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EFFECTIVENESS OF THE ESG APPROACH IN PORTFOLIO SELECTION – AN EMPIRICAL EVIDENCE FROM THE US STOCK MARKET

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Abstract. The purpose of this study is to explore whether ESG (Environmental, Social, and Governance) criteria can serve as a valuable tool for investors when making rational decisions about financial security selection and portfolio construction. By applying Modern and Post-Modern portfolio theories (MPT and PMPT) under the conditions of ESG and Return Max criterion, our primary objective was determined: *"Is ESG a criterion for investors in the rational selection of financial securities and portfolio construction?"* A five-year analysis (2018–2023) was carried out on 484 financial securities (companies) from the S&P 500 Stock Index to answer this question. Data collected included the daily close price of the S&P 500 Stock Index, its constituents (484 stocks), ESG scores, risk-free rate, and the equity risk premium of the U.S. market. The results showed that financial securities chosen based on the Return Max criterion were generally undervalued on the market; however, this was not consistently observed by ESG Max where examples of overvalued securities were also identified. Nevertheless, using the Sharpe and Sortino Ratio performance indicators, it was concluded that the return per unit of assumed risk is more appealing to investors (with risk aversion) when considering the portfolios built on the ESG Max criterion.

Keywords: ESG, modern portfolio theory, post-modern portfolio theory, return, S&P 500 Stock Index, Sharpe Ratio, Sortino Ratio.

JEL Classification: C12, C51, G11.

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1. Introduction

The new paradigm of financial asset portfolio management is based on the concept of sustainable finance (Fatemi & Fooladi, 2013; Singhania et al., 2023).

Portfolio management theories have evolved through several stages, from a purely financial approach centered on shareholder value, financial security returns, and associated risk, generally with a short-term orientation, to the approach of Sustainable Finance. Sustainable Finance has so far followed an evolutionary path in three phases delimited by various legal regulations and investment strategies. As a result, the three phases are:

Sustainable Finance 1.0, which took the first step in redefining shareholder value by introducing ethical, moral, and even religious values into investment decision-making, such as avoiding investments in unethical sectors (e.g., tobacco companies, weapons producers, etc.), also known as "sin stocks."

Sustainable Finance 2.0, which introduced stakeholder value, considering financial, social, and environmental aspects with a medium-term orientation. In this phase, ESG (Environmental, Social, and Governance) factors began to be included in investment analysis alongside traditional financial indicators, although there is no standardized reporting framework for ESG.

Sustainable Finance 3.0, which adopts a long-term orientation based on common good value and the investment strategy prioritizes companies that are not only financially sustainable but also generate a positive impact alongside financial returns, investors adopting a "double materiality framework" (Dragomir et al., 2024).

According to a study carried out by Schoenmaker, at the time of the study (2017a, 2017b), the majority of companies and investors were at the level of Sustainable Finance 1.0, and level 3.0, towards which they are aiming, few companies reached it (Schoenmaker, 2017a, 2017b), "*sustainable investments represent for approximately 3% of the total market*" (Kemfert & Schmalz, 2019), but, starting with 2016, the growth rates of sustainable investments have registered significant increases: the market of ESG investing increased in 2017–2018 by 42% in Canada, by 38% in the USA, by 11% in Europe, by 46% in Australia and from 474 billion (end of 2016) to 2.2 trillion (end of 2018) in Japan (Drei et al., 2019). As can be noticed from the information above, the ESG investing approach is relatively new considering its current form, but it originates in ethical and socially responsible investing.

The ESG investing approach requires investors to move from an investment approach based exclusively on the expected financial return to an approach that also considers the impact of the companies they choose to invest in on the environment and society (Uzsoki, 2020). This type of approach has as its basic idea the investment in sustainable companies not only from a financial point of view but also considering the three pillars of sustainability. ESG investing involves considering the company's non-financial performance in addition to its financial performance. So, ESG investing introduces new criterion for the selection by investors of the companies in which to invest, and that criterion is the ESG factors. Thus, when building a portfolio of companies, an investor will consider both the expected financial return and the company's ESG factors, which reflect the company's impact on stakeholders. This approach is based on the belief that a company's ESG performance strongly indicates its future financial performance and sustainability. The objective of ESG investing is to generate positive social and environmental outcomes while also generating financial returns. ESG investing makes the transition from investment strategies that only avoided "sin stocks" to more advanced strategies that apply all the principles of sustainability, thus building ESG portfolios (Blank et al., 2016). Even though progress has been made in ESG measurement and ESG disclosure regulation, an important problem persists, namely the lack of an unanimously accepted methodology, but there are ongoing efforts to harmonize ESG reporting standards (Khan, 2022). There are still inconsistencies in ESG ratings between agencies because of different measurement methodologies, factor weighting, and data sources, which lead to different results and make it hard for investors to compare companies and assess their actual ESG performances. A unitary approach regarding ESG reporting and scoring standardization is essential to solve these challenges in the near future.

The relevance of this study lies in its empirical evidence about the role of ESG as a selection criterion for individual financial securities and portfolio construction, demonstrating that ESG-based portfolios can offer higher risk-adjusted returns. The results of this study are important for academia as they contribute to the literature on ESG and portfolio optimization. The study fills the gap between sustainable investing and traditional investing approaches by integrating ESG with modern portfolio theory (MPT) and post-modern portfolio theories (PMPT). The study offers practical perspectives too, which makes it relevant to financial analysts, investors, and fund managers, providing evidence-based results to support their ideas and decisions regarding the importance of sustainable investments, insights about how to include ESG in portfolio construction, information about how to address valuation risks, such as potential overvaluation of ESG focused financial securities. Besides this, it also fosters critical thinking about the relationship between sustainability and financial returns. Further, it consolidates the idea of ESG investing as a promising option for selecting financial securities and portfolio construction.

Given these debates, this study aims to clarify a relevant current issue, which also constitutes the primary objective of this research: *Is ESG a criterion for investors in the rational selection of financial securities and portfolio construction?*

For reductionist clarity, the primary objective was divided into research directions, and the two research directions in turn include secondary objectives:

- *Direction 1*: Analysis of the return and risk of individual financial securities selected according to the criteria: maximum return, respectively, maximum ESG.
- *Direction 2*: Analysis of the return and risk of portfolios built on the criteria: maximum return, maximum ESG, applying the Modern and Post-Modern portfolio theory.

MPT is a scientific construct that is based on the assertion that investors are characterized by risk aversion. As a result, the model proposed by Markowitz within this theory (the model implements the hypotheses of the theory) is the way to optimize the correlation between the expected return and the risk of a portfolio of financial securities. In this understanding, it is considered that the return on the securities in the portfolio is in the form of a random variable, where the risk is given by the variance of returns.

However, even though the return-risk criterion is widely accepted in financial practice, it is also accepted in academia. From the point of view of investor behavior, things are a little more complicated. From a technical point of view, the variance of the portfolio return, as a measure of risk, considers its determination of both positive and negative returns compared to the return expected by investors.

As a result, an alternative to this situation is to modify the return-risk criterion into the return-downside risk criterion, starting from the premise that investors have aversion to the downside risk, the measure of which is given by the semi-variance. This issue is the subject of the Post-Modern portfolio theory (PMPT). The technical aspects regarding the two theories above are described in the methodology of our paper.

