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ESG screening strategies and portfolio performance: how do they fare in periods of financial distress?

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Abstract

This paper analyses the impact of screening strategies based on ESG (Environmental, Social, Governance) scores, with a focus on periods of financial distress such as the 2008 global recession and the 2020 Covid-19 pandemic. To this end, negative and positive screening strategies based on Bloomberg ESG disclosure scores and different screening thresholds are set up from the 559 stocks belonging to the EURO STOXX index in the period 2007-2021. To compare ESG portfolios performance with a benchmark passive strategy, we compute risk-adjusted performance measures: the Sharpe ratio and the alphas resulting from both a one-factor model and the Carhart four-factor model. Three main results emerge. First, each single ESG dimension has a different role in determining performance: environmental and governance screens, and the combined ESG ones, generally lead to over performance, in contrast to the social screens. Second, ESG screens represent better performing strategies in the long-term, whereas, when the focus is on times of financial distress, the passive strategy appears to perform better and ESG portfolios do not seem to represent a safe haven. Finally, positive screening strategies, and in particular those based on the social dimension, limit diversification benefits and are characterized by significant underperformance during periods of crises. These results are useful to address ESG portfolio optimization and to gauge the role that finance may have in support of sustainable economic development.

Keywords: sustainable finance, Socially Responsible Investments (SRI), Environmental, Social, Governance (ESG), positive and negative screening strategies, portfolio performance

J.E.L. classification: C32, G01, G11, M14, Q01

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1. Introduction

In the latter decades, consideration of the environment and more generally sustainability has significantly increased also in finance where the attention was also spurred by the Action Plan for Financing Sustainable Growth (European Commission, 2018). As a consequence, professional investors have accelerated the integration of Environmental, Social and Governance (ESG) factors into their investment decisions also encouraged by the introduction of the Principles for Responsible Investment (PRI, 2017) and attracted by the opportunity to improve their business and risk management.

Prior to the outburst of ESG factors, socially responsible investments (SRI) developed in the early 2000s, with the aims to generate social and/or environmental value primarily with respect to financial performance. The focus on non-strictly financial aspects allows investors to increase their non-financial utility (Bollen, 2007; Benson and Humphrey, 2008; Renneboog et al., 2008), and it is referred to as the "psychic return" by Beal et al. (2005) and "psychic dividend" by Ainsworth et al. (2017), whereby the latter represents the minimum level of utility required to prefer the SRI to the non-SRI. Based on UK and US data between 2000 and 2015 Ainsworth et al. (2017) find that "psychic dividend" decreased during the years thus proving that investors require a lower non-financial compensation to choose the SRI asset.

Among SRI strategies, the so-called first generation ones are the negative screening strategies, which are based on exclusion of assets not in line with a SRI policy, while the second generation ones are the positive screening strategies, which essentially consist in selecting assets meeting high standards of social responsibility.[1] A more recent development of SRI consists in the integration of ESG dimensions into investment decisions. According to the Global Sustainable Investment Alliance this can be done in alternative ways: negative/exclusionary screening, positive/best in class screening, norms-based screening, sustainability themed investing, ESG integration, impact/community investing, corporate engagement and shareholder action. The two most widespread ones are the ESG integration strategy with $25.2 trillion in asset under management globally, and the negative/exclusionary screening strategy with $15.9 trillion in assets under management (GSIA, 2021).[2] The debate on the performance of the strategies recalled so far is inconclusive: on one hand evidence of higher profitability is motivated by the inclusion of financially stronger companies in the SRI portfolio, since responsible firms can rest on satisfied employees, a solid firm loyalty and are

[1] For an excellent review of the early literature on SRI see Renneboog et al. (2008).

[2] Overall, in 2020 total assets committed to sustainable and responsible investment strategies reached $12 trillion in Europe and $17 trillion in the United States. American sustainable assets grew by 95% from 2016 to 2020 while European sustainable assets remained quite stable, mainly because Europe has introduced stricter sustainability standards for sustainable finance products (Technical Expert Group, 2020).

less likely to be involved in environmental fines and lawsuits (e.g. Edmands, 2011; Herremans et al., 1993); on the other, SRI strategies could limit diversification benefits by reducing portfolio sizes (e.g. Girard et al., 2007; Ortas et al., 2014).

The aim of this paper is to investigate the impact on portfolio risk and return of screening strategies implemented according to ESG scores. To this end, we take a European benchmark index (EURO STOXX) to represent a passive strategy, and we set up different portfolios that improve the index ESG score as well as scores for each single E, S and G dimension. Such an improvement is obtained by means of both negative and positive screening strategies and considering different exclusion thresholds. Scoring rests on Bloomberg ESG scores, which assess firm's transparency on ESG issues. The risk-adjusted performance of the ESG screened portfolios is compared with the benchmark-passive one based on Sharpe Ratio and alpha. The analysis is performed over the period from 2007 to 2021 in order to include two periods of financial distress: 2008 global recession and 2020 Covid-19 pandemic, which are two most significant financial crises over all the EU.[3]

The present research contributes to SRI literature in three main directions. First, it computes portfolio risk-adjusted performance by means of two different measures: Sharpe Ratio and alpha resulting from both a one-factor model and the Carhart four-factor model. Second, the comparison of portfolio performance is tested also across periods of financial distress (i.e. the global recession and the Covid-19 crisis) so as to test the safe-haven property of ESG portfolios. Third, our screens are based on Bloomberg ESG disclosure score while the most existing studies use other scores such as those by Sustainalytics, Thomson Reuters or MSCI. This latter contribution is relevant given the current debate about the quality and divergence of different ESG scoring providers.

Three main results emerge. First, each single environmental, social and governance dimension has a different role in determining portfolio performance with respect to the benchmark passive portfolio: environmental and governance screens together with the combined ESG screens generally lead to over performance, in contrast to the social screens and results do not depend on the risk-adjusted measure used. Second, different time horizons and phases of the economic and financial cycle are associated to different results: over the entire 2007-2020 period, ESG screened portfolios outperform the benchmark in terms of both the Sharpe ratio and alphas, while during periods of financial distress this is not true and ESG portfolios do not seem to represent a safe haven. Finally, portfolio performance is driven also by the choice of the strategy and the screening threshold: negative screens overperform in the long-term, not in the shorter time spans of financial distress; positive

[3] In this connection, the European debt crisis (2010-2011) had a major effect in Greece, Ireland, France, Italy, Portugal, Spain, but not all over the EU.

screening strategies, and especially the ones that involve the social dimension, are characterized by significant underperformance during periods of crises possibly due to the limit to diversification benefits that positive screening imposes.

The paper is structured as follows. Section 2 proposes a literature review on SRI and in particular on the integration between SRI and ESG strategies. Section 3 illustrates the main characteristics of the dataset used and Section 3 describes the empirical approach implemented. Section 4 discusses results based on the Sharpe ratio and alpha, while Section 5 presents robustness tests based on alternative risk and performance measures. Finally, Section 5 concludes.

2. Literature Review

The literature on socially responsible investing (SRI) has been developing rapidly since the early 2000s and has been growing significantly in the recent years also spurred by the introduction of ESG issues into investment practice also in connection with financial market distressed as the one associated to Covid 19.

A first strand of literature investigates investors' preferences and attitudes towards investing in responsible assets. According to the literature review in Renneboog et al. (2008), most studies show that investors are willing to accept a lower return in exchange for social and sustainable objectives. Further, investors take non-strictly financial aspects into account during their decision-making process (Hong and Kacperczyk, 2009; Hong and Kostovetsky, 2012). Based on a survey conducted in the Netherlands, Bauer and Smeets (2015) find that social identification with responsible products play an important role in investment decision and Rossi et al. (2019) show that Dutch households are willing to accept a lower return when investing in SRI. Gutsche and Ziegler (2019) demonstrate a strong willingness to pay for sustainable responsible investments in Germany, in particular for certified products. Barreda-Tarrazona et al. (2011) highlight the role of information: individuals prefer investing in funds that explicitly inform about their SRI nature. Hartzmark and Sussman (2019) demonstrate that US mutual fund investors positively consider social and environmental issues since the demand for funds varies in relation to their sustainability ratings. Moreover, Jansson et al. (2014) underscores the role of socio-demographic factors: the willingness to invest in SRI is stronger among women and is positive correlated with the level of education and income.

A second strand of literature focuses on the performance of SRI funds compared to conventional ones without reaching a consensus. Revelli and Viviani (2015) argue that the heterogeneity in SRI financial performance could be attributed to different geographical area (e.g. Europe vs. US) in which different strategies are dominant and to the asset type (e.g. bonds vs. stocks). Likewise, contrasting results might depend on the specific type of SRI portfolio and on different ESG criteria used by the

fund (Hudson, 2006; Dimson et al., 2015). Moreover, another issue is the difficulty of isolating the SRI effect over the fund overall performance: Galema et al. (2008) demonstrate that when adopting Fama and French (1993) factor model, the book-to-market factor could incorporate some socially responsible features, resulting in an insignificant relationship between SRI and stock return. Capelle-Blancard and Monjon (2014), reviewing an extensive empirical literature on the financial performance of SRI mutual funds, conclude that most studies do not find a significant difference in risk-adjusted returns between SRI and conventional funds (for example Statman, 2000; Bauer et al., 2005; 2007; Renneboog et al., 2008; Derwall and Koedijk 2009). To be stressed that performance comparison at fund level may have many confounding effects such as management fees (Kempf and Osthoff, 2007).

A related and very recent strand of literature investigates the performance of SRI portfolios based on ESG screening strategies. Verheyden et al. (2016) implement negative screening using Sustainalytics ESG scores in the period from 2010 to 2015 and identifies a positive effect on performance due to a higher return and lower risk as measured by volatility, drawdown and CVaR. Moreover, although high exclusion thresholds may excessively alter the investment universe and undermine the improvements in risk-return, they find a minimal penalty in terms of portfolio diversification. Similarly, Alessandrini and Jondeau (2020) measure the impact of negative screening on both passive investments and smart beta strategies, based on ESG scores on MSCI ACWI Index over the period 2007-2018 and find that the ESG strategy does not reduce the risk-adjusted performance. Auer (2016) compares the performance of the STOXX Europe 600 index with several portfolios set up by applying negative ESG screening and using Sustainalytics scores in the period 2004-2012: he finds that adopting low exclusion threshold, investors can make socially responsible decisions without sacrificing financial performance and only the governance factor allows the investor to achieve significantly better performance than the traditional benchmark. The latter result supports the theory that good corporate governance brings both financial and non-financial benefits to the investor (Gompers et al., 2003). By contrast, Hübel and Scholz (2020) implement positive and negative screening strategies with different cut-offs based on Thomson Reuters EIKON ESG ratings on European stocks over the period 2003-2016, and find that firms with low environmental ratings outperform those with a higher rating. However, during the financial crisis, highly social companies perform better than less social companies.

