



Interfaces with Other Disciplines

Constant and variable returns to scale DEA models for socially responsible investment funds

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ABSTRACT

In order to evaluate the performance of socially responsible investment (SRI) funds, we propose some models which use data envelopment analysis (DEA) and can be computed in all phases of the business cycle. These models focus on the most crucial elements of an investment in mutual funds.

In the literature both constant and variable returns to scale DEA models have been used to evaluate the performance of mutual funds. We carry out an empirical investigation on European SRI equity funds to test the presence of returns to scale (RTS).

Another aspect taken into account by the empirical investigation is the measurement of the degree of social responsibility of SRI equity funds in various European countries. In addition, we analyse the performance of the funds considered with the different DEA models proposed, which differ in the way the ethical objective is taken into account.

Moreover, the paper focuses on another crucial issue regarding socially responsible investing: the comparison of the performances between SRI and non-SRI funds. The empirical study suggests that the ethical objective can be pursued without having to renounce financial rewards.

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1. Introduction

Data envelopment analysis (DEA) can be used to define mutual fund performance measures that let us take into consideration several input variables, such as different risk measures and the initial and exit fees of the investment, as well as several output variables, such as a return indicator but also indicators related to other objectives of the investors (see e.g. Murthi et al. (1997) and Basso and Funari (2001)).

DEA models can also easily integrate non-financial objectives that drive the choices of investors who turn their attention to socially responsible investing (SRI). Actually, the market of socially responsible investment funds has seen a marked increase in the last decade both in the US and in Europe, while the traditional indicators used to evaluate the performance of mutual funds do not allow to take account of non-financial aspects, such as the ethical level of mutual funds. Along this line, Basso and Funari (2003) present some DEA models designed to evaluate the performance of SRI funds, which explicitly consider the ethical level of the mutual funds among the outputs.

In order to evaluate the performance of both SRI and non-SRI funds, we apply some special models which use the DEA technique.

Unlike much of the literature on mutual funds, in this contribution we propose to focus on what can be considered as the most crucial elements of an investment in mutual funds: the capital which is invested at the beginning of the holding period, the risk that has to be sustained, the final value which is withdrawn at the end of the holding period and a measure of the degree of social responsibility.

In order to compute the net final value of the investment, first of all we have to choose the initial capital and the holding period of the investment. Then we have to take into account the charges entailed by the investment in the mutual fund (initial or exit fees), which lower the overall profitability of the financial investment. Let the capital invested in the mutual funds, net of the initial fees, be the same for all funds (say equal to 1); this means that the payout required by fund j (with $j = 1, 2, \dots, n$, n being the number of mutual funds considered) is equal to

$$K_j = \frac{1}{1 - c_{Ej}} \quad j = 1, 2, \dots, n, \quad (1)$$

while the final value of the investment net of the exit fee can be computed as follows

$$M_j = (1 + R_j)^T (1 - c_{Ej}) \quad j = 1, 2, \dots, n, \quad (2)$$

where R_j denotes the mean rate of return of fund j in the holding period of length T considered, measured on an annual basis using

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the compound interest regime, and c_{ij} and c_{ej} denote the initial and exit charges required by the fund.

Note that $M_j \geq 0 \forall j$; this means that, using the final value as a measure of profitability in place of the mean return, we overcome the computational difficulties encountered in slump periods, in which the mean return is negative for many mutual funds. This is especially important in periods of financial crises, when the historical mean returns of most mutual funds are negative and the models that rely on mean returns are forced to resort to one of the devices suggested to deal with the problem of the presence of negative data in DEA models, that often complicate the interpretation of the DEA scores. For example, among the models which can be used in order to tackle the problem of negative output data in the DEA analysis we may cite the additive models, which are translation invariant (see Cooper et al. (2000), Ali and Seiford (1990) and Lovell and Pastor (1995)), the input oriented BCC model (see Chen and Lin (2006)), the range directional model proposed in Silva Portela et al. (2004) and the semi-oriented radial measure recently proposed in Emrouznejad et al. (2010), Lamb and Tee (2012) also propose a way to deal with negative risk measures.

As for the question of which DEA model is more suitable for the evaluation of the performance of SRI and non-SRI funds, we may wonder whether it is better to use a constant or a variable returns to scale model; for a discussion on the issue of returns to scale (RTS) in DEA we refer to Banker et al. (2011). In the literature both the CCR and the BCC models (see e.g. Cooper et al. (2000)) have been used to evaluate the performance of mutual funds, often without an explicit discussion of the motivations. On the one hand, the CCR model, which exhibits constant returns to scale (CRS), has the advantage of allowing for a generalization of well known financial performance indices such as the Sharpe ratio (see the pioneering contributions Murthi et al. (1997) and Basso and Funari (2001)). On the other hand, the BCC models are more flexible and allow to consider variable returns to scale (VRS) (see for example Glawischnig and Sommersguter-Reichmann (2010)); an empirical investigation of RTS in the mutual fund market is presented in Kerstens et al. (2011).