The remainder of the paper is structured as follows. A literature review section evaluates the current state of research on ESG and return as criteria in portfolio construction and identifies the contributions and limitations of the previous studies. The Methodology and Data section elaborates on our choices in research design and data collection (source, sample, categories, timeframe). The Results and Discussion section introduces and interprets the research results against the existing literature. The Conclusions present the study's main findings, highlight its theoretical and practical implications, explain its limitations, and suggest directions for future research.

2. Literature review

Now, the new paradigm in finance, namely sustainable finance, which seeks to integrate sustainability principles into investment decisions faces challenges due to an insufficient alignment between the evolving financial theory (which now incorporates qualitative variables) and the research methods and financial models that remain predominantly quantitative (Lagoarde-Segot, 2019; Dimmelmeier, 2023). Currently, investment approaches based on ESG investing are largely discussed within academic circles. The professional environment has no unified practical approach regarding what "*ESG investment in the context of a complex, integrated economy*" entails (Cornell, 2020).

The transition from agency theory to stakeholder theory (Paranque & Pérez, 2016) requires abandoning the short-term approach in favor of aligning market participants with a long-term vision in financial decision-making (Schoenmaker, 2017a). This means replacing the efficient markets hypothesis with the adaptive markets' hypothesis, which better reflects a stakeholder-oriented perspective (Schoenmaker, 2017b).

The expansion of sustainable finance practices must be supported by the development of tools to assist in investment decision-making in line with the objectives of this new paradigm (Odell & Ali, 2016; Varmaz et al., 2024). Additionally, central and commercial banks can play a crucial role in encouraging green investments by adapting lending policies for companies seeking loans for sustainable projects (Dörry & Schulz, 2018; Stawska & Jabłońska, 2021; Naeem et al., 2023). However, national regulations must create the legal framework for banks to implement such measures.

Some authors view ESG investing as an attempt by the state to shift the responsibility for addressing social and environmental issues onto the market, when, in fact, only the state has the capacity to prevent such problems. As Pucker and King (2022) note, "*ESG investing isn't designed to save the planet.*"

In Figure 1 below a timeline illustrating key milestones in sustainable finance evolution can be found.

Figure 1. Sustainable finance evolution (source: authors' elaboration based on The Financial Stability Board (2015), United Nations Environment Programme Finance (2017), European Commission (n.d.), Schoenmaker (2019), and Securities and Exchange Commission (2024))

Another debate centers on the returns generated by investing in companies with high ESG scores (Jin, 2022; Dhasmana et al., 2023). Do ESG portfolios offer higher returns? Some authors have demonstrated through studies that stocks with low ESG scores tend to deliver higher returns than those with high ESG scores. This is because such stocks are often undervalued and may experience subsequent price increases, leading to higher returns for investors. Even if they remain undervalued, they often have a higher dividend-to-price ratio, resulting in higher returns (Hvidkjær, 2017). On the other hand, an extensive study by Gerhard Halbritter and Gregor Dorfleitner, utilizing the Carhart four-factor model and cross-sectional Fama and MacBeth regressions, found no significant difference in return between companies with high ESG ratings and those with low ESG scores (Halbritter & Dorfleitner, 2015; Shanaev & Ghimire, 2022). A study carried out over 10 years on companies in the USA and Europe demonstrated the opposite of previous conclusions, namely that higher ESG-rated companies have led to higher stock returns (Giese et al., 2019). However, a similar study carried out over a period from 2010–2019 concluded that "ESG investing tended to penalize both passive and active ESG investors between 2010 and 2013, while contrastingly, ESG investing was a source of outperformance from 2014 to 2019 in Europe and North America" (Drei et al., 2019). But a study of 325 companies that form the BSE 500 index, conducted for the period 2014–2021, highlights "*a negative ESG disclosure premium stating that firms with high levels of disclosure earn less returns compared with the firms with less disclosures*" (Khandelwal et al., 2023).

A key issue that affects ESG-based investments and the returns associated with these investments is related to ESG uncertainty. The "*lack of consistency of ESG information disclosure and ratings provided by different rating agencies*", the lack of unitary standards for ESG measurement and reporting, and the lack of clear definitions and regulations regarding what "*really green investments, ESG investment*" means, generates the feeling of ESG uncertainty that affects (Avramov et al., 2022; Kemfert & Schmalz, 2019):

- investors, as they perceive these investments as risky and for this reason, the demand for ESG investing decreases or the claim to obtain a higher return related to these investments increases, correlated with the level of perceived risk;
- "green" companies that report ESG metrics, as they may face a higher cost of capital.

Analyzing the risk of contagion and its impact on the value of financial securities, evidence suggests that during periods of high volatility, the risk of contagion does not differentiate between securities with high ESG scores and those with lower ESG scores (Cerqueti et al., 2021). From a long-term investor perspective, another study conducted on 1,600 publicly listed companies that report ESG scores over 10 years demonstrated that companies with high ESG ratings tend to be more competitive in the market, achieve a higher long-term return, which turns into providing increased dividends to shareholders (Giese et al., 2019).

A study conducted on 180 companies in the U.S. concluded that, in the long term, "*high sustainability companies*" perform better than companies that have not adopted sustainable practices, both in the stock market and in terms of return (Eccles et al., 2014). Similarly, for publicly listed companies in China, a positive relationship has been established between the ESG score and the companies' market value and financial performance (Zhou et al., 2022).

For now, the conclusions of the studies that addressed this topic, the link between a company's ESG score and its stock returns, do not converge towards a unified outcome (Husse & Pippo, 2021). One of the reasons why the results are contradictory may be that the analyzed period is too long, and before 2008, few companies took ESG principles into account. These practices, which address the financial sustainability of investments, have only intensified and taken shape in more recent years (Bennani et al., 2018). Another reason for the inconsistent results regarding the performance of ESG portfolios may be the fact that investors concerned with sustainable investments do not only have financial expectations; the expectations of traditional investors and those of ESG investors may be different (Drei et al., 2019; Goldstein et al., 2022).

The approach regarding ESG as a criterion in selecting individual financial securities and portfolio construction, from the analysis in current research, a valid conclusion can be drawn: the importance of the ESG factor in rational investment decision-making is increasing. The integration of ESG factors into the construction of financial asset portfolios is a subject of interest for individual investors, institutional investors, and portfolio managers. This is evident in the growing number of signatories to the United Nations Principles for Responsible Investment (PRI), which increased from 63 signatories in 2006 to 3,826 in 2021. Signing the PRI involves adhering to six principles, as shown in Figure 2. Additionally, in 2020, one-third of the funds invested by U.S. institutional investors were directed toward ESG strategies, a 42% increase from 2018 (Edmans, 2022).

Figure 2. The six principles for responsible investment (source: Principles for Responsible Investment, 2024)

It can be noticed that investors use the ESG score to choose financial securities as a means of managing risk, based on the premise that companies with a high ESG score:

- have a lower risk of being involved in future scandals or being fined (Amel-Zadeh & Serafeim, 2018);
- face lower capital costs (Cornell, 2021);
- demonstrate better long-term management, which reduces the risk of unfavorable incidents (Giese et al., 2019);
- exhibit higher financial performance, increased market value, and lower market risk, particularly those with strong environmental and governance components in their ESG index (Ramírez-Orellana et al., 2023). However, another study using a conditional factor model failed to yield conclusive results regarding the relationship between the ESG score and a company's financial risk level (Lindsey et al., 2023).