Finally, the relevance of ESG dimensions spurred by the Covid-19 related financial markets stress attracted the attention of data providers and managers of responsible investment funds. For example, Morningstar refers to ESG investments as “equity vaccine” able to outperform other investments during the pandemic (Willis, 2020), and MSCI provides evidence of its four ESG-

oriented indices outperforming a broad market counterpart index during the coronavirus crisis (Nagy and Giese, 2020). Broadstock et al. (2021) use a novel dataset covering China's CSI300 constituents and find that high-ESG portfolios generally outperform low-ESG portfolios during times of Covid-19 financial crisis. Rubbaniy et al. (2021) show the safe-haven properties of ESG stocks during Covid-19 pandemic by finding a significant and positive co-movement between ESG indices from global and emerging markets and the global Covid-19 fear index (GFI) that has a high predictive power to measure the disease's severity and spread. By contrast, Pedini and Severini (2022) find that no ESG asset can be considered as a safe haven during the various crises considered over the period from January 2007 to November 2021. Further, Deners et al. (2021) show that US firms with a high ESG score did not experience a superior performance both during the first quarter of 2020 and considering the full year. Finally, Takahashi and Yamada (2021) examine the stock price reactions of Japanese firms during the Covid-19 outbreak and they do not find evidence that ESG scores lead to higher abnormal returns.

In sum, a few main gaps emerge in the SRI literature considering screening strategies. First, although its rapid growth, Auer (2016) argues the literature mainly covers the US market and rely on fund's alpha to evaluate risk-adjusted performance without considering other risk-adjusted measures based on total risk rather than the systematic component only. Second, a limited number of studies covers the governance dimension and the period analysed is on average three years.

To fill these gaps, the present study provides further evidence of ESG screening effects on portfolio performance based on: a European market investment set, a long period (2007-2021) that allows a focus on spans of financial distress (i.e. global recession of 2008 and Covid-19 pandemic of 2020), the use of risk-adjusted measures for both total risk and systematic risk (Sharpe ratio and alpha respectively).

3. Dataset and descriptive statistics

The asset universe of the present paper consists of stocks belonging to the EURO STOXX Index.[4] The choice of this index is driven by the fact that it is among the most liquid in the Eurozone, as proved by its use as the underlying of various financial products (e.g. ETFs, derivatives) and all stock prices are in the same currency (Euro) so that results are not affected by exchange rates. The sample period is January 2007 - December 2021 and thus includes both the global recession of 2008 and the Covid-19 pandemic of 2020.

[4] The EURO STOXX Index is a broad and liquid subset of the STOXX Europe 600 Index. It is characterized by a variable number of components and it represents large, mid and small capitalisation companies of 11 Eurozone countries: Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Spain.

Figure 1 highlights that in the period the index shows a certain variability in its components, which ranged from 320 stocks in 2009 to 287 stocks in 2016. We select all the stocks belonging to the index in January of each year, because the variability between months in the same year is lower than the variability between different years. The final sample of 559 stocks represents the index quite accurately and allows us to avoid survivorship bias. Monthly total returns are calculated as the percentage change in stock price at the end of each calendar month and dividends are considered. Stock prices and dividends are retrieved from Bloomberg. The risk-free rate chosen to compute excess returns is the 1-month Euribor retrieved from the database of the German Central Bank.[5]

Figure 1. Number of components of the EURO STOXX

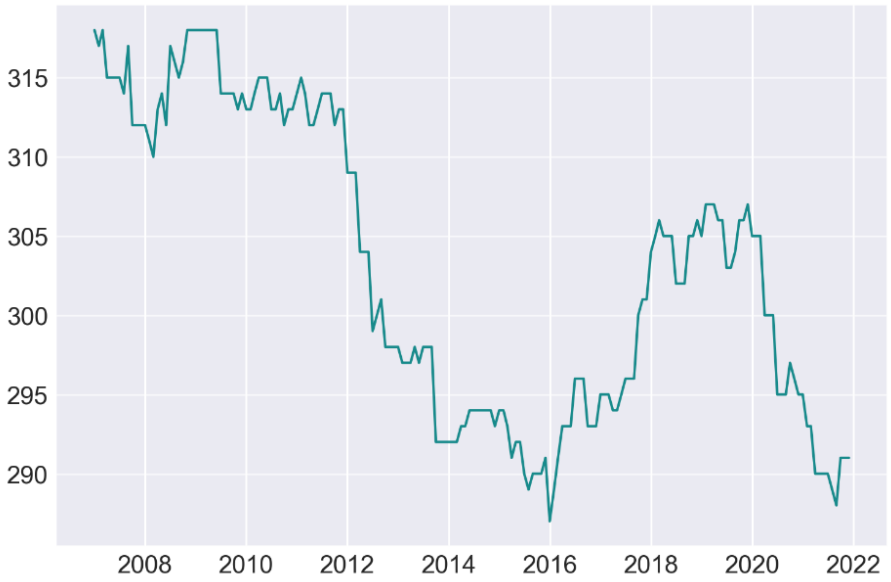


Table 1 presents descriptive statistics of the monthly returns. Stocks mean returns range from a negative -15.204% to a positive + 9.431% with an average value of -0.184% and standard deviation ranges from 1.365% to 35.772% with an average of 9.770%. Returns skewness and kurtosis show variability (the former ranges from -2.881 to 3.647, the latter from -1.576 to 22.764) indicating that single stocks have a non-normal returns distribution.

Table 1. Descriptive statistics of stock returns

	Min	Max	Median	Mean	SD	Skewness	Kurtosis
Mean	-15.204%	9.431%	0.606%	0.184%	2.303%	-2.061	9.655
SD	1.365%	35.772%	8.751%	9.770%	4.442%	2.201	7.476
Skewness	-2.881	3.647	0.007	0.061	0.791	0.771	3.870

[5] https://www.bundesbank.de/en/statistics/time-series-databases

Kurtosis	-1.576	22.764	1.273	2.244	3.046	2.316	7.472

Notes: the table reports minimum, median, mean, maximum, standard deviation (SD), skewness and kurtosis of the stocks time series mean, standard deviation, skewness and kurtosis. For the sample of 559 stocks from 2007 to 2021, returns are indicated in percentage and they are considered only for the years a stock is listed in the EURO STOXX.

ESG scores are retrieved from Bloomberg, which provides for each company an overall ESG disclosure score and the three components (environmental, social, and governance). The choice is determined by two main reasons: first, Bloomberg ESG scores are available also for years further back with respect to others; second, this is novel with respect to previous studies and thus we can evaluate the impact of different score methodologies. [6]

Bloomberg ESG scores measure the company's transparency on these issues and range between 0 and 100. Moreover, scores consider the sector to which the company belongs and each component is weighted according to the relative importance of the company with respect to the sector. The assessment is conducted annually on the basis of public data provided by companies through sustainability reports, annual reports, websites, publicly available resources and direct contact with the companies being assessed. Data covers 120 ESG indicators including: pollutant emissions, the effect of climate change, pollution, waste disposal, renewable energy, discrimination, diversity, community relations, working conditions, human rights, shareholders' rights, and managers' remuneration. In case of missing data Bloomberg penalises the company by reducing the ESG rating.

Table 2 reports ESG score statistics: the average ESG score is 39.567 with great variability both across stocks and across the three ESG dimensions. On average, the social dimension shows the larger score interval that ranges from 3.333 to 80.702, while the environmental dimension exhibits the lower score of 1.786. The governance dimension has a mean score of 54.271 and displays a distribution more shifted to the right as shown in Figure 2. When we compare the four distributions, we can see that environmental, social and the combination of ESG dimensions show a similar shape characterized by a negative kurtosis, while the governance dimension has a positive kurtosis (0.629). All mean scores for each E,S,G dimension and the combined ESG have a negative skewness (-0.263, -0.373, -0.740, -0.475 respectively), i.e. a longer left tail meaning that there are few companies with particularly low scores compared to the average values.

Concerning the standard deviation, the minimum value is 0, since for some companies the ESG scores remained constant in the period they were listed in the EURO STOXX. The maximum volatility values are all around 20, in particular the highest value is for the social dimension (25.322) implying that some stocks registered a significant upgrade or downgrade of their score. However,

[6] Sustainalytics, for example, has a low coverage before 2014 and this is explained by the fact that before 2014, it was the needs of Sustainalytics clients that determined which companies received the ESG score (Auer, 2016).

