

SOME EFFECTS ON THE EFFICIENT FRONTIER OF THE INVESTMENT STRATEGY: A PRELIMINARY APPROACH

PAZ MÉNDEZ-RODRÍGUEZ

mpmendez@uniovi.es

*Dpto. Economía Cuantitativa, Universidad de Oviedo
Avda. del Cristo s/n, Oviedo, Asturias*

ANA GARCÍA BERNABEU

angarber@esp.upv.es

*Depto. Economía y Ciencias Sociales
Plaza Ferrándiz y Carbonell s/n, Alcoy, Alicante*

ADOLFO HILARIO

ahilario@disa.upv.es

*Depto. Ingeniería de Sistemas y Automática
Plaza Ferrándiz y Carbonell s/n, Alcoy, Alicante*

BLANCA PÉREZ-GLADISH

bperez@uniovi.es

*Dpto. Economía Cuantitativa, Universidad de Oviedo
Avda. del Cristo s/n, Oviedo, Asturias*

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ABSTRACT: In this work an indicator of the social responsibility degree of mutual funds is proposed based on the mutual fund's screening policy and on the quality of the information provided by the fund manager. Once this indicator is obtained it is included as a constraint in the mean-variance classical optimization model. An exploratory numerical experiment is presented in order to check the possible effect on the efficient frontier of different SRI strategies.

Keywords: socially responsible investment strategy, negative screening, positive screening, mutual funds, efficient frontiers.

RESUMEN: En este trabajo presentamos un indicador del grado de responsabilidad social de los fondos de inversión. El indicador propuesto se basa en el número de filtros sociales aplicados por los gestores de los fondos y en la calidad de la información sobre el proceso de aplicación de los filtros. Una vez obtenido este indicador se incorpora como restricción en el modelo de optimización de Markowitz. Finalmente presentamos un experimento numérico mediante el que se pretende realizar una primera exploración de los efectos sobre la frontera eficiente de las distintas dimensiones de responsabilidad social y de las diferentes estrategias inversoras.

Palabras clave: estrategia de inversión socialmente responsable, filtro negativo, filtro positivo, fondos de inversión, fronteras eficientes.

1. Introducción

Socially Responsible Investing (SRI) is broadly defined as an investment process that integrates not only financial but also social, environmental, and ethical concerns into investment decision making. The main SRI tool is investment in socially responsible mutual funds (SRMF) and the most common socially responsible investment strategy is screening. This investment strategy consists of checking companies for the presence or absence of certain social, environmental, ethical and/or good corporate governance characteristics. The following table displays main currently used SRI strategies.

Most authors rely on the screening intensity of a mutual fund (number of applied screens) as a proxy of mutual funds' social responsibility degree (see Barnett and Salomon, 2006; Renneboog *et al.*, 2008; Lee *et al.*, 2010; Jegourel and Maveyraud, 2010; Scholtens, 2007; Ballesteros *et al.* 2012; Bilbao *et al.* 2012; Pérez-Gladish *et al.* 2013; Gupta *et al.* 2013 and Cabello *et al.* 2013). In this paper, according to the current practice of main social rating agencies and researchers in the academic field, we propose a measurement of mutual funds' social responsibility degree based on their social screening intensity and strategy.

Three steps have been taken into account. In a first step, we identify the main criteria affecting SRI decisions and we propose quantitative performance indicators for each of the considered criteria. In this work, these indicators rely on screening intensity (number of social, environmental, governance and/or ethical screens applied by the fund) which is the main SRI strategy.

The proposed indicators take into account different screening strategies and different social, environmental, governance and ethical features. In the second step, we aggregate the individual indicators in order to measure the socially responsible performance of the mutual funds based. With this aim, preferential subjective weights from a fictitious investor are obtained. Through these weights the investor is able to reflect the importance he is willing to give to the different social responsibility dimensions (environment, social, governance...) and to the different SRI strategies (negative and/or positive screening).

The proposed socially responsible indicator also incorporates a correcting factor which takes into account the quality of the non-financial information provided by the mutual funds related to their screening process. In the third step, a SRI expert, who is the person in charge of the mutual funds evaluation process, weighs the different quality of non-financial information indicators which will serve as a proxy of the transparency and credibility of the information on the screening process and of the degree of SRI expertise of the mutual fund manager. The social responsibility degree, obtained in this way, is then incorporated in Markowitz's mean-variance model (Markowitz, 1952) and the efficient frontiers are obtained for different social responsibility strategies (see Drut, 2010 and Utz *et al.* 2014).