A study by Verheyden et al. (2016) identified "*an unequivocally positive contribution to risk-adjusted returns when using a 10% best-in-class ESG screening approach. Both the global and developed market portfolios show higher returns, lower (tail) risk, and no significant reduction in diversification potential despite the reduction in the number of companies*", concluding that the inclusion of the ESG factor in the decision-making process contributes to a better foundation for investment decisions (Verheyden et al., 2016; Teti et al., 2023). This idea is further supported by another study demonstrating that portfolios integrating ESG metrics offered superior returns for investors compared to conventional portfolios while also presenting lower risk; however, these portfolios are preferred by long-term-oriented investors (Kotsantonis et al., 2016; Liu et al., 2023). Conversely, some argue that ESG should be regarded as any other intangible asset of the company: "*Investor engagement on ESG factors shouldn't be put on a pedestal compared to engagement on other value drivers. We want great companies, not just companies that are great at ESG*" (Edmans, 2022).

As a result of the above, different perspectives on ESG, some authors consider ESG a new investment approach and others an investment selection criterion. Our positioning in this paper is to approach ESG as an investment portfolio selection criterion.

3. Methodology and data

Given the primary objective mentioned in the Introduction section, the present study aims to satisfy the following four secondary research objectives:

- *Secondary Objective 1*: Are the individual financial securities selected based on the criteria of maximum Return or maximum ESG undervalued?
- *Secondary Objective 2*: Do the individual financial securities selected based on the maximum ESG criterion offer a higher excess/additional return above the risk-free rate

per unit of assumed risk, compared to those selected based on the maximum return criterions?

- *Secondary Objective 3*: Does the structure of the minimum variance portfolio (characteristic of investors with extreme risk aversion) constructed based on the maximum ESG criterion offer an additional/excess higher return above the risk-free rate per unit of assumed risk, compared to that offered by the portfolio constructed on the criterion maximum return?
- *Secondary Objective 4*: Does the structure of the efficient portfolio (characteristic of risk-averse investors) constructed based on the maximum ESG criterion offer an additional/excess higher return above the risk-free rate per unit of assumed risk, compared to that offered by the portfolio constructed based on the maximum return criterion?

Regarding the two criteria for selecting securities in the portfolio, we consider ESG Max and Return Max. The ESG Max criterion, measured as a score, between 0 and 100, where the score 0 (minimum) signifies a very low level of sustainable performance, and the score 100 (maximum) shows an excellent level of sustainable performance of the company. The ESG score is calculated annually by Thomson Reuters using its methodology. The Return Max criterion, i.e. the maximum profitability that a financial security records, is calculated by the authors starting from daily stock prices, considering the stock year as 252 days. Daily returns are determined based on daily stock prices, used to calculate average annual returns. For each criterion, the top five stocks that register the maximum ESG score, respectively Return Max, in the analyzed period (2018–2023), will be included in the investment portfolio, applying the two theories described in the methodology, MPT and PMPT.

A synthesis of the particularities between the two theories addressed in the paper are presented in Table 1 below.

Table 1. Differences between MPT and PMT (source: author's elaboration)

Theory/Particularities	MPT	PMPT
Behavioral premise	Risk Aversion	Loss Aversion
Optimization criterion	Return-Risk	Return-Downside Risk
Risk measure	Variance	Semi-Variance
Performance measure	Sharpe Ratio	Sortino Ratio

3.1. Methodological framework

In what follows, we will present the methodology used to answer the four secondary research objectives we established in this study. In this sense, the theoretical framework we considered for realizing this approach is to consider the capital market as an equilibrium market. By a capital market in equilibrium, we mean the definition provided by Sharpe: "All investors can borrow at a risk-free interest rate, and investor expectations are homogeneous" (Sharpe, 1964).

To satisfy *objectives* 1 and 2 of our study, we opted for the use of the Security Market Line (SML) and the Sharpe ratio. From the perspective of a rational investor, the SML represents a benchmark for evaluating financial securities or a portfolio. Suppose the return of a security or a portfolio is above the SML. In that case, it is considered undervalued (offering a higher return for its level of risk). If its return is below the SML, it is considered overvalued (offering a lower return for its level of risk). SML allows for a rational theoretical representation of the expected returns of financial securities characterized by systematic, non-diversifiable risk, under the mean-variance behavioral assumption (MVB).

However, this standard approach can be surpassed by considering an alternative behavioral hypothesis, the mean-semi variance behavioral hypothesis (MSB) (Estrada, 2004). This alternative is justified by the fact that only a decrease in returns concerns investors. In this sense, MSB is almost perfectly correlated with expected utility (and with the expected compound utility of returns) and can, therefore, be defended along the same lines used by Levy and Markowitz (1979) and Markowitz (1991) to defend MVB (Estrada, 2002).

Let i be a financial security traded on the capital market and included in the market portfolio M $(i \supset M)$, and let $R_i \sim N(\mu_i, \sigma_i^2)$ and $R_M \sim N(\mu_M, \sigma_M^2)$ be two continuous random variables normally distributed, with known, constant, and non-zero means (μ_i, μ_M), and known, constant, and non-zero variances (σ_i^2, σ_M^2). Where: R_i – the return of financial security i; R_M – the return of the capital market, calculated based on the representative stock index.

We know that in a capital market equilibrium, the expected return of a financial security is determined by the CAPM (Capital Assets Pricing Model) as follows:

$$E(R_i) = Rf + | E(R_M) - Rf | \times \beta_i, \tag{1}$$

where: $E(R_i)$ = expected return of financial security i; $E(R_M)$ – expected return of the capital market; $[E(R_M) - Rf]$ – market risk premium; $[E(R_M) - Rf] \times \beta_i$ – risk premium of financial security i; β_i volatility coefficient; Rf – risk-free interest rate. Moreover, for an optimal portfolio, we will have:

$$E\left(R_P\right) = \sum_{i=1}^{n} x_i E\left(R_i\right), \text{ with } \sum_{i=1}^{n} x_i = 1, \tag{2}$$

where: $E\left(R_P\right)$ – expected return of the portfolio; n – the number of securities in the portfolio; x_i – the weight of security i in the portfolio.

From Equations (1) and (2), by substitution, we will have:

$$\begin{aligned} E\left(R_P\right) &= Rf\left(x_1 + \ldots + x_n\right) + \left[E\left(R_M\right) - Rf\right] \times \left[\beta_1 x_1 + \ldots + \beta_n x_n\right] = \\ E\left(R_P\right) &= Rf + \left[E\left(R_M\right) - Rf\right] \times \left[\beta_1 x_1 + \ldots + \beta_n x_n\right]. \end{aligned} \tag{3}$$

These situations arise because, rationally, for the same amount of market risk of a financial security, we cannot have more than the same amount of return, or equivalently, for the same amount of return, we cannot have more than the same amount of market risk.

