

## RESEARCH ARTICLE

# The impact of ESG factors on financial efficiency: An empirical analysis for the selection of sustainable firm portfolios

Gianpaolo Iazzolino<sup>1</sup>  | Maria Elena Bruni<sup>1</sup>  | Stefania Veltri<sup>2</sup>  |  
Donato Morea<sup>3</sup>  | Giovanni Baldissarro<sup>1</sup>

<sup>1</sup>Department of Mechanical, Energy and Management Engineering, University of Calabria, Rende, Italy

<sup>2</sup>Department of Business Administration and Law, University of Calabria, Rende, Italy

<sup>3</sup>Department of Mechanical, Chemical and Materials Engineering, University of Cagliari, Cagliari, Italy

## Correspondence

Donato Morea, Department of Mechanical, Chemical and Materials Engineering, University of Cagliari, Via Marengo, 2, Cagliari 09123, Italy.  
Email: [donato.morea@unica.it](mailto:donato.morea@unica.it)

## Abstract

Environmental, Social, and Governance (ESG) factors are increasingly at the center of corporate and investment decisions. In this context, the aim of the paper was to test whether ESG factors impact on financial efficiency of a sample of firms belonging to different European sectors. This study enriches the literature of the field through a multi-sectoral analysis. The Data Envelopment Analysis was used as widely considered in empirical and financial studies. Research findings showed that ESGs impact on firm efficiency differently over sectors: some of them are more sensitive than others to ESG factors. Furthermore, for most sensitive sectors the risk-return characteristics related to ESGs were represented in order to provide insights for investors aiming to construct efficient and sustainable firm portfolios to invest in.

## KEYWORDS

DEA, ESG, financial efficiency, financial sustainability, multi-sectoral analysis, risk-return relationship

## 1 | INTRODUCTION

The growing concerns about climate change, geopolitical instability and uncertainty in financial markets have transformed the concept of sustainability into a concern for many institutional and private investors. The new sustainability paradigm, based on respect for and control of Environmental, Social, and Governance (ESG) factors, is increasingly at the center of corporate and investment decisions (Durand et al., 2019).

The concept of ESG was first introduced in 2006, in the United Nations Principles for Responsible Investment (UNPRI) report. Since that year, numerous non-governmental organizations and institutions began to promote ESG information disclosure and evaluation. Also, governments have enacted laws, regulations, and policies related to ESG, as evidenced by the non-financial reporting directive issued by the European Union (EU) in 2014, which stipulated that non-financial

information disclosure of large enterprises should cover ESG issues (Liu et al., 2022).

In 2018, global assets managed with sustainability criteria have grown exponentially to reach \$31 trillion (Lanza et al., 2020). As of March 2020, 3826 institutions worldwide have joined the Principles of Responsible Investment and consider ESG issues during decision-making processes, compared to 734 in 2010 (Yuan et al., 2022).

Environmental, social, and governance has radically changed corporate strategies that have switched from pursuing the more traditional profit logic to maximizing social interest, taking into account environmental protection, social responsibility, and corporate governance policies. Companies that have shifted their focus to ESG factors, and thus have a greater awareness of sustainability, are able to create new virtuous approaches to business. ESG issues have become a topic of interest also for shareholders, and governments as they reflect a risk management issue, while for companies they have



become an integral part of competitive strategy, especially since the Covid-19 pandemic (Manabe & Nakagawa, 2022).

In the literature, ESG dimensions are used in Corporate Social Responsibility (CSR) studies to investigate their effect on corporate profitability and value creation and in Social and Responsible Investing (SRI). This is the focus of our article, as a proxy for the investment strategy that integrates ESG concerns with financial objectives into investment decision-making (La Torre et al., 2021).

However, as ESG focuses more on the non-financial areas of corporate management, its impact on Corporate Financial Performance (CFP) is not unique and consolidated (Nirino et al., 2021). In fact, on the one hand, some studies believe that ESG enhances stakeholders' confidence in the company and reduces the cost of financing and consequently improves CFP (Friede et al., 2015). ESG could lead to better profits and market value also enhancing employee productivity and teams' management capabilities (Branco & Rodrigues, 2006), improving corporate reputation or reducing reputational risks (Chen, Hasan, et al., 2021; Dhaliwal et al., 2011; Zumente & Jūlija, 2021). On the other hand, other studies argue that ESG activities may reduce a company's cash flow, thus reducing CFP (Duque-Grisales & Aguilera-Caracuel, 2021).