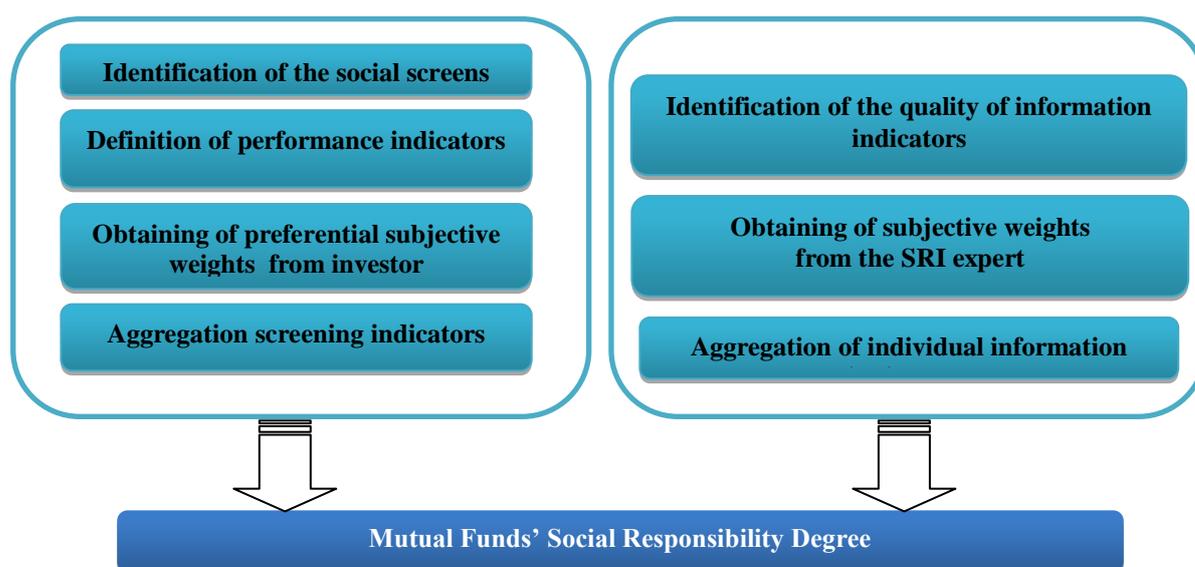


Figure 1. Construction of an aggregated social responsibility indicator

Finally, an empirical study is carried out on 110 U.S. domiciled large cap equity mutual funds (conventional and socially responsible mutual funds members of the Social Investment Forum (SIF)) in order to illustrate the proposed approach.

Table 1. Main SRI strategies

Investment Strategy	Description
Negative Screening	It implies avoiding investing in companies whose products and business practices are harmful to individuals, communities, or the environment.
Positive Screening	It implies investing in profitable companies that make positive contributions to society, for example, that have good employer-employee relations, strong environmental practices, products that are safe and useful, and operations that respect human rights around the world
Community Investment	Directs capital from investors and lenders to communities that are underserved by traditional financial services institutions. In the U.S. and around the world, community investing makes it possible for local organizations to provide financial services to low-income individuals and to supply capital for small businesses and vital community services, such as affordable housing, child care, and healthcare.
Shareholder Activism	Involves socially responsible investors who take an active role as the owners of corporate America. These efforts include talking (or “dialoguing”) with companies on issues of social, environmental or governance concerns. Shareholder advocacy also frequently involves filing, and co-filing shareholder resolutions on such topics as corporate governance, climate change, political contributions, gender/racial discrimination, pollution, problem labor practices and a host of other issues. Shareholder resolutions are then presented for a vote to all owners of a corporation. The process of dialogue and filing shareholder resolutions generates investor pressure on company management, often garners media attention, and educates the public on social, environmental and labor issues. Such resolutions filed by SRI investors are aimed at improving company policies and practices, encouraging management to exercise good corporate citizenship and promoting long-term shareholder value and financial performance.

Source: SIF (2012)

The structure of the article is as follows. In the following section we will discuss the measurement of mutual funds’ portfolio’s social responsibility degree. Section 3 will present the computation of the mean-variance efficient frontiers including constraints establishing minimum bounds on the social responsibility degree of the portfolio. Section 4 will illustrate the use of the proposed indicators and will analyze the effect of different SRI strategies and individual dimensions with some numerical experiments and, finally, in section 5 main conclusions are presented.

2. Measurement of Social Responsibility of Mutual Funds

Let us consider a set of mutual funds $\{F_i\}_{i=1}^n$ and a set of social responsibility screens $\{S_j\}_{j=1}^m$. Each mutual fund ($i=1\dots n$) is evaluated with respect to each screen ($j = 1\dots m$) using the following binary variables:

$$s_{ij} = \begin{cases} 0 & \text{if fund } i \text{ does not apply screen } j \\ 1 & \text{otherwise} \end{cases}$$

Definition 1. The screening intensity of a mutual fund i , SI_i , is defined as:

$$SI_i = \sum_{j=1}^m \frac{\omega_j s_{ij}}{m}, \quad \omega_j \in [0,1], \quad SI_i \in [0,1] \quad (1)$$

where ω_j are preferential weights which reflect the importance given by the investor to each screen j .