In conclusion, we use:

For secondary objective 1:

$$E\left(R_i\right) > \mu_i \to \text{ security } i \text{ is overvalued;} \tag{4}$$

$$E\left(R_i\right) < \mu_i \to \text{ security } i \text{ is undervalued;} \tag{5}$$

$$E\left(R_i\right) = \mu_i \to \text{ it is in equilibrium.} \tag{6}$$

For secondary objective 2:

$$\frac{E\left(R_i\right) - R_f}{\sigma_i}.$$

The standard approach described above can be surpassed by considering downside risk. Why? As mentioned earlier, only the downward movements of a financial security's return are considered concerning for the investor. This has led to the development of D-CAPM (Downside Capital Asset Pricing Model), aimed at aligning the standard CAPM theory with investor behavior. Below, we specify only the particularities.

Formally (Estrada, 2002, 2007):

$$\text{D-}E\left(R_i\right) = Rf + \left[E\left(R_M\right) - Rf\right] \times \beta_i^D, \tag{7}$$

where: β_i^D – downside beta; D-$E\left(R_i\right)$ – downside expected return of security i

Analytically, for this case, Estrada tells us that:

$$\beta_i^D = \frac{E\left\{\min\left[\left(R_i - \mu_i\right), 0\right] \times \min\left[\left(R_M - \mu_M\right), 0\right]\right\}}{E\left\{\min\left[\left(R_M - \mu_{M,}\right), 0\right]^2\right\}}, \tag{8}$$

where: $E\left\{\min\left[\left(R_i - \mu_i\right), 0\right] \times \min\left[\left(R_M - \mu_{M,}\right), 0\right]\right\}$ – the co-semi-variance of the return of security i with the return of the capital market, and $E\left\{\min\left[\left(R_M - \mu_{M,}\right), 0\right]^2\right\}$ – the semi-variance of the capital market return.

The issue of measuring systematic risk (β_i^D) in the D-CAPM model was revisited by Venkataraman, who stated that the co-semi-variance term in the numerator of expression (8) is incompatible with CAPM in the mean-semi variance framework, arguing that replacing β_i from the CAPM model with β_i^D The mean-semi variance framework is invalid. Venkataraman's proposed solution is to derive the relationship between CAPM and downside beta. The appropriate downside beta can be deduced only by deriving CAPM in the mean-semi variance framework.

Formally, following the derivation, the proposed solution (Venkataraman, 2023) is:

$$\beta_i^D = \frac{E\left[\left(\min(R_M - \mu_{M,} 0\right) \times (R_i - \mu_i)\right]}{\sigma_{pB}^2}, \tag{9}$$

where: $\sigma_{pB}^2 = E\left[\min\left\{\left(\alpha R_i + \left(1-\alpha\right) R_m\right) - \left(\alpha \mu_i + \left(1-\alpha\right) \mu_M\right), 0\right\}\right]^2$; α = the share of security i in the M market portfolio.

For a portfolio, like the above framework, we can write:

$$\text{D-}E\left(R_p\right) = Rf + \left[E\left(R_M\right) - Rf\right] \times \left[\beta_1^D x_1 + \ldots + \beta_n^D x_n\right], \tag{10}$$

where: D-$E\left(R_p\right)$ – downside expected return of portfolio p.

Objectives 3 and *4* of our study will be tested within the framework of Modern portfolio theory (MPT) and Post-Modern portfolio theory (PMPT). We opt to calculate synthetic indicators of portfolio performance. In this context, we will use the Sharpe ratio for Modern portfolio theory (MPT) and the Sortino ratio for Post-Modern portfolio theory (PMPT). Based on the results obtained from these performance ratios, we will draw conclusions for various optimal portfolios that we calculated (located on the Markowitz frontier). To make the results comparable and to allow us to conclude, the chosen criterion is the expected returns of the investor, which are common to both types of portfolios we constructed, both within MPT and PMPT.

The Sharpe ratio (Sh) measures the excess/additional return of the portfolio over the risk-free rate per unit of portfolio risk $\left(Sh = \frac{E\left(R_p\right) - Rf}{\sigma p}\right)$, while the Sortino ratio (Sor) measures the excess/additional return of the portfolio over the risk-free rate per unit of downside risk of the portfolio $\left(Sor = \frac{E\left(R_p\right) - Rf}{\sigma_{p(D)}}\right)$, where: σ_p and $\sigma_{p(D)}$ represent the volatility of the portfolio and the downside volatility of the portfolio, respectively.

MPT is a theoretical construct within the formal MVB framework and can be described by the following study directions: (1) determining the optimal structure of the minimum variance portfolio (MVP), characteristic of rational investors with extreme risk aversion; (2) determining the optimal structure of the efficient portfolio (EP), characteristic of rational investors with risk aversion (in this case, the minimum risk is determined for a given expected return by the investor, or vice versa). Portfolios between MVP and $\frac{\partial \mu_p}{\partial \sigma_p^2} = 0$ are called efficient portfolios.

Formally, for these situations, the portfolio equations can be written as follows:

$$E\left(Rp\right) = \sum_{i=1}^{n} x_i E\left(R_i\right); \tag{11}$$

$$VAR\left(Rp\right) = \sum_{i=1}^{n} \sum_{j=1}^{n} x_i x_j \sigma_{ij}; \tag{12}$$

$$\sum_{i=1}^{n} x_i = 1, \tag{13}$$

where: $VAR\left(Rp\right)$ – the variance of the portfolio's return; x_j – the weight of security j in the portfolio; x_i – the weight of security i in the portfolio; σ_{ij} – the covariance between the returns of security i and the returns of security j; n – the number of securities in the portfolio.

The optimal structure of the MVP can be achieved by minimizing a Lagrange function $\left(\frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} x_i x_j \sigma_{ij} + \lambda_1\left(\sum_{i=1}^{n} x_i - 1\right)\right)$, with one restriction, $\left(\sum_{i=1}^{n} x_i = 1\right)$, which allows the minimization of portfolio risk, and thus we will have (Brătian et al., 2016):

$$\begin{pmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \\ \lambda_1 \end{pmatrix} = \begin{pmatrix} \sigma_1^2 & \sigma_{12} & \cdots & \sigma_{1n} & 1 \\ \sigma_{21} & \sigma_2^2 & \cdots & \sigma_{2n} & 1 \\ \vdots & \vdots & \ddots & \vdots & \vdots \\ \sigma_{n1} & \sigma_{n2} & \cdots & \sigma_n^2 & 1 \\ 1 & 1 & \cdots & 1 & 0 \end{pmatrix}^{-1} \cdot \begin{pmatrix} 0 \\ 0 \\ \vdots \\ 0 \\ 1 \end{pmatrix}, \tag{14}$$

where: $\sigma_i^2 = VAR\left(R_i\right) = E\left\{\left[\left(R_i - \mu_{i,}\right)\right]^2\right\}$; $\sigma_{ij} = E\left\{\left[\left(R_i - \mu_i\right)\right] \times \left[\left(R_j - \mu_j\right)\right]\right\}$,

where: λ_1 is the Lagrange multiplier.