Existing researches on the ESG-CFP association results are ambiguous, inconclusive, and contradictory (Pham et al., 2022), and a likely explanation of these mixed results could be related to the CFP and ESG performance measures as well as to the methods used. Generally, the current studies on the association between ESG and CFP relied on measures of corporate performance as financial or market output performance, such as earnings, revenues, Return On Equity (ROE), Return On Investment (ROI), market value, Tobin's Q, and so forth. There are few researches that use alternative measure beyond account-based and market-based measures, such as value-based metrics (La Torre et al., 2021), or measuring firm performance with operating, input performance, highlighting a literature gap (Pham et al., 2022). In our study, we want to cover this gap by measuring the corporate performance with the financial and market efficiency, not using simple financial or market ratios, but instead using two inputs and three outputs to arrive at a throughout value by employing Data Envelopment Analysis (DEA) methodology, consistently with Pham et al. (2022). Furthermore, DEA methodology allows us to overcome the problems that could be caused by a potential reverse causality relationship between ESG and CFP. In other words, interpreting the causal issues of ESG and corporate performance from the perspective of inputs and outputs may be more meaningful, as this approach enables us to truly understand the differences in the efficiency of a company's input resources in terms of ESG and profitability (Gillan et al., 2021; Lu et al., 2023). For this reason, in this study, we introduce the DEA model to measure the CFP.

Differently from other studies using DEA to measure CFP (Bruna et al., 2022; Lu et al., 2023), our study is original as: (a) it does not use DEA as a first step to find a CFP measure to be used in a regression model able to investigate the ESG-CFP association; instead we use

DEA to integrate ESG with CFP to figure out if including ESG into corporate efficiency leads to more efficient investment decision making; (b) unlike the majority of other papers on the ESG-CFP association, it does not consider that including ESG in investment decision is better or worse in general terms, but that it depends on the ESG sensitivity of the different sectors. ESG performance thus matters only for those sectors characterized by a high sensitivity to ESG.

Since the ESG performance varies across industries (Yuan et al., 2022), our paper enriches the ESG literature showing which industries are most sensitive to ESG issues. The aim of the research is to test whether ESG factors impact on financial performance of a sample of firms belonging to different European sectors. Specifically, a comparative multi-sector analysis on a sample of 1979 listed European Companies from the different industry sectors (Energy, Financial, Healthcare, Industrials, Materials, Consumer, and Technology) of the Thomson Reuters Business Classification (TRBC) classification, is provided. The dataset consists of financial and sustainability indicators, extracted from Refinitiv Eikon, and also risk indicators (ESG Risk) extracted from Sustainalytics. All data refer to the year 2021. In this context, companies do not pay equal attention to each of the three ESG pillars. The companies that are more concerned with environmental performance score higher on the Environmental (E) pillar, while companies with a greater focus on social responsibility score higher on the Social (S) pillar than on the pillars E and Corporate Governance (G) (Amel-Zadeh & Serafeim, 2018). Therefore, in order to bypass these differences, which could negatively affect the results, it was decided to use Refinitiv's ESG score calculated as the arithmetic mean of the score of each of the three pillars.

From a methodological point of view, the DEA was used. It is one of the most used methodologies used to comparatively assess the performance of different companies and a technique widely considered in empirical and financial studies. DEA provides an evaluation of the so-called financial efficiency of a firm, measured by input/output ratios when multiple inputs and outputs are considered. In this respect, DEA provides a robust way of comparatively assessing the financial performance of firms through efficiency scores, and allows to objectively identify the best practitioners and the position of each company with respect to those ones, simultaneously considering different outputs and inputs.

Results show that ESGs impact differently on firm efficiency over sectors. In particular, some of them are more sensitive than others to ESG factors. Moreover, for sectors more sensitive it was represented the risk-return characteristics related to ESGs in order to provide insights for investors aiming to construct efficient and sustainable firm portfolios to invest in. In fact, since financial markets crashed in late February 2020, investors have especially demanded low-ESG risk funds and discarded the high-risk ones (Ferriani & Natoli, 2021).

The paper is organized as follows. Section 2 reviews the literature in the field. Section 3 describes the methodology and data set used. Section 4 contains the empirical results and discusses the same. Finally, Section 5 concludes the paper, highlighting the limitations of the research as well as future research directions.

## 2 | LITERATURE REVIEW AND RESEARCH QUESTIONS

ESG factors are topics of growing interest at an international level (Galletta et al., 2022). The strand of scientific research evaluating the impact of ESG factors on a company's Financial Performance (FP) has been enriched in recent years with a multiplicity of studies and empirical models. However, there is still little clarity regarding the link between ESG and FP, as empirical results are not unique (Rahi et al., 2022). In particular, some studies (Azmi et al., 2021; Bruna et al., 2022; De Lucia et al., 2020) showed that there is a positive relationship between ESG and FP, albeit nonlinear.

