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ORIGINAL RESEARCH

The impact of ESG risks on corporate value

Gil Cohen[1]

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Abstract
The following research has analyzed the linkage between ESG sustainability scores to the firm's valuations. We provide evidence that the total ESG score is diminishing for the S & P500 firms from 2019 till 2021 meaning that these risks factors take their rightful place in the global economy. We find that the impact of environmental risks on the firm's valuation is not significant enough. Moreover, we found that while the "Beta" risk factor of the S & P500 carries environmental risks, it does not hold such risks for Nasdaq100 stocks, and therefore, we recommend strengthening the environmental education to investors and other financial industry participants. This research also provides evidence that social risk impact negatively the simple excess return for both the S & P500 and nasdaq100 stocks indicating that social issues must be mitigated in order to maximize a firm value. Moreover, we find that the traditional CAPM "Beta" carries environmental and corporate governance risks for the S & P500 stocks. However, it totally neglects social risks and therefore it can not be used in modern ages where social risk are very important to all participants of the global economic environment.

Keywords NASDAQ · ETF · Systematic risk · Solar energy · Wind energy · Beta

JEL Classification O16 · O35 · P43

1 Introduction

Climate finance seeks to support actions that will address climate change issues. The Kyoto Protocol 1997 and the Paris Agreement 2015 call for financial assistance from parties with more financial resources to those that are less endowed and more vulnerable. This recognizes that the contribution of countries to climate change and their capacity to prevent it and to cope with its consequences vary enormously. Climate finance is needed for mitigation because large-scale investments are required to significantly reduce emissions. The Paris agreement sets the goal of zero net greenhouse gas emissions from human activity. Each party is obligated to set targets for emissions reduction or limitation, implement domestic measures to achieve those targets, and submit data on its progress for

✉ Gil Cohen
gilc@wgalil.ac.il

[1] Western Galilee Academic College, Acre, Israel

international review and evaluation. The second milestone of 2015 was the adoption of the Sustainable Development Goals (SDGs) by the 194 countries of the UN General Assembly addressing global social issues and environmental challenges that threaten the sustainability of human society. Global goals were set, including poverty eradication, good health and well-being, quality education, clean energy, sustainable cities, responsible consumption and production, and action on climate change. Amid these changes, corporate managers began to embrace environmental management, equal opportunity, work-life balance, labor rights, and other socially responsible policies as integral to the management of business risks and opportunities. At the same time, investors began to recognize the importance of ESG (Environmental, Social and Corporate Governance) risks in investment decisions. ESG risks are measured by scores for each component (E, S, and G) that sum up the total ESG risk score. For example, Intel corporation risk scores are 4.4, 5. 9, and 7 for E, S, and G, respectively, summing up to a total of 17 which represent the total ESG risks score. Micron Technology has the same total ESG score as Intel, however, it is comprised of 6.6, 5.1, and 5.8 for E, S, and G, respectively, meaning that Micron imposes more environmental risks and fewer social and corporate governance risks than Intel. Individual investors and institutional investors evaluate the total risk score and its component according to their values and preferences.

ESG holds social and environmental responsibilities to corporates that are used to sanctify revenues and profits above all other corporate goals and missions ensuring the long life of a company through a combination of financial profitability, environmental protection, and social responsibilities. ESG investment is a set of global guidelines drawn up under UN leadership stating that investment managers should incorporate ESG factors when making investment decisions and are required to provide information representing their approach to responsible investment. According to Kawaguchi (2017), incorporating ESG factors mean including issues relating to the environment such as carbon emissions, energy efficiency, resources efficiency, recycling, water resources, renewable energy, preservation of forests, and marine resources. Social issues include workplace diversity, working conditions across the supply chain, forced labor, and modern slavery. Those policies which were regarded as additional cost factors are now being treated differently since mounting threats to humanity such as climate change and wealth gaps are now being recognized by consumers, stakeholders, corporate workers, and governments.

There are two important aspects of the impact of sustainability on the financial markets as a whole and on investments and portfolio construction. First, investors are more concerned about ESG issues and prefer to invest in firms that are aware of these issues and are willing to invest resources to reduce their sustainability risks. Second, more and more investment houses are stating that they will not continue to invest in companies that harm the environment. For example, in July 2021, “Altshuler Shaham” which is the largest investment house in Israel, announced that it intends to end its investment in companies with more than a quarter of their revenues in the future in carbon. Moreover, the investment house argued that the move is not due to climatic activism, but from an economic perspective, in their view, “climatic risks are investment risks”. Such an important move from the leader of the institutional investors that dominates the financial market would essentially drive companies to take care of their environmental issues. However, this revolution had not come without protests and debates initiated by private investors that use the services of those institutional investors. In their view, not investing in high ESG risk stocks may harm returns on their portfolios and eventually massive abandonment of that investment house by unsatisfied customers. “Altshuler Shaham” is the first swallow in Israel that may be followed by other investment houses. A massive joining of this movement by private

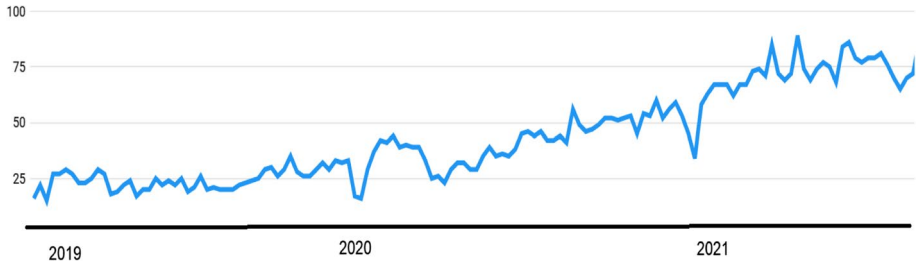


Fig. 1 Google Trends Relative Importance of the ESG from 2019 untill 2021

and institutional investors can really change the world by forcing companies that seek public funds to better care about sustainability issues. Figure 1 shows the relative importance of Google trends based on the ESG risk measurement.

Figure 1 shows a growing worldwide interest in the ESG risk rating demonstrating the world's increasing concerns about environmental, social, and corporate governance issues.

This study is designed to examine to what extent ESG risks affect companies value in recent years (2019–2021) for S & P500 and Nasdaq100 companies. The data is used for which the ESG risk score is calculated. It is examined to what extent these risk factors are embedded in the traditional systematic risk "Beta" and their impact on stock's excess returns. Such an attempt has never been tried before by prior research. Moreover, this research is also unique in its methodology and updated data. Only a few past research have attempted to directly derive from the financial markets the impact of ESG risks on the risk and return involved in the investing process. Moreover, past researchers have addressed each ESG risk separately and therefore a more comprehensive approach is adopted in the following research.

