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Abstract

This thesis extends existing scientific knowledge about a still more popular investment concept commonly known as ‘socially responsible investing’. It consists of three separate yet highly interrelated studies. The first study investigates how far so called socially responsible investments differ from conventional investments in terms of particular indicators of social responsibility. Studying a relatively large sample of mutual funds it turns out that socially responsible investments do indeed surpass conventional investments with respect to all applied indicators. However, despite being statistically significant, the respective difference is found to be rather moderate in absolute terms. In fact, to a large extent both groups of funds tend to invest in companies with a comparable degree of social responsibility. In the second study, almost traditionally, the relation between social responsibility and financial performance is analyzed. However, instead of adhering to existing investment portfolios, the indicators introduced in the first study are used to construct portfolios of the most and least socially responsible companies. Then, financial performance of those portfolios is compared. Interestingly, both the most as well as the least socially responsible companies are found to achieve returns equal or even higher than the market. When compared to each other, the most socially responsible companies tend to be slightly outperformed by the least socially responsible companies. This result suggests that for individuals to invest in a socially responsible way social responsibility itself must increase their utility. Finally, in the third study, the costs of social responsibility are analyzed from the perspective of an investor with mean-variance preferences and perfect information about the probability distribution of future returns. Here, the investor selects his or her optimal investment portfolio from a set of portfolios, which do satisfy a particular social responsibility constraint, defined in terms of the indicators introduced in the first study. Strengthening that constraint, the resulting effect on financial performance of the optimal investment portfolio is investigated. Once again it turns out that when pursuing social responsibility investors must be ready to accept considerable drops in financial performance.

Introduction

Socially responsible investing has a long history. From the restrictions of unethical investment practices enacted by Jewish law in ancient times, through the moral principles applied by Methodists in the 18th century, until the boycotts of companies involved in unethical operations around the world, such as the provision of weapons for the Vietnam war in the 1970s or the support for the Apartheid regime in South Africa in the 1980s. Over the last few decades asset volume allocated in so called socially responsible investments (SRI) has increased substantially. Starting with \$ 40 billion at the beginning of the 1980s mostly in U.S. alone total assets under management allocated in form of SRI have grown to almost \$ 10 trillion in U.S. and Europe combined at the beginning of 2010. Overall, SRI have grown even faster than the rest of the market, so called conventional investments, thus increasing their market share as well. In the U.S., where the respective market share is the highest, currently almost one in nine dollars is invested in SRI. Nevertheless, there seems to be sufficient potential for even more growth in the future. Indeed, according to Geczy et al. (2003) referring to a poll conducted by the Opinion Research Corporation in 2001 “about 50 % of U.S. investors reported that they consider social criteria when making investment decisions”.

To this day no unique definition of socially responsible investing exists. Probably the most frequently used definition is the one introduced by Social Investment Forum defining socially responsible investing as “*an investment process that considers the social and environmental consequences of investments, both positive and negative, within the context of rigorous financial analysis*”. Alternatively, Waddock (2003) defines SRI as “*investments based on criteria other than simple return on investment*”. Similarly, Sheppers and Sethi (2003) call an investment a SRI if “*a non-