Specifically, Fulton et al. (2012) examine more than 100 academic studies on sustainable investments from around the world and shows that 85% of the studies emphasize a nonlinear but positive correlation between FP and ESG strategies. Brogi et al. (2022) proposed a model to support the inclusion of ESG factors in banks' risk assessment of firms and showed that increased ESG awareness is strongly and very significantly associated with improved solvency and reduced credit risk of firms. Agoraki et al. (2023) demonstrated that European firms with lower ESG reputational risk are less financial constrained and perform better.

In contrast, Rahi et al. (2022) find a negative relationship between ESG practices and FP, expressed through Return On Invested Capital (ROIC), ROE, and Earnings Per Share (EPS). In some cases, no significant correlation has been found between ESG scores and profitability or firm value (Atan et al., 2018), as well as Guenster (2012) and Humphrey et al. (2012a) revealed that a CSR-related investment strategy does not significantly affect risk or return. Lahouel et al. (2021) showed that Corporate Social Performance (CSP) has a negative and significant impact on FP.

In this climate of ambiguity, the only view of common agreement between the two strands of literature has its basis on the fact that investing too much on ESG factors has a negative impact on financial performance, as it unbalances the corporate financial structure (Pacelli et al., 2022).

Halbritter and Dorfleitner (2015), with their application, found that ESG portfolios do not show significant performance differences between companies with high and low ESG rating levels; the same for Azmi et al. (2021). Results obtained by Rojo-Suárez and Alonso-Conde (2023) are consistent with the theory according to which ESG strategies determine only transitory effects on the cost of equity and the market value of firms.

Di Tommaso and Thornton (2020) showed that low levels of ESG activity positively affect bank value, but high levels of ESG activity show diminishing returns to scale and are associated with a modest reduction in bank value, and pointed out that the lack of a relationship between ESG activity and the cost of debt suggests that higher ESG activity does not reduce the risk of bank default. Yeh et al. (2022), studying Taiwanese banks efficiency by using the DEA, found that the two factors that mainly influence efficiency are governance and innovation. The study on banks of Forgione et al. (2020) found that a high

level of activity in the social and environmental dimensions of CSR are associated with a low level of efficiency.

Pham et al. (2022) used the DEA in the transportation industry and found that environmental and social score positively impact business performance while governance score negatively affects business performance. Lu et al. (2023) investigated Apple Inc.'s value-chain counterparts by also using DEA and found that ESGs affect firm efficiency, even if the influence is more on eco-efficiency than on profitability efficiency.

Cek and Eyupoglu (2020) found that social and governance performance positively affect economic performance while environmental performance does not show a significant relationship with economic performance.

The relationship between ESG performance and FP was also explored by Bruna et al. (2022) by using a time-lagged panel regression model on a sample of 350 European listed companies observed from 2014 to 2019. The authors found a positive and significant impact of ESG performance on FP when a mandatory extra-financial disclosure regime is in force. De Lucia et al. (2020) conducting a study of 1038 public companies based in Europe, using a combined approach of machine learning techniques and an interferential model (ordered logistic regression) found the existence of a positive relationship between ESG practices and financial indicators (Return On Assets (ROA) and ROE). Atan et al. (2018), conducting a study of a panel of Malaysian firms, found no significant relationship between single and combined ESG factors and firm profitability (i.e., ROE) and firm value (i.e., Tobin's Q). La Torre et al. (2021) studied the link between ESG factors and financial benchmarks in the bank sector by using accounted-based indicators (ROA and ROE), market-based indicators (Market to Book value, Tobin's Q) and furthermore value-based metrics (EVA spread).

This trend has developed because investors are increasingly looking for stable risk-return profiles. Indeed, there are many studies showing that sustainable investments lead to risk-adjusted market returns that are often higher than those obtained using traditional financial models (Chen, Zhang, et al., 2021; Ouchen, 2022).

In addition to provide assessments of corporate performance, on ESG issues, they strive to reduce information asymmetries and help stakeholders assess the nature of corporate ethics and sustainability (Cappucci, 2018).

It is clear that sustainable growth can happen if and only if all global corporations take responsibility for environmental safeguard activities, including low carbon emissions, green energy, and climate risk mitigation, and if all this is accompanied by adequate financing and investment for relevant projects that ensure better financial performance for corporations (Zhang & Lucey, 2022). In fact, during this transition process companies may face financial constraints that will reduce available financial capital, and only "green" financing will ensure their economic performance (Zhou et al., 2016).

The aim of this study is to provide empirical evidence for the effect of ESG score on financial performance of companies operating in different sectors in Europe, enriching the literature on multi-sectoral analysis.



As mentioned above, there are many studies in the literature that examine the relationship between ESG and financial performance, but only a few conduct a multi-sectoral analysis (Pacelli et al., 2022; Serban et al., 2022). Some of these studies focus on analyzing the relationship in specific countries (Humphrey et al., 2012b; Kim et al., 2013), others on specific sectors (Abdi et al., 2022; Uyar et al., 2020; Zhao et al., 2018).