2 Literature review

The understanding that profitability alone does not ensure the long-run existence of an organization is well-established by researchers (For example Elkington 1997; Lo 2010; Schaltegger et al. 2013). Shareholders now understand that investing funds and resources in easing environmental and social risk can be beneficial to the stock value as well as their image to the public. Sustainability usually refers to Environmental, Social and corporate Governance (ESG) issues that have public implications. Corporate sustainability has become vital for organizations' long-term success (Eccles et al. 2012; Ortiz-de-Mandojana and Bansal 2016), and it has been increasingly studied in the academic literature in recent decades. The literature on the subject mainly deals with Corporate Social Responsibility (CSR) improves employee motivation and the firm's surrounding business atmosphere (Montiel 2008). Corporate sustainability generally refers to the integration of financial profitability, environmental protection, and social responsibility into organizations' mission declarations and applied to everyday activities (Elkington 1997; Lo 2010; Schaltegger et al. 2013). The world commission on environment and development, 1987, defined corporate sustainability as meeting the needs of a firm's direct and indirect stakeholders such as shareholders, employees, clients, pressure groups, communities, etc., without compromising its ability to meet the needs of future stakeholders as well. Following these objectives,

researchers have dealt with issues such as assessing corporate sustainability (Topple et al. 2017), improving sustainability engagement (Schönherr et al. 2017), providing investment opportunities (Schramade 2017), and designing sustainable business models (Morioka et al. 2017, 2018). Although many researchers have focused on corporate sustainability models and efforts, not many have tried to document the effect of sustainability risks on the financial markets. Since the financial market is a good futures proxies, a lot about the present and future of different sustainability aspects may be learned. Nizam et al. (2019) have studied the impact of sustainability on banks' performance. They concluded that financial performance and social and environmental performance are related, but evidence for the banking sector remains limited and inconclusive. Garcia et al. (2019) have found that larger companies have higher levels of performance. They also found that companies in sensitive industries present superior environmental performance even when controlling for size and country. Corporate environmental responsibility is now defined as the way in which organizations incorporate environmental issues into their operations to eliminate waste and emissions and reduce to minimum bad effects on the country's natural resources. Li et al. (2020) constructed a Corporate Environmental Responsibility (CER) engagement measurement to examine the relationship between CER engagement and firm value as based on a sample of 496 China's A-share listed companies from 2008 to 2016. The results show that when firms start to adopt environmental regulations, CER would have a negative effect on firm value. However, at a specific level, CER would start to enhance firm value positively.

A relatively new discussion in the literature deals with ESG disclosure effects on firms. Chen and Xie (2022) showed that ESG disclosure has a positive effect on corporate financial performance. The positive effect of ESG disclosure on the financial performances was found to be more pronounced in firms with ESG investors, and companies with longer inception, high agency costs and media attention. Schiemann and Tietmeyer (2022) investigated whether ESG disclosure moderates the relation between ESG controversies and analyst forecast accuracy and found that analyst' forecasts errors are higher for firms with higher exposure to ESG controversies. They also discovered that ESG disclosure can moderate controversies and analysts' forecasts errors. Furthermore, they identify that ESG disclosure is important when social controversies exist. Christensen et al. (2022) try to explain the disagreements across rating agencies by firm's ESG disclosure. They found that disclosure ls positively related to ESG rating disagreements. Moreover, they found that greater ESG disagreement is associated with a larger price movement, higher volatility, and a lower likelihood of issuing external financing. Khalid et al. (2022) found that the governance structure of firms plays a significant role in ESG disclosure. Their finding confirms that ESG disclosure is associated with a productive role of board size, current ratio, and low corruption towards environmental exposure.

Rubbaniy et al. (2021) discovered a significant herding behavior of leading U.S ESG stocks for both bull and bear market conditions. They explained that the herding behavior is driven by international motives rather than fundamental factors and concluded that the phenomena can lead to asset mispricing and add to market inefficiency. Van Der Beck (2021) estimated the impact of sustainable fund on individual stocks and found that every dollar invested in sustainable funds increase the value of green stocks by 0.4 dollars. He concluded that price pressures from mutual funds reduce green firms' cost of capital. Lioui and Tarelli (2022) measured ex-ante return spread using differences in ESG rating and exposure to other firm characteristics. They documented strong variation of the alpha factor in the time series which is negatively related to media attention to ESG. Stotz (2021) found that discount rates of high ESG stocks have fallen relative to low ESG stocks. However, in his view discount rate changes do not reflect changes

in risk rather it is related to investors' ESG preferences. Avramov et al. (2022) analyzed the impact of uncertainty of corporate ESG profile on the firm's valuation and on portfolio management issues. They found that CAPM alpha and beta both rise with ESG uncertainty.

Corporate social responsibility is a broad concept whereby companies integrate social concerns into their business operations. As the use of corporate responsibility expands, it is becoming increasingly important to have a socially conscious image. Consumers, employees, and stakeholders prioritize socially responsible companies when choosing a brand or investment opportunity. Businesses can practice social responsibility by donating money, products, or services to nonprofit organizations or volunteering their personnel and physical resources for social causes. An important part of social responsibility is ethical labor practices. By treating all employees fairly and ethically without gender or any other discrimination firms gain a positive attitude from their business environment including customers, suppliers, competitors, and shareholders. Baohua et al. (2020) investigated corporate innovation from the perspective of a firm's employee-related Corporate Social Responsibility (CSR) in China. They found that more employee-related CSR generates more innovation success. Their results also suggest that a firm's incentive to offer better employee-related CSR is an important determinant of its innovation. Lee et al. (2013) examined whether portfolios comprising high-ranked Corporate Social Performance (CSP) firms out/underperform portfolios comprised of low-ranked CSP firms for a US sample of firms covering the period from 1998 to 2007. Their results are consistent with the "no-linkage" hypothesis, which argues that no significant difference in risk-adjusted performance is expected between high- and low-ranked CSP-formed portfolios. Unlike Lee et al. (2013) in our research conducted on much more recent data, it is found that corporate environmental and social risks are negatively correlated to excess returns of stocks. While the most consistent influential factor is the social risks. These findings shed light on the enormous importance of investors' value and human business conduction methods.