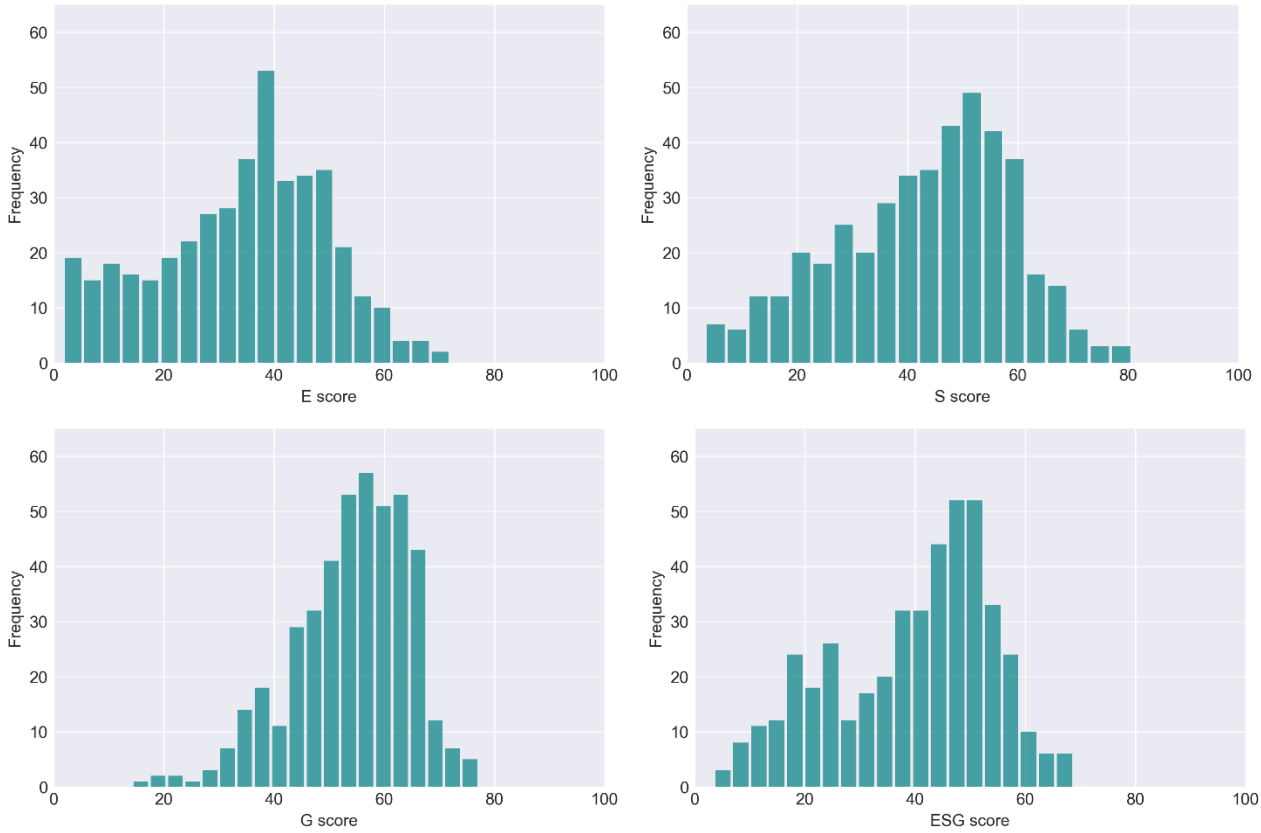
given the slight positive skewness of volatility (0.707, 0.456, 0.626, 0.589), most companies have maintained a constant or low-variation score.

Table 2. ESG scores

	Min	Max	Median	Mean	SD	Skewness	Kurtosis
Mean E score	1.786	71.899	36.286	34.106	15.402	-0.263	-0.556
Mean S score	3.333	80.702	45.614	43.074	15.923	-0.373	-0.450
Mean G score	14.286	77.157	55.929	54.271	10.550	-0.740	0.629
Mean ESG score	3.509	68.801	43.039	39.567	14.387	-0.475	-0.648
SD E score	0.000	24.667	6.871	7.706	5.075	0.707	0.111
SD S score	0.000	25.322	7.796	8.512	5.389	0.456	-0.342
SD G score	0.000	19.463	5.357	6.181	4.181	0.626	0.070
SD ESG score	0.000	20.677	6.264	6.811	4.321	0.589	-0.124

Notes: the table reports minimum, median, mean, maximum, standard deviation (SD), skewness and kurtosis of the time series mean and standard deviation of Bloomberg E, S, G and ESG scores. The number of stocks for which Bloomberg provides E, S, G, ESG scores are 424, 431, 442 and 442 respectively. For each stock, scores are considered only for the years a stock is listed in the EURO STOXX.

Figure 2. Distribution of mean ESG scores



Notes: the figure shows the distribution of the time series mean of E, S, G and ESG scores for each stock in the sample that have a Bloomberg score. The number of stocks for which Bloomberg provides E, S, G, ESG scores are 424, 431, 442 and 442 respectively. For each stock, scores are considered only for the years a stock is listed in the EURO STOXX.

Finally, it is interesting to compare correlation coefficients among mean ESG scores (see Table 3). The E and S dimensions have a quite high correlation (78.5%), while the G dimension exhibits a lower correlation with both the E component (59.2%) and the S one (55.6%). As expected, the ESG score shows higher positive correlations with all factors, and especially with the environmental one (96%), a result indicating that the ESG score is mainly determined by the E dimension.

Table 3. Correlation among ESG scores

	E score	S score	G score	ESG score
E score	1			
S score	0.785	1		
G score	0.592	0.556	1	
ESG score	0.960	0.885	0.738	1

Notes: the table shows correlation coefficients of the mean E, S, G and ESG scores for each stock in the sample that have a Bloomberg score. The number of stocks for which Bloomberg provides E, S, G, ESG scores are 424, 431, 442 and 442 respectively. For each stock, scores are considered only for the years a stock is listed in the EURO STOXX.

4. ESG screened and benchmark portfolios: set up and descriptive analysis

In order to compare the performance of SRI portfolios with a benchmark one, we have to make a choice both on the former and on the latter. To represent SRI portfolios we decide to assume both negative and positive ESG screening strategies, while as benchmark we take a passive strategy.[7] The first choice is motivated by the fact that screening strategies are extremely popular as highlighted in the Section 2. The choice of a passive strategy as a benchmark is motivated by the popularity of this type of strategies as shown by the success of assets such as Exchange Traded Funds (ETFs) that provide broad diversification and low costs by not charging performance fees.

Specifically, we set up screened portfolios based on different exclusion thresholds and the Bloomberg ESG scores of each stock using both the combined ESG score, but also the individual E, S, and G ones since, according to Galema et al. (2008), the aggregation of different ESG dimensions may determine confounding effects. For each dimension (E, S, G and combined ESG) and for each strategy we construct three portfolios based on different exclusion thresholds:10%, 20% and 30% for the negative screening strategy, and 70%, 80% and 90% for the positive screening strategy. For example, we sort the sample of 559 stocks according to their Bloomberg environmental score and in the 10% negative screening for the environmental dimension, exclude the lowest 10%, while in the 70% positive screening we keep the highest 30%.[8] As a result, 24 socially responsible portfolios are

[7] According to Van Duuren et al. (2015) SRI has several similarities with active management since most ESG investors also aim to beat the benchmark.

[8] For each year we consider only stocks that made up the EURO STOXX index at January of that year and we consider only stocks that have an ESG score in order to precisely sort them. The latter condition implies that in the first years of

constructed. All portfolios are equally weighted to avoid overexposure to stocks with higher market capitalisation and to improve portfolio diversification. Screened portfolios are rebalanced every year, since the Bloomberg ESG score is available annually on December, 31: e.g. the ESG score on December, 31 2006 impacts portfolio screening for the full year 2007. The benchmark portfolio is also a simple equally weighted portfolio of the unscreened sample. All portfolio return series appear to be stationary, non-normal and with marginal autocorrelation (see Table A1 in the Appendix).

Before comparing the screened portfolios with the benchmark passive strategy by means of performance indicators, we look at cumulative returns graphically (Figure A1 in the Appendix). All portfolios follow a similar path: cumulative returns sharply decrease during the global recession (2008-2009), increase from 2012 following the Sovereign bond crisis, and appear more volatile in recent years. Over the whole period, portfolios resulting from a negative screening strategy always obtain a higher cumulative return compared to the benchmark and, except for the social dimension, the 30% screening threshold has the highest cumulative return. To be noted that the difference is more apparent since 2009 and keeps increasing afterwards, likely due to a growing attention to sustainability issues. While negative screening is monotonically performance, positive screening strategy produces a variety of results, probably due to the fact that this type of screening may reduce diversification compared to the benchmark. Overall, environmental portfolios register a superior performance compared to the benchmark and from 2012 onwards the 80% and 90% portfolios outperform the others. By contrast for social portfolios, positive screening does not always produce a performance superior to the benchmark that ends up with the highest cumulative return in 2021. Concerning governance portfolios, the 90% portfolio registered the highest cumulative returns over the whole period. Unsurprisingly, combined ESG portfolios show a combination of the patterns previously described: worth noting is that in the 90% combined ESG portfolio has the worst performance, due to high correlation between the ESG score with the social one (see Table 3).

Overall, for both negative and positive screened portfolios, the difference in cumulative returns between the benchmark and the socially responsible portfolios is more pronounced in the most recent years.

5. Portfolio performance: comparison based on risk-adjusted indicators

A more thorough analysis of the comparative performance of ESG screened portfolios with the benchmark has to be done on the basis of risk-adjusted performance measures.

the time period considered a smaller number of stocks are included in each portfolio; in fact, from 2007 to 2021 Bloomberg gradually increased the number of stocks for which it provided an ESG score.

We start with the widely used Sharpe ratio (SR), which for portfolio p is calculated as the ratio of the portfolio mean excess return μ and its standard deviation σ:

$$SR_p = \frac{\mu}{\sigma} \quad (1)$$

In order to compare the Sharpe ratio of different portfolios, a bootstrap test is implemented (Ledoit and Wolf, 2008). Such statistical test is robust to non-normality, correlation and errors due to small samples (Auer, 2016; Auer and Schuhmacher, 2013). [9] The null hypothesis implies that the Sharpe ratio of a portfolio is the same as the Sharpe ratio of the benchmark:

$$H_0: \Delta = \eta_i - \eta_b = 0$$

where:

η_i = true Sharpe ratio of the portfolio i

η_b = true Sharpe ratio of the benchmark.

Second, since Sharpe ratios is a risk-adjusted measure based on total risk, in order to account for systemic risk only we compute alpha that captures the abnormal risk-adjusted return. Alpha is retrieved both from the CAPM (Sharpe, 1964; Lintner, 1965; Mossin, 1966) as represented in equation 2 and from the Carhart (1997) four-factor model as represented in equation 3.

$$R_{i,t} = a_i + \beta_i Mkt_t + \varepsilon_{i,t} \quad (2)$$

where:

$R_{i,t}$ = excess return of portfolio $i = 1, \dots, N$ at date $t = 1, 2, \dots, T$

a_i = "Jensen's alpha" i.e. abnormal risk-adjusted return

Mkt_t = excess return of the market portfolio at date $t = 1, 2, \dots, T$, i.e. the market factor

β_i = the sensitivity of portfolio i return to the market factor

$\varepsilon_{i,t}$ = a random error term with mean equal to zero and variance equal to $\sigma_{\varepsilon i}^2$.

$$R_{i,t} = a_i + \beta_{i,Mkt} Mkt_t + \beta_{i,SMB} SMB_t + \beta_{i,HML} HML_t + \beta_{i,MOM} MOM_t + \varepsilon_{i,t} \quad (3)$$

where:

$R_{i,t}$ = excess return of portfolio $i = 1, \dots, N$ at date $t = 1, 2, \dots, T$

a_i = "Jensen's alpha" i.e. abnormal risk-adjusted return

Mkt_t = excess return of the market portfolio, i.e. the market factor at date $t = 1, 2, \dots, T$

$\beta_{i,Mkt}$ = the sensitivity of portfolio i return to the market factor

SMB_t = small minus big, i.e. the Fama-French size factor at date $t = 1, 2, \dots, T$

$\beta_{i,SMB}$ = the sensitivity of portfolio i return to the size factor

[9] Sharpe ratio is a widely used measure also for returns that deviate from a normal distribution (Auer, 2016).