With the aim of investigating whether ESG performance can be considered as a driver for improving corporate financial performance measured in terms of efficiency and as a way for building efficient and sustainable investment portfolios, we formulate the following research questions (RQ).

1. RQ1: Do ESG factors improve the overall efficiency of companies? Which sectors are most sensitive to ESG factors?
2. RQ2: What are the characteristics of the different sectors in terms of risk-return from the investor perspective of constructing an efficient and sustainable firm portfolio to invest in?

### 3 | THE EMPIRICAL RESEARCH

In this section, the empirical research is described. The methodology and data used are illustrated.

#### 3.1 | Methodology

As it can be seen from the literature review, different methodologies are employed in the empirical articles. In this paper, to investigate the association between ESG scores and firm performance/risk, we use DEA, a nonparametric approach, widely studied and used in many empirical applications (Stefanoni & Voltes-Dorta, 2021), which addresses the comparative evaluation of processes with multiple inputs and outputs of different Decision-Making Units (DMUs) (Belù, 2009) by means of linear programming.

Data envelopment analysis, used to assess the efficiency and inefficiency of a group of companies, allows us to obtain a synthetic index through which it is also possible to estimate how far inefficient companies are from the frontier that defines efficiency (Bruna et al., 2022).

Data envelopment analysis has been widely used for financial applications (Abreu et al., 2019; Bruni et al., 2014). At the same time, the use of DEA to measure the impact of ESG factors on corporate financial efficiency is still under-researched (Petridis et al., 2022). Xie et al. (2019) examining the effect of ESG on corporate efficiency, calculated with DEA, found that ESG disclosure has a positive association with corporate efficiency at the moderate level of disclosure, rather than at the high or low level of disclosure. We mention a few other studies that used the DEA to investigate the impact of ESGs on efficiency (Alam et al., 2022; Stefanoni & Voltes-Dorta, 2021).

The model proposed by Charnes et al. (1978), or CCR model, is the one used by us to develop the empirical analysis.

In our DEA model, we have considered two inputs:

1. Total Assets;
2. Total Equity;

and three outputs:

1. Earnings Before Interest Tax Depreciation Amortization (EBITDA);
2. Revenues;
3. ESG scores.

The Refinitiv's ESG score, calculated as the arithmetic mean of the score of each of the three pillars, was used since companies do not pay equal attention to each of the three ESG pillars (E, S, and G) (Amel-Zadeh & Serafeim, 2018).

Since we want to assess the impact of ESG scores on business efficiency, ESG is firstly excluded and after included, so we compare efficiency without ESG and efficiency with ESG. In order to answer the RQ1, we first set a threshold = 0.6 (which constitutes the threshold of sufficiency) on efficiency with ESG to select for each sector the companies with a high efficiency (efficiency greater than the threshold). Next, for selected companies in each sector, we calculated a gap between efficiency with ESG and efficiency without ESG and analyzed its average value to understand in which sectors ESG scores impact more on efficiency values. After this analysis, to address the RQ2, we changed our point of view by moving to the side of an investor who has to make investment decisions with the goal of building an efficient and sustainable portfolio. At this stage, we focused only on companies in the sectors that are most sensitive to ESG factors. The risk-return relationship was evaluated by assuming that efficiency values (with ESG) are indicators of return, while ESG risk is an indicator of risk.

#### 3.2 | Sample and data

The Thomson Reuters Refinitiv Eikon database which is considered one of the most accurate and reliable sources of ESG information (Drago et al., 2019), was used to collect all the data. ESG scores have high informative power and their application is widespread in the financial sector (Pacelli et al., 2022). Refinitiv covers more than 4500 companies worldwide and scores each company by considering three pillars: E, S, G. Furthermore, it contains also economic data and information. For industry categories, we used the Thomson Reuters Business Classification (TRBC) (Industry category) (Figure 1). Covering over 250,000 securities in 130 countries to 5 levels of granularity, the Refinitiv Business Classifications (TRBC) is the most comprehensive, detailed, and up-to-date sector and industry classification available ([www.refinitiv.com](http://www.refinitiv.com)). We considered the more recent available data (year 2021).

As it can be seen from the Table 1, we employed data from 1979 listed European Companies, for a total of 9895 observations in 2021.