Let us consider a set of indicators for the quality of the non-financial information provided by the mutual funds $\{Q_k\}_{k=1}^l$. Each mutual fund ($i=1 \dots n$) is evaluated with respect to each of these indicators ($k=1 \dots l$) using the following binary variables:

$$q_{ik} = \begin{cases} 0 & \text{if fund } i \text{ does not accomplish indicator } k \\ 1 & \text{otherwise} \end{cases}$$

Definition 2. The quality of the non-financial information provided by a mutual fund i , QI_i , is defined as:

$$QI_i = \sum_{k=1}^l \lambda_k \frac{q_{ik}}{k}, \quad \lambda_k \in [0,1], \quad QI_i \in [0,1] \quad (2)$$

where λ_k are preferential weights which reflect the importance given by the SRI expert to each quality of information indicator k . This synthetic indicator, QI_i , will have a rewarding/penalizing effect on the screening intensity as the number of applied screens is not a sufficient indicator by itself of the social responsibility degree of a mutual fund due to the usual lack of information on the screening process. We will assume that the effect of this rewarding/penalizing factor on the screening intensity is multiplicative.

Definition 3. The Social Responsibility Degree of mutual fund i is defined as:

$$SRD_i = SI_i \times QI_i, \quad SRD_i \in [0,1] \quad (3)$$

Thus, if $QI_i = 0$ this factor will have a penalizing effect on the fund and therefore, its Social Responsibility Degree, SRD_i , will be zero (it does not matter how many screens are applied by the fund if the quality of the information with regards to the screening process is zero). On the other hand, if $QI_i = 1$ we will be rewarding the screening process and we will accept the screening intensity, SI_i , as a good proxy of the Social Responsibility Degree, SRD_i , of the mutual fund.

3. Computation of Mean-Variance Efficient Frontiers including a social responsibility constraint

In this section, we consider the mean-variance approach first proposed by Markowitz (1952) including a new constraint on the portfolio's social responsibility degree.

Definition 4. Let us define the portfolio's expected return as:

$$E_p(R)\bar{x} = \sum_{i=1}^n E(R_i)x_i, \quad (4)$$

where: x_i represents the percentage of the investor's budget invested in mutual fund i and R_i is a random variable representing the return of mutual fund i . The portfolio's expected return will be approximated considering the historical mean as the forecast of the expected return on the mutual fund for a given observation period:

$$\hat{E}(R_i) = \frac{1}{T} \sum_{t=1}^T r_{it}, \quad i = 1, \dots, n \quad (5)$$

where r_{it} is the realization of the random variable R_i over the period t obtained using historical data.

Definition 5. The portfolio's risk is defined as:

$$\sigma^2(R_p) = \sum_{i=1}^n \sum_{r=1}^n \sigma_{ir} x_i x_r \quad (6)$$

where σ_{ir} is the covariance between returns of mutual funds i and r which will be approximated as follows:

$$\hat{\sigma}_{ir} = \frac{1}{T} \sum_{t=1}^T (r_{it} - \hat{E}(R_i))(r_{rt} - \hat{E}(R_r)), \quad i, r = 1, \dots, n \quad (7)$$

Let $SRD_p = (SRD_1, SRD_2, \dots, SRD_n)$ be a vector containing the mutual funds' social responsibility degrees. Following the current practice of rating agencies and academics we will assume a linearity hypothesis (see for example, Drut, 2010, Barrachini, 2007, Scholtens, 2007 and Bilbao et al. 2012).

Definition 6. The portfolio's social responsibility degree can be defined as:

$$SRD_p = \sum_{i=1}^n SRD_i x_i \quad (8)$$

The following constraints will be included in the optimization model: minimum bounds on the portfolio's social responsibility degree:

$$\sum_{i=1}^n SRD_i x_i \geq c \quad (9)$$

The sum of the proportions to be invested in the mutual funds should be equal to 1 which means 100% of the total budget should be invested in the portfolio:

$$\sum_{i=1}^n x_i = 1 \quad (10)$$

Finally, short sales will not be allowed:

$$x_i \leq 0, \quad i = 1, \dots, n \quad (11)$$

We will solve the following quadratic optimization problem for a given minimal expected return μ and for a given portfolio's social responsibility minimum threshold c :

$$\begin{aligned} \min \quad & \sigma^2(R_p) = \sum_{i=1}^n \sum_{r=1}^n \sigma_{ir} x_i x_r \\ \text{s.t.} \quad & E_p(R) \bar{x} = \sum_{i=1}^n E(R_i) x_i \geq \mu \\ & \sum_{i=1}^n SRD_i x_i \geq c \\ & \sum_{i=1}^n x_i = 1 \\ & x_i \leq 0, \quad i = 1, \dots, n \end{aligned} \quad (12)$$

4. Numerical experiments

Our database is composed of both, conventional and socially responsible mutual funds. The set of socially responsible mutual funds (25 mutual funds) consists of all the large cap equity mutual funds which are members of the Social Investment Forum (SIF).

For the conventional mutual funds our initial database, provided by Morningstar Ltd, consisted of 10,038 open end U.S. large cap equity mutual funds. We applied a filter to this database in order to obtain the set of funds with complete weekly return data from 8/22/2000 to 8/21/2010.

The applied filter gave rise to a set of 1505 mutual funds. Our random sample consists of around 5% of this last set of funds, i.e. 85 conventional U.S. large cap equity mutual funds with inception date prior to 22/08/2000 and complete weekly return data for the 10 year period.