As for the orientation of the models, the contributions that use a BCC model to evaluate the performance of mutual funds tend to adopt an input orientation, because the BCC model with this orientation is translation invariant with respect to output variables, thus allowing to overcome the problem posed by the presence of negative mean returns. However, with our choice of variables, the problem of negative data is bypassed by construction, so that we are no longer bound in the choice of the model orientation. In our opinion, the model orientation which is more suitable for evaluating the performance of mutual funds is the output one, since the usual objective of investors is to maximize the value of the output variables (in our case, the final value of the investment and the ethical level of the fund) without increasing the value of the input variables (in our case, the initial payout and one or more risk measures).

The DEA models proposed are used to carry out an empirical investigation of European SRI equity funds in the period June 2006–June 2009. We test whether returns to scale are constant or variable and investigate both the degree of social responsibility of SRI funds in various European countries and their performance. To this end, we also present a method that evaluates the degree of social responsibility by taking the main ethical features into account.

Finally, we focus the attention on another crucial issue regarding socially responsible investing, long debated in the literature: the comparison of the performances between SRI and non-SRI funds. In particular, the empirical study tries to ascertain if the ethical aim has to be reached at the expense of financial rewards.

For more than two decades the literature have tried to compare the performance of socially responsible and non-socially responsible investments. Interestingly, most empirical studies find

that the performance of socially responsible funds is not statistically different from the performance of conventional mutual funds. Indeed, the first studies carried out, but also more recent analyses, do not find significant differences comparing the performance of SRI and non-SRI US mutual funds (Bauer et al., 2005; Bello, 2005; Hamilton et al., 1993; Statman, 2000). The same conclusion is reached for the performance of European funds (Bauer et al., 2005; Cortez et al., 2009; Kreander et al., 2002, 2005) and for funds of other countries (Bauer et al., 2007; Bauer et al., 2006); an analogous result is reported also for sovereign bonds (Drut, 2010). On the other hand, some empirical analysis on the performance of socially responsible investments show evidence that SRI portfolios exhibit a better performance than unscreened conventional investments (see Derwall et al. (2005) and Kempf and Osthoff (2007) for US stock portfolios, Fernandez-Izquierdo and Matallin-Saez (2008) for Spanish mutual funds), while there are also some empirical results supporting the opposite conclusion that SRI funds exhibit an inferior reward-to-risk performance (Bilbao-Terol et al., 2012; Chang and Witte, 2010).

The paper is organized as follows. In Section 2 we present three CRS DEA models that differ in the way the ethical objective is taken into account and the three corresponding VRS models. In Section 3 we study the relations that exist among the performance measures obtained with the different models. Section 4 defines the ethical measure proposed and Section 5 summarises the specific analysis of the degree of social responsibility of European SRI funds. The empirical results on the performance of European SRI funds are synthesized in Section 6, while Section 7 compares the performance of SRI and non-SRI mutual funds. Finally, Section 8 presents some conclusions.

2. Models with constant and variable returns to scale

In this section we present some DEA models with constant and variables RTS which can be adopted to analyse the performance of both SRI and non-SRI funds. We begin with the basic models without the ethical measure, which can be used to evaluate the performance of non-SRI funds. The VRS version will be used in Section 7 also to test if the SRI funds require a sacrifice in terms of financial returns.

For the basic notions on DEA models we refer the reader to the huge literature on the subject (see for example Cooper et al. (2000), Cooper et al. (2011) and, applied to a financial context, Gregoriou and Zhu (2005)).

2.1. DEA-C and DEA-V models

Let us denote by:

$\{1, 2, \dots, n\}$	the set of mutual funds considered
K_j	the initial payout invested in fund $j \in \{1, 2, \dots, n\}$
β_j	the β -coefficient of fund j (the ratio of the covariance between the fund and the market returns to the variance of the market return)
M_j	the final value for fund j
v_1	the weight assigned to the initial payout K_j
v_2	the weight assigned to the β -coefficient
u	the weight assigned to the final value M_j
ε	a non-Archimedean constant that prevents the weights from vanishing (see for example Cooper et al. (2000))

A CCR basic DEA model for the computation of the performance measure of mutual fund $o \in \{1, 2, \dots, n\}$ can be written as follows:

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