**FIGURE 1** Thomson Reuters Business Classification (TRBC).  
Source: Authors' elaboration.

Economic Sector	Business Sector	Industry Group
Energy	Energy-Fossil Fuels	Coal
		Oil & Gas
	Oil & Gas Related Equipment and	
Materials	Renewable Energy	
	Uranium	
	Chemicals	
Industrials	Mineral Resources	Metals & Mining
	Applied Resources	Paper & Forest Products
	Industrial Goods	
Consumer Cyclical	Industrial & Commercial Services	
	Transportation	
	Automobiles & Auto Parts	Textiles & Apparel
Consumer Non-Cyclicals	Cyclical Consumer Products	Homebuilding & Construction Supplies
		Leisure Product
	Cyclical Consumer Services	Hotels & Entertainment Services
Financials	Retailers	Media & Publishing
	Food & Beverages	Beverages
		Food & Tobacco
Healthcare	Personal & Household Product Service	
	Food & Drug Retailing	
	Consumer Goods Conglomerates	
Technology	Banking & Investment Services	Banking Services
	Insurance	
	Investment Holding Companies	
Utilities	Healthcare Services & Equipment	Healthcare Equipment & Supplies
	Pharmaceuticals & Medical Research	Pharmaceuticals
	Technology Equipment	
Real Estate	Software & IT Services	
	Financial Technology (Fintech) &	
	Telecommunication Services	Electrical Utilities & IPPs
Institutions, Associations & Government Activity		
Academic & Educational Services		

**TABLE 1** Data.

Sectors (Europe)	No. companies	No. observations
Energy	90	450
(Basic) Materials	190	950
Industrials	463	2315
Consumer (Cyclicals and Non-Cyclicals)	494	2470
Financials	207	1035
Healthcare	153	765
Technology	315	1575
Utilities	67	335
Total	1979	9895

Source: Authors' elaboration.

In addition, we extracted ESG Risk values, defined by the European Banking Authority (EBA), as the negative materialization of ESG factors (EBA, 2021), from the Sustainalytics database ([www.sustainalytics.com](http://www.sustainalytics.com)). Sustainalytics' ESG Risk Rating has a focus on financial materiality: it measures the degree to which a company's enterprise value is exposed to material ESG issues, by reflecting the relevance of each ESG issue in each company's unique context within its subindustry (Folqué et al., 2021). In detail, Sustainalytics' ESG Risk Ratings measure a company's exposure to sector-specific material ESG risk and how well a company is managing those risk. In particular, Pillar E risks are the most important and can be broken down into two macro-categories:

1. Physical risks (caused by adverse weather events);
2. Transition risks (the shift to a green economy brings with it economic and social consequences).

These two risk categories directly impact on the value of tangible and intangible assets. Pillar S risks can have a very negative impact on the economy and corporate reputation. Pillar G risks are very significant, as an inadequate code of conduct or failure to act against money laundering can very negatively affect the ability to generate positive returns (EBA, 2021). It can be identified five categories of ESG risk severity that could impact a company's enterprise value:

1. 0 to 10 Negligible risk;
2. 10 to 20 Low risk;
3. 20 to 30 Medium risk;
4. 30 to 40 High risk;
5. 40 to 50 Severe risk.

## 4 | RESULTS AND DISCUSSION

The empirical analysis was carried in two steps, corresponding to the two RQs introduced in Section 2.

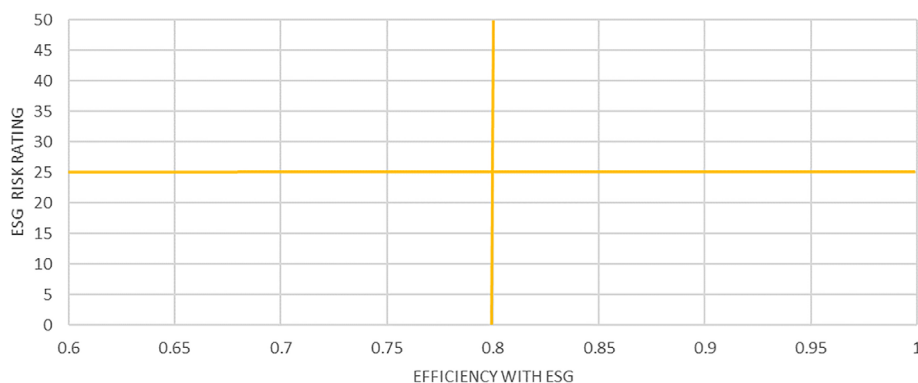
As far as the RQ1 is concerned, from the analysis of the results reported in Table 2, it is evident that some sectors show a higher average gap than other sectors.

Detailed tables (Table 1A, Table 2A, Table 3A, Table 4A, Table 5A, Table 6A, Table 7A, Table 8A) with the data of the sectors considered are reported in the Appendix.

**TABLE 2** Gap values.

	Energy	Financial	Healthcare	Industrial	Materials	Consumer	Technology	Utilities
GAP	18.66%	5.11%	4.10%	3.71%	11.92%	13.41%	9.21%	5.35%

Source: Authors' elaboration.

**FIGURE 2** Chart risk-return. Source: Authors' elaboration.

In particular, the following points can be observed.