In order to measure the degree of Socially Responsibility of mutual funds we will take into account 41 screens grouped in four dimensions and 8 indicators for the quality of the non-financial information (see tables in the appendix for a description of each screen and indicator).

Once each mutual fund ($i=1 \dots 110$) has been evaluated with respect to each screen ($j=1 \dots 41$) and with respect to each quality of information indicator ($k=1, \dots, 8$) we measure their Socially Responsible Degree.

Table 2 displays the main social responsibility dimensions taken into account and tables in the appendix display in detail each of the applied screens and quality of information indicators.

Table 3 displays Mutual Funds' Socially Responsible Degree (SRD_i). We have also calculated the Socially Responsible Degree when only negative screening is considered as investment strategy (SRD_i^{neg}) and for the case in which only positive screening is taken into account (SRD_i^{pos}).

We have grouped funds in families with a common manager (as the same SRI strategy is applied to all the funds under his/her management).

Table 2. Description of main SRI dimensions

Dimension	Description
Environmental, Social and Governance (ESG)	The United Nations Principles for Responsible Investment (UNPRI) was created in 2005 to provide a framework for incorporating Environment, Social and Governance (ESG) considerations into mainstream investment and ownership practices. ESG criteria measure Corporate Social Responsibility across a range of issues that impact a company's various stakeholders: environment, community & society, customers, employees & supply chain, governance & ethics.
Products and Services	Some mutual funds have been screening out companies that participate in the production of alcohol, tobacco, or gambling products, known collectively as the "sin" screens, for over 60 years. Other popular negative screens include military weapons production, firearms, and nuclear power.
Quality of information provided by the mutual fund manager	Socially responsible investors need to carefully examine the mutual funds' prospectus to see if the fund investment strategy and social responsible guidelines meet their needs. However, this information might not be provided or, if it is, might be sometimes unreliable. Socially responsible funds are not always forthcoming about which companies (and why) are included in their portfolios.

The first column in table 3 displays the Quality of Information score for each mutual fund. As we can observe mutual funds F25, F17, F22 and F23 obtain the best scores with regards to the transparency and credibility of the information provided by the fund manager. Funds F19, F20 and F21 are the worst performers.

Table 3. Socially Responsible Degree based on the followed investment strategy

Family	Funds	QI_i	SRD_i	SRD_i^{neg}	SRD_i^{pos}
Calvert	F1-F16	0.625	0.088	0.188	0.139
Domini	F17	0.750	0.125	0.357	0.220
Green Century	F18	0.625	0.172	0.268	0.416
MMA Praxis	F19	0.500	0.150	0.167	0.265
Neuberger Berman	F20-21	0.500	0.150	0.167	0.159
Parnassus	F22-F23	0.875	0.244	0.286	0.265
Sentinel	F24	0.500	0.175	0.262	0.220
Walden	F25	0.875	0.284	0.542	0.416
Other	F26-F110	0	0	0	0

Dhaliwal *et al.* (2011) show that firms with high corporate social responsible rates tend to disclose more information than the ones with low rates as these firms want to reflect a positive image to investors and other stakeholders. This is consistent with the obtained results in this work where funds with the higher score for the quality of information indicator (F25, F17, F22, F23) are also the ones obtaining higher scores on the degree of social responsibility (see tables 3 and 4).

Table 4. Mutual Funds' Socially Responsible Degree based on different socially responsible dimensions

Family	Funds	SRD_i^{env}	SRD_i^{soc}	SRD_i^{gov}	SRD_i^{prod}
Calvert	F1-F16	0.156	0.234	0.625	0.341
Domini	F17	0.313	0.516	0.375	0.409
Green Century	F18	0.313	0.313	0.000	0.511
MMA Praxis	F19	0.125	0.125	0.000	0.500
Neuberger Berman	F20-21	0.125	0.125	0.000	0.500
Parnassus	F22-F23	0.219	0.273	0.875	0.875
Sentinel	F24	0.125	0.219	0.500	0.455
Walden	F25	0.219	0.219	0.438	0.477
Other	F26-F110	0	0	0	0

From the previous tables we can rank socially responsible mutual funds based on their Socially Responsible Degree taking into account the quality of the non-financial information provided by the fund manager. The obtained quantitative information can be later incorporated into a portfolio selection model allowing individual investors to select mutual funds taking into account not only financial but also non-financial criteria. As we can observe in table 5, the ranking changes depending on the socially responsible strategy (positive screening, negative screening or both, what we have called "total" screening) and on the considered social responsible dimension (environment, social, governance or product and processes).