And consequently, given the optimal structure of the portfolio, we will have:

$$E\left(R_p\right)_{MVP} = \left(x_1 x_2 \ldots x_n\right) \times \begin{pmatrix} E\left(R_1\right) \\ E\left(R_2\right) \\ \vdots \\ E\left(R_n\right) \end{pmatrix}. \tag{15}$$

And the volatility of the portfolio for this case $\left(\sigma_{p(MVP)} = \sqrt{VAR\left(Rp\right)}\right)$ is:

$$\sqrt{\left(x_1 x_2 \ldots x_n\right) \cdot \begin{pmatrix} \sigma_1^2 & \sigma_{12} & \cdots & \sigma_{1n} \\ \sigma_{21} & \sigma_2^2 & \cdots & \sigma_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \sigma_{n1} & \sigma_{n2} & \cdots & \sigma_n^2 \end{pmatrix} \cdot \begin{pmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{pmatrix}}. \tag{16}$$

Similarly, the optimal structure of the EP can be achieved by minimizing a Lagrange function $\left(\frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} x_i x_j \sigma_{ij} + \lambda_1\left[\sum_{i=1}^{n} x_i E\left(R_i\right) - E\left(R_p\right)\right] + \lambda_2\left(\sum_{i=1}^{n} x_i - 1\right)\right)$, with two restrictions, $\sum_{i=1}^{n} x_i E\left(R_i\right) = E\left(R_p\right)$, and $\left.\sum_{i=1}^{n} x_i = 1\right)$, which allows for minimizing the portfolio risk, and thus we will have (Brătian et al., 2016):

$$\begin{pmatrix} x_1 \\ \vdots \\ x_n \\ \lambda_1 \\ \lambda_2 \end{pmatrix} = \begin{pmatrix} \sigma_1^2 & \cdots & \sigma_{1n} & E\left(R_1\right) & 1 \\ \vdots & \ddots & \vdots & \vdots & \vdots \\ \sigma_{n1} & \cdots & \sigma_n^2 & E\left(R_n\right) & 1 \\ E\left(R_1\right) & \cdots & E\left(R_n\right) & 0 & 0 \\ 1 & \cdots & 1 & 0 & 0 \end{pmatrix}^{-1} \cdot \begin{pmatrix} 0 \\ \vdots \\ 0 \\ E\left(Rp\right) \\ 1 \end{pmatrix}, \tag{17}$$

where: λ_1, λ_2 are the Lagrange multipliers;

And the volatility of the portfolio for this case, where the result is obtained based on the expected return given by the investor, $\left(\sigma_{p(EP)} = \sqrt{VAR\left(Rp\right)}\right)$ is:

$$\sigma_{p(EP)} = \sqrt{\left(x_1 x_2 \ldots x_n\right) \times \begin{pmatrix} \sigma_1^2 & \cdots & \sigma_{1n} \\ \vdots & \ddots & \vdots \\ \sigma_{n1} & \cdots & \sigma_n^2 \end{pmatrix} \times \begin{pmatrix} x_1 \\ \vdots \\ x_n \end{pmatrix}}. \; . \tag{18}$$

Similar to the formal framework of MVB and MPT, PMPT is a theoretical construct within the formal MSB framework. The difference between PMPT and MPT is that the behavioral assumption is different in the MSB formal framework, as we have mentioned. For this case, we will denote by D-MVP the downside minimum variance portfolio and by D-EP the downside efficient portfolio and the latter are encompassed between D-MVP and $\frac{\partial \mu_{p(D)}}{\partial \sigma_{p(D)}^2} = 0$. This is valid since PMPT is a generalization of MPT, with Modern portfolio theory being nothing more than a particular case of Post-Modern portfolio theory.

The formal differences in this framework are:

$$\sigma^2_{(D)i} = E\left\{\min\left[\left(R_i - B\right),0\right]^2\right\}, \tag{19}$$

where: B – benchmark.

And we define B like this: $B = \max\left(\mu_i\ ,0\right)$

$$\sigma_{(D)ij} = E\left\{\min\left[\left(R_i - B\right),0\right] \times \min\left[\left(R_j - B\right),0\right];\right\}\ ; \tag{20}$$

$$E\left(R_p\right)_{D-MVP} = \left(x_1 x_2 \ldots x_n\right) \times \begin{pmatrix} D - E\left(R_1\right) \\ D - E\left(R_2\right) \\ \vdots \\ D - E\left(R_n\right) \end{pmatrix}; \tag{21}$$

$$\sigma_{p(D-MVP)} = \sqrt{\left(x_1 x_2 \ldots x_n\right) \cdot \begin{pmatrix} \sigma^2_{(D)1} & \sigma_{(D)12} & \cdots & \sigma_{(D)1n} \\ \sigma_{(D)21} & \sigma^2_{(D)2} & \cdots & \sigma_{(D)2n} \\ \vdots & \vdots & \ddots & \vdots \\ \sigma_{(D)n1} & \sigma_{(D)n2} & \cdots & \sigma^2_{(D)n} \end{pmatrix} \cdot \begin{pmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{pmatrix}}; \tag{22}$$

$$\sigma_{p(D-EP)} = \sqrt{\left(x_1 x_2 \ldots x_n\right) \times \begin{pmatrix} \sigma^2_{(D)1} & \cdots & \sigma_{(D)1n} \\ \vdots & \ddots & \vdots \\ \sigma_{(D)n1} & \cdots & \sigma^2_{(D)n} \end{pmatrix} \times \begin{pmatrix} x_1 \\ \vdots \\ x_n \end{pmatrix}}, \tag{23}$$

where: $\sigma^2_{(D)i}$ – the semi-variance of the return of security i; $\sigma_{(D)ij}$ – the co-semi variance between the returns of security i and the returns of security j; $E\left(R_p\right)_{D-MVP}$ – the expected return of the downside minimum variance portfolio; $\sigma_{p(D-MVP)}$ – the downside volatility of the minimum variance portfolio; $\sigma_{p(D-EP)}$ – the downside volatility of the efficient portfolio.

Note: for Equation (23), we specify that the result obtained is a function of the expected return rate and is provided by the investor (see above how we defined efficient portfolios, differential calculus, and matrix calculus).

3.2. Data and sampling

This study's sample consists of securities (stocks) from the S&P 500 Index. The convenience sampling method, which is part of the non-probability sampling, was used.

The S&P 500 Index is composed of companies (503) from all sectors of activity as follows: *Technology* sector (90); Industrials sector (72); *Consumer Cyclicals* sector (66); *Healthcare* sector (64); *Financials* sector (58); *Consumer Non-Cyclicals* sector (40); *Utilities* sector (32); *Real Estate* sector (30); *Basic Materials* sector (27); *Energy* sector (24).

The data included in our study for the sample described above are the daily Close Prices, ESG Scores, the S&P 500 Index daily Close Price, the Risk-Free Rate (US Treasury yield), and

U.S. Equity Risk Premium. The period analyzed is five years, from 27/12/2018 until 28/12/2023. If a trading year consists of 252 days, it leads to 1.260 daily observations for five years. The data has been gathered as follows:

- For the 503 companies from the S&P 500 Index, the daily close prices were obtained using Microsoft Excel 365, Stocks tab customized for the period analyzed (from 27/12/2018 until 28/12/2023, 1.260 observations). The data was retrieved from Refinitiv Eikon;
- The annual ESG Scores for the sample in our study were obtained from Refinitiv Eikon;
- The daily close prices for the S&P 500 Index were obtained from the Nasdaq website, historical data (from 27/12/2018 until 28/12/2023, 1.260 observations);
- The Risk-Free Rate considered was the U.S. Treasury Yield 5 Years, 3.879% at the moment we started our study;
- Aswath Damodaran provided and calculated the Equity Risk Premium for the U.S. market at 4.60%.