- ESG has a different impact depending on the sector being considered, and this shows that there are sectors that are more sensitive and others less sensitive to ESG factors. This result is in line with other works (Pacelli et al., 2022).
- The four sectors (i) Energy, (ii) Materials, (iii) Consumer and (iiii) Technology for which we find a high gap (>9%) are very sensitive to ESG factors. Indeed, the Energy sector (composed by Oil & Gas, Renewable Energy and Coal Companies) is highly sensitive especially from the environmental point of view. Companies belonging to this sector are under intense social and environmental vigilance due to the nature of their activities (Pacelli et al., 2022). In this context, the study by Serban et al. (2022) also shows the high impact of ESG scoring in this sector which is among the sectors that are leader in terms of sustainable practices.

Regarding the sector Materials, composed by companies producing chemicals, metals, minerals, and mining, the study by Madison and Schiehl (2021) points out the high sensitivity of the sector to ESG factors, especially to the E pillar. In addition, the study of Miralles-Quirós et al. (2018) showed that this sector is also sensitive to the S pillar.

The sector Consumer is sensitive to the three ESG pillars in a different way within its internal components. In fact, the E pillar is not highly significant, while the impact of the S pillar score is very strong (Chodnicka-Jaworska, 2021). This situation could be closely related to the type of companies that are part of this sector, namely food, personal products and drugs.

The Technology sector is very sensitive to the G pillar, that measures how well a company's systems and processes ensure that its board members and executives act in the best interests of long-term shareholders (Chodnicka-Jaworska, 2021). This result is in line with the work of Egorova et al. (2022) which

shows that Information Technology (IT) companies have one of the lowest scores in E-component and S-component compared to other industries.

For the purpose of providing an answer to RQ2, we comment on the final column of tables containing the data of the aforementioned four sectors (Tables 1A, 5A, 6A, 7A, in Appendix).

We represented each company in a chart, as shown in Figure 2, having on the two axes the following variables:

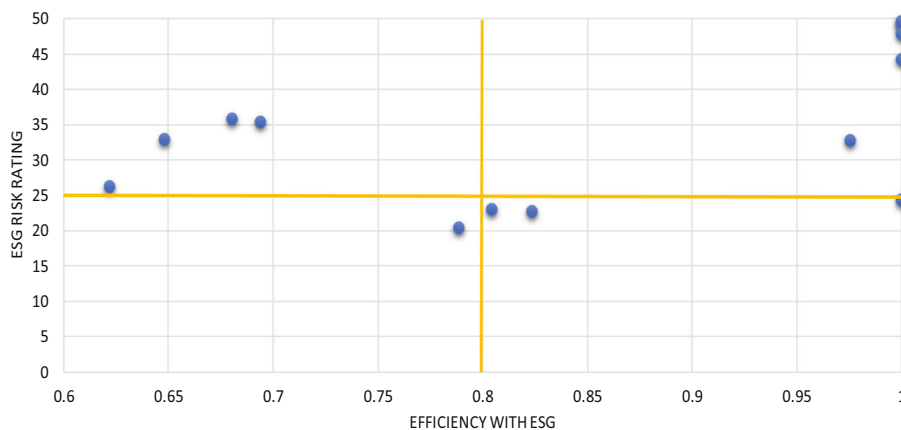
- x-axis: Efficiency (with ESG);
- y-axis: ESG risk.

The chart represents the “desirability” of each company from the perspective of a potential investor, such as a bank or institutional investor, who needs to select a portfolio of companies to invest in. The position of each company in the chart represents the “Risk-Return” pair of the investment in that company. In fact, we can consider that ESG Risk = Risk and Efficiency with ESG = Return.

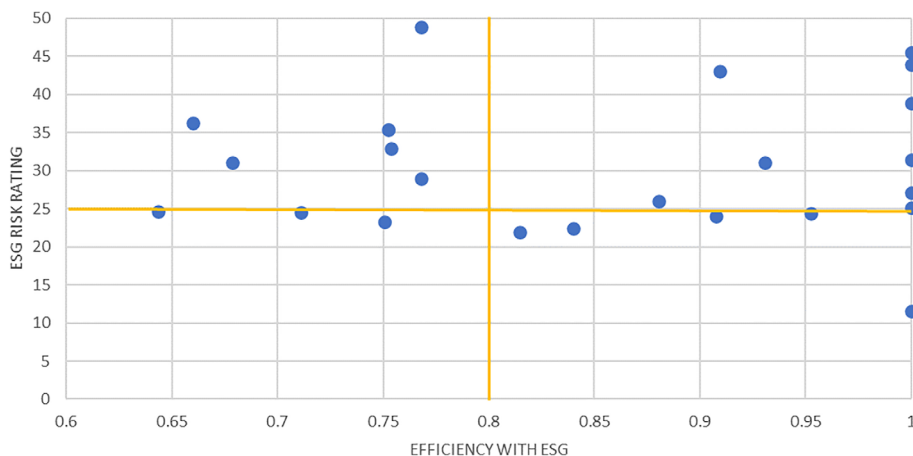
From the analysis of the charts for the aforementioned four sectors, the following conclusions can be drawn.