HML_t = high minus low, i.e. the Fama-French value factor at date $t = 1, 2, \dots, T$

$\beta_{i,HML}$ = the sensitivity of portfolio i return to the value factor

MOM_t = the Carhart momentum factor at date $t = 1, 2, \dots, T$

β_i = the sensitivity of portfolio i return to the momentum factor

$\varepsilon_{i,t}$ = a random error term with mean equal to zero and variance equal to $\sigma_{\varepsilon i}^2$.

The implementation of (2) and (3) requires the choice of the market factor, which we take to be represented by the benchmark portfolio, since it is set up from the stocks in the EUROSTOXX index and all the components of the screened portfolios are also included in the benchmark. Fama-French SMB and HML factors and the Carhart MOM factor are available on Kenneth French's website and are converted into Euro by following Glück et al. (2021).[10]

We analyse portfolio performance over the full period and in two sub-periods of financial distress: global recession of 2008-2009 and Covid-19 crisis of 2020. For the first crisis we focus on the period from January 2008 to June 2009, because the global recession officially ended in June 2009 according to the National Bureau of Economic Research.[11] For the Covid-19 crisis we focus on the period from March 2020, when the World Health Organization classified Covid-19 as a global pandemic, to May 2021, when Covid-19 became less severe thanks to vaccines. Descriptive statistics of the excess returns over the whole sample period and in the two periods of financial distress are reported in Table A2 and A3 in the Appendix.

5.1 Comparison based on the Sharpe ratio

Results regarding the Sharpe ratio analysis are summarised in Table 4. Over the whole period 2007-2021, the benchmark Sharpe ratio is negative and equal to -0.011, whereas for ESG screened portfolios it ranges from -0.038 (90% social portfolio) to 0.021 (90% environmental portfolio). Negatively screened portfolios overperform in terms of Sharpe ratio compared to the benchmark. The highest performance is related to the environmental dimension and specifically to the 20% and 30% screened portfolios. The performance difference with respect to the benchmark of all screened portfolios is statistically significant, in contrast to Auer (2016) that does not find a significant beneficial effect for environmental and social portfolios with high cut-offs. Governance portfolios Sharpe ratio is always greater than the benchmark at a 5% statistical level and this is in line with the SRI literature (Auer, 2016; Cremers and Nair, 2005; Gompers et al., 2003) showing that higher governance commitment is beneficial. Overall, we find a performance difference that is statistically significant although small (on average -0.012), since all portfolios considered are characterized by a

[10] https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

[11] https://www.nber.org/research/business-cycle-dating

Sharpe ratio very close to zero (e.g. -0.011 for the benchmark). Periods characterized by higher Sharpe ratios may determine higher differences in performance although not always statistically significant as in Auer (2016) that is based on the European index STOXX 600 over the period 2004-2012.

As for positive screening strategies, only environmental portfolios with high thresholds statistically outperforms the benchmark, those screened on the social dimension are characterized by a lower Sharpe ratio, even if the difference with the benchmark is not significant, and the remaining others have Sharpe ratios very similar to the benchmark.

Table 4. Sharpe ratios: 2007 – 2021

Portfolio	**SR**	**Diff**	**p-value**
Benchmark	-0.011		
Negative screening			
10% E	-0.002	-0.009*	0.075
20% E	0.005	-0.016**	0.024
30% E	0.007	-0.018**	0.042
10% S	-0.001	-0.011**	0.040
20% S	0.002	-0.013**	0.044
30% S	0.001	-0.012*	0.094
10% G	-0.002	-0.009**	0.034
20% G	-0.001	-0.010**	0.045
30% G	0.002	-0.013**	0.041
10% ESG	-0.003	-0.009*	0.074
20% ESG	0.002	-0.013**	0.036
30% ESG	0.003	-0.014*	0.075
Positive screening			
70% E	0.003	-0.014	0.334
80% E	0.017	-0.028*	0.083
90% E	0.021	-0.032*	0.083
70% S	-0.013	0.002	0.898
80% S	-0.025	0.014	0.410
90% S	-0.038	0.027	0.262
70% G	-0.001	-0.010	0.363
80% G	-0.010	-0.001	0.919
90% G	0.011	-0.023	0.250
70% ESG	0.000	-0.011	0.435
80% ESG	0.005	-0.016	0.327
90% ESG	-0.008	-0.003	0.873

Notes: the table shows the Sharpe ratio for the benchmark and for the socially responsible portfolios. In addition, the differences (Diff) between the Sharpe ratio of the benchmark and the Sharpe ratio of the socially responsible portfolios is reported. The last column shows the p-value of the Ledoit and Wolf (2008) test. ***, ** and * represent significance at 1, 5, 10% levels, respectively.

When focusing on periods of financial distress (Table 5) results change. During the global recession, all negatively screened portfolios do not show significant differences with respect to the benchmark. Positively screened portfolios statistically underperform the benchmark, in particular: all portfolios based on social screening, the 70% E-screened and the 80% and 90% ESG screened portfolios. This result is not aligned with Hübel and Scholz (2020), who find that highly social companies perform better during the financial crisis. During Covid-19 crisis, results are quite similar. All negatively screened portfolios reduce the performance, but no difference is statistically significant. On the other hand, among positive screening strategies, only 70% and 90% social portfolios show a significant lower performance, whereas environmental portfolios are the only ones obtaining a higher Sharpe ratio, which is small and marginally significant.

In sum, results over the long term prove over performance with respect to a passive strategy of negative screens and nearly no impact of positive screens. By contrast, over the two periods of financial distress, negative screens do not affect performance, whereas positive screens in a few cases based on the social dimension are associated with under performance. However, it has to be recalled that positive screening highly reduces diversification and this may in turn affect performance (Girard et al., 2007; Ortas et al., 2014).

Table 5. Sharpe ratios: a comparison across the two crises

	Global recession			Covid-19 crisis		
Portfolio	SR	Diff	p-value	SR	Diff	p-value
Benchmark	-0.538			0.309		
Negative screening						
10% E	-0.545	0.007	0.584	0.305	0.003	0.730
20% E	-0.552	0.014	0.310	0.306	0.003	0.840
30% E	-0.567	0.029	0.104	0.288	0.020	0.257
10% S	-0.542	0.004	0.693	0.294	0.014	0.124
20% S	-0.550	0.013	0.305	0.297	0.012	0.218
30% S	-0.557	0.019	0.199	0.307	0.002	0.881
10% G	-0.532	-0.006	0.411	0.299	0.009	0.376
20% G	-0.544	0.006	0.441	0.297	0.012	0.382
30% G	-0.544	0.006	0.673	0.293	0.016	0.327
10% ESG	-0.536	-0.001	0.879	0.308	0.001	0.922
20% ESG	-0.540	0.003	0.832	0.300	0.009	0.533
30% ESG	-0.557	0.020	0.168	0.288	0.020	0.289
Positive screening						
70% E	-0.596	0.059 *	0.059	0.325	-0.016	0.506
80% E	-0.566	0.028	0.319	0.328	-0.020	0.550
90% E	-0.579	0.041	0.273	0.338	-0.030	0.235
70% S	-0.593	0.056 **	0.026	0.264	0.044 *	0.080
80% S	-0.596	0.058 **	0.044	0.261	0.048	0.119

90% S	-0.733	0.195	***	0.001	0.236	0.072 *	0.063
70% G	-0.554	0.017		0.494	0.302	0.007	0.795
80% G	-0.521	-0.017		0.745	0.306	0.002	0.947
90% G	-0.514	-0.024		0.765	0.308	0.001	0.993
70% ESG	-0.572	0.035		0.215	0.293	0.016	0.531
80% ESG	-0.597	0.059	*	0.060	0.294	0.015	0.548
90% ESG	-0.605	0.067	**	0.049	0.290	0.019	0.536

Notes: the table shows the Sharpe ratio for the benchmark and for the socially responsible portfolios. In addition, the differences (Diff) between the Sharpe ratio of the benchmark and the Sharpe ratio of the socially responsible portfolios is reported. The last column shows the p-value of the Ledoit and Wolf (2008) test. ***, ** and * represent significance at 1, 5, 10% levels, respectively.

5.2 Comparison based on alphas

The analysis based on alpha as performance measure for the entire period is reported in Table 6, where the estimates are performed according to both the CAPM and the Carhart four factor models represented in eq. (2) and (3). Results are comparable to those based on the Sharpe ratio and the literature. In fact, all negatively screened portfolios perform significantly better than the benchmark consistently with Derwall (2005) analysis in which US firms with higher environmental scores obtain a higher performance in terms of alpha. Further, estimates based on the four-factor model show that also some positive screening strategies, (70% G, 90% G and 80% ESG) over perform the benchmark. Results are similar also on the two financial crises. When we consider the global recession (Table 7), beside underperformance of socially screened portfolios also governance screened ones with 70% and 90% cut-offs result to underperform the benchmark as results from the four-factor model. Finally, when focusing on the Covid-19 crisis (see Table 8), all screened portfolios, even social portfolios with high cut-offs, do not exhibit a performance that is statistically different than the benchmark. Thus, results overall confirm those based on Sharpe ratio. Therefore, outcomes based on alpha confirm that SRI portfolios are unable to significantly perform differently from the benchmark in period of market distress.