Several agencies produce ESG ratings like Moody's ESG, S&P Global, Sustainalytics, and MSCI. Berg et al. (2022) documented the agency's rating measurement, scope, and weight divergence and found that measurement contributes 56% of the divergence, scope 38%, and weight 6%. Their results call for future attention to how the data underlying ESG ratings are generated. Serafeim and Yoon (2022) investigated market reaction to ESG news and consensus on the rating of different rating agencies. They found that in the presence of high disagreement between raters, the relation between news and market reactions weakens. In this research, we use Sustainalytics' ESG scores as our database. Filbeck et al. (2019) examined whether firms rated highly by Sustainalytics based on ESG criteria are associated with superior long-term stock price performance. They documented that firms with a better G score produce significant positive alpha values. On the other hand, firms characterized by weak governance principles are penalized by the market. They concluded that improved governance scores and to a lesser extent improved social scores produce statistically significant positive alpha values whereas negative changes in environmental scores are positively received by the market. We also documented that excess return is negatively related to high social risks, however, unlike Filbeck et al. (2019), we documented a positive relationship between high corporate governance risks and excess return. The change can be explained by investors' preferences evolving over the years since our tests were conducted on later data and by the more advanced rating methodology used by Sustainalytics.

Table 1 ESG Risks Scores for a Sample of Companies

	Stock Ticker	E	S	G	ESG
1	BA	7.1	19.7	7.9	34.7
2	AAPL	0.6	6.9	9.2	16.7
3	XOM	18.5	9.8	8.1	36.4
4	AMZN	5.6	14.8	9.9	30.3
5	AAL	11.5	12.3	5.3	29.1
6	AMAT	3.8	2.6	5.1	11.5
7	BAC	1.6	14.4	11.2	27.2
8	BIIB	0	13.2	7.8	21
9	WMT	4.4	13.9	6.3	24.6
10	CRM	2.3	6.4	4.5	13.2
Averge		5.5	11.4	7.5	24.5
St.d		5.7	5.0	2.2	8.7
Max		18.5	19.7	11.2	36.4
Min		0	2.6	4.5	11.5

St.d = standard deviation

3 Data and methodologies

Our database contains all S & P500 and Nasdaq100 stocks annual returns from 2019–2021 and yearly ESG scores that were calculated by Sustainalytics.[1] Sustainalytics' ESG Risk Ratings are designed to help investors identify and understand ESG risks at the security and portfolio level and adjust their portfolios accordingly. The ESG rating is constructed according to the following measures: 1. A company's risk is measured against its industry peers and against the global universe. 2. The magnitude to which a company is exposed to ESG Risk and how well the company is managing that risk 3. Transparency into Company Events that may impact a company's operations, stakeholders, or the environment. Stocks prices and ESG scores were obtained from Yahoo finance portal quotes Sustainalytics scores in their sustainability section (see for example Boeing company[2]). Table 1 consists of a sample of a random ten well-known companies' ESG scores.

Table 1 demonstrates the wide range of risk scores for each of the ESG components. The highest average score is attributed to social risk, followed by corporate governance, while the lowest risk is sourced by environmental issues. Moreover, environmental risk has the highest standard deviation while corporate governance risk has the lowest. Each investor, both private and institutional takes into consideration the above ESG risks along with more traditional investment risks such as earnings and stock price volatility. For example, an investor with developed social responsibilities senses will prefer to invest in Applied Materials (ticker AMAT) than in Boeing (ticker BA), and an investor that environmental responsibilities are important to her will prefer to invest in Biogen (ticker BIIB) than in Exxon Mobil (ticker XOM). Sustainalytics ESG Risk Ratings are designed to help investors identify and understand financially material ESG risks at the security and portfolio level and how they might affect the long-term performance of equity and fixed-income

[1] https://www.sustainalytics.com/

[2] https://finance.yahoo.com/quote/BA/sustainability?p=BA

investments. The company's ESG risk rating is comprised of a quantitative score that represents units of unmanaged ESG risk with lower scores representing less unmanaged risk. Unmanaged risk is measured on an open-ended scale starting at zero (no risk) and, for 95% of cases, a maximum score below 50. Based on their quantitative scores, companies are grouped into one of five risk categories (negligible, low, medium, high, or severe). These risk categories are absolute, meaning that a 'high-risk assessment reflects a comparable degree of unmanaged ESG risk across all subindustries covered. This means that a bank, for example, can be directly compared with an oil company or any other type of company. Moreover, the ESG risk ratings, combined with qualitative analyses, provide a differentiated risk signal and deeper insights into the materiality of certain ESG issues for a company and what the company is or is not doing to manage them effectively. ESG Risk Ratings is sourced by the world's transition to a more sustainable economy and that the effective management of ESG risks should, therefore, be associated with superior long-term enterprise value. Moreover, ESG issues are often sourced by the firm's global structure and size facing different business surrounding characterized by local ESG challenges. Moreover, large firms are screened by multiple agencies and analysts that shed public light on the malpractice of ESG issues. In addition, large firms have more resources than small firms to invest in improving their ESG profile.

We started our analysis with descriptive statistics of our data followed by figures that demonstrate the development of the ESG scores over the years 2019–2021. Then we measured the impact of the firm's size in B$ on the ESG components (Eq. 1).

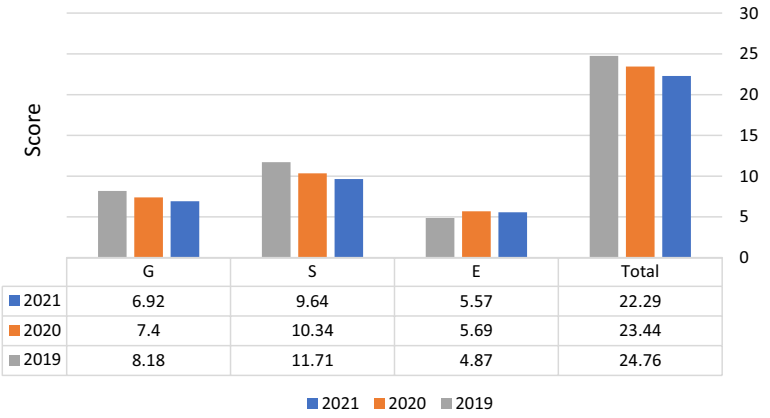
$$E_i, S_i, G_i = \beta_0 + \beta_1 * log(\text{Size}_i) + \varepsilon_i \tag{1}$$

where: E_i, S_i, G_i are E, S, and G scores of stock I in a specific year. $Size_i$ in the firm's size in B$.

Next, we examine the linkage between ESG risk factors and the stock's abnormal returns. In the financial literature, the link between a firm's risks and the stock's abnormal return is well documented (see for example Griffin and Lemmon 2002). The impact of increased risks on stock returns varies dramatically on investors' perception in terms of the firm's chances to continue capturing market shares and future survival. Maiti (2020) found that three factors' models with market, size and ESG perform better than the Fama–French (FF) three-factor model. Moreover, he documented that portfolios formed based on these factors performed better than portfolios that were formed using traditional methodologies.