Table 5. Mutual Funds' ranks based on investment strategy and dimensions

Family	Funds	Rank SRD_i	Rank SRD_i^{neg}	Rank SRD_i^{pos}	Rank SRD_i^{env}	Rank SRD_i^{soc}	Rank SRD_i^{gov}	Rank SRD_i^{prod}
Calvert	F1-F16	8	6	8	5	4	2	8
Domini	F17	7	2	6	1	1	5	7
Green Century	F18	4	4	2	2	2	6	2
MMA Praxis	F19	6	8	4	6	7	6	3
Neuberger	F20-21	5	7	7	7	8	6	4
Parnassus	F22-F23	2	3	3	3	3	1	1
Sentinel	F24	3	5	5	8	5	3	6
Walden	F25	1	1	1	4	6	4	5
Other	F26-F110	9	9	9	9	9	6	9

Figure 2 displays different mean-variance efficient frontiers obtained for both, a non-SR investor (conventional investor) and a social conscious investor (SR investor). The efficient frontier for the conventional investor has been obtained eliminating the social responsible constraint in (12). For the social conscious investor we have displayed the results for a minimum portfolio's social responsibility degree $c=0.25$. For higher social responsibility degrees the problem results infeasible. As it was expected, for a given expected return the socially responsible efficient portfolios are much riskier than the conventional ones. In this case, we have not distinguished among the type of screen, positive or negative.

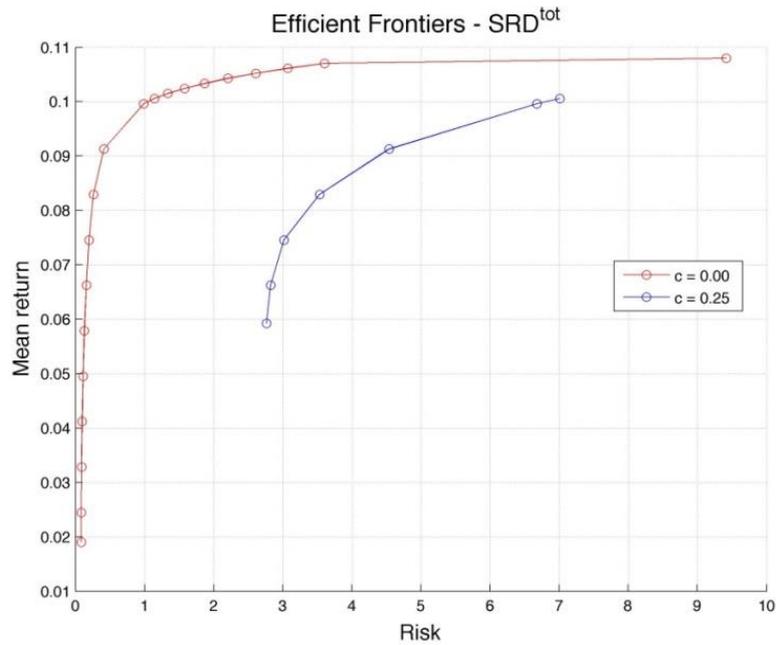


Figure 2. Mean-variance efficient frontiers for a non-SR investor and a SR investor ($c=0.25$)

Let us now consider two different investors, one willing to follow an investment strategy based only on negative screening and another one willing to follow a strategy based on positive screening. That is, the first investor would like to avoid from his investments those funds investing in companies which are harmful for the environment and society and the second investor would like to include in his portfolio investments in companies with a good behavior. As we can observe in table 5, the scores obtained by the mutual funds are different for each investment strategy. If we compare the efficient frontiers obtained for both investment strategies, we can observe how a strategy based on negative screening implies less risk for the same levels of returns. Eliminating controversial investments (investments in companies susceptible of receiving financial penalties, for example) reduces financial risk (see table 6).

Let us suppose now that the investor wants to focus only on one social responsibility dimension. Figure 4 displays the efficient frontiers obtained for each of the considered social responsible dimensions (environment, social, governance, products and processes). We can observe how for the same return levels efficient portfolios which only focus on the environment responsible dimension are significantly much riskier than efficient portfolios focusing on the rest of individual dimensions. Results for the social, governance and products and processes dimensions are similar although the governance and products and processes dimensions are the less risky (see table 7).

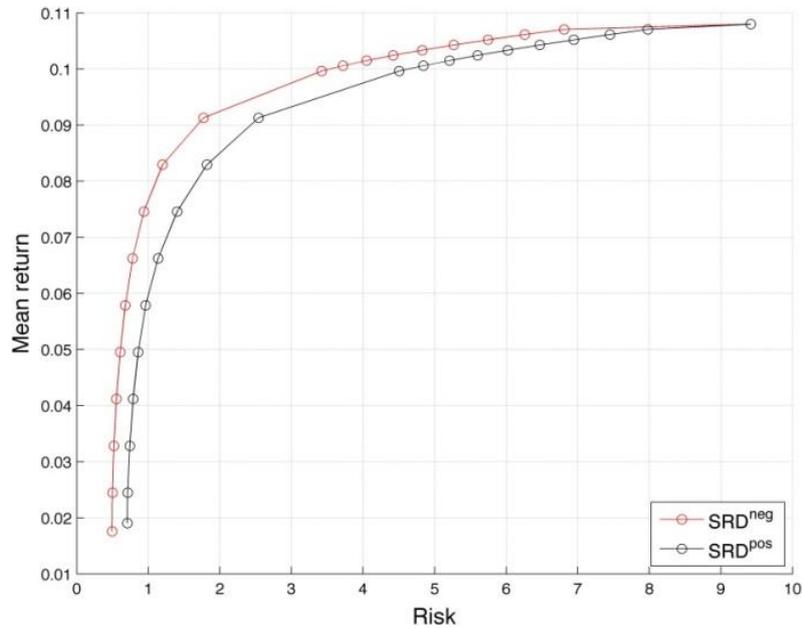


Figure 3. Mean-variance efficient frontiers depending on screening strategy and $c=0.25$