Table 6. Alphas: 2007-2021

		Alpha		**Mkt**	**SMB**	**HML**	**MOM**
	Benchmark	0		1			
		0.000		1.000	0.000	0.000	0.000
Negative screening	10% E	0.055	*	1.001			
		0.068	**	0.997	-0.078	0.046	0.013
	20% E	0.093	**	1.000			
		0.115	***	0.993	-0.122	0.076	0.017
	30% E	0.104	**	0.996			
		0.123	***	0.989	-0.132	0.118	0.038
	10% S	0.062	**	0.999			
		0.073	**	0.995	-0.065	0.041	0.011

	20% S	0.074	**	0.995			
		0.091	***	0.990	-0.102	0.076	0.022
	30% S	0.073	*	0.999			
		0.097	***	0.992	-0.137	0.092	0.023
	10% G	0.055	*	1.003			
		0.076	***	0.994	-0.061	0.037	-0.005
	20% G	0.060	**	0.995			
		0.091	***	0.982	-0.080	0.045	-0.012
	30% G	0.078	**	0.997			
		0.111	***	0.984	-0.111	0.066	-0.002
	10% ESG	0.051	*	1.004			
		0.067	**	0.999	-0.078	0.031	0.001
	20% ESG	0.077	**	1.007			
		0.103	***	0.995	-0.093	0.075	0.007
	30% ESG	0.082	*	1.002			
		0.116	***	0.987	-0.131	0.113	0.016
Positive screening	70% E	0.082		0.984			
		0.110		0.981	-0.235	0.110	0.040
	80% E	0.162	*	0.966			
		0.182	**	0.973	-0.261	0.072	0.040
	90% E	0.195	*	1.004			
		0.212	**	1.012	-0.273	0.097	0.056
	70% S	-0.012		0.995			
		0.052		0.965	-0.229	0.216	0.029
	80% S	-0.085		1.011			
		0.005		0.971	-0.272	0.220	0.003
	90% S	-0.159		0.950			
		-0.110		0.927	-0.279	0.289	0.085
	70% G	0.064		1.047			
		0.141	**	1.007	-0.149	0.175	-0.016
	80% G	0.007		1.042			
		0.088		1.002	-0.166	0.156	-0.026
	90% G	0.139		1.031			
		0.252	**	0.972	-0.171	0.202	-0.053
	70% ESG	0.066		1.009			
		0.118		0.992	-0.261	0.160	0.029
	80% ESG	0.093		1.003			
		0.143	*	0.988	-0.260	0.147	0.028
	90% ESG	0.017		1.010			
		0.067		0.992	-0.271	0.206	0.051

Notes: the table shows the alpha for the benchmark and for the socially responsible portfolios. Alpha is estimated from equations 4 and 5. ***, ** and * represent significance at 1, 5, 10% levels, respectively.

Table 7. Alphas: Global recession

	Alpha		**Mkt**	**SMB**	**HML**	**MOM**
Benchmark	0.000		1.000			

		0.000	1.000	0.000	0.000	0.000
Negative screening	10% E	-0.081	0.984			
		0.051	1.001	-0.081	0.056	0.029
	20% E	-0.156	0.965			
		-0.122	0.966	-0.147	0.048	-0.001
	30% E	-0.296	0.934			
		-0.235	0.940	-0.099	0.040	0.009
	10% S	-0.051	0.977			
		-0.057	0.974	-0.022	0.023	-0.001
	20% S	-0.140	0.963			
		-0.101	0.966	-0.113	0.035	0.002
	30% S	-0.203	0.956			
		-0.146	0.965	-0.173	-0.003	-0.004
	10% G	0.056	0.992			
		0.071	0.991	-0.047	0.039	0.003
	20% G	-0.064	0.978			
		-0.154	0.961	-0.052	0.027	-0.023
	30% G	-0.074	0.962			
		0.028	0.980	-0.113	-0.019	0.010
	10% ESG	0.006	0.994			
		0.060	1.004	-0.092	-0.015	0.002
	20% ESG	-0.037	0.985			
		-0.021	0.982	-0.108	0.070	0.000
	30% ESG	-0.207	0.953			
		-0.170	0.957	-0.131	0.013	-0.003
Positive screening	70% E	-0.575 *	0.896			
		-0.297	0.936	-0.139	0.062	0.058
	80% E	-0.305	0.909			
		0.078	0.951	-0.200	0.228	0.094
	90% E	-0.467	0.961			
		0.058	1.039	-0.123	0.083	0.120
	70% S	-0.560 *	0.896			
		-0.783 *	0.863	-0.235	-0.045	-0.080
	80% S	-0.620	0.922			
		-0.870 *	0.890	-0.331	-0.125	-0.105
	90% S	-1.645 ***	0.766			
		-1.378 **	0.837	-0.352	-0.341	-0.009
	70% G	-0.194	0.986			
		-0.662 *	0.902	-0.076	0.083	-0.108
	80% G	0.121	1.006			
		-0.690	0.869	-0.109	0.055	-0.195
	90% G	0.087	0.948			
		-1.670 *	0.682	-0.182	-0.244	-0.455
	70% ESG	-0.374	0.926			
		-0.470	0.903	-0.218	0.072	-0.037
	80% ESG	-0.598 *	0.904			
		-0.860 *	0.871	-0.143	-0.118	-0.088

	90% ESG	-0.675 *	0.897			
		-0.408	0.951	-0.126	-0.144	0.035

Notes: the table shows the alpha for the benchmark and for the socially responsible portfolios. Alpha is estimated from equations 4 and 5 and the associated ***, ** and * represent significance at 1, 5, 10% levels, respectively.

Table 8. Alphas: Covid-19 crisis

		Alpha	Mkt	SMB	HML	MOM
	Benchmark	0.000	1.000			
		0.000	1.000	0.000	0.000	0.000
Negative screening	10% E	-0.025	1.036			
		0.052	1.042	-0.077	0.045	0.033
	20% E	-0.018	1.066			
		0.165	1.046	-0.073	0.116	0.048
	30% E	-0.170	1.103			
		0.071	1.070	-0.075	0.158	0.061
	10% S	-0.117	1.047			
		-0.051	1.043	-0.034	0.043	0.021
	20% S	-0.097	1.053			
		0.010	1.048	-0.073	0.040	0.011
	30% S	-0.012	1.036			
		0.130	1.034	-0.091	0.100	0.061
	10% G	-0.074	1.047			
		0.033	1.032	-0.040	0.054	0.013
	20% G	-0.093	1.047			
		0.065	1.024	-0.056	0.073	0.011
	30% G	-0.129	1.069			
		0.075	1.026	-0.024	0.111	0.014
	10% ESG	-0.006	1.038			
		0.093	1.037	-0.063	0.074	0.047
	20% ESG	-0.068	1.068			
		0.117	1.036	-0.043	0.105	0.025
	30% ESG	-0.166	1.097			
		0.130	1.054	-0.097	0.152	0.035
Positive screening	70% E	0.148	1.084			
		0.232	1.117	-0.162	0.039	0.055
	80% E	0.181	1.034			
		0.212	1.112	-0.239	0.061	0.134
	90% E	0.264	1.069			
		0.174	1.126	-0.070	0.043	0.118
	70% S	-0.364	1.096			
		0.090	1.015	-0.146	0.103	-0.083
	80% S	-0.399	1.149			
		0.127	1.036	-0.142	0.020	-0.208
	90% S	-0.609	1.144			
		-0.175	1.115	-0.308	0.019	-0.100

70% G	-0.045	1.147			
	0.349	1.048	0.001	0.227	0.022
80% G	0.008	1.043			
	0.323	1.015	-0.151	0.179	0.072
90% G	0.053	1.184			
	0.651	1.071	-0.180	0.124	-0.126
70% ESG	-0.122	1.119			
	0.181	1.114	-0.241	0.076	0.005
80% ESG	-0.116	1.109			
	0.123	1.078	-0.118	0.029	-0.056
90% ESG	-0.154	1.191			
	0.257	1.104	-0.061	0.187	-0.005

Notes: the table shows the alpha for the benchmark and for the socially responsible portfolios. Alpha is estimated from equations 4 and 5 and the associated ***, ** and * represent significance at 1, 5, 10% levels, respectively.

6. Alternative risk and performance measures

In order to give greater robustness to the results presented in Section 5, here we analyse alternative risk and performance measures that are useful in the presence of non-symmetrical distributions. Specifically we use the Conditional Sharpe ratio, the Calmar ratio and the Sortino ratio.[12] As the Sharpe ratio, these measures consider the average excess return at the numerator of the ratio, however they differ for the risk measure used at the denominator: the Conditional Sharpe ratio uses Conditional Value at Risk (CVaR), i.e. the expected loss that exceeds VaR; the Calmar ratio uses the maximum drawdown, i.e. the highest cumulated percentage loss incurred over the entire investment period; the Sortino ratio uses the square root of the lower partial moment of order two, i.e an estimate of downside risk. [13]

Performance of screened portfolios is measured over the full period (see Table 9) and over subsamples as in the previous analysis (Table 10 and 11). Overall, performance results are robust also using different risk measures. Over the period from 2007 to 2021 results based on alternative performance measures are totally aligned with Sharpe ratio and alphas and confirm that all screens, except for positive screens on the social dimension, lead to a superior performance with respect to the benchmark. When focusing on periods of crisis, results in general support previous findings that ESG screened portfolios do not significantly differ from the passive portfolio and are characterized by an underperformance. However, if we consider the Covid-19 crisis and positive screening strategies, some slight misalignments emerge. Specifically, the performance of governance and ESG portfolios is in line with alphas resulting from the four-factor model instead of the Sharpe ratio.

[12] For those alternative performance measures, we adopt a mere descriptive analysis since no statistical tests for performance differences are available.

[13] We take the 95% VaR calculated on historical basis as the reference.

Nevertheless, these deviations are small and do not indicate statistically significant differences from the passive strategy, as both the Sharpe ratios and alphas associated with these portfolios do not support significant over/underperformance (see Table 5 and Table 8).

