognition justice (identifying who benefits or is burdened), and procedural justice [open access and engagement in policy decision-making processes (Jenkins et al., 2016)]. Social equity evaluations have been used for energy policy, energy emissions, energy law, energy finance, climate policy, and, most recently, energy transitions (McCauley and Heffron, 2018; Chapman et al., 2019).

Regarding energy-related sustainability evaluations, most of the studies focused on the more easily quantified environmental and economic aspects, or when considering social equity, they place more emphasis on qualitative rather than quantitative factors (Evans et al., 2009; Chapman et al., 2016).

In studies that evaluate sustainability and social equity quantitatively, a number of common factors come to the fore. Among them is the concept of employment, including relations (Valizadeh and Hayati, 2021), unemployment ratios and age

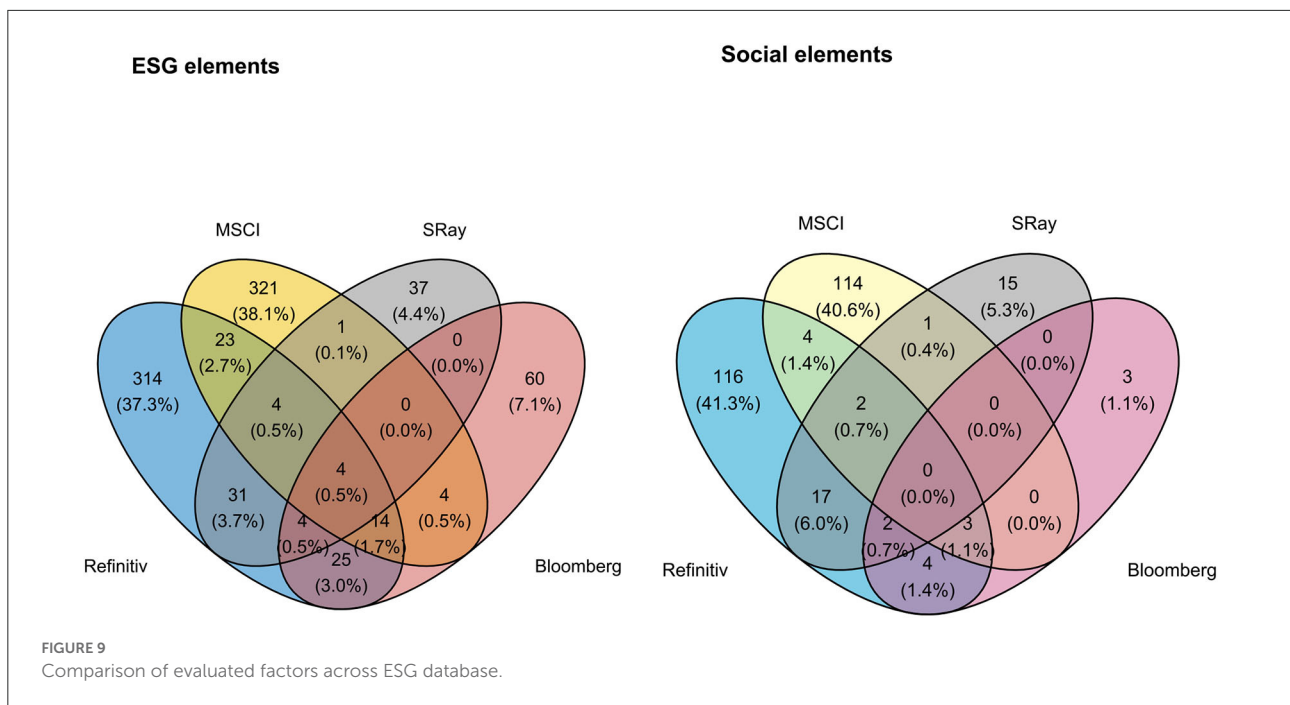
groups (Farber et al., 2014; El-Geneidy et al., 2016; Caggiani et al., 2017; Yuan et al., 2017; Camporeale et al., 2019; Emrich et al., 2020; Chapman et al., 2021), and how different policies and technological shift affect employment outcomes. Moreover, income and education, which are often closely correlated, are also considered important in the literature (Farber et al., 2014; Oswald Beiler and Mohammed, 2016; Silva et al., 2018; Shigetomi et al., 2020; Chapman et al., 2021). Access is another factor of social equity that can be quantified, including access to energy, transportation, and essential facilities (Farber et al., 2014; Shigetomi et al., 2020; Chapman et al., 2021; Larimian and Sadeghi, 2021). Furthermore, recognizing that there is often a gap not only between nations but also within nations, some studies also investigate the urban–rural divide and the gaps between genders and different age groups (Farber et al., 2014; Oswald Beiler and Mohammed, 2016; Ruiz et al., 2017; Su et al., 2017; Yuan et al., 2017; Chen et al., 2018; Silva et al., 2018; Guo et al., 2020; Karakoc et al., 2020). Generally, the literature includes distributive, recognition, and procedural aspects of social equity evaluations, with some focusing on this aspect quantitatively (Bennett et al., 2020). As the concept of social equity is still in its nascent phase, the overlap of concepts is not consistent, and to enable quantitative evaluations of social aspects, economic and environmental factors are co-opted when considered socially important.