After gathering all the data, as shown above, 484 companies out of 503 remained in the sample study, which had all the data (daily close prices and ESG Score). For the analyzed sample, based on the daily returns, we calculated the average daily return and then annualized it. For the analyzed period of 5 years, we calculated the average annual return for each company in the sample; thus, applying the Return Max criterion, we identified the top 5 companies with the highest returns that we selected for the portfolio construction. The ESG score is calculated annually by Thomson Reuters Eikon; as a result, for the analyzed period of 5 years, the average annual ESG score was calculated for each company in the sample. Thus, applying the ESG Max criterion, we identified the top 5 companies with the highest ESG scores we selected to construct the portfolio.

4. Results and discussions

In our approach to achieving the general objective of the study through the two directions drawn but also the secondary research objectives developed for each direction, we studied, analyzed, collected data, and applied the previously described methodology on a sample of 484 companies from the S&P Index 500 from the U.S., over an analyzed period of five years. From the perspective of Modern and Post-Modern portfolio theories, we obtained the following empirical results according to the criteria of ESG Max and Return Max, with the Sharpe and Sortino Ratios as performance indicators.

Regarding secondary objectives, 1 and 2, the results are shown in Tables 2 and 3 below. Therefore, regarding objective 1 the following results that we obtained can be observed:

- In the case of the individual financial securities selected based on the ESG Max criterion, we find that only 2 out of 5 securities are undervalued, respectively Microsoft Corporation (CAPM 9.31% $< \mu$ 26.24%) and Baker Hughes Company (CAPM 9.24% $< \mu$ 9.31%);
- In the case of the individual financial titles selected based on the Return Max criterion, we note that all 5 securities are undervalued.

Regarding objective 2 the following can be observed results:

- In the case of individual financial securities selected on the ESG Max criterion, we find a Sharpe Ratio between (0.12 and 0.18); The financial securities analyzed have a return expected by investors above the risk-free rate of return per unit of risk of the security lower than 1, being considered a risky investment (Corporate Finance Institute, 2024);

- In the case of individual financial securities selected on the Return Max criterion, we find a Sharpe Ratio between (0.06 and 0.15); The financial securities analyzed have a return expected by investors above the risk-free rate of return per unit of risk of the security lower than 1, being considered a risky investment (Corporate Finance Institute, 2024);
- Given the previous data, we can summarize the following: the financial securities selected on the Return Max criterion are undervalued on the market, which we do not find in the case of ESG Max, where we also record instances of overvalued securities, but with all this, based on the Sharpe Ratio performance indicator, we find that the return per unit of assumed risk is more attractive for investors on ESG Max criterion.

Table 2. ESG (source: author's own calculations)

Indicators/ Companies	Microsoft Corporation	Colgate-Palmolive Company	3M Company	Intel Corporation	Baker Hughes Company
Rf (5Y, %)	3.88%	3.88%	3.88%	3.88%	3.88%
μ (day, %)	0.10%	0.02%	–0.04%	0.01%	0.04%
μ (year, %)	26.24%	5.67%	–11.07%	1.67%	9.31%
σ (day, %)	1.92%	1.31%	1.76%	2.46%	2.85%
σ (year, %)	30.51%	20.79%	28.01%	39.01%	45.22%
ERP (%)*	4.60%	4.60%	4.60%	4.60%	4.60%
Volatility coefficient	1.18	0.53	0.81	1.21	1.16
CAPM (%)	9.31% Undervalued	6.32% Overvalued	7.60% Overvalued	9.45% Overvalued	9.24% Undervalued
Sharpe Ratio	0.18	0.12	0.13	0.14	0.12

Note: * value provided by Aswath Damodaran.

Table 3. Return (source: author's own calculations)

Indicators/ Companies	Enphase Energy, Inc.	Super Micro Computer, Inc.	Builders FirstSource, Inc.	NVIDIA Corporation	Tesla, Inc.
Rf (5Y, %)	3.88%	3.88%	3.88%	3.88%	3.88%
μ (day, %)	0.26%	0.24%	0.22%	0.22%	0.20%
μ (year, %)	66.34%	60.29%	54.79%	54.34%	49.76%
σ (day, %)	4.82%	3.58%	3.31%	3.24%	4.08%
σ (year, %)	76.53%	56.85%	52.54%	51.48%	64.79%
ERP (%)*	4.60%	4.60%	4.60%	4.60%	4.60%
Volatility coefficient	1.59	0.76	1.58	1.73	1.52
CAPM (%)	11.20% Undervalued	7.37% Undervalued	11.17% Undervalued	11.82% Undervalued	10.87% Undervalued
Sharpe Ratio	0.10	0.06	0.14	0.15	0.11

Note: * value provided by Aswath Damodaran.

Regarding secondary objective 3, the results are presented in Tables 4 and 5. So, regarding the third objective the following results that we obtained can be observed:

- In the case of the portfolio built on the ESG Max criterion, we find that MVP has a Return of 19.10% and a Risk of 10.16%, as a result, for an investor with extreme risk aversion, it offers a return above the rate of return without risk per unit assumed risk of 0.33 (Sharpe Ratio); in the case of EP, which offers the return closest to the market return, it has a Return of 13.08% and a Risk of 23.05%. A graphic representation of the results obtained, and which confirm the theory are presented in Figure 3;
- In the case of the portfolio built on the Return Max criterion, we find that MVP has a Return of 15% and a Risk of 39.31%; as a result for an investor with extreme risk aversion, it offers a return above the rate of return without risk per unit of risk assumed by 0.28 (Sharpe Ratio); in the case of EP, which offers the return closest to the market return, it has a Return of 18% and a Risk of 40.39%. A graphic representation of the results obtained, which confirms the theory, is presented in Figures 3, 4, and 5.

Given the previous data, we can summarize that the portfolio built on the ESG Max criterion offers a superior performance analysis based on the Sharpe indicator compared to the one built on the Return Max criterion.

Table 4. MPT results based on ESG Max criterion (source: author's own calculations)

					MVP*			EP**					MP***
Risk (%)	36.99	26.52	21.36	19.78	19.10	19.46	20.77	23.05	25.57	47.54	89.82	0.00	21.40
Portfolio Return (%)	3	6	8	9	10.16	11	12	13.08	14	20	30		13.08
CML (%)	19.78	15.28	13.06	12.38	12.09	12.24	12.81	13.79	14.87	24.31	42.49	3.88	13.08
Sharp Ratio	–0.02	0.08	0.19	0.26	0.33	0.37	0.39	0.40	0.39	0.34	0.29		0.43

Note: * Minimum Variance Portfolio; ** Efficient Portfolio; *** Market Portfolio.

