Is a Socially Responsible Investment Necessarily Efficient? Evidence from SRI Mutual Funds and Sin Stocks

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ABSTRACT

Socially responsible investment (SRI) integrates environmental, social, and governance (ESG) issues into decision-making and has grown significantly, attracting academic interest. Despite mixed empirical findings, some literature intriguingly suggests SRI outperforms financially, which contradicts theoretical expectations that restricted portfolios should underperform. Applying Markowitz's Modern Portfolio Theory and Tobin's Separation Theorem to a sample of 259 SRI mutual funds and 159 sin stocks, we conclude that investing exclusively in SRI funds is inefficient. However, while SRI may hinder financial performance, it should not be discouraged, as many investors value the responsible use of their savings despite lower returns. This study highlights the need to expand investment efficiency criteria beyond risk and return, aligning more closely with investors' broader utility functions.

Keywords: SRI; Socially Responsible Investment; Portfolio Allocation; Sin Stocks.
JEL Codes: G11; G23; G40

I. Introduction

Socially responsible investment (SRI) appeared in the 1960s as a niche for humanitarian investors who wanted to do good through investments (Utz & Wimmer, 2014). Since then, it has matured into a significant investment category, with increasing environmental and social concerns, reaching $35.3 trillion in assets under management globally in 2020, accounting for 35.9% of total assets under management (Global Sustainable Investment Alliance (GSIA, 2021). The growing importance of socially

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conscious investments has also been observed through collective investment undertakings. In the US, SRI mutual funds have attracted more flows than conventional funds (Bialkowski & Starks, 2016). There is vast empirical literature on the financial performance of SRI mutual funds, providing mixed evidence (Utz & Wimmer, 2014). Some studies report the financial outperformance of SRI funds (Derwall et al., 2005; Edmans, 2011). Others report evidence of underperformance (Brammer et al., 2006; Mănescu, 2011). Furthermore, some studies find no significant differences between the performances of SRI and conventional investments (Schröder, 2007; Statman & Glushkov, 2009).

The starting point of this research is the considerable empirical literature showing that SRI mutual funds perform better than mutual funds without social investment restrictions. However, theoretically, it does not hold. Effectively, ceteris paribus, a portfolio with investment restrictions, should not perform better than an unrestricted portfolio (Renneboog et al., 2008).

Assuming that the performance of SRI funds, which reject the so-called "sin stocks", is efficient and superior to conventional (unrestricted) funds, adding sin stocks to SRI funds should not increase their performance. Therefore, we will resort to the Modern Portfolio Theory of Markowitz (1952) and Tobin's Separation Theorem (1958) to determine if the efficiency of SRI portfolios increases by adding sin stocks. That is, to see if SRI funds would see their risk-adjusted returns, measured by the Sharpe ratio (Sharpe, 1966), increase by adding these sin stocks. Hence, this study aims to answer the following question: does the efficiency of an SRI portfolio increase by adding sin stocks?

Samples of SRI funds and sin companies were collected to accomplish this objective. A portfolio was created with the ineligible companies (the "Black Sheep" portfolio). Finally, in light of Tobin (1958), we estimated an optimal portfolio for each Black Sheep portfolio and SRI fund pair. The weights of the Black Sheep portfolio and each SRI fund on such portfolios were computed and analyzed. If the weight of the Black Sheep portfolio in the efficient portfolio is null or negative, then the restriction does not imply a loss of efficiency. However, if the weight of the Black Sheep portfolio in the efficient portfolio is positive, then choosing SRI has a cost, impeding financial performance. We use several performance measures (Sharpe ratio, Treynor ratio, and Jensen's alpha).

This research differs from the existing empirical studies, which tend to focus on comparing the financial performance of SRI funds vis-à-vis "conventional" mutual funds (Gil-Bazo et al., 2010; Utz & Wimmer, 2014) or against a market benchmark (Lean et al., 2015; Weber et al., 2010). In this research, more than comparing returns, the purpose was to find out if any combination between SRI mutual funds and sin stocks can lead to a greater risk-adjusted return than the one that may be obtained by only investing in SRI mutual funds.

For the samples considered, adding sin stocks improved the efficiency of SRI funds almost every time and for any SRI fund. We concluded that socially responsible investment is inefficient when applying Markowitz's Modern Portfolio Theory.

This does not mean that investing in SRI funds should be discouraged or does not make sense. It is worth noting that we do not analyze the utility of investments. For many investors, the increased utility that comes from knowing that their savings are used

responsibly will outweigh the loss of utility from a higher return. Then, although they may perform better regarding the risk-return binomial if they include sin stocks in their portfolios, some investors will undoubtedly have less utility if they consider the investment's social effects. What the study shows is that it cannot be said that SRI mutual funds perform better (from the point of view of the risk-return binomial) than investment alternatives that, ceteris paribus, have no restrictions stemming from social responsibility policies. This study also implies that we will probably have to rethink the criteria by which investments are efficient. Suppose investors do not decide on the basis of the risk-return binomial, or at least if they do not decide solely on the basis of expected risk and return. In that case, we should incorporate other factors into the criteria for making investments that make the choice more consistent with investors' true utility function.

This paper is organized as follows. In the following section, we review the most relevant literature concerning socially responsible investment and the more relevant theories on portfolio management. Then, in section 3, we describe the data and the methodology employed. In section 4, the results are presented. Finally, in section 5, we draw the main conclusions, implications, extensions, and limitations of our study.