- Energy:** Figure 3 shows that many companies are in quadrants I and II, indicating that ESG risk is high for most companies. From the perspective of a potential investor who wants to take into account the right trade-off between risk and return, the choice would mostly fall on companies that are in quadrants III and IV (better). If the investor were interested more in return than risk, and thus in a speculative investment, the best choice might fall on the firms that are in quadrant I. Companies in the second quadrant should be not considered from a possible investment portfolio because they have low efficiency and high risk.
- Materials:** Figure 4 shows that in this sector 65% of the selected companies have risk values higher than the average (Egorova

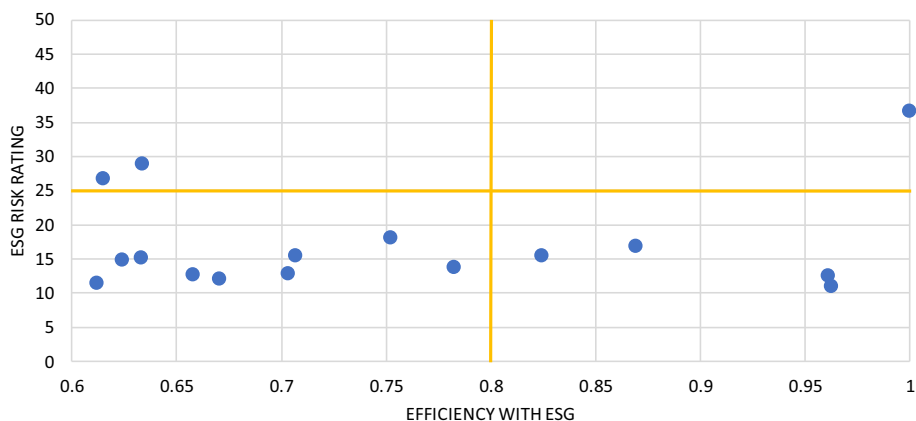
**FIGURE 3** Risk-return for sector energy. Source: Authors' elaboration.



**FIGURE 4** Risk-return for sector materials. Source: Authors' elaboration.



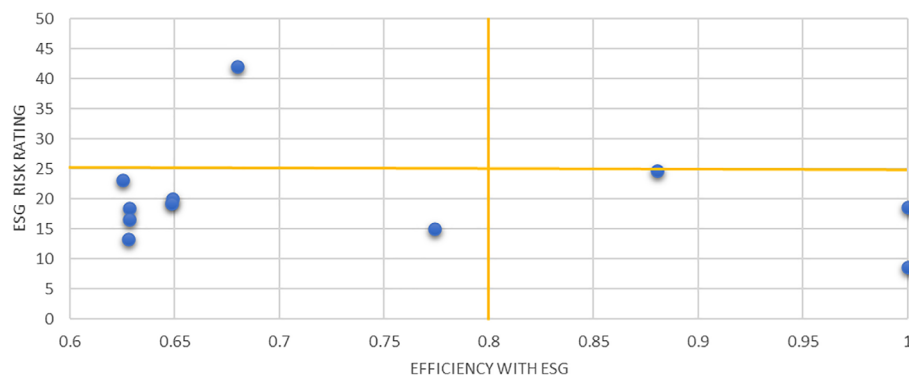
**FIGURE 5** Risk-return for sector consumer. Source: Authors' elaboration.



et al., 2022). Materials is the sector that contains the largest number of companies in the first quadrant, and this underlines that ESG has a very positive impact on efficiency (many values are equal to 1). From the perspective of a potential investor, the choice could fall both on companies in quadrant IV, but also on companies in quadrant I, which are an excellent alternative to build an appropriately differentiated portfolio.

3. *Consumer*: Figure 5 shows that 81% of the selected companies have ESG risk values below the mean value; henceforth, companies in this sector are less subject to ESG risks. The negative note

that emerges from the graphical representation is that 9 out of 16 companies are in quadrant III, that is, they have efficiency lower than the average value (0.8). So, even if the impact of ESG scores on efficiency is high, as it results from the gap, the values of efficiency do not increase so much when considering the ESGs. This can be explained from the fact that the number of companies belonging to the sector is very high (494 companies). In this case, from the perspective of a potential investor, the investor's choice could fall on both Quadrant IV and some companies in Quadrant III, particularly those with the efficiency values closest to the mean value.