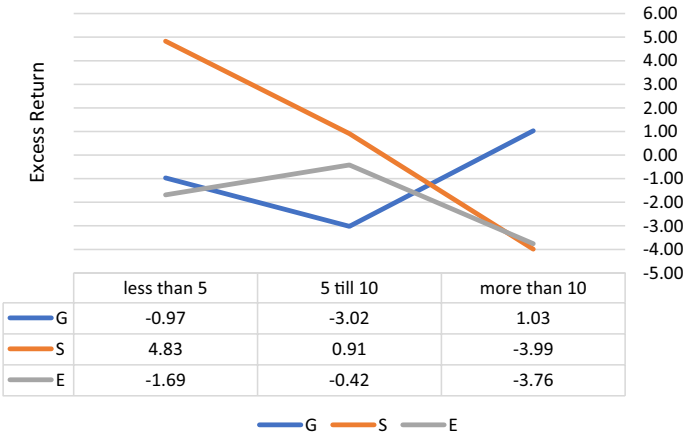
Abnormal return is usefully measured using two methodologies. 1. Stocks return over the index (S & P500 or Nasdaq100) return (Eq. 2) and 2. Stocks return over CAPM required return (Eq. 3). The abnormal return is calculated annually representing the annual abnormal return of the individual stocks over their index return and over their required return according to the CAPM model and their systematic risk embodied in their "Beta". The risk-return theoretical framework, argue that the higher risk involved the higher return should be expected. Maiti concluded that ESG risk factors are important to the process of returns predictions and therefore must be considered during investment decisions. Cornell (2021) argued that there are two primary factors that affect the returns of high ESG firms, rating, investor preferences, and risk. Companies with low ESG risk scores experience a lower cost of capital which is usually related to lower expected returns. Unlike Cornell (2021) using Sustainalytics' ESG rating, we found that for all the examined years high S risk score is associated with lower excess return which is consistent with Maiti (2020). This phenomenon also occurs with respect to E in some years for S & P500 stocks.

The results are summarized in Tables 3 and 4 and Figs. 2 and 3.



	G	S	E	Total
2021	6.92	9.64	5.57	22.29
2020	7.4	10.34	5.69	23.44
2019	8.18	11.71	4.87	24.76

Fig. 2 S & P500 ESG Score, 2019–2021. E is Environmental risks; S is social risks and G is corporate Governance risks



	less than 5	5 till 10	more than 10
G	-0.97	-3.02	1.03
S	4.83	0.91	-3.99
E	-1.69	-0.42	-3.76

Fig. 3 Excess Returns for S & P500 stocks for Different ESG Categories. G = corporate governance risk score, S = social risk score, E = environmental risk score. Excess return is returns above the S & P500 returns

$$RS_i - RI = \beta_0 + \beta_1(E_i) + \beta_2(S_i) + \beta_3(G_i) + \varepsilon_i \tag{2}$$

where: $RS_i - RI_i$ = Yearly Excess return of stock i over the index return. The index is the S & P500 or Nasdaq100, E_i = environmental risk score of stock i, S_i = social risk score of stock i, G_i = governance risk score of stock i

$$CAPM_i = \beta_0 + \beta_1(E_i) + \beta_2(S_i) + \beta_3(G_i) + \varepsilon_i \tag{3}$$

where: $CAPM_i$ = CAPM yearly excess returns of stock i, E_i = environmental risk score of stock i, S_i = social risk score of stock i, G_i= governance risk score of stock i.

Finally, we examined whether the traditional systematic risk factor "Beta" which captures the stock's systematic risk is affected by ESG risk factors. Our purpose is to examine whether

Table 2 ESG Risk Factors for S & P500 and Nasdaq100 Stocks

		E	S	G	ESG
S & P500	Average	5.44	9.96	7.18	22.7
	St.d	5.21	4.07	2.53	7.08
	Max	22.74	23.67	16.43	40.92
	Min	0	0	0	9.13
Nasdaq100	Average	4.00	10.12	6.92	21.08
	St.d	4.42	3.73	1.98	6.05
	Max	19.3	20.3	12.4	35
	Min	0	3.5	3.6	11
T stat		2.70	0.95	1.12	2.14

T stat is the t critical two tail test for mean equality

Table 3 ESG Risks Categories Distribution of S & P500 and Nasdaq100 stocks

ESG	Negligible 0–10	Low 11–20	Medium 21–30	High 31–40	Severe 40+	Total
S & P500	3 (0.6%)	185 (37%)	210 (42%)	94 (18.8%)	8 (1.6%)	500
Nasdaq100	2 (2%)	51 (51%)	38 (38%)	9 (9%)	0 (0%)	100
E	0–0.5	0.5–2	2–5	5–10	10+	
S & P500	21 (4.2%)	154 (30.8%)	118 (23.6%)	108 (21.6%)	99 (19.8%)	500
Nasdaq100	24 (24%)	22 (22%)	23 (23%)	23 (23%)	8 (8%)	100
S	1–5	5–8	8–10	10–15	15+	
S & P500	53 (10.6%)	115 (23%)	96 (19.2%)	185 (37%)	51 (10.2%)	500
Nasdaq100	10 (10%)	23 (23%)	25 (25%)	33 (33%)	9 (9%)	100
G	3–5	5–7	7–8	8–10	10+	
S & P500	82 (16.4%)	185 (37%)	97 (19.4%)	75 (15%)	61 (12.2%)	500
Nasdaq100	13 (13%)	37 (37%)	23 (23%)	18 (18%)	9 (9%)	100

ESG factors are inbounded in the systematic risk factor, or if they are separate risks that should be valued separately by investors. If the "Beta" consists of all ESG factors, it can be used to represent those risks along with the more traditional risks, without the need for their separate identification and measurement. The theoretical model is presented in Eq. 4 and the implementation for the S & P500 stocks and Nasdaq100.

$$\beta S_i = \beta_0 + \beta_1\left(E_i\right) + \beta_2\left(S_i\right) + \beta_3\left(G_i\right) + \varepsilon_i \tag{4}$$

where: βSi=the "Beta" of stock i is the 5 years systematic risk factor calculated by finance. yahoo.com (0.29–2.77),E_i = environmental risk score of stock i (from 0–18.5), S_i= social risk score of stock i (2.6–19.7), G_i= governance risk score of stock i (4.5–11.5). The dependent E_i, S_i, G_i values are derived from years 2019–2021.