II. Literature Review

A. Socially Responsible Investment

Socially responsible investment (SRI), also referred to as ethical or sustainable investment, incorporates environmental, social, and corporate governance issues (ESG) into investment decision-making. A significant body of literature is devoted to the consequences of considering ESG criteria when making investment decisions. Thus, for example, Pedersen et al. (2021) argue that considering ESG scores alters the efficient frontier. Avramov et al. (2022) show that the CAPM alpha and effective beta rise with ESG uncertainty. Similarly, Albuquerque et al. (2019) show that corporate social responsibility reduces systematic risk and increases company value, and these effects are stronger for companies with high product differentiation. Kanamura (2020) shows that green bond investment performance is superior to conventional bond investment performance, while Alves et al. (2022) found that there is no pricing difference between bonds that mainly differ with respect to their green label. Other papers seek to understand how ESG scores can affect company performance. Some highlight the role of investor preferences and risk (Cornell, 2021; Cornell & Shapiro, 2021), while others emphasize their effect on companies' cost of capital (e.g., Alves & Meneses, 2024), and some discuss the objective function of the firms in a context of stakeholder capitalism (e.g., Fama, 2021).

Another body of literature is dedicated to socially responsible investment decision-making and its consequences. In this context, the literature reports that unlike conventional investments, SRI incorporates investment criteria to select (positive screens) or exclude (negative screens) assets derived from environmental, social, corporate governance, or ethical standards. As such, responsible investors usually shun

investing in "sin stocks" (alcohol, gambling, tobacco, weapons, etc.) while preferring companies that adopt quality policies regarding environmental sustainability, community relations, and labor conditions. Frequently, SRI investors become involved in shareholder activism and engage with local communities to stimulate firms to gear towards these goals (Capelle-Blancard & Monjon, 2012; Renneboog et al., 2008).

Although the first SRI mutual fund was only created in 1971 in the US, ethical investing has its roots in ancient foundations, namely in Christian, Islamic and Jewish religions, which advocate that money should be used ethically, for instance, when conceding loans or forbidding excessive interest rates. This first SRI mutual fund was denominated the Pax World Fund. The fund, conceived for investors that contested the Vietnam War and militarism in general, excluded investments in weapon contractors. Since the 1960s, social movements, including anti-war and anti-racism campaigns, placed under the spotlight the social impact of investments, which led to the origination of the aforementioned fund. At the same time, a movement pressure applied by US and European SRI investors in the 1980s concerning the institutionalized racial segregation system of apartheid in South Africa identified companies with operations in South Africa to divest such businesses.

Additionally, mutual funds were requested not to include firms doing business in South Africa in their portfolios. Furthermore, environmental disasters such as the Chornobyl nuclear plant in 1986 also made investors aware of the negative impact that industrial development can have on the environment. Recently, corporate scandals have made corporate responsibility and governance a critical matter for SRI investors, with transparency, governance and sustainability appearing as fundamental SRI screens (Renneboog et al., 2008).

Even though "ethical" and "socially responsible" are often used interchangeably, the use of the term "ethics" has decreased, with only half of SRI articles including that word in the 2000s, compared to eighty per cent in the 1990s (Capelle-Blancard & Monjon, 2012). These authors note that the most convincing justification for the decreasing usage of the word "ethics" appears to be that both practitioners and researchers are not interested in placing much importance on the moral issues that are typically linked with the word "ethics". In line with this trend, the Ethical Investment Association, created in 1999, was renamed Responsible Investment Association Australasia in 2007. Moreover, another trend is the shift from "socially" to "sustainable". Two clear examples are the name change of the UK Social Investment Forum (UKSIF) into UK Sustainable Investment and Finance and the US Social Investment Forum (USSIF), which became the Forum for Sustainable and Responsible Investment. Nonetheless, socially responsible investing is the preferred term in this research.

Socially responsible investment has grown into a mature investment industry, with increasing environmental and social concerns and many assets under management. Renneboog et al. (2008). state that part of this growth is justified by the alterations in regulation related to the disclosure of ethical, social and environmental information by listed companies and pension funds. It started in the UK in 2000, and other countries have followed, passing regulations requiring pension funds to disclose SRI-related

information. Furthermore, France was the first country to oblige listed companies to report on social, ethical, and environmental standards in 2001.

In the United States, the region in which there are more SRI assets under management, representing 48% of global SRI assets in 2020 (GSIA, 2021), the SRI assets managed by money managers rose 43% from 2018 to 2020, reaching $16.6 trillion, increasing substantially from the $569 billion in 2010. Moreover, mutual funds are responsible for 19% of socially responsible investments (US SIF Foundation [USSIF], 2020).

B. SRI Investment Screens

The investment screens used in SRI have been evolving. Typically, SRI mutual funds employ a combination of multiple types of screens. The USSIF (2020) reported that just 5% of money managers applied only one ESG criterion, a decreasing percentage, with most managers (58%) considering two to four criteria. The remaining 37% of money managers applied at least five ESG criteria.

Traditionally, SRI screens are classified into two groups: negative and positive. The oldest and most simple SRI strategy is negative screening. Such screens exclude specific companies or sectors from SRI portfolios based on specific social, ethical and environmental criteria. A typical example of a negative screen is taking a large pool of assets, such as the S&P 500 and then excluding companies from the alcohol, defense, gambling and tobacco sectors and/or firms with weak performance concerning environmental protection and labor relations. Further negative screens can include abortion, animal testing, irresponsible foreign operations, poor workplace conditions, pornography and violation of human rights. After applying the negative screening, the portfolio is built through financial and quantitative techniques (Renneboog et al., 2008). Many of these examples fall into product-related criteria, such as investment restrictions on firearms or tobacco industries. The USSIF (2020) reported that excluding specific sectors from SRI investments was employed for $4.94 trillion of assets, 30% of SRI, in 2020. Moreover, restricting tobacco investment was the most popular specific product-related criterion, affecting $2.1 trillion in SRI investments, followed by military and weapons, considered in SRI investments worth $1.2 trillion. Furthermore, 69% of money managers admitted employing a negative/exclusionary strategy, the second highest value.