**FIGURE 6** Risk-return for sector technology. Source: Authors' elaboration.

4. *Technology*: Figure 6 shows that in this sector quadrant I is totally empty, and thus there are no companies that have high values of both efficiency and risk. Specifically, in this sector 9 out of 11 companies have ESG risk values below the average value. Like the Consumer sector, this sector is little dependent on ESG risks. From the perspective of a potential investor, the choice could fall on companies in quadrant IV and III.

It can be seen that for the Energy and Materials sectors high efficiency values correspond to high risk, while the Technology and Consumer sectors have lower ESG risk. The Energy sector is characterized by high levels of ESG risk and this is plausible because it is a very environmentally sensitive sector as member companies are under intense social and environmental scrutiny due to the nature of their activities. For the Materials sector, our results suggest that the impact of ESG factors is very significant. In this context, the study of Miralles-Quirós et al. (2018) indicated that the materials sector is a socially sensitive industry and that improvement toward the firm's social rating will result in a financial benefit for the firms in this sector. Our results regarding the technology sector are in line with other studies (Belù, 2009) that highlight the fact that companies belonging to this sector are positively affected by the impact of sustainability-related factors on business efficiency scores. Regarding the Consumer sector, it is composed by two different subsectors, namely Consumer Cyclical and Consumer non-Cyclical. In particular, the Consumer Cyclical sector contains firms operating in the automobiles and auto parts, textile and apparel, household goods, hotels and entertainment, and other retailing businesses, whereas the Consumer non-Cyclical contain firms that operate in food and beverages, personal and household products and services as well as drug retailing (see TRBC, in Figure 1). There are specific aspects regarding this sector that make it difficult to draw clear indications on the impact of ESGs since this sector is composed by several, non-similar, groups of firms. As there are not previous studies regarding this sector with the ESG scores, it is difficult to make a comparative analysis against other studies.

In general, our results are in line with those obtained in most of other studies. However, they are in contrast to those obtained in the study by Serban et al. (2022), who, after conducting a sector analysis state that ESG score, have a high impact in the utilities sector, especially for small-cap companies. Instead, in our case the results suggest

that ESG scores do not significantly influence the efficiency values of companies belonging to this sector.

The remaining four sectors, namely: Financial, Healthcare, Industrial and Utilities, did not show a significant sensitivity to ESG factors.

## 5 | CONCLUSIONS, LIMITATIONS OF THE STUDY AND FUTURE RESEARCH DIRECTIONS

Environmental, social, and governance factors are of increasing interest to national and international institutions. It is becoming more and more evident for all the firms that, in addition to pursuing the more traditional logic of profit, it is also crucial to consider the impact on society and the environment, and that taking into account strategies related to climate change is as important as considering human capital development and corporate management policies.

Not only corporations but also financial institutions have recognized that their lending and investment operations affect the health of planet and have taken action to decrease financing projects that damage environment. Integrating environmental sustainability criteria into investment decisions and supporting the development of sustainable finance is required for different banking business models (Galletta et al., 2022).

The work was developed with a twofold objective: specifically, the primary objective was to assess how ESG factors impact business efficiency values in different sectors, while the secondary objective was to understand how efficiency with ESG and ESG Risk affect the construction of efficient and sustainable portfolios. In particular, using a sample of 1979 listed firms belonging a various industrial sector, it was calculated business efficiency value so taking into account both financial and sustainability factors. From the analysis of the gap, calculated as the difference between efficiency with and without ESG, we can say that ESGs impact on firm efficiency differently over sectors. Furthermore, it was provided empirical evidence for supporting the construction of efficient and sustainable portfolios by mapping sectors in terms of risk-return.

As for the limitations of our research, a first problem could be related to the subjectivity of the measures selected to assess firm performance, so future research could be carried out using different



inputs and outputs. In addition, future research could be conducted to identify which of the three ESG pillars mostly impacts on the relationship between ESG and financial performance by analyzing the impact of the three ESG pillars separately. One of the main issues we found during our research is that methodologies for assessing ESG scores are mainly immature: there are still no standardized methods, so policy actions are needed to make non-financial disclosure more transparent to investors and, likewise, to provide companies with generalized and unambiguous guidance for non-financial (i.e., ESG) reporting. Finally, a technical limitation that could be subject to further research is related to the value of the threshold that was fixed to 0.6 (sufficiency) in this study. Future research could be addressed to either consider all the companies belonging to the sample or fix a different value of threshold. Other research can consider a sensitivity analysis or different investigations on the industries belonging to the sample.

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## ORCID

Gianpaolo Iazzolino  <https://orcid.org/0000-0001-9756-1223>

Maria Elena Bruni  <https://orcid.org/0000-0002-3152-5294>

Stefania Veltri  <https://orcid.org/0000-0002-0747-7253>

Donato Morea  <https://orcid.org/0000-0003-0995-6685>

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