From a regional perspective, Europe is strongly represented in the literature along with the United States and with some case studies on Southeast Asia. Global studies are only beginning to emerge in the most recent literature, which is largely due to the relatively recent emergence of concepts and data limitations.

## Discussion and conclusion

As the ESG market is expanding rapidly, with total global ESG investments of \$35.3 trillion in 2020, ESG rating providers play an increasingly important role in the investment process through their assessments of companies across various ESG metrics. However, the lack of common theorization (different definitions of good CSR) and commensurability (different measurements), which has been pointed out in various studies (Chatterji et al., 2016) and examined in detail in this paper, highlights the improvements required in the field of ESG assessment to provide clear and transparent information to investors and to reduce confusion among companies that are trying to enhance their ESG performance.

Considering the effect of ESG factors on corporate performance, in summary, we find that the overall trend of the short-term effect on profitability is unclear. The effect on ROA or ROE is still far from conclusive. In terms of stock return, the results vary, as they utilize different ESG metrics. Multiple factors, such as samples from different markets and periods, could also be a reason for the inconsistent results.



However, most of the current ESG evaluations do not reflect the financial impact, accounting measures, and short-term market returns sufficiently. The trend is robust and favorable when testing the effect on Tobin’s Q, cost of equity, or other risks, which indicate the nature of ESG activities, thereby enhancing corporate sustainability in the long term. Although it is out of scope of this paper, future research could focus on the difference between ESG metrics and conduct an in-depth analysis of the metrics that impact upon financial outcomes.

To have a closer look at the ESG metrics, we first investigate how the results of the ESG ratings correlate across the four widely used databases (Thomson Reuters’ Refinitiv, MSCI, Bloomberg, and Arabesque S-Ray). The results reveal that the four investigated databases have low correlations, with the correlations of integrated ESG scores ranging from 0.318 (MSCI and Bloomberg) to 0.549 (Refinitiv and Bloomberg). Moreover, regarding the ratings of the ESG components, it is also difficult to find strong correlations between these databases. Based on the accessible methodology materials of the four ESG ratings, we also collect the elements assessed in each ESG database and present the significant divergence of the elements assessed across the four databases. The ratios of exclusive elements are 37.3% in Refinitiv’s ESG scores, 38.1% in MSCI’s ESG scores, 4.4% in S-Ray’s ESG scores, and 7.1% in Bloomberg’s ESG scores. Regarding the social aspect, there are 281 elements in all the four databases, which is 33.4% of all the ESG elements. There are no common items in all the databases. The number of social elements in Bloomberg and S-Ray is much lower than that of Refinitiv and MSCI. Although the ESG metrics and the investment market are evolving rapidly, with

investors, corporations, and the public giving more priority to the “S” in ESG, which includes social equity issues, such as diversity, income inequality, workers’ safety, systemic racism, and companies’ broader role in society. There is significant divergence among the different ESG databases in the elements assessed under the social category.

To provide a suitable yardstick for the assessment of social aspects, we investigated existing approaches used for social equity evaluations through a systematic review and closely examined the key elements assessed in these studies. Some of the common factors that we find in the studies that evaluated sustainability and social equity quantitatively are the concept of employment, such as relations, unemployment ratios and age groups, as well as income and education, which were also found to be important elements in ESG metrics (e.g., gender balance, salary, and training). In social equity studies, access is a factor which is considered important and which can be quantified, including access to energy, transportation, and essential facilities, whereas quantifying access is rarely observed in the major ESG metrics. Due to the influence of ESG metrics, the differences in the rating methodologies and the level of transparency in the rating decisions, which also incorporate qualitative judgments, are critical to understanding the resilience of the ESG financial intermediation chain. The results of this paper contribute to advancing the research community’s and practitioners’ knowledge by providing a detailed examination of commensurability of major ESG metrics, and whether these ESG metrics capture critical social elements. Furthermore, the results of this paper reveals the importance of promoting the transparency and comparability of

scoring methodologies of established ESG rating providers and indices, as well as highlighting the importance of investigating studies and practices that quantitatively assess sustainability and social equity issues to ensure the overall veracity and quality of ESG metrics, as well as providing some evidence for their future expansion and improvement.

## Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

## Author contributions

AK, AC, KY, JX, JI, and ST carried out the analyses and wrote the manuscript with support from SM. AK and SM supervised the project. All authors contributed to the article and approved the submitted version.

## Funding

This research is supported by JSPS KAKENHI Grant Number JP20H00648 and the Environment Research and Technology Development Fund (JPMEERF20201001) of the Environmental Restoration and Conservation Agency of Japan.

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## Acknowledgments

We would like to thank Mr. Okita and Mr. Ike from Vector Group for providing their insights and expertise on ESG investment market during number of discussions.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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