Positive screening is the selection of stocks that comply with superior ESG standards. Generally, positive screens emphasize corporate governance, the environment, labor relations, the stimulation of cultural diversity and the sustainability of investments. Often, it functions as a selection of companies with good performance in renewable energy and community engagement. Frequently, positive screening is combined with the "best in class" strategy, in which companies are ranked within each sector based on ESG performance, and then only firms performing better than their peers are selected (Renneboog et al., 2008). A positive/best-in-class approach was applied by 60% of money managers (USSIF, 2020). Negative and positive screens are usually considered first- and second-generation SRI screens.

The third generation of screens is an integrated approach to choosing companies based on ESG criteria, containing both negative and positive screens. This strategy may be called "sustainability" or "triple bottom line". A practical example of the employment of this approach is the MSCI KLD 400 Social Index. This index covers firms with excellent ESG scores while rejecting companies that harm the environment or society.[1] The methodology for selecting the index's constituents is split into two phases. First, companies in the nuclear power, tobacco, alcohol, gambling, military weapons, civilian firearms, genetically modified organisms and adult entertainment industries are excluded (negative screening). Second, to be eligible, firms must have an MSCI ESG Controversies score higher than two and an MSCI ESG rating above "BB" (positive screening; MSCI, 2022).

The fourth generation combines the third generation, sustainable investing, with shareholder activism. In this approach, portfolio managers try to influence companies' behavior through direct conversations with the management or by using voting rights at general meetings (Renneboog et al., 2008). Shareholders in public companies have the right to vote on topics presented by management or other shareholders at the annual general meeting. Moreover, shareholders can exert additional influence by filing proposals on ESG-related topics, which investors may vote on, raising the awareness of the management and the board of directors of such issues. In fact, from 2018 through to the middle of 2020, money managers and institutional investors who managed $1.98 trillion in assets had filed shareholder resolutions on ESG matters (USSIF, 2021). Investors can also communicate with the managers of portfolio firms. Often, socially responsible investors join investor networks to gain scale in spreading their messages. An example is the Carbon Disclosure Project (CDP), which had more than 500 institutional investors managing assets worth $106 trillion, joining them by 2020, taking part in an initiative which demanded global companies to report on greenhouse gas emissions and evaluate the impact of climate change and other environmental issues (USSIF, 2021).

More than 90% of the socially responsible assets held by money managers in the US in 2020 were screened, considering criteria from all ESG categories (environment, social, and governance). However, concerning specific criteria, climate change/carbon emissions (environmental) was by far the leading factor, and was considered in a quarter of sustainable investments, $4.18 trillion (USSIF, 2021).

C. SRI subjects unrelated to financial performance

The growing importance of socially conscious investments has led to several studies in this area in recent decades. When considering the proportion of investment articles that concern SRI, the relative number has doubled from the 1990s to the 2000s (Capelle-Blancard & Monjon, 2012). Nevertheless, most studies focused on the financial performance of socially responsible investments, with those articles being the most cited. Little attention has been paid to SRI subjects unrelated to financial performance.

[1] Notice that the literature shows that ESG scores differ significantly from provider to provider (Berg et al., 2022). As such, the results obtained may vary from one source to another source.

Therefore, research on moral values, ethics, or altruism is scarce and has declined, which is surprising considering that the point of SRI is that it exceeds the financial features. One compelling finding is that the SRI literature seems to be under-theorized on topics such as why investors engage in SRI, the connection between regulation and SRI and non-financial performance, with most of the attention being aimed at the financial performance of SRI funds.

On the non-financial performance side of SRI research, there are some studies regarding the ethical performance of SRI funds, that is, checking if the funds labelled SRI are SRI and have better ethical standards than conventional funds. For instance, Utz and Wimmer (2014) do not find much evidence of SRI funds having a higher ethical rating than conventional funds, concluding that the SRI label has become more of a marketing tool, used to lure in investments, taking advantage of a trendy investment category, rather than a genuine way of accomplishing ethical preferences through investments. This result contrasts with the work of Kempf and Osthoff (2008). All ethical criteria analyzed found that SRI funds had a significantly higher ethical ranking than conventional funds, indicating that SRI funds are not conventional funds with an SRI label.

D. Financial Performance and SR Investments

Do SRI investors decide to invest considering only the risk-return attributes, or are they willing to accept suboptimal financial performance to satisfy their personal goals concerning social responsibility? SRI applies multiple screening approaches to select stocks that comply with specific environmental, governance, ethical, and social criteria, restricting the investment opportunities available to non-SRI investors. Therefore, SRI may constrain diversification possibilities, shifting the efficient frontier towards worse risk-return combinations rather than conventional portfolios. If markets value the investment opportunities correctly, SRI underperformance is expected as SRI funds may underinvest in financially appealing investments that do not comply with ethical standards and overinvest in projects that are not financially interesting but promote sustainability policies. Therefore, if markets are efficient, the argument that SRI underperform conventional investments is quite strong (Renneboog et al., 2008).

However, Renneboog et al. (2008) mention that if markets are inefficient in the short run, mispricing ESG information, an argument can be developed for SRI outperformance. First, the authors say that remarkable environmental and social performance is an indication of quality managers, and thus, SRI screening can lead to better stock selection. Second, social and environmental screening diminishes the probability of suffering high costs amidst ecological disasters and social crises. Third, such hypothesis states that such value-relevant information would not be available to investors if not for SRI screening, which may help SRI fund managers select securities and generate better risk-adjusted returns than non-SRI funds. Finally, it should be noted that if the efficient market hypothesis holds, conventional portfolio managers could easily mimic such strategies, eliminating the advantage of SRI managers.