Table 9. Portfolio performance under alternative risk measures: 2007 - 2021

	Excess returns (%)	Risk measures (%)			Performance measures		
Portfolio	**Mean**	**CVaR**	**MDD**	**LPM2**	**Cond. SR**	**Calmar**	**Sortino**
Benchmark	-0.065	15.560	84.585	20.429	-0.004	-0.001	-0.014
Negative screening							
10% E	-0.010	15.530	83.129	20.224	-0.001	0.000	-0.002
20% E	0.027	15.382	82.387	19.960	0.002	0.000	0.006
30% E	0.039	15.263	81.562	19.776	0.003	0.000	0.009
10% S	-0.003	15.511	82.627	20.052	0.000	0.000	-0.001
20% S	0.009	15.404	82.371	19.835	0.001	0.000	0.002
30% S	0.007	15.401	82.576	20.101	0.000	0.000	0.002
10% G	-0.011	15.507	83.222	20.199	-0.001	0.000	-0.002
20% G	-0.005	15.359	83.185	19.865	0.000	0.000	-0.001
30% G	0.013	15.399	82.749	19.936	0.001	0.000	0.003
10% ESG	-0.015	15.615	83.237	20.354	-0.001	0.000	-0.003
20% ESG	0.011	15.609	82.685	20.309	0.001	0.000	0.003
30% ESG	0.017	15.412	82.185	20.051	0.001	0.000	0.004
Positive screening							
70% E	0.017	15.143	82.003	19.705	0.001	0.000	0.004
80% E	0.099	14.763	80.527	18.531	0.007	0.001	0.023
90% E	0.130	15.521	81.287	20.564	0.008	0.002	0.029
70% S	-0.077	15.105	84.685	20.277	-0.005	-0.001	-0.017
80% S	-0.151	15.512	86.484	21.105	-0.010	-0.002	-0.033
90% S	-0.222	15.124	87.379	20.126	-0.015	-0.003	-0.049
70% G	-0.004	15.872	84.422	21.836	0.000	0.000	-0.001
80% G	-0.061	15.495	85.683	21.624	-0.004	-0.001	-0.013
90% G	0.072	14.794	82.080	20.050	0.005	0.001	0.016
70% ESG	0.000	15.309	82.860	20.286	0.000	0.000	0.000
80% ESG	0.027	15.012	83.172	20.005	0.002	0.000	0.006
90% ESG	-0.049	15.408	83.504	21.134	-0.003	-0.001	-0.011

Notes: beside the excess returns mean, the table shows alternative risk measures (CVaR, maximum drawdown - MDD - and lower partial moment of order two - LPM2 -) and the corresponding alternative performance measures (Conditional Sharpe ratio, Calmar ratio and Sortino ratio).

Table 10. Portfolio performance under alternative risk measures: global recession

	Excess returns (%)	Risk measures (%)			Performance measures		
Portfolio	**Mean**	**CVaR**	**MDD**	**LPM2**	**Cond. SR**	**Calmar**	**Sortino**
Benchmark	-5.598	24.084	70.568	107.120	-0.232	-0.079	-0.541
Negative screening							
10% E	-5.590	24.123	69.843	105.247	-0.232	-0.080	-0.545
20% E	-5.556	23.440	69.316	102.038	-0.237	-0.080	-0.550

30% E	-5.523	22.990	68.406	97.665	-0.240	-0.081	-0.559
10% S	-5.521	24.232	69.447	103.259	-0.228	-0.080	-0.543
20% S	-5.533	23.604	69.093	101.691	-0.234	-0.080	-0.549
30% S	-5.554	23.440	69.155	101.494	-0.237	-0.080	-0.551
10% G	-5.495	24.366	69.830	104.650	-0.226	-0.079	-0.537
20% G	-5.539	23.821	69.817	102.909	-0.233	-0.079	-0.546
30% G	-5.461	23.518	69.086	101.640	-0.232	-0.079	-0.542
10% ESG	-5.557	24.383	70.012	106.238	-0.228	-0.079	-0.539
20% ESG	-5.553	23.903	69.865	104.309	-0.232	-0.079	-0.544
30% ESG	-5.539	23.336	68.936	100.387	-0.237	-0.080	-0.553
Positive screening							
70% E	-5.591	22.676	67.927	95.937	-0.247	-0.082	-0.571
80% E	-5.392	21.441	67.197	93.393	-0.251	-0.080	-0.558
90% E	-5.844	24.507	70.023	108.231	-0.238	-0.083	-0.562
70% S	-5.576	21.206	68.546	92.674	-0.263	-0.081	-0.579
80% S	-5.781	22.041	70.390	99.215	-0.262	-0.082	-0.580
90% S	-5.933	18.585	68.553	85.483	-0.319	-0.087	-0.642
70% G	-5.711	23.759	70.636	105.564	-0.240	-0.081	-0.556
80% G	-5.513	22.183	70.164	102.154	-0.248	-0.079	-0.545
90% G	-5.218	18.692	68.104	88.672	-0.279	-0.077	-0.554
70% ESG	-5.556	22.318	68.738	97.751	-0.249	-0.081	-0.562
80% ESG	-5.660	21.564	68.575	94.841	-0.262	-0.083	-0.581
90% ESG	-5.694	21.294	68.443	95.174	-0.267	-0.083	-0.584

Notes: beside the excess returns mean, the table shows alternative risk measures (CVaR, maximum drawdown - MDD - and lower partial moment of order two - LPM2 -) and the corresponding alternative performance measures (Conditional Sharpe ratio, Calmar ratio and Sortino ratio). Given the small number of observations for each portfolio, Conditional VaR coincides with the 95% VaR.

Table 11. Portfolio performance under alternative risk measures: Covid-19 crisis

	Excess returns (%)	Risk measures (%)			Performance measures		
Portfolio	**Mean**	**CVaR**	**MDD**	**LPM2**	**Cond. SR**	**Calmar**	**Sortino**
Benchmark	2.415	18.319	5.169	23.591	0.132	0.467	0.497
Negative screening							
10% E	2.476	18.998	5.473	25.393	0.130	0.452	0.491
20% E	2.557	19.693	5.435	27.140	0.130	0.470	0.491
30% E	2.495	20.640	5.646	29.755	0.121	0.442	0.457
10% S	2.412	19.342	5.544	26.302	0.125	0.435	0.470
20% S	2.445	19.266	5.612	26.213	0.127	0.436	0.478
30% S	2.491	19.122	5.235	25.656	0.130	0.476	0.492
10% G	2.453	19.187	5.574	25.893	0.128	0.440	0.482
20% G	2.436	19.165	5.991	26.002	0.127	0.407	0.478
30% G	2.453	19.666	6.170	27.383	0.125	0.398	0.469
10% ESG	2.501	19.120	5.463	25.689	0.131	0.458	0.493
20% ESG	2.510	19.709	5.572	27.278	0.127	0.450	0.481
30% ESG	2.482	20.256	5.951	28.850	0.123	0.417	0.462

Positive screening							
70% E	2.767	19.523	4.215	26.584	0.142	0.656	0.537
80% E	2.679	18.691	4.474	24.684	0.143	0.599	0.539
90% E	2.846	19.553	4.231	26.764	0.146	0.673	0.550
70% S	2.282	19.747	6.701	27.851	0.116	0.341	0.432
80% S	2.377	20.127	7.133	28.977	0.118	0.333	0.442
90% S	2.153	20.156	8.728	29.875	0.107	0.247	0.394
70% G	2.724	21.103	5.459	31.107	0.129	0.499	0.488
80% G	2.526	18.854	4.601	25.392	0.134	0.549	0.501
90% G	2.912	20.028	6.094	29.440	0.145	0.478	0.537
70% ESG	2.580	20.034	5.277	28.067	0.129	0.489	0.487
80% ESG	2.563	19.678	5.244	27.289	0.130	0.489	0.491
90% ESG	2.723	21.689	4.704	32.772	0.126	0.579	0.476

Notes: beside the excess returns mean, the table shows alternative risk measures (CVaR, maximum drawdown - MDD - and lower partial moment of order two - LPM2 -) and the corresponding alternative performance measures (Conditional Sharpe ratio, Calmar ratio and Sortino ratio). Given the small number of observations for each portfolio, Conditional VaR coincides with the 95% VaR.

7. Conclusion

Fostered by an empirical literature that has not reached univocal results about the relationship between SRI and the risk-return profile of a financial portfolio, this paper aims to analyse the impact of SRI screening strategies based on Bloomberg ESG disclosure scores with a focus on periods of financial distress such as 2008 global recession and the 2020 Covid-19 pandemic. Specifically, we construct socially responsible portfolios starting from 559 stocks that made up the EURO STOXX index in January of each year from 2007 to 2021, then we compare their performance with a benchmark portfolio that represents a passive strategy by computing risk-adjusted performance measures such as the Sharpe ratio and the alphas resulting from both a one-factor model and the Carhart four-factor model.

Three are the main results. First, each single E, S and G dimension has a different role in determining portfolio performance. Environmental and governance screens have in general a positive effect increasing the portfolios performance. In contrast, social screens sometimes adversely affect portfolio performance. The combined ESG screening is affected by the correlation of the combined ESG dimension with single dimensions and in the analysed sample it has a 95% correlation with the environmental dimension. To be noted that results do not depend on the risk-adjusted measure used.

Second, different time horizons and phases of the economic and financial cycle are associated to different results. Over the entire 2007-2020 period, ESG screened portfolios outperform the benchmark in terms of both the Sharpe ratio and alphas. However, during periods of financial distress this is not true: negative screens do not affect performance, whereas positive screens in a few cases

based on the social dimension are associated with under performance. In other words, in periods of financial distress ESG portfolios do not seem to represent a safe haven.

Finally, portfolio performance is driven also by the choice of the strategy and the screening threshold. ESG negative screens represent better-performing strategies in the long-term, whereas, when the observation period is narrowed to times of financial distress, the passive strategy appears to be better performing. Moreover, positive screening strategies, and in particular the ones that involve the social dimension, are characterized by significant underperformance during periods of crises possibly due to the limit to diversification benefits that positive screening impose.

Given the increasing attention for socially responsible investments, our results are relevant for both individual investors and the asset management industry that includes banks, private and wealth management companies, investment funds, pension funds. Since different types of investors may have different investment horizon and preferences in terms of ESG dimensions, our results are useful to address ESG portfolio optimization and to gauge the role that ESG finance may have in support of sustainable economic development.