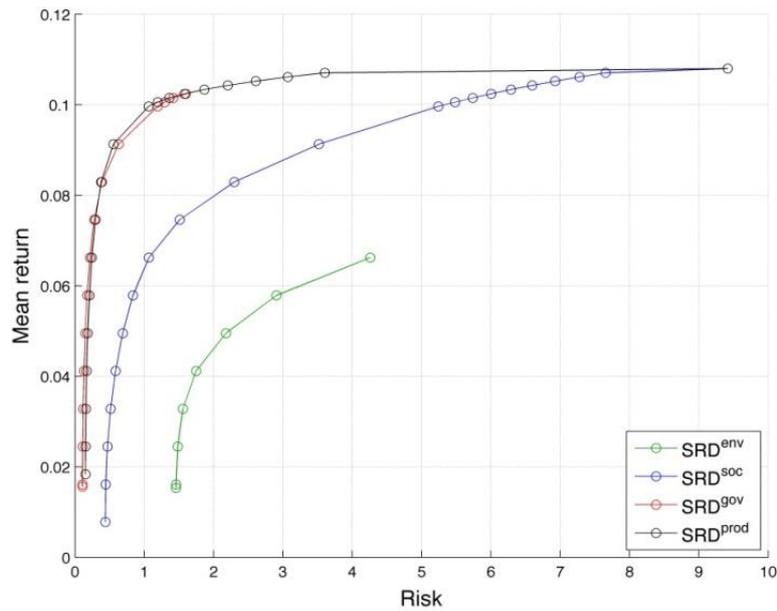


Figure 4. Mean-variance efficient frontiers for different social responsible dimensions and $c=0.25$

The obtained result is consistent with the results obtained when comparing a positive screening strategy with a negative screening strategy as in the products and processes dimension all the applied screens are negative: exclusion of companies related with alcohol, tobacco, firearms, pornography, etc. (see table 2 for a detailed description and table 3A in the appendix) while for the environment dimension both types of screens, positive and negative are applied. Within the governance dimension only two positive screens are considered both related to board issues.

Table 6. Efficient portfolios for different SRI strategies and $c=0.25$

Portfolio	SRI ^{total}		SRI ^{neg}		SRI ^{pos}	
	Return	Risk	Return	Risk	Return	Risk
P1	0.059276	27.633	0.017577	0.49468	0.017577	0.49468
P2	0.066237	28.218	0.024474	0.4998	0.024474	0.4998
P3	0.07459	30.155	0.032826	0.51973	0.032826	0.51973
P4	0.082942	35.329	0.041179	0.55574	0.041179	0.55574
P5	0.091295	45.366	0.049532	0.60796	0.049532	0.60796
P6	0.099647	66.788	0.057884	0.67906	0.057884	0.67906
P7	0.10058	70.099	0.066237	0.7813	0.066237	0.7813
P8			0.07459	0.93821	0.07459	0.93821
P9			0.082942	12.003	0.082942	12.003
P10			0.091295	17.722	0.091295	17.722
P11			0.099647	34.221	0.099647	34.221
P12			0.10058	37.187	0.10058	37.187
P13			0.1015	40.515	0.1015	40.515
P14			0.10243	44.206	0.10243	44.206
P15			0.10336	4.826	0.10336	44.826
P16			0.10429	52.676	0.10429	52.676
P17			0.10522	57.455	0.10522	57.455
P18			0.10614	62.596	0.10614	62.596
P19			0.10707	68.101	0.10707	68.101
P20			0.108	94.166	0.108	94.166