Furthermore, a case can be made for investors not caring only about financial attributes when engaging in socially responsible investments. First, there is evidence that

SRI funds, which have financial and social goals, have received more investment than conventional funds. Bialkowski and Starks (2016) analyzed the money flows of US SRI and conventional mutual funds and observed that SRI mutual funds attracted more flows than conventional funds, on average. Moreover, Bollen (2007), besides studying the money flows of US SRI funds, also considers the past returns of such funds. He finds that the volatility of flows is lower for SRI funds than for conventional funds, which suggests that social investors' assets are "stickier". Moreover, money flows of socially responsible funds are less sensitive to lagged negative returns than conventional funds, but significantly more sensitive to lagged positive returns. The author concludes that socially conscious investors seem to obtain utility from non-financial, socially responsible factors, especially when SRI funds generate positive returns. Renneboog et al. (2006) studied the money flows of SRI funds across 17 countries. They report that SRI investors care more about past positive returns than negative ones unless persistent underperformance exists. The relation between money flows and past performance depends on the forms and intensities of the SRI screening activities. This latter finding is again consistent with the proposition that SRI investors consider non-financial attributes when investing.

A vast number of studies were conducted on the financial performance of SRI, comparing it with the performance of conventional investments, and conclusions diverged. First, some studies have found no significant differences in performance (Schröder, 2007; Statman & Glushkov, 2009). Second, studies show that socially responsible investments have better financial performance (Derwall et al., 2005; Edmans, 2011), and this is also the case when you invest directly in shares instead of funds (Blankenberg & Gottschalk, 2018). Third, some studies conclude that conventional investments perform better (Brammer et al., 2006; Mănescu, 2011). Finally, some have concluded that it depends on the investment horizon and that during the financial crisis, SRIs performed worse than conventional funds, unlike before the crisis (Wei, 2018). In the short run, this divergence may be explained in light of the work conducted by Derwall et al. (2011), which presents two hypotheses: the shunned-stock hypothesis and the errors-in-expectation hypothesis. The shunned-stock hypothesis states that substantial demand for SR investment and/or shortage demand for "irresponsible" assets, due to SR investors avoiding buying them, depresses the price of "irresponsible" assets, which will make them experience more significant returns than SR investments (conventional outperformance). On the other hand, the errors-in-expectation hypothesis predicts that SR investments can generate higher returns because the market systematically underestimates the financial importance of corporate social responsibility (CSR) due to the subjectivity of CSR and outdated accounting standards, for instance (SRI outperformance). Both effects can only coexist in the short run, with the authors expecting that sooner or later, investors will comprehend the impact of CSR on firms' future cash flows and that, thus, the higher returns of SR investments due to the errors-in-expectation hypothesis disappear in the long run.

In their thorough literature review, Renneboog et al. (2008) conclude that there is little evidence that SRI funds significantly over or underperform non-SRI funds. This conclusion is corroborated by Revelli and Viviani (2015), who conducted an extensive

analysis of studies testing the relationship between SRI and financial performance, demonstrating that including corporate social responsibility concerns in stock market portfolios is neither a strength nor a weakness vis-à-vis conventional investment.

As Renneboog et al. (2008) noted, comparing the average performance of SRI funds with conventional funds may not necessarily present valuable information to an investor who can selectively invest in a subset of mutual funds. That is, unless you are somehow restricted to either investing in a pool of SRI funds or a pool of non-SRI funds, you can design your optimal portfolio with the investment opportunities available, for which the information on whether the generality of SRI funds perform better or worse, on average, than the generality of non-SRI funds may not be of much help. The present research also aims to tackle this issue from a portfolio management perspective, trying to conclude whether SRI funds should include sin stocks when aiming at investment efficiency, i.e., maximizing risk-adjusted return and, potentially, how considerable the weight of such stocks should be. Equivalently, the goal is to determine if SRI fund managers are maximizing the risk-adjusted return of their investors by carrying out SRI screening, in this case, excluding sin stocks.

E. The (In)efficiency of SRI Funds

The starting point of this research is the considerable empirical literature showing that SRI mutual funds perform better than the rest. Remember that SRI funds apply multiple screening approaches to select stocks that comply with specific environmental, governance, ethical, and social criteria, restricting the investment opportunities available to non-SRI investors. Theoretically, the proposition does not hold. Ceteris paribus, a portfolio with investment restrictions, should not perform better than an unrestricted portfolio. SRI screening can constrain diversification possibilities, shifting the efficient frontier towards worse risk-return combinations than conventional portfolios (Renneboog et al., 2008).

However, if SRI funds, which reject the so-called sin stocks, have superior performance compared to conventional funds, which can freely invest in such stocks, then adding sin stocks to such funds should not increase the efficiency of such portfolios. The aim is to answer the following question: does the efficiency of an SRI portfolio increase by adding sin stocks?

It is expected that investment exclusively in SRI mutual funds is inefficient, with the efficiency of an SRI portfolio increasing when adding sin stocks. In addition to the literature review presented, the following studies corroborate this expectation.

First, Geczy et al. (2021), who studied the cost of imposing the SRI constraint on investors looking for the highest Sharpe ratio by comparing the optimal portfolio built from SRI funds and the optimal portfolio built from non-SRI funds, demonstrated that enforcing SRI restrictions can provoke significant financial costs on mean-variance optimizing investors, which is consistent with the idea that SRI funds are suboptimal. Furthermore, the costs were even higher when the authors only considered SRI funds that screened out sin stocks.

Second, Renneboog et al. (2008) suggest that SRI portfolio managers, given their multi-task job of accomplishing both social and financial goals, may see their incentives

to aim at economic efficiency, that is, maximizing risk-adjusted returns decrease, increasing agency costs.