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Appendix

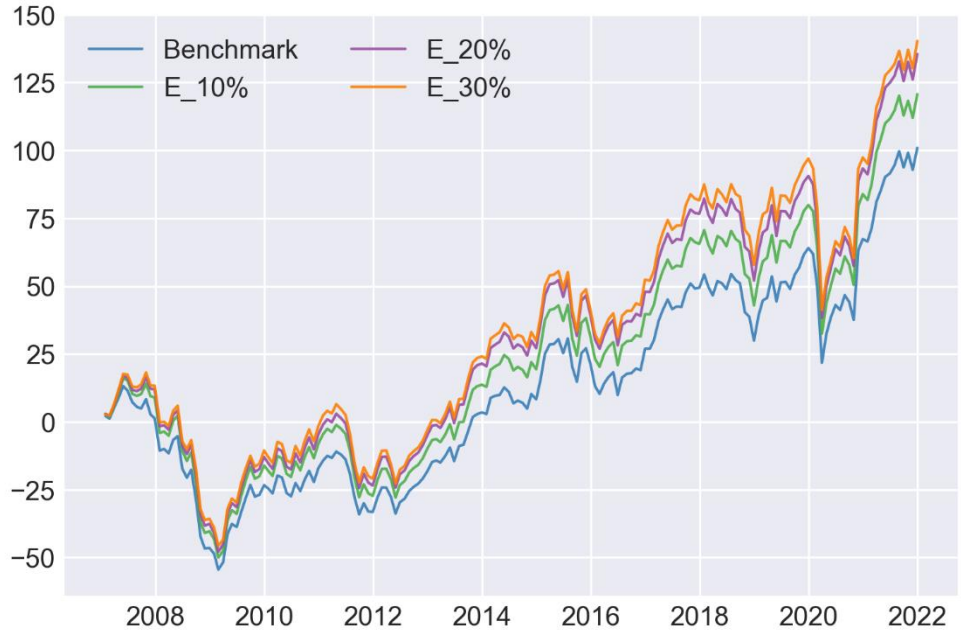
Table A1. Main diagnostic tests for the portfolio return series

Test	**ADF test**	**PP test**	**KPSS test**	**Shapiro-Wilk test**	**Ljung-Box test**
Null hypothesis	Unit root	Unit root	Stationarity	Normal distribution	No autocorrelation
Portfolio					
Benchmark	< 0.01	< 0.01	> 0.1	< 0.01	0.085
Negative screening					
10% E	< 0.01	< 0.01	> 0.1	< 0.01	0.068
20% E	< 0.01	< 0.01	> 0.1	< 0.01	0.092
30% E	< 0.01	< 0.01	> 0.1	< 0.01	0.138
10% S	< 0.01	< 0.01	> 0.1	< 0.01	0.098
20% S	< 0.01	< 0.01	> 0.1	< 0.01	0.087
30% S	< 0.01	< 0.01	> 0.1	< 0.01	0.075
10% G	< 0.01	< 0.01	> 0.1	< 0.01	0.096
20% G	< 0.01	< 0.01	> 0.1	< 0.01	0.101
30% G	< 0.01	< 0.01	> 0.1	< 0.01	0.112
10% ESG	< 0.01	< 0.01	> 0.1	< 0.01	0.080
20% ESG	< 0.01	< 0.01	> 0.1	< 0.01	0.081
30% ESG	< 0.01	< 0.01	> 0.1	< 0.01	0.112
Positive screening					
70% E	< 0.01	< 0.01	> 0.1	< 0.01	0.286
80% E	< 0.01	< 0.01	> 0.1	< 0.01	0.233
90% E	< 0.01	< 0.01	> 0.1	< 0.01	0.176
70% S	< 0.01	< 0.01	> 0.1	< 0.01	0.121
80% S	< 0.01	< 0.01	> 0.1	< 0.01	0.147
90% S	< 0.01	< 0.01	> 0.1	< 0.01	0.476
70% G	< 0.01	< 0.01	> 0.1	< 0.01	0.057
80% G	< 0.01	< 0.01	> 0.1	< 0.01	0.088
90% G	< 0.01	< 0.01	> 0.1	< 0.01	0.130
70% ESG	< 0.01	< 0.01	> 0.1	< 0.01	0.206
80% ESG	< 0.01	< 0.01	> 0.1	< 0.01	0.203
90% ESG	< 0.01	< 0.01	> 0.1	< 0.01	0.325

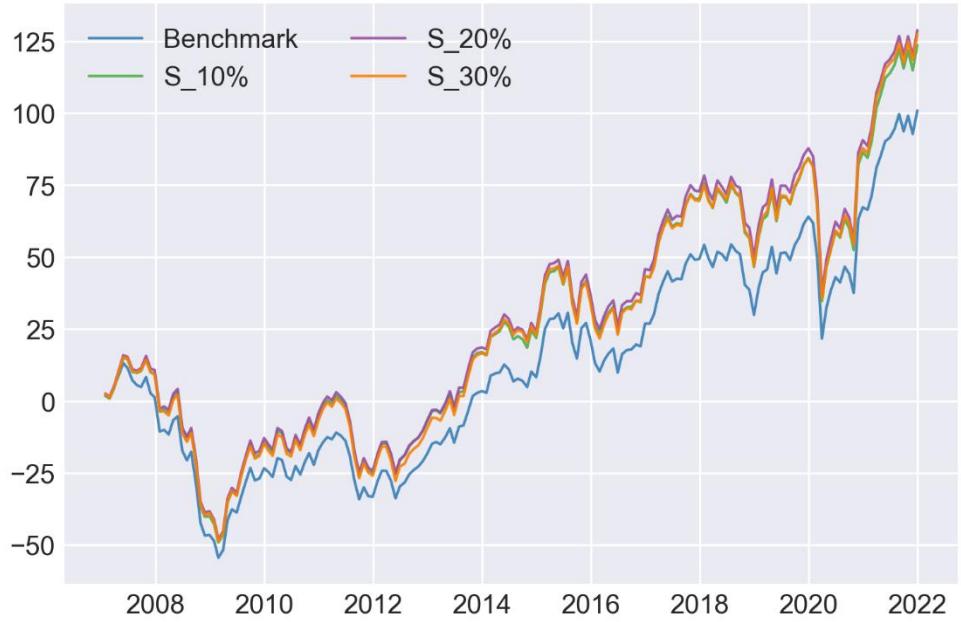
Notes: the table reports p-values of different diagnostic tests for the full period 31/01/2008-31/12/2021. Tests are conducted only over the full period, because in both crises subsamples the power of the tests decreases due to the smaller number of observations. The Augmented Dickey-Fuller test i.e. ADF (Dickey and Fuller, 1979), the Philipps-Perron test i.e., PP (Phillips and Perron, 1988) and the KPSS test (Kwiatkowski et al., 1992) are for stationarity while the Shapiro-Wilk test (Shapiro and Wilk, 1965) is a normality test and the Ljung-Box test (Ljung and Box, 1978) examines the null hypothesis of independence in the return time series.

Figure A1. Cumulative returns (in %): ESG screend portfolios vs benchmark

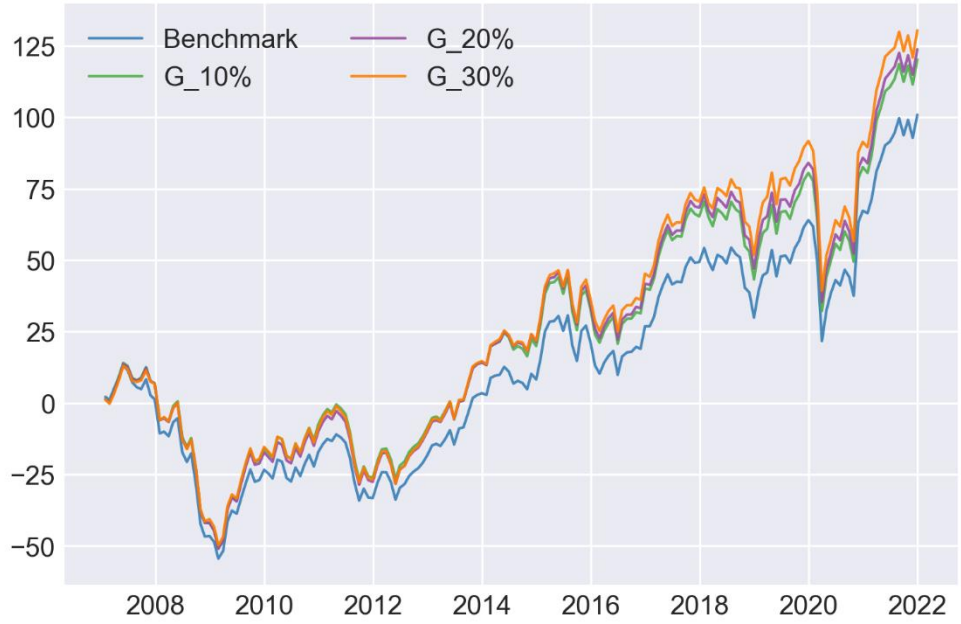
a) Environmental portfolios (negative screening)



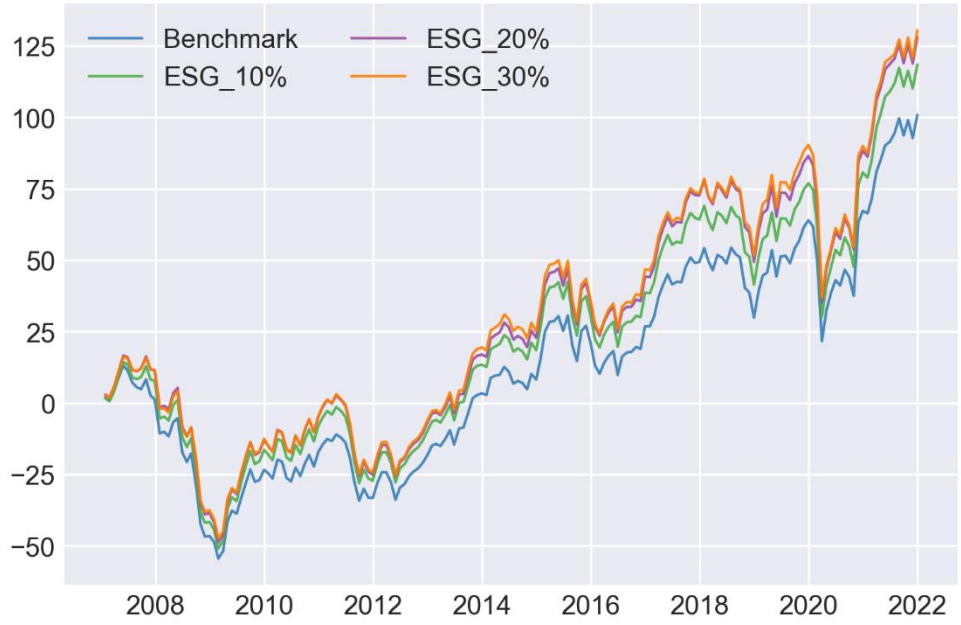
b) Social portfolios (negative screening)