Table 4 ESG Components and the firm's Size from 2019 till 2021

	Dependent/ Independent	$E_{i,t}$	$S_{i,t}$	$G_{i,t}$	$ESG_{i,t}$
S & P500 2019–2021	$\alpha_{i,t}$	8.81** (6.8)	8.05** (7.95)	5.92** (7.86)	22.79** (12.72)
	$\delta_{i,t}$	−2.17** (−3.4)	1.49** (2.25)	1.15** (3.07)	0.47 (0.53)
Nasdaq100 2019–2021	$\alpha_{i,t}$	6.80** (3.49)	12.26** (7.35)	4.80** (5.59)	23.93** (8.83)
	$\delta_{i,t}$	−1.47 (−1.5)	−1.10 (−1.32)	1.09** (2.54)	−1.47 (−1.08)
S & P500 2021	$\alpha_{i,t}$	8.32** (3.80)	8.23** (5.42)	6.28** (5.63)	21.96** (7.78)
	$\delta_{i,t}$	−2.03** (−2.51)	1.04 (1.34)	0.74** (1.98)	0.17 (0.12)
S & P500 2020	$\alpha_{i,t}$	9.17** (4.5)	8.10** (5.18)	6.33** (5.29)	23.62** (8.53)
	$\delta_{i,t}$	−2.28** (−2.20)	1.47** (2.16)	0.99** (2.51)	0.18 (0.26)
S & P500 2019	$\alpha_{i,t}$	9.48** (2.77)	9.72** (3.50)	5.08** (2.35)	24.29** (5.11)
	$\delta_{i,t}$	−2.41 (−1.56)	1.17 (0.93)	1.73** (2.14)	0.50 (0.23)

E is Environmental risks; S is social risks and G is corporate Governance risks the numbers in the brackets are the t statistics. *=statistically significant ($p < 0.05$)

4 Results

We start our results by showing descriptive statistics of our data. Table 2 summarizes the results of the ESG components while Table 3 shows the distribution of S & P500 and Nasdaq100 companies across five risk categories.

Table 2 indicates that on average Nasdaq100 stocks carry fewer ESG risks than S & P500 stocks. Although tech companies are less harmful to the environment and carry fewer corporate governance risks than industrial S & P500 stocks, they hold higher social risks than S & P500 stocks. Moreover, the difference in averages between the two groups of companies is significant for the total ESG and E risks and not statistically different for S and G. Table 3 demonstrates that 20.4% of S & P500 stocks carry high and severe ESG risks compared to only 9% of the Nasdaq100 stocks. In addition, 37.6% of S & P500 stocks compared to 51.2% of nasdaq100 stocks carry negligible or low ESG risks. Regarding E risks categories, 41.4% of S & P500 companies carry high or severe environmental risks compared to only 31% of Nasdaq100 companies. Moreover, 35% of S & P500 companies are considered with negligible or low impact on the environment, while this number rises to 44% for the S & P500 stocks. This result may be caused by the nature of the technological sectors traded on the Nasdaq compared to the traditional industrial sectors traded on the NYSE.[3] Moreover, the globalized nature of the Nasdaq100 stocks compare to more U.S oriented S & P500 stocks might contribute to the observed differences. Global corporations act under different legal conditions that might not be as strict as in the U.S in terms of labor force rights. Regarding Sand G the distribution across social and corporate governance risks categories of S & P500 and Nasdaq100 do not differ dramatically. Figure 1 shows the evolution of the ESG score of S & P500 stocks from 2019–2021.

Figure 1 shows that the total ESG score of the S & P500 stocks is in a declining trend from 24.76 in 2019 to 22.29 in 2021 (10%). A clear decline trend is also spotted for

[3] NYSE = New York Stock Exchange.

the G and S factors from 8.18 and 11.71 in 2019 to 6.92 and 9.64 in 2021, 15.4% and 17.7%, respectively. In contrast, the E factor has risen from 4.87 in 2019 to 5.69 in 2020 (16.8%) and dropped slightly to 5.57 in 2021 producing a total of 14.3% increase from 2019 to 2021.

We use Eq. 1 to examine whether the ESG as a whole and its components are affected by the firm's size in B$ and show the results in Table 4.

Table 4 shows that for the entire sample of the S & P500 the firm's size is negatively related to E and positively related to S and G. For the Nasdaq100 stocks, only G is found to be positively correlated to the firm's size while for the other two, E and S no significant correlation to size has been found. The positive correlation between the firm's size and G occurs for the S & P500 in all the examined years while the negative impact of size on E occurs significantly only in recent years 2020–2021. These findings point out that according to the ESG score large firms on average are less harmful to the environment, less concerned about the social implication of their operation and that they are harder to be governed. The first result is optimistically pointing out that when firms grow and become global conglomerates, they prioritize their environmental impact while the latter result is caused by the difficulty of corporate control over a large international firm (see for example Sullivan and Gouldson 2017). Results also show that the total ESG score is not affected by the firm's size probably because of the opposite effect on its components. We now examine the linkage between ESG risk factors and the stock's abnormal returns using two methodologies. 1. Stocks excess return over the index returns (S & P500 or Nasdaq100, Eq. 2) and 2. Stock excess return over CAPM required returns Eq. 3). The results are summarized in Tables 5 and 6 and Figs. 2 and 3.

Table 5 demonstrates that for the three examined years, the S & P500 and Nasdaq100 stock's excess return is negatively dependent on the S score and positively on the G score while E does not impact the stock's excess returns. However, year-by-year examination shows that E has a negative influence on S & P500 stocks excess return only in 2019 with no such impact on the nasdaq100 stocks. These results agree with the results obtained by Maiti (2021) who concluded that ESG risk factors are important to the process of returns predictions and therefore must be considered during investment decisions. These results also indicate that although large companies make an extensive effort to be perceived by the public as caring for the environmental aspect of their operation, the impact of their efforts on their company's value is limited. The positive influence of G on the firm's excess returns suggests that corporate governance risks measured by G increase the excess return when it was expected to do the opposite. A possible explanation for that was suggested by Hsu and Liao (2022) who argued that good corporate governance can mitigate the impact of COVID-19 on stock price volatility and trading volume but may not help to enhance stock returns. Ding et al. (2021) evaluated the connection between corporate characteristics and the reaction of stock returns to COVID-19 cases using data on more than 6,700 firms across 61 economies. They found that the stock markets positively price small amounts of managerial ownership but negatively price high levels of managerial ownership during the pandemic. The results documented here demonstrate an important insight into the financial markets, pointing out that crises such as the recent pandemic can change investors' preferences and stock valuations. Breaking the ESG score into three categories we plotted Fig. 2 for the S & P500 stocks and Fig. 3 for the Nasdaq100 stocks.

Figure 2 shows the decline of excess return with the increase of S as the prime phenomenon. Moreover, the stock's excess return moves the opposite way for the E and G categories. The highest excess return was documented for the mid-E category (5 to 10).