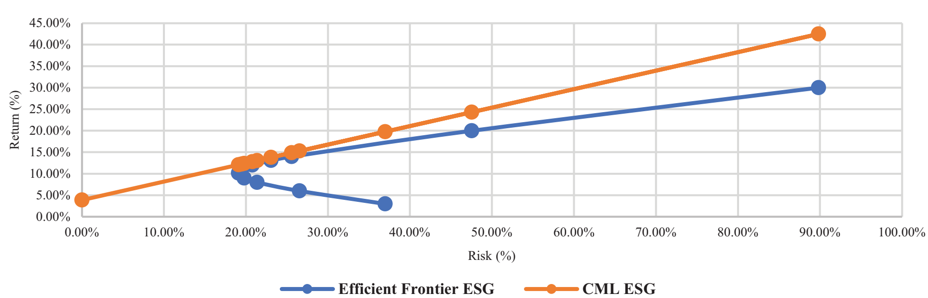

Figure 3. MPT Efficient Frontier (EF) and Capital Market Line (CML) for the ESG Max criterion

Table 5. MPT results based on Return Max criterion(source: author's own calculations)

					MVP*			EP**					MP***
Risk (%)	66.37	49.70	44.96	41.73	39.31	38.19	38.61	40.39	43.41	47.43	109.89	0.00	21.40
Port-folio Return (%)	9	12	13	14	15	16.25	17	18	19	20	30		13.08
CML (%)	32.40	25.24	23.21	21.82	20.78	20.29	20.47	21.24	22.54	24.27	51.11	3.88	13.08
Sharp Ratio	0.08	0.16	0.20	0.24	0.28	0.32	0.34	0.35	0.35	0.34	0.24		0.43

Note: * Minimum Variance Portfolio; ** Efficient Portfolio; *** Market Portfolio.

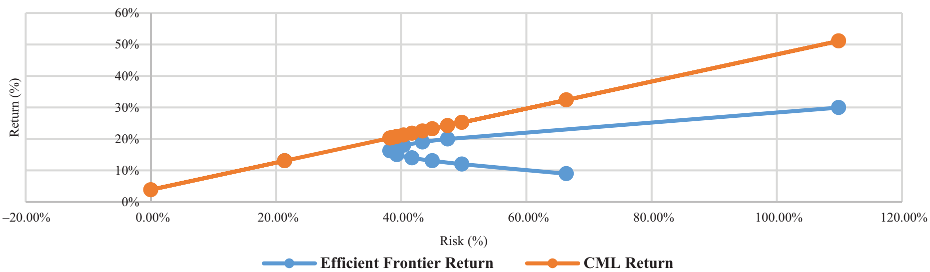

Figure 4. MPT EF and CML for the Return Max criterion

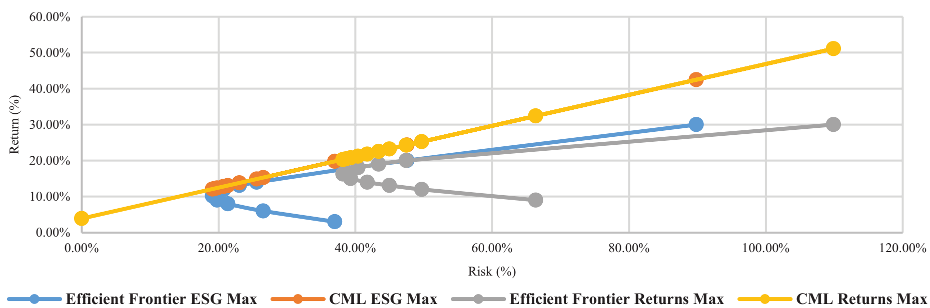

Figure 5. MPT EF and CML for Both ESG Max and Return Max criterions, 5 years data

Regarding secondary objective 4, the results obtained are presented in Tables 6 and 7 below. So, regarding objective 4 we can see the following results obtained:

- In the case of the portfolio built on the ESG Max criterion, we find that MVP has a Return of 9.86% and a Risk of 14.47%, as a result, for an investor with extreme risk aversion, it offers a return above the rate of return without risk per unit of assumed risk of 0.41 (Sortino Ratio); in the case of EP, which offers the return closest to the market return, it has a Return of 13.08% and a Risk of 17.38%. A graphic representation of the results obtained, and which confirm the theory are presented in Figure 6;

- In the case of the portfolio built on the Return Max criterion, we find that MVP has a Return of 17% and a Risk of 31.73%, as a result, for an investor with extreme risk aversion, it offers a return above the rate of return without risk per unit of risk assumed by 0.48 (Sortino Ratio); in the case of EP, which offers the return closest to the market return, it has a Return of 20% and a Risk of 32.12%. A graphic representation of the results obtained, and which confirms the theory are presented in Figures 6, 7, and 8.

Given the previous data, we can summarize the fact that the portfolio built on the ESG Max criterion compared to the one built on the Return Max criterion offers superior performance, analysis based on the Sharpe Ratio (for MPT), and Sortino Ratio (for PMPT), as shown in Table 8 below.

Table 6. PMPT results based on ESG Max criterion (source: author's own calculations)

					MVP*			EP**					MP***
Risk (%)	25.12	18.51	15.50	14.69	14.47	14.86	15.82	17.38	19.05	33.64	36.36	56.21	15.97
Portfolio Return (%)	3	6	8	9	9.86	11	12	13.08	14	20	21	28	13.08
CML (%)	18.35	14.54	12.81	12.34	12.21	12.44	13.00	13.89	14.86	23.26	24.82	36.25	13.08
Sortino Ratio	–0.03	0.11	0.27	0.35	0.41	0.48	0.51	0.53	0.53	0.48	0.47	0.43	0.58

Note: * Minimum Variance Portfolio; ** Efficient Portfolio; *** Market Portfolio.

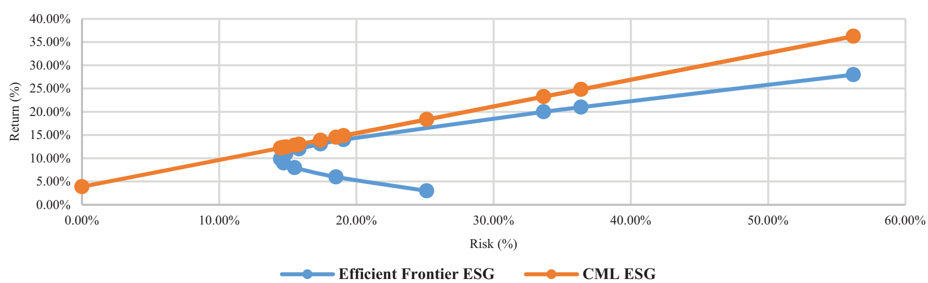

Figure 6. PMPT EF and CML for the ESG Max criterion

Table 7. PMPT results based on Return Max criterion (source: author's own calculations)

						MVP*		EP**				MP***
Risk (%)	50.32	45.15	41.08	33.99	31.73	30.51	30.74	32.12	34.59	67.41	0.00	15.97
Portfolio Return (%)	12	13	14	16	17	18.41	19	20	21	28		13.08
CML (%)	32.87	29.89	27.54	23.46	22.16	21.46	21.59	22.38	23.81	42.72	3.88	13.08
Sortino Ratio	0.16	0.20	0.25	0.36	0.41	0.48	0.49	0.50	0.49	0.36		0.58

Note: * Minimum Variance Portfolio; ** Efficient Portfolio; *** Market Portfolio.