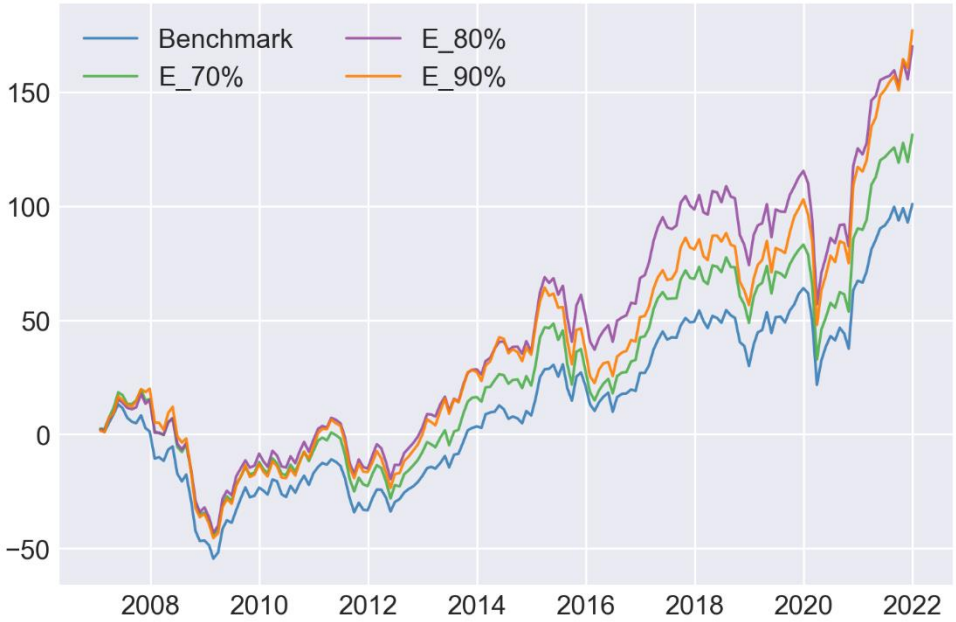
c) Governance portfolios (negative screening)



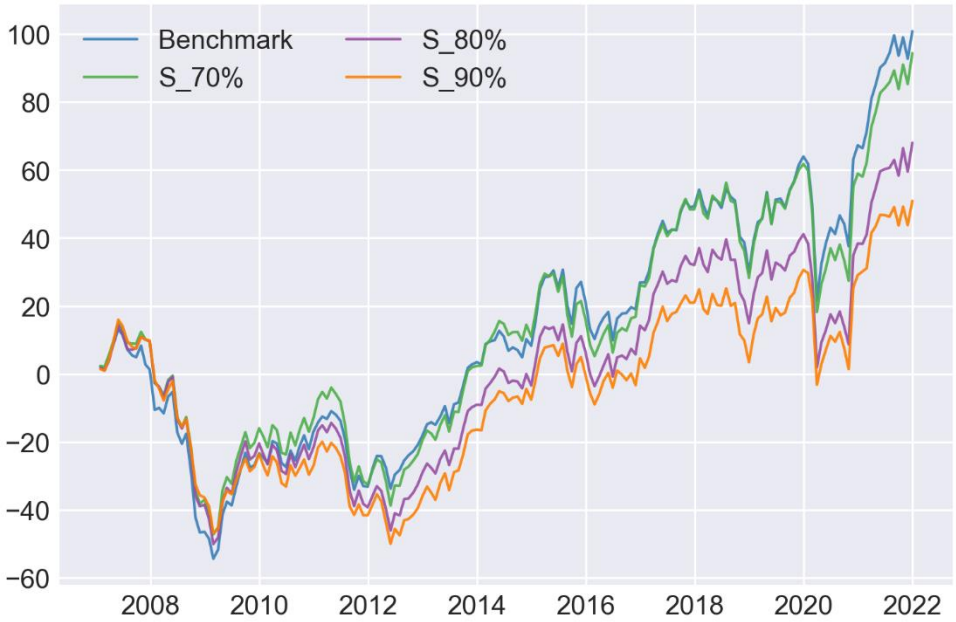
d) Combined ESG portfolios (negative screening)



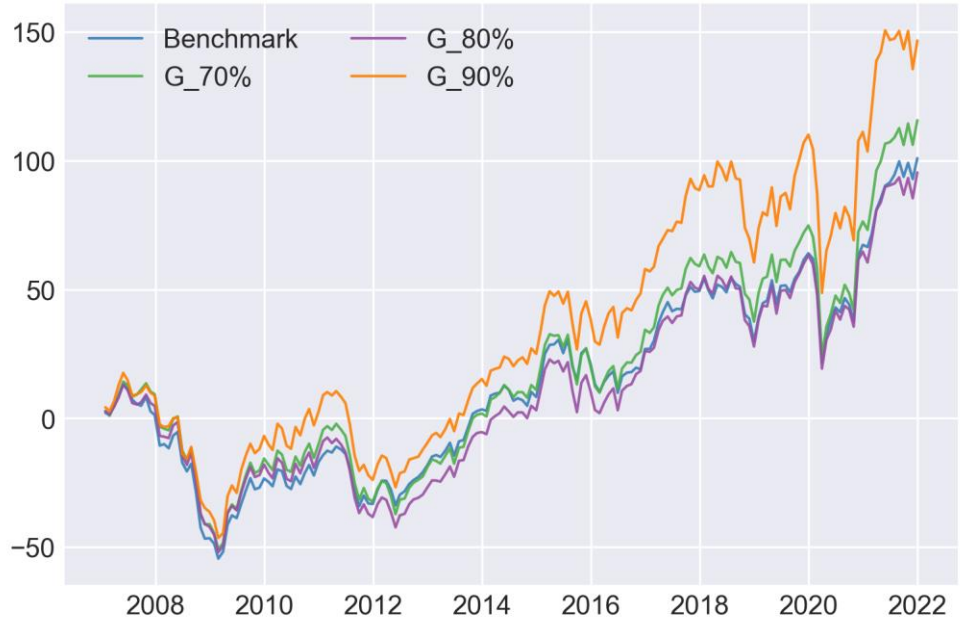
e) Environmental portfolios (positive screening)



f) Social portfolios (positive screening)



g) Governance portfolios (positive screening)



h) Combined ESG portfolios (positive screening)

Table A2. Portfolio excess returns: 2007 – 2021

Portfolio	Min (%)	Max (%)	Mean (%)	SD (%)
Benchmark	-24.084	20.651	-0.065	6.287
Negative screening				
10% E	-24.123	20.464	-0.010	6.301
20% E	-23.440	20.508	0.027	6.292
30% E	-22.990	21.179	0.039	6.290
10% S	-24.232	20.338	-0.003	6.289
20% S	-23.604	20.289	0.009	6.264
30% S	-23.440	19.869	0.007	6.282
10% G	-24.366	20.534	-0.011	6.315
20% G	-23.821	20.397	-0.005	6.261
30% G	-23.518	20.495	0.013	6.275
10% ESG	-24.383	20.418	-0.015	6.320
20% ESG	-23.903	20.707	0.011	6.339
30% ESG	-23.336	21.219	0.017	6.324
Positive screening				
70% E	-22.676	21.317	0.017	6.284
80% E	-21.441	20.022	0.099	6.161
90% E	-24.507	20.169	0.130	6.484
70% S	-21.206	22.387	-0.077	6.335
80% S	-22.041	24.706	-0.151	6.527
90% S	-20.156	24.308	-0.222	6.293
70% G	-23.759	21.914	-0.004	6.624
80% G	-22.183	24.185	-0.061	6.631
90% G	-20.028	24.798	0.072	6.648
70% ESG	-22.318	22.617	0.000	6.434
80% ESG	-21.564	22.498	0.027	6.412
90% ESG	-21.689	24.170	-0.049	6.561

Notes: the table reports minimum, maximum, mean and standard deviation (SD) of monthly excess returns of both the benchmark and the socially responsible portfolios in the period 2007-2021.

Table A3. Portfolio excess returns: crisis periods

	Global recession				Covid-19 crisis			
Portfolio	Min (%)	Max (%)	Mean (%)	SD (%)	Min (%)	Max (%)	Mean (%)	SD (%)
Benchmark	-24.084	20.651	-5.598	10.410	-18.319	19.220	2.415	7.824
Negative screening								
10% E	-24.123	20.464	-5.590	10.263	-18.998	19.895	2.476	8.110
20% E	-23.440	20.085	-5.556	10.067	-19.693	20.508	2.557	8.356
30% E	-22.990	19.418	-5.523	9.749	-20.640	21.179	2.495	8.652
10% S	-24.232	20.338	-5.521	10.188	-19.342	20.030	2.412	8.197
20% S	-23.604	19.982	-5.533	10.051	-19.266	20.289	2.445	8.242
30% S	-23.440	19.521	-5.554	9.980	-19.122	19.869	2.491	8.124
10% G	-24.366	20.534	-5.495	10.334	-19.187	20.042	2.453	8.197
20% G	-23.821	20.397	-5.539	10.190	-19.165	20.182	2.436	8.206
30% G	-23.518	19.163	-5.461	10.036	-19.666	20.495	2.453	8.383
10% ESG	-24.383	20.418	-5.557	10.360	-19.120	19.892	2.501	8.130
20% ESG	-23.903	20.707	-5.553	10.277	-19.709	20.457	2.510	8.368
30% ESG	-23.336	19.704	-5.539	9.939	-20.256	21.219	2.482	8.609
Positive screening								
70% E	-22.676	17.292	-5.591	9.377	-19.523	21.317	2.767	8.523
80% E	-21.441	18.816	-5.392	9.533	-18.691	20.022	2.679	8.162
90% E	-24.507	19.144	-5.844	10.100	-19.553	20.169	2.846	8.407
70% S	-21.206	19.003	-5.576	9.396	-19.747	22.387	2.282	8.636
80% S	-22.041	19.395	-5.781	9.700	-20.127	24.706	2.377	9.102
90% S	-18.585	13.845	-5.933	8.100	-20.156	24.308	2.153	9.110
70% G	-23.759	21.369	-5.711	10.304	-21.103	21.914	2.724	9.026
80% G	-22.183	24.185	-5.513	10.588	-18.854	19.684	2.526	8.248
90% G	-18.692	24.798	-5.218	10.153	-20.028	23.384	2.912	9.448
70% ESG	-22.318	18.869	-5.556	9.705	-20.034	22.617	2.580	8.811
80% ESG	-21.564	19.412	-5.660	9.486	-19.678	22.498	2.563	8.729
90% ESG	-21.294	18.707	-5.694	9.414	-21.689	24.170	2.723	9.404

Notes: the table reports minimum, maximum, mean and standard deviation (SD) of monthly excess returns of both the benchmark and the socially responsible portfolios during periods of financial distress (i.e. the global recession and the Covid-19 crisis).

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