Table 7. Efficient portfolios for different SRI dimensions and $c=0.25$

Portfolio	SRI ^{env}		SRI ^{soc}		SRI ^{gov}		SRI ^{prod}	
	Return	Risk	Return	Risk	Return	Risk	Return	Risk
P1	0.015354	14.581	0.0078038	0.43836	0.015628	0.10994	0.018353	0.15141
P2	0.016121	14.583	0.016121	0.44513	0.016121	0.10995	0.024474	0.15254
P3	0.024474	14.828	0.024474	0.46757	0.024474	0.11225	0.032826	0.15787
P4	0.032826	15.582	0.032826	0.51371	0.032826	0.11885	0.041179	0.16823
P5	0.041179	17.468	0.041179	0.58609	0.041179	0.13061	0.049531	0.18477
P6	0.049531	21.778	0.049532	0.68804	0.049532	0.14882	0.057884	0.20919
P7	0.057884	29.067	0.057884	0.83729	0.057884	0.17589	0.066237	0.24407
P8	0.066237	42.587	0.066237	10.665	0.066237	0.21656	0.074589	0.29573
P9			0.074589	1.51	0.074589	0.27934	0.082942	0.37677
P10			0.082942	22.979	0.082942	0.38744	0.091295	0.55575
P11			0.091295	35.195	0.091295	0.6302	0.099647	10.618
P12			0.099647	52.415	0.099647	11.942	0.10058	11.947
P13			0.10058	54.823	0.10058	12.963	0.1015	1.361
P14			0.1015	57.367	0.1015	14.185	0.10243	15.818
P15			0.10243	60.046	0.10243	15.993	0.10336	18.648
P16			0.10336	62.879	0.10336	1.865	0.10429	22.057
P17			0.10429	65.941	0.10429	22.057	0.10522	26.066
P18			0.10522	69.238	0.10522	26.066	0.10614	30.697
P19			0.10614	72.771	0.10614	30.697	0.10707	36.037
P20			0.10707	76.538	0.10707	36.037	0.108	94.166
P21			0.108	94.166	0.108	94.166		

As it can be observe, for this threshold SR-efficient frontiers are identical when positive and negative screening are considered as individual investment strategies but when compared with a total screening strategy (no distinction is made for the type of screening strategy) the risk is considerably higher than the risk of the positive and negative strategies taken separately. For higher social responsibility ratings for the same return risk more than doubles its value when only a positive screening strategy is followed.

Thus, excluding investment in companies with a “bad” social responsible behavior seems to be less risky than “rewarding” companies with a good behavior.

5. Conclusions

In this paper we have proposed to measure mutual funds’ social responsibility in a flexible way taking into account different SRI dimensions and strategies. In doing so, we have taken into account the number and type of applied screens as well as the transparency and credibility of the information provided by the mutual funds which acts as a proxy for the mutual fund’s manager ability to pick up the SRI mutual funds.

After computing efficient frontiers corresponding to different SRI strategies and dimensions we conclude that including a SRI constraint in the optimization model implies, as expected, a movement of the efficient frontier to the south east of the mean–variance space. That is, for the same return level risk tends to be greater as the level of social responsibility increases with independence of the applied type of screens. However, it is interesting to observe how in the case of negative screening, the risk levels seem to be lower than the ones obtained for positive screening. The obtained results must be interpreted with caution. The aggregate social performance degree of a mutual fund reflects the combination of its performance relative to multiple dimensions. From the obtained results we can observe how for a mutual fund its social performance differs depending on the considered dimension. Since the social performance of a mutual fund is a multidimensional construct the expected impact on financial efficiency in terms of risk and return may vary from one social dimension to another.

Taking into account a large number of socially responsible dimensions and sub-dimensions individually could allow us to better assist the individual investor in his/her portfolio selection decisions as we will be able to better profile his/her socially responsible preferences.

Another aspect to be taken into account is the activity sector of the firm invested in by the mutual fund. For example industries like the ones involved in coal or chemical issues are more exposed than others to environmental concerns. For other industries, as apparel, toy or footwear, which are intensive in labour aspects as employee relations and human rights may be the most important social performance dimensions.

One interesting direction for further research would be to define as a benchmark portfolio the ideal portfolio (where all the solutions are optimal with respect to all the considered criteria) and to try to minimize using compromise programming the distance of the different efficient portfolios to the benchmark portfolio using different metrics. The distances obtained in this way could be considered proxies of the cost of imposing SR-constraints into the mean-variance optimization model.

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Appendix

Table 1A. Environmental screens (positive or negative) and descriptors of performance

<i>ENVIRONMENT</i>				YES	NO
A. Climate/Clean Tech	+	A1	The fund invests in companies that have taken significant measures to reduce the contributions of their operations to global climate change and air pollution through the use of renewable energy, other clean fuels, or through the introduction of energy efficient programs or sale of products promoting energy efficiency.		
	-	A2	The funds avoid investing in companies which derive revenues from the sale of coal or oil and its derivative fuel products.		
	+	A3	The fund invests in companies which derive substantial revenues from the development of innovative products with environmental benefits, including remediation products, environmental services, or products that promote the efficient use of energy.		
B. Pollution/Toxics	-	B1	The fund avoids investing in companies which manufacturer ozone depleting chemicals such as HCFCs, methyl chloroform, methylene chloride, or bromines.		
	-	B2	The fund avoids investing in companies which are substantial producer of agricultural chemicals, including pesticides.		
	-	B3	The fund avoids investing in companies which have substantial liabilities for hazardous waste, or has recently paid significant fines or civil penalties for waste management violations.		
	-	B4	The fund avoids investing in companies which have recently paid substantial fines or civil penalties for, or it have a pattern of controversies regarding, violations of air, water, or other environmental regulations.		
	-	B5	The fund avoids investing in companies whose emissions of toxic chemicals into the air and water from individual plants are notably high.		
	+	B6	The fund invests in companies which have strong pollution prevention programs, including both emissions and toxic-use reduction programs.		
	-	B7	The fund avoids investing in companies which are owners or operators of nuclear power plants, excluding electric utility co's.		
C. Environment/Others	+	C1	The fund invests in companies that are either a substantial user of recycled materials in its manufacturing processes, or major firms in the recycling industry.		
	+	C2	The fund invests in companies that have demonstrated a superior commitment to management systems through ISO 14001 certification and other voluntary programs.		