Table 5 Stocks Excess Return over the Index (S & P500 or Nasdaq100)

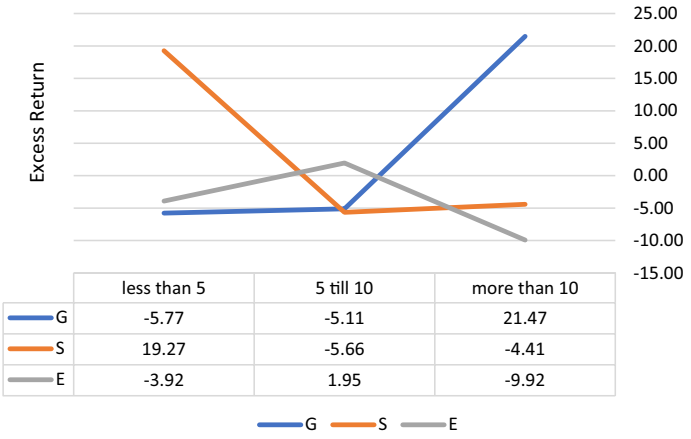
Dependent/ Independent	RS&P 2019–2021	RN 2019–2021	RS&P 2021	RS&P 2020	RS&P 2019	RN 2021	RN 2020	RN 2019
β_1	1.12 (0.16)	−15.48 (1.46)	−3.34 (−0.34)	−2.65 (−0.21)	10.66 (0.87)	9.11* (1.73)	−68.8** (−2.51)	13.30 (0.99)
$E_{i,t}$	0.08 (0.21)	0.00 (0.00)	0.811.52	0.09 (0.14)	−1.29** (−2.03)	0.30 (0.98)	−0.25 (−0.16)	−0.07 (−0.09)
$S_{i,t}$	−1.20** (−2.44)	−1.18* (1.82)	−2.60** (−3.52)	0.27 (0.30)	−1.30* (−1.85)	−0.88** (−2.20)	−0.91 (−0.46)	−1.76* (−1.83)
G_{it}	1.23** (2.12)	3.54** (2.50)	3.52** (3.34)	−0.37 (−0.30)	0.72 (0.63)	−0.05 (−0.07)	10.36** (2.81)	0.32 (0.18)
F	2.21	2.25	6.17	0.52	3.51	2.58	2.84	1.26
R^2	0.18	0.14	0.22	0.02	0.17	0.12	0.13	0.09

The dependent variable is $S_{i,t} - RI_t$, were $RS_{i,t}$ = stock i returns in year t and $RI_{i,t}$ = the S & P500 or Nasdaq100 returns in year t. The dependent variable presented in the table is RS&P when the index is S & P500 and RN when the index is Nasdaq100. $E_{i,t}$ $S_{i,t}$ $G_{i,t}$ = the E,S and G risk scores of stock i at year t. The numbers in the brackets are T statistics. * Significant at 90% significance level, ** significant at 95% significance level

Table 6 Stocks Excess Returns over the CAPM Required Returns

Dependent/ Independent	RS&P 2019–2021	RN 2019–2021	RS&P 2021	RS&P 2020	RS&P 2019	RN 2021	RN 2020	RN 2019
β_1	3.97 (0.56)	−13.69 (−1.38)	1.62 (0.16)	−1.91 (−0.14)	14.54 (1.01)	16.17* (1.70)	−66 ** (−2.6)	15.26 (1.22)
$E_{i,t}$	−0.19 (−0.52)	−0.13 (−0.23)	0.51 (1.05)	−0.09 (−0.13)	−1.66** (−2.23)	0.28 (0.91)	−0.45 (−0.32)	−0.21 (−0.30)
$S_{i,t}$	−0.76 (−1.47)	−0.52 (−0.74)	−2.23** (−3.25)	0.75 (0.79)	−0.87 (−0.84)	−0.75** (−1.95)	0.19 (0.10)	−1.00 (−1.12)
G_{it}	0.33 (0.46)	2.44** (1.96)	2.42** (2.32)	−1.09 (−0.84)	−0.21 (−0.16)	−0.26 (−0.35)	8.53** (2.50)	−0.94 (−0.56)
F	1.68	2.01	4.85	0.37	2.12	2.30	3.21	0.89
R^2	0.05	0.14	0.19	0.02	0.19	0.09	0.13	0.04

The dependent variable CAPM$\alpha_{i,t}$ is the CAPM excess returns of stock i at year t. the dependent variable presented in the table is RS&P when the index is S & P500 and RN when the index is Nasdaq100. $E_{i,t}$ $S_{i,t}$ $G_{i,t}$ = the E, S, and G risk scores of stock i in year t. The numbers in the brackets are T statistics. * Significant at 90% significance level, ** significant at 95% significance level



	less than 5	5 till 10	more than 10
G	-5.77	-5.11	21.47
S	19.27	-5.66	-4.41
E	-3.92	1.95	-9.92

Fig. 4 Excess Returns for Nasdaq100 stocks for Different ESG Categories. G = corporate governance risk score, S = social risk score, E = environmental risk score. Excess return is returns above the Nasdaq100 returns

Figure 3 demonstrates that excess return falls sharply as S grows from less than 5 categories to 5 to 10 categories. The opposite occurs when G grows from less than 5 categories to more than 10. Here again, the highest excess return was documented for the mid-E category (5 to 10).

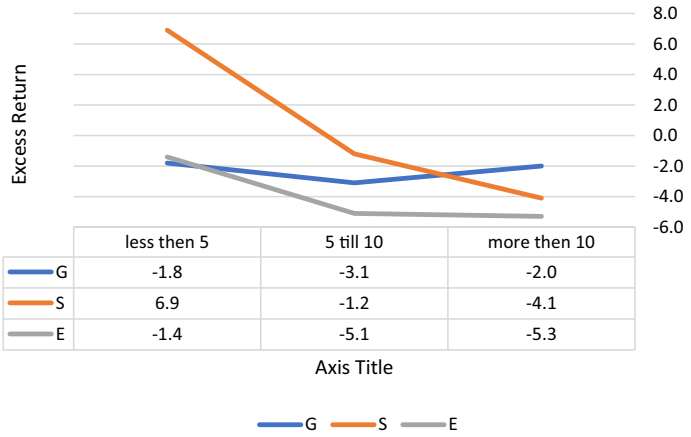
Table 6 demonstrates that S & P500 stock's CAPM excess returns cannot be explained by.

the ESG risks scores for the S & P500 for the entire period. This result contrasts with the reported simple excess returns reported in Table 5. However, in 2021 a negative impact of S and a positive impact of G on excess returns were documented. E is negatively correlated to CAPM excess return only in 2019. The table also shows a positive impact of G on Nasdaq100 CAPM excess return for the entire sample and for 2020 and a negative impact of S in 2021.