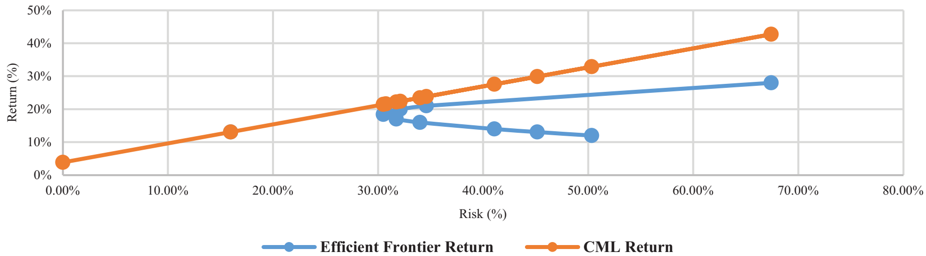

Figure 7. PMPT EF and CML for the Return Max criterion

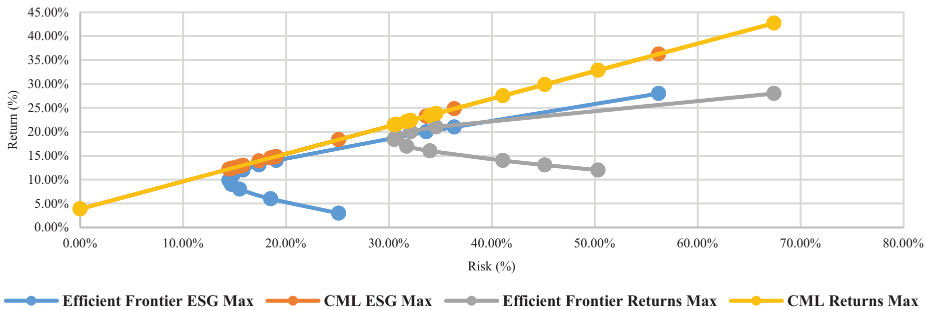

Figure 8. PMPT EF and CML for Both ESG Max and Return Max criterions, 5 years data

Table 8. ESG Max versus Return Max portfolios performance indicators (source: author's own calculations)

Criterion	Portfolio Performance Indicator	MVP*	EP**	MP***
ESG Max	MPT – Sharpe Ratio	0.33	0.40	0.43
	PMPT – Sortino Ratio	0.41	0.53	0.58
	Δ%	24%	33%	35%
Return Max	MPT – Sharpe Ratio	0.28	0.35	0.43
	PMPT – Sortino Ratio	0.48	0.50	0.58
	Δ%	71%	43%	35%

Note: * Minimum Variance Portfolio; ** Efficient Portfolio; *** Market Portfolio.

Under the MPT methodological framework, we can conclude that portfolios with the ESG Max criterion, have superior performance in terms of Sortino Ratio than those with the Return Max criterion, for both MVP (0.33 > 0.28) and EP (0.4 > 0.38), which means that portfolios constructed under ESG Max criterion offer an additional/excess higher return above the risk-free rate per unit of assumed risk compared to the one with Return Max criterion. The results of the PMPT, shows that for an investor with extreme risk aversion, the portfolio constructed on the ESG Max criterion offers a return above the rate of return without risk per unit of assumed risk (Return of 13.08%, Risk of 17.38%, and a Sortino Ratio of 0.53), while the portfolio build on the Return Max criterion offers a Return of 20%, Risk of 32.12%, and a Sortino Ratio of 0.50, which makes the portfolio build on the ESG Max criterion more performant than the Return Max one, in terms of additional/excess higher return above the risk-free rate per unit of assumed risk. The situation is different when looking at the MVP, where Sortino Ratios shows a better performance for the Return Max criterion portfolio than ESG Max one (0.48 > 0.41).

5. Conclusions

The general objective of the paper was to research if the ESG is a criterion for investors in the rational selection of financial securities and portfolio construction. Following the theoretical methodology of the Modern and Post-Modern portfolio theory and collecting the data for the period 2018–2023 (1.260 observations – trading days) of the S&P 500 Stock Index, on a sample of 484 stocks (companies) covering Basic Materials, Consumer Cyclicals, Consumer Non-Cyclicals, Energy, Financials, Healthcare, Industrials, Real Estate, Technology, Utilities, financial securities and portfolios constructed based on the ESG Max criterion are more performant than those on the Return Max criterion.

Following the first research direction and its two secondary research objectives, we can conclude that the financial securities selected on the Return Max criterion are undervalued on the market (all 5 individual stocks, CAPM < μ), which we do not find in the case of ESG Max, where we also record instances of overvalued securities (3 out of 5 individual stock, CAPM > μ. In the case of the ESG Max criterion, the Sharpe ratio is between 0.12 and 0.18, compared to the Return Max criterion, where the Sharpe Ratio is between 0.06 and 0.15. Although a Sharpe Ratio lower than 1 indicates a risky investment, with all this, based on the Sharpe Ratio performance indicator, we find that the return per unit of assumed risk is more attractive for investors with the stocks selected based on the ESG Max Criterion.

For an investor with extreme risk aversion, the ESG Max criterion offers superior performance (portfolio return above the risk-free rate per unit of risk assumed) compared to the portfolio built on the Return Max criterion. Moreover, for an investor with risk aversion, portfolios built on the ESG Max criterion, both MPT and PMPT, offer superior performance compared to portfolios built on the Return Max criterion.

Summing it up, this study contributes to the new paradigm of financial assets management, by analyzing two important criterions in building a portfolio, the Return criterion, and the mainstream one the ESG criterion. The study also provides some empirical results by analyzing one of the most important markets and stock indexes, namely, U.S. market and S&P 500 Stock Index, for a period of five years (2018–2023), supported by the theoretical framework of the cornerstone in the portfolio theory, MPT and PMPT. Also, it provides investors, portfolio managers, and academia, with evidence-based results to support their ideas and decisions regarding the importance of sustainable investments.

The study shows that the research has limitations that remain to be addressed in future research. On the one hand, the empirical results obtained cannot be generalized to other capital markets. As a result, the research methodology can be applied to research the differences between the two criterions ESG and Return on different markets (developed or emerging ones) and stock indexes. On the other hand, this research covers five years, so having a more extended period for analysis might reflect other results in the long run, but the reporting of ESG for publicly traded companies to cover a more extended period would have concluded with minimal sample size. Finally, given that ESG Scores were provided by Refinitiv Eikon and calculated based on their proprietary methodology, the use of ESG Scores in future studies provided by another company would be helpful in comparing the consistency of the results obtained.

Data availability statement

The datasets for the daily close prices for the companies in the S&P 500 Index and for the S&P 500 Index were retrieved from Refinitiv Eikon using Microsoft Excel 365, Data Types: Stocks.

The datasets for the ESG Scores were retrieved from the LSEG Data Platform, formerly Refinitiv Eikon platform: https://workspace.refinitiv.com/web

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Author contributions

R-AȘ, DMM, VB, AO and MH conceived the study and were responsible for the design and development of the data analysis. VB was responsible for the methodology. R-AȘ and AO were responsible for data collection and analysis. R-AȘ and VB were responsible for data interpretation. VB and R-AȘ were responsible for getting the empirical results. DMM and MH prepared the literature review. R-AȘ, DMM and VB wrote the first draft of the article. MH and AO were responsible for the final conclusions.

Disclosure statement

The authors declare no conflict of interest.

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