Therefore, when considering the findings that SRI constraints imply a financial cost, translating the SRI portfolio into a suboptimal portfolio when compared to a conventional one (Geczy et al., 2021) and that SRI portfolio managers may have weaker incentives to pursue economic efficiency vis-à-vis conventional fund managers (Renneboog et al., 2008), in conjunction with the theoretical premise that an SRI, and thus, a restricted portfolio should not perform better than a conventional portfolio, it is possible to conclude that unrestricted portfolios (Renneboog et al., 2008) and SRI investors seem to consider other factors beyond financial performance when investing (Bialkowski & Starks, 2016; Bollen, 2007; Renneboog et al., 2006). Furthermore, it is expected that adding sin stocks to SRI funds ought to increase efficiency.

F. Theory of Portfolio Management

Investment and portfolio management have building blocks from what is known as Modern Portfolio Theory (MPT), which was developed based on the work of Markowitz (1952). This author rejected the traditional rule in portfolio selection that stated that the investor should maximize the discounted expected value of future returns, introducing a rule in which investors would bear in mind the expected return, but also the variance of return as a measure of risk, considering the former as attractive and the latter as unattractive.

The variance of a portfolio depends on the covariance between the securities that compose that portfolio. According to the framework introduced by Markowitz (1952), there is diversification and the "right kind" of diversification. This means that diversification is not only about investing in multiple assets, following the old "do not put all your eggs in one basket" proverb, but investing in securities that have small covariances among themselves. That is, reducing variance is about putting eggs in multiple and different baskets. An exciting implication of the Markowitz diversification concept is that if an investor diversifies his investment between two portfolios with equal variance, the combined portfolio's variance will generally be lower than the variance of either initial portfolio. It will never be larger. There is one case in which the variance remains the same: when the portfolios are perfectly correlated, the correlation coefficient between them is maximum, equaling one. In such situations, if one portfolio moves in a specific direction, the other will also move in the same direction with the same magnitude, offering no diversification.

Moreover, modern portfolio theory, also known as mean-variance analysis, states that by having estimates of returns, volatilities, and covariances of a series of investment opportunities, along with a set of investment restrictions, one can compute an optimal mean-variance efficient frontier (Fabozzi et al., 2002). Such a frontier is efficient because each point of that curve represents a portfolio with the maximum expected return for a specific level of risk or, equivalently, the minimum risk available for a certain level of excepted return (Fabozzi et al., 2002). Those portfolios are known as efficient portfolios, which are the best possible portfolios that an investor can obtain for a specific level of

risk/expected return. This means that MPT enables optimization to generate multiple efficient portfolios with different expected return/risk combinations. Thus, other investors with different restrictions and profiles will select different efficient portfolios.

Tobin (1958) added leverage to portfolio theory by introducing a risk-free asset. He showed that by forming a portfolio composed of an efficient and risk-free asset, it is possible to create portfolios with better performance than those on the efficient frontier. In the framework of Tobin's separation theorem, portfolio selection starts with computing the optimal portfolio of risky assets common to all risk-averse holders. Then, each investor would combine such a portfolio with a risk-free asset, considering their degree of risk aversion (Buiter, 2003). This optimal portfolio that all investors should hold is the efficient portfolio that is touched by a tangent line drawn from the point of the risk-free asset to the efficient frontier. Therefore, this line, often called the capital market line, represents all feasible combinations of the risk-free asset and a risky portfolio that presents the best-expected return/risk combinations.

Therefore, if investors aim to achieve the best expected return/risk combinations possible, they must be in the CML, maximizing the risk premium per unit of risk. That is, maximizing the Sharpe ratio (Sharpe, 1966).

G. Investment Performance Measures

Performance measures offer a way to evaluate the performances of different portfolios and the performance of a particular portfolio in different periods (Jobson & Korkie, 1981). Such measures combine the two distinct components of performance, the return and the risk, into a single measure that adjusts for differences in risk, and thus, at least at a theoretical level, allow an irrefutable ranking of the performance of investments that present different risks and returns (Friend & Blume, 1970).

According to Jobson and Korkie (1981), performance measures can be classified into three categories. The first category concerns measures encompassing total risk of return quantified through standard deviation. The second category includes performance measures based on what is known as market, systematic or non-diversifiable risk of return, represented by beta. The third category does not involve a risk pricing model. The measures considered in this research are the Sharpe ratio, the Treynor ratio, and Jensen's alpha. The first measure falls into the first category of measures, while the other two are included in the second category.

The Sharpe ratio is the better-known performance measure (Eling & Schuhmacher, 2007). Defined by Sharpe (1966) as the reward-to-variability ratio, the numerator represents the difference between the average annual return of a portfolio and the risk-free interest rate, which is the reward obtained by the investor for carrying risk, the risk premium. The denominator is the standard deviation of the annual rate of return, which represents the risk the investor carries.

The Treynor ratio is the excess return from the risk-free rate, i.e., the risk premium per unit of systematic risk, represented by the beta (Friend & Blume, 1970). The Treynor ratio only differs from the Sharpe Ratio in the denominator, which considers the beta factor and thus systematic risk instead of the standard deviation, which measures total risk.

The beta of a portfolio is the division of the covariance between the return of such a portfolio and the market's return by the variance of the market return. It measures the non-diversifiable or systematic risk (Friend & Blume, 1970). The market's return is proxied by using the return of a market index (Eling & Schuhmacher, 2007).

Then, the performance measure of Jensen (1968), known as Jensen's alpha, is simply the rate of return of security greater than the one implied by the Capital Asset Pricing Model (CAPM).

Theoretically, these measures can lead to different conclusions about the comparative performance of two alternative investments. Nevertheless, some studies show that different performance measures yield identical rankings of performances of investments (Eling & Schuhmacher, 2007; Pedersen & Rudholm-Alfvin, 2003; Pfingsten et al., 2004). Notice that uncertainty about the company's ESG profile can have asset pricing and portfolio implications (Avramov et al., 2022).

III. Data and Methodology

A. Data

This research implied collecting a sample of socially responsible investment mutual funds and a sample of sin stocks and their monthly returns from June 2012 until May 2022. The data is from the Refinitiv Eikon Datastream database. The 10-year US Treasury Bond data was retrieved from the US Treasury website.

First, a sample of SRI funds had to be identified. The approach to identifying SRI funds was similar to that of Weber et al. (2010), using SRI-related keywords like sustainable, environmental, ethical, or social. We did this in Refinitiv Eikon by selecting equity mutual funds through the "Theme & Strategy" filter and choosing the critical word "ethical". Furthermore, an additional filter was applied. Considering that an SRI label is not enough to ensure that a fund follows a socially responsible investment policy (Utz & Wimmer, 2014), only funds with a Refinitiv's ESG Combined Score equal to or greater than B+ (66.67/100) were considered. Finally, by only retrieving funds with at least ten years of history, we ended up with a sample of 259 SRI funds.

Then, we identified and collected a sample of companies from sin sectors ineligible to be included in the SRI funds (the "sin stocks"). In this process, we looked at the selection methodology applied by SRI indexes, namely the MSCI KLD 400 Social Index, and by academics (Fabozzi et al., 2008; Hong & Kacperczyk, 2009). Launched in 1990, the MSCI KLD 400 Social Index is the oldest SRI index. It rejects companies in nuclear power, tobacco, alcohol, gambling, military weapons, civilian firearms, genetically modified organisms, and adult entertainment industries (MSCI, 2022). Hong and Kacperczyk (2009) considered "sin stocks" public companies producing tobacco, gambling, and alcohol, while Fabozzi et al. (2008) used stocks from adult services, biotech, gambling, defense, tobacco and alcohol industries. These last authors only deemed a company a sin stock if the revenue from one of those industries surpassed 30% of the firm's total revenue. We applied a similar criterion. We considered sin stocks to be the companies where at least 30% of total sales originated in the armaments, alcohol, tobacco or

gambling sectors. This process obtained a sample of 159 sin stocks, from 34 different countries around the world.

B. Methodology

Optimal portfolios

This study aims to determine if the efficiency of SRI portfolios increases by adding the neglected sin stocks. To test it, we use the framework of the mean-variance analysis to check whether SRI funds see their risk-adjusted returns, measured by the Sharpe ratio, increase when adding sin stocks to the portfolio.

In practice, the empirical testing of this research concerns building optimal risky portfolios, i.e., efficient portfolios that maximize the risk premium per unit, commonly referred to as the Sharpe ratio, in a world where there are two available risky assets: a portfolio of sin stocks ("Black Sheep" portfolio), and an SRI mutual fund.

It is worth highlighting that if the estimated optimal portfolio, which is the most efficient portfolio available, with the highest Sharpe ratio, holds both the SRI mutual fund and the "Black Sheep" portfolio, then the inclusion of the "Black Sheep" portfolio increases the efficiency of the investment portfolio. It would be equivalent to saying that by adding those sin stocks to its portfolio, the SRI mutual fund would generate a larger risk-adjusted return. Hence, the investment in that SRI mutual fund is not financially efficient. That is, we will conclude by analyzing the weight of the "Black Sheep" portfolio in the optimal efficient portfolio. Suppose the weight of the "Black Sheep" portfolio in the optimal portfolio is null or negative. In that case, the sin stocks do not improve the Sharpe ratio of SRI funds, and the investment restriction imposed by socially responsible investing does not imply a loss of efficiency. However, if the weight of the "Black Sheep" portfolio in the efficient portfolio is positive, then choosing SRI has a cost and impedes financial performance. Thus, investors looking for the most efficient investment portfolio should consider investing beyond socially responsible investments.

We conducted this analysis in nine different time frames using monthly data for the ten years from June 2012 until May 2022. Utilizing the previous 24 months of historical returns to make our estimates, we carried outdid the intended testing in May 2014 and in May of each one of the eight following years.

First, we had to create nine "Black Sheep" portfolios using the 159 sin stocks. We assumed equal weights; thus, the expected annual return of such portfolios was estimated as the average of the annualized returns of such stocks in the previous 24 months. We compute the standard deviation of the nine portfolios. Finally, as we had nine periods, we built nine variance-covariance matrixes from the returns of the 159 stocks and through matrix calculus, we obtained the standard deviations of the portfolios.

Then, for each one of the nine time periods, we built 259 optimal risky portfolios for each pair $\left(\text{"Black Sheep"} ; \text{SRI fund}_j,\ j = 1, \ldots, 259\right)$ by maximizing the Sharpe ratio of the portfolios. We did so through the Solver add-in in Excel, for which we set to maximize the cell containing the Sharpe ratio formula by changing the weight of the "Black Sheep" portfolio (w_{BS}) in the whole portfolio. Note that only two assets were considered in the

estimation of these optimal portfolios, the "$Black\ Sheep$" portfolio and a $SRI\ fund_j$, so $w_{SRI} = 1 - w_{BS}$.

This process also implied computing the correlation between the monthly returns of the "Black Sheep" portfolio and each SRI mutual fund as well as estimating the expected return and standard deviation of each fund, which was carried outdone as usual in a mean-variance analysis, considering the returns for the 24 previous months. The risk-free rate is the 10-year US Treasury Bond rate at the beginning of June for each of the nine years.

For robustness purposes, we repeated this process, considering that the portfolios of sin stocks, the Black Sheep portfolios, incurred transaction costs that reduced their return by 2.5%, considering nine Black Sheep portfolios.

With the optimal portfolios estimated, we then collected and analyzed the weights of the Black Sheep portfolio and each SRI fund in the composition of the efficient portfolios to conclude.

Performance Measures

To complement this research and obtain more robust conclusions, we computed three measures used to evaluate and rank the performances of investment portfolios: Sharpe ratio, Treynor ratio and Jensen's alpha.

With the returns and standard deviations of the Black Sheep's portfolio for the nine periods, computing the Sharpe ratios was very straightforward. For the SRI funds, we calculated the individual Sharpe Ratio for the 259 funds each year and then estimated the sample average each year, obtaining nine SRI Sharpe ratios.

The process for computing the Treynor ratio and Jensen's alpha had two major differences from the aforementioned process. First, we had to estimate the beta factor, which is the denominator for the Treynor ratio and is one of the inputs of the CAPM. This implied computing the covariance of returns between our sample portfolios and the market portfolio and the variance of the market portfolio. We considered the usual S&P 500 index as the market portfolio and retrieved monthly returns of the index for the 10 years from June 2012 until May 2022. Second, we created a "Combined SRI portfolio" for which we would compute a single beta for each period instead of computing 259 betas and 259 measures nine times. This portfolio was comprised of 259 SRI funds, assuming equal weights. With the Betas and the market portfolio return estimated, we incorporated the risk-free rate to compute the Treynor ratios and Jensen's alphas for the Black Sheep and the Combined SRI portfolio in the nine time periods.

Finally, we analyzed the measures of the Black Sheep and the SRI funds. It is worth noting that the Sharpe and Treynor ratio represents the excess return per unit of risk (total or systematic risk), so the higher the ratio, the better. Jensen's alpha is the abnormal return generated by a portfolio, that is, the difference between the actual and the expected return predicted by the CAPM, so the larger the alpha, the better the performance.

IV. Results

A. Weights on the Optimal Portfolio

From the nine periods considered, in six (2014, 2015, 2016, 2017, 2018 and 2019), the Black Sheep had a positive weight on the optimal portfolio in all 259 portfolios estimated (see Table 1). This means that sin stocks increased the investment efficiency for all 259 SRI mutual funds considered. It should be mentioned that in 2022, only in one instance this was not the case, as the Black Sheep portfolio is part of 258 out of 259 optimal portfolios. In 2021, this was the case for more than 90 per cent of the portfolios, and in 2020, even though that number is considerably smaller, Black Sheep still cut across most portfolios. With this evidence, the conclusion seems straightforward. For the samples considered, sin stocks improve the efficiency of SRI funds most of the time and for any SRI fund.

Table 1: The weights of the Black Sheep and SRI funds in the optimal portfolios.

	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
$w_{BS} > 0\%$	259	259	259	259	259	259	159	237	258
Average w_{BS}	65%	102%	200%	262%	148%	309%	>10000%	>10000%	152%
Short sell SRI	11	122	248	253	243	243	159	196	200
$w_{SRI} > 0\%$	235	137	11	6	16	16	100	63	59
Average w_{SRI}	35%	-2%	-100%	-162%	-48%	-209%	<-10000%	<-10000%	-52%

However, more than sin stocks being part of the portfolios, they were crucial. They had an average weight larger than 100% in all periods except 2014, meaning an investor would have to invest all of its funds in the sin stocks. Then, short sell (if possible) the SRI fund and use those proceeds to invest more in sin stocks to reach the maximum efficiency, the maximum Sharpe ratio, which describes the risk premium per unit of risk. This also applies to the years 2020 and 2021, although those years present some unusual figures, likely due to the drastic and unstable effects of the pandemic crisis. One can also see that, in all periods except 2014 and 2015, the optimal portfolio usually assumed a short position on the SRI fund. This occurred most notably from 2016 to 2019, in which 243 or more optimal portfolios, out of 259, shorted the SRI fund, i.e., the SRI fund had a negative weight on the optimal portfolio, and, thus, the portfolio of sin stocks had a weight larger than 100%.2014 is the only year in which the SRI funds present an average positive weight, with around one-third of the optimal investment going to socially responsible investments, on average.

The evidence is significant and clear. For the samples considered, socially responsible investment is not efficient. By choosing SRI, investors are hindering their financial performance, and thus, investors looking for the most efficient investment portfolio should consider investing beyond the realm of socially responsible investments.

To test the robustness of these results, and because one could argue that SRI mutual funds face transaction costs that worsen their performance, which is not reflected on the constructed portfolio of sin stocks, we repeated this analysis, imposing transaction costs on the Black Sheep portfolio. It is worth highlighting that Edelen et al. (2013) found that mutual funds incurred average trading costs of 1.44%, while Wermers (2000) observed

that mutual funds faced a 1.6% decrease in their returns due to transaction costs. Subsequently, we decided to carry out the analysis again, considering that the portfolio of sin stocks incurred transaction costs that reduced its return by 2.5% (see Table 2).

Table 2: The weights of the Black Sheep and SRI funds in the optimal portfolios.

	2014	2015	2016	2017	2018	2019	2020	2021	2022
$w_{BS} > 0\%$	259	259	259	259	259	231	159	223	258
Average w_{BS}	56%	96%	196%	259%	144%	436%	>10000%	>10000%	133%
Short sell SRI	8	78	238	252	233	211	159	180	172
$w_{SRI} > 0\%$	251	181	21	7	26	48	100	79	87
Average w_{SRI}	44%	4%	-96%	-159%	-44%	-336%	<-10000%	<-10000%	-33%

Even in this situation, the case for SRI funds only became slightly better, with the difference being relatively insignificant from the previous analysis. Consequently, we determine that the conclusions drawn from Table 1 are robust and still hold when adding transaction costs to the Black Sheep portfolio.

B. Performance Measures

We compute three measures to evaluate and rank the performances of investment portfolios (Sharpe ratio, Treynor ratio and Jensen's alpha) for the Black Sheep (Black Sheep portfolios with added transaction costs) and the SRI portfolios in the nine time periods (see Table 3). The larger any measure, the better the performance.

When looking at the risk premium, the reward obtained by incurring risky investments per unit of total risk, represented by the Sharpe ratio, we observe that the sin stocks provided a larger reward to investors in eight of the nine periods. On average, an additional 1% of standard deviation in a portfolio of sin stocks generated an additional 1.21% return, while the reward was just 0.58% for socially responsible investment mutual funds.

Table 3: The performance measures for the Black Sheep and SRI portfolios.

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2014-22
Sharpe Ratio										
BS'	**2.07**	**2.26**	**1.15**	**1.17**	**2.37**	**0.12**	-0.12	**0.92**	**0.98**	**1.21**
SRI	1.86	1.27	0.23	0.13	0.61	-0.09	**-0.04**	0.68	0.58	0.58
Treynor Ratio										
BS'	0.29	**0.33**	**0.17**	**0.15**	**0.28**	**0.02**	-0.03	**0.22**	**0.22**	**0.18**
SRI	**0.34**	0.31	0.05	0.02	0.12	-0.03	**-0.02**	0.17	0.12	0.12
Jensen's Alpha										
BS'	5.80%	**11.87%**	**9.30%**	**7.27%**	**9.17%**	**-3.68%**	-2.14%	**-2.33%**	5.58%	**4.54%**
SRI	**6.79%**	8.18%	0.01%	-3.95%	-0.18%	-6.40%	**-0.70%**	-4.45%	**-1.32%**	-0.23%

The conclusion is similar, although not so robust when looking at the Treynor ratio. Once again, the performance of the Black Sheep portfolio was better than SRI funds, on average, and in seven out of the nine periods studied. From 2014 until 2022, sin stocks

provided a reward of 0.18% per unit of systematic risk, measured by beta, while SRI mutual funds generated a 0.12% unitary reward.

The analysis of Jensen's alpha provides a clearer illation. On average, SRI funds experienced returns close to the expected (-0.23%), while the neglected sin stocks experienced a substantial abnormal return of 4.54%. Moreover, in six out of the nine periods, the Black Sheep portfolio discounted from transaction costs provided larger abnormal returns than socially responsible investment funds.

As expected, the three measures deliver similar insights. On average, and most of the time, the portfolio of sin stocks outperforms socially responsible investment mutual funds. This finding corroborates the results reported in Tables 1 and 2, implying that SRI funds could increase their performance by including sin stocks in their portfolios. Therefore, investors who want maximum financial efficiency should not invest in SRI mutual funds.

IV. Conclusions

Since the 1960s, concern about environmental, governance and social issues has gathered momentum. Concomitantly, socially responsible investment (SRI) has developed into a highly relevant investment class, representing $35.3 trillion in assets under management in 2020, accounting for 35.9% of total assets under management in the world (GSIA, 2021). Mutual funds have also observed the rising notoriety of socially conscious investments. SRI mutual funds have been attracting more flows than conventional funds (Bialkowski & Starks, 2016).

The empirical literature on SRI funds is vast, focusing on studying their financial performance and comparing it with conventional investments. The evidence is mixed (Utz & Wimmer, 2014). Nonetheless, the significant literature demonstrating the financial outperformance of SRI funds is intriguing. However, theoretically, it does not hold. Ceteris paribus, a portfolio with investment restrictions should not perform better than an unrestricted portfolio (Renneboog et al., 2008). Therefore, we resorted to the Modern Portfolio Theory of Markowitz (1952) and Tobin's Separation Theorem (Tobin, 1958) to find out if the efficiency of SRI portfolios increases by adding sin stocks, that is, to see if SRI funds would see their risk-adjusted returns increase by adding stocks that socially responsible investors typically reject. We did so by building optimal risky portfolios, i.e., efficient portfolios that maximize the risk premium per unit, commonly referred to as the Sharpe ratio, in a world where there were two available risky assets: a portfolio of sin stocks (the Black Sheep portfolio), and an SRI mutual fund. Then, we analyzed the weights of these assets in the optimal portfolios.

The results were strong. For the samples considered, sin stocks improved the efficiency of SRI funds almost every time and for any SRI fund. This means that socially responsible investment is inefficient, representing a financial cost. In most situations, holding even a small portion of SRI mutual funds was detrimental, with results suggesting short-selling SRI funds to invest more than 100 per cent in sin stocks. The main implication is that, by choosing SRI, investors are hindering their financial

performance. Thus, investors looking for the most efficient investment portfolio should consider investing beyond socially responsible investments.

We also computed three investment performance measures (Sharpe ratio, Treynor ratio and Jensen's alpha) to compare the performance of the Black Sheep and SRI portfolios. All measures delivered similar conclusions. Sharpe and Treynor ratios showed us that sin stocks reward risk better than SRI mutual funds, providing a larger risk premium per unit of risk. Jensen's alpha was significantly greater for sin stocks, evidencing substantial abnormal returns, which did not occur, on average, for socially responsible investing.

It is worth noting that we do not analyze the utility of investments. For many investors, the increased utility that comes from knowing that their savings are used responsibly will outweigh the loss of utility from a higher return. Although they may perform better regarding the risk-return binomial if they include sin stocks in their portfolios, some investors will undoubtedly have less utility if they consider the investment's social effects.

This study demonstrates that it cannot be said that SRI mutual funds perform better (from the point of view of the risk-return binomial) than investment alternatives that, ceteris paribus, have no restrictions stemming from social responsibility policies. This study also implies that it is necessary to rethink the criteria by which investments are efficient, particularly when investors do not base their decision solely on the basis of expected risk and return. If that is the case, we should incorporate other factors into the criteria for making investments that make the choice more consistent with investors' true utility function.

This study obviously has limitations in how we define sin stocks. We do not include sectors such as nuclear energy, genetically modified organisms, and adult entertainment. Future studies could also incorporate transaction costs differently and more refinedly than the one used in this study.

Conflicts of Interest: The authors declare no conflict of interest.

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