Figure 4 shows a decline in S & P500 CAPM excess return as S and E grow in the category. In contrast, the excess return is minimized for the mid-G category and rises for the biggest category.

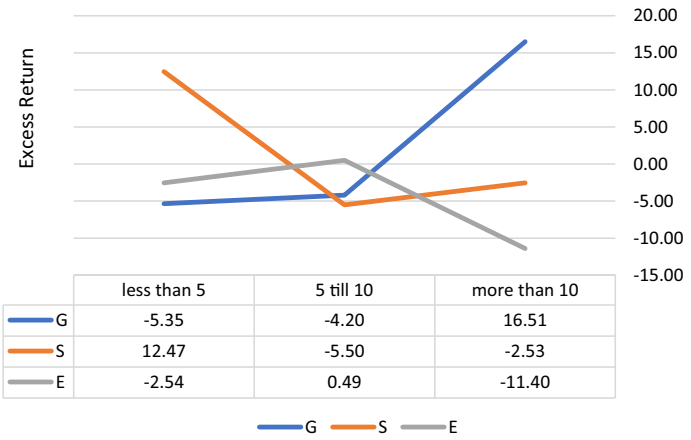
Figure 5 demonstrates the rise in CAPM excess return for nasdaq100 stocks with G categories in contrast to the moderate behavior of the S & P500 stocks which was documented in Table 4. Moreover, the CAPM excess return for Nasdaq100 stocks moves in a different direction with S and E.

The traditional CAPM model assumes that the systematic risk "Beta" contains all the risks of a company in relation to market risks. This assumption was examined by prior studies. Giese et al. (2019) used MSCI ESG rating data to show that ESG information is transmitted to a firm's valuation through its systematic risk profile resulting in lower costs of capital and higher valuation. They also suggested that changes in a company's ESG score may be a useful financial indicator. Following Giese et al. using Sustainalytics' data, we tested the impact of ESG scores on the firm's CAPM systematic risk factor ("Beta"). (Fig 6). However, unlike Giese et al. (2019), we examined each ESG component's separate impact on the firm's systematic risk factor. Jin (2022) suggested an alternative ESG integration framework to reflect the systematic ESG risks. His approach



	less then 5	5 till 10	more then 10
G	-1.8	-3.1	-2.0
S	6.9	-1.2	-4.1
E	-1.4	-5.1	-5.3

Fig. 5 CAPM Excess Returns of S & P500 stocks for Different ESG Categories. G = corporate governance risk score, S = social risk score, E = environmental risk score. Excess return is returns above the CAPM required returns



	less than 5	5 till 10	more than 10
G	-5.35	-4.20	16.51
S	12.47	-5.50	-2.53
E	-2.54	0.49	-11.40

Fig. 6 CAPM Excess Returns of Nasdaq100 stocks for Different ESG Categories. G = corporate governance risk score, S = social risk score, E = environmental risk score. Excess return is returns above the CAPM required returns

shows that institutional investors can manage systematic ESG risks, rather than individual ESG risks when optimizing a portfolio.

The theoretical model is presented in Eq. 4 and the implementation for the S & P500 stocks and Nasdaq100 are presented in Eqs. 5 and 6, respectively.

$$\beta Si = 0.86 + 0.013(Ei) - 0.023(Si) + 0.044(Gi) \tag{5}$$

T stat (6.94) (1.98) (-2.51) (3.52).
F = 5.18, R^2=0.17

$$\beta Si = 0.93 + 0.004(Ei) - 0.003(Si) + 0.042(Gi) \quad (6)$$

T stat (6.27) (0.57) (-2.35) (2.09).

F = 3.56, $R^2 = 0.15$.

Equations 5 and 6 indicate that S and G influence the systematic risk "Beta" in the same direction for S & P500 and Nasdaq100 stocks, G positive and S negative. This important finding indicates that the "Beta" risk factor not only fails to capture the social risk embedded in a firm's operations, but it falls when social risk is growing. These results add knowledge to Giese et al. (2019) who concluded that the traditional systematic risk factor contains ESG risks information. Since in this article we proved that excess return is negatively related to social risk, an important implication is that the traditional "Beta" is unable to capture an important aspect of risk and therefore a new "Beta" should evolve to adjust to this important risk factor. Equations 5 and 6 also point out that while E is positively affecting "Beta" for the S & P500 stocks, it does not do the same for Nasdaq100 stocks. These findings may be a result of the nature of S & P500 industrial polluting firms compared to the more environmentally friendliness of the technological sectors. Like Jin (2022), we also show that the traditional "Beta" does not capture social risks for all the examined firms and environmental risks for Nasdaq100 stocks. Moreover, the traditional "Beta" decreases with social risks while it should have been the opposite. These results indicate that corporate governance should be separated from the total ESG measurements and that it is embedded in the traditional "Beta", and that environmental and social risks should be considered separately in the process of constructing optimal portfolios.

5 Summary and concluding remarks

The following research has analyzed the linkage between ESG sustainability scores to the firm's valuations. The growing public interest in sustainability issues is growing fast and more and more parts of the investing industry take seriously sustainability issues into their consideration. We provide evidence that the total ESG score is diminishing for the S & P500 firms from 2019 to 2021 meaning that these risks factor take their rightful place in the global economy. Moreover, we documented a size negative impact on the E risk score meaning that the larger the firm is it is more concerned with the environmental aspects of its operations. On the other hand, excluding 2019 for the S & P500 stocks, the impact of environmental risks on the firm's valuation is not significant enough. Moreover, we found that while the "Beta" risk factor of the S & P500 carries environmental risks, it does not hold those risks for Nasdaq100 stocks. Although the environmental impact of the industrial S & P500 firms is perceived as more damaging, in our view, the bad influence of the technological sector is underestimated. Therefore, we recommend strengthening environmental education to investors and other financial industry participants declaring clearly that firms that harm the environment should suffer a lower valuation compared to firms that take actions to lower their environmental burden. This research also provides evidence that social risk impact negatively the simple excess return for both the S & P500 and nasdaq100 stocks indicating that social issues must be mitigated in order to maximize a firm value. Moreover, we find that the traditional CAPM "Beta" carries environmental and corporate governance risks for the S & P500 stocks. However, it totally neglects social risks and therefore it cannot be used in modern ages where social risks are very important to all participants of the global economic environment. This paper and others have pointed up

that a new era in the financial market has started. Investors are more aware of ESG issues and demand actions to mitigate the risks associated with them. Moreover, firms that invest funds mitigating environmental and social risks will be rewarded by public sympathy and eventually higher stock valuations. Future research should examine the impact of specific environmental issues such as carbon emissions and social issues such as gender equality and employee salaries on stock returns.