Table 2A. Social and governance screens (positive or negative) and descriptors of performance

SOCIAL				YES	NO
D. Community Investment	+	D1	The fund invests in companies that have been generous in its giving inside/outside the U.S.		
	+	D2	The fund invests in companies that are either a leader in their support for primary or secondary public school education, or the companies have offered significant support for youth job-training programs.		
	+	D3	The fund invests in companies that are prominent participant in public/private partnerships that support housing initiatives for the economically disadvantaged.		
	+	D4	The fund invests in companies that are strongly engaged in other positive community programs such as activity programs for the children, the older or the unemployed.		
	+	D5	The fund invests in companies that have a superior commitment in the improvement of the neighborhood.		
	-	D6	The fund avoids investing in companies which have recently been involved in major tax disputes involving Federal, state, local or non-U.S. government authorities, or are involved in controversies over their tax obligations to the community.		
E. Diversity & EEO	+	E1	The fund invests in companies that have made substantive progress in the promotion of women and/or minorities to senior executive line positions.		
	+	E2	The fund invest in companies that have innovative hiring or other human resources programs for women and/or minorities, or that have a superior reputation as employers of women and/or minorities.		
F. Human Rights	+	F1	The fund invests in companies that have undertaken outstanding or innovative initiatives primarily related to labor rights in its supply chain outside the U.S.		
	+	F2	The fund invests in companies that have established relations with indigenous peoples near its proposed or current operations (either in or outside the U.S.) that respect their sovereignty, land, culture, human rights, and intellectual property.		
	-	F3	The fund avoids investing in companies that have problems with human rights or directly support governments that systematically deny human rights.		
G. Labor Relationships	+	G1	The fund invests in companies that have strong health and safety programs.		
	+	G2	The fund invests in companies that have outstanding programs addressing employee work/life concerns.		
	+	G3	The fund invests in companies that have strong retirement benefits program.		
	+	G4	The fund invests in companies that have exceptional steps to treat its unionized workforce fairly.		
	+	G5	The fund invests in companies that strongly encourage employee involvement through active participation in management decision-making, and/or through ownership in the companies by granting stock options to a majority of their employees.		
GOVERNANCE				YES	NO
H. Board Issues	+	H1	The fund invests in companies that have fair executive pay policies consistent with industry norms and company's financial condition.		
	+	H2	The fund invests in companies with governance policies that promote independence, accountability and transparency.		

Table 3A. Products and processes screens (positive or negative) and descriptors of performance

PRODUCTS AND PROCESSES			YES	NO	
I. Alcohol	-	I1	The fund avoids investing in companies which license their company or brand name to alcohol products.		
	-	I2	The fund avoids investing in companies which manufacture or are involved in manufacturing alcoholic beverages including beer, distilled spirits, or wine.		
	-	I3	The fund avoids investing in companies which derive revenues from the distribution (wholesale or retail) of alcohol beverages.		
J. Animal Testing	-	J1	The fund avoids investing in companies which use animals to test the toxicity of chemicals in consumer products as toiletries, tobacco or household cleaning products.		
	-	J2	The fund avoids investing in companies which use animals to test cosmetics.		
K. Defense/Weapons	-	K1	The fund avoids investing in companies which derive revenues from the sale of conventional weapons systems and/or ammunition or earned money from the sale of nuclear weapons or weapons systems.		
L. Gambling	-	L1	The fund avoids investing in companies which produce goods and/or provide services related to gambling.		
M. Tobacco	-	M1	The fund avoids investing in companies which license their company or brand name to tobacco products.		
	-	M2	The fund avoids investing in companies which produce tobacco products, including cigarettes, cigars, pipe tobacco, and smokeless tobacco products.		
	-	M3	The fund avoids investing in companies which derive revenues from the production and supply of raw materials and other products necessary for the production of tobacco products.		
	-	M4	The fund avoids investing in companies which derive revenues from the distribution (wholesale or retail) of tobacco.		

Table 4A. Description of "Quality of Information" indicators

QUALITY OF INFORMATION PROVIDED BY MUTUAL FUNDS: TRANSPARENCY & CREDIBILITY				
N. Screening Approach	N1	The fund indicates the explicit criteria for screening decisions.		
	N2	The fund applies social screening first, then financial screening.		
O. Advocacy & Public Policy	O1	The fund has a proxy voting policy and discloses voting practices and reasoning for decisions.		
	O2	The fund sponsor/co-sponsors shareholder resolutions.		
P. Research process	P1	The fund presents a description of its SRI research methodology and process.		
	P2	The fund has its own internal research team composed by experts in SRI analyzing company activities in order to identify suitable investments.		
	P3	The fund uses external research expert providers such as rating agencies to get that information.		
Q. External Control	Q1	The fund is engaged in an ethical external audit periodically.		