References

Avramov D, Cheng S, Lioui A, Tarelli A (2022) Sustainable investing with ESG rating uncertainty. J Financ Econ 2:145. https://doi.org/10.1016/j.jfineco.2021.09.009

Baohua L, Sun PY, Zeng Y (2020) Employee-related corporate social responsibilities and corporate innovation: Evidence from China. Int Rev Econ Financ 70:357–372

Berg F, Kölbel JF, Rigobon R (2022) Aggregate confusion: the divergence of ESG ratings. Rev Financ 26(6):1315–1344

Chen Z, Xie G (2022) ESG disclosure and financial performance: Moderating role of ESG investors. Int Rev Financ Anal. https://doi.org/10.1016/j.irfa.2022.102291

Christensen DM, Serafeim G, Sikochi A (2022) Why is corporate virtue in the eye of the beholder? the case of ESG rating. Account Rev 97(1):147–175

Cornell B (2021) ESG preferences, risk and return. Eur Financ Manag 27(1):12–19

Ding W, Levine R, Lin C, Xie W (2021) Corporate immunity to the COVID-19 pandemic. J Financ Econ 141(2):802–830

Eccles, R., Ioannou, I., & Serafeim, G. (2012, January 6). Is sustainability now the key to corporate success? *The Guardian*. Retrieved from https://www.theguardian.com/sustainable-business/sustainability-key-corporate-success.

Elkington J (1997) Cannibals with forks: the triple bottom line of 21st century business. Capstone Publishing Ltd, Oxford

Filbeck A, Filbeck G, Zhao X (2019) Performance assessment of firms following sustainalytics ESG principles. J Invest 28(2):7–20

Garcia AS, Mendes-Da-Silva W, Orsato RJ (2019) Corporate sustainability, capital markets, and ESG performance. In: Mendes-Da-Silva W (ed) Individual Behaviors and Technologies for Financial Innovations. Springer, Berlin

Giese G, Lee LE, Melas D, Nagy Z, Nishikawa L (2019) Foundation of ESG investing: How ESG affects equity valuation, risk, and performance. J Portf Manag 45(5):69–83

Griffin JM, Lemmon ML (2002) Book to market equity, distress risks and stocks return. J Financ 57(5):2317–2336

Hsu YL, Liao LK (2022) Corporate governance and stock performance: the case of COVID-19 crisis. J Account Public Policy 41:4

Jin I (2022) Systematic ESG risk and decision criteria for optimal portfolio selection. J Portf Manag 48(10):206–225

Kawaguchi, M. (2017, June 6). *The Evolution of ESG Investing: from Ethical Concern to Corporate value*. The Tokyo Foundation for Policy Research. Retrieved from https://www.tkfd.or.jp/en/research/detail.php?id=407

Khalid F, Razzaq A, Ming J, Razi M (2022) Firm characteristics, governance mechanisms, and ESG disclosure: how caring about sustainable concerns? Environ Sci Pollut Res 29:82064–82077. https://doi.org/10.1007/s11356-022-21489-z

Lee DD, Faff RW, Rekker SAC (2013) Do high and low-ranked sustainability stocks perform differently? Int J Account Inf Manag 21(2):116–132

Li Z, Liao G, Albitar K (2020) Does corporate environmental responsibility engagement affect firm value? The mediating role of corporate innovation. Bus Strateg Environ 29(3):1045–1055

Lioui A, Tarelli A (2022) Chasing the ESG factor. J Bank Financ 139:106498

Lo SF (2010) Performance evaluation for sustainable business: a profitability and marketability framework. Corp Soc Responsib Environ Manag 17:311–319

Maiti M (2021) Is ESG the succeeding risk factor? J Sustain Financ Invest 11(3):199–213. https://doi.org/10.1080/20430795.2020.1723380

Montiel I (2008) Corporate social responsibility and corporate sustainability: separate pasts, common futures. Organ Environ 21(3):245–269

Morioka SN, Bolis I, Evans S, Carvalho MM (2017) Transforming sustainability challenges into competitive advantage: multiple case studies kaleidoscope converging into sustainable business models. J Clean Prod 167:723–738
Morioka SN, Bolis I, Carvalho MM (2018) From an ideal dream towards reality analysis: proposing sustainable value exchange matrix (SVEM) from systematic literature review on sustainable business models and face validation. J Clean Prod 178:76–88
Nizam E, Ng A, Dewandaru G, Nagayev R, Nkoba MA (2019) The impact of social and environmental sustainability on financial performance: a global analysis of the banking sector. J Multinatl Financ Manag 49:35–53
Ortiz-de-Mandojana N, Bansal P (2016) The long-term benefits of organizational resilience through sustainable business practices. Strateg Manag J 37(8):1615–1631
Rubbaniy, G., Ali.S., Siriopoulos. C., Samitas, A. (2021). Global Financial Crisis, COVID-19, Lockdown, and Herd Behavior in the US ESG Leader Stocks. SSRN: https://ssrn.com/abstract=3868114 or http://dx.doi.org/https://doi.org/10.2139/ssrn.3868114
Schaltegger S, Beckmann M, Hansen EG (2013) Transdisciplinary in corporate sustainability: Mapping the field. Bus Strateg Environ 22(4):219–229
Schiemann F, Tietmeyer R (2022) ESG controversies ESG disclosure and analyst forecast accuracy. Int Rev Financ Anal. https://doi.org/10.1016/j.irfa.2022.102373
Schönherr N, Findler F, Martinuzzi A (2017) Exploring the interface of CSR and the sustainable development goals. Trans Corp 24(3):33–47
Schramade W (2017) Investing in the UN sustainable development goals: opportunities for companies and investors. J Appl Corp Financ 29(2):87–99
Serafeim G, Yoon A (2022) Stock price reactions to ESG news: the role of ESG ratings and disagreement. Rev Acc Stud. https://doi.org/10.1007/s11142-022-09675-3
Stotz O (2021) Expected and realized returns on stocks with high- and low-ESG exposure. J Asset Manag 22:133–150. https://doi.org/10.1057/s41260-020-00203-z
Sullivan R, Gouldson A (2017) The Governance of corporate responses to climate changes: an international comparison. Bus Strateg Environ 26(4):413–425
Topple C, Donovan JD, Masli EK, Borgert T (2017) Corporate sustainability assessments: MNE engagement with sustainable development and the SDGs. Trans Corp 24(3):61–71
van der Beck P (2021) Flow-Driven ESG Returns. Swiss Financ Inst Res Paper No. https://doi.org/10.2139/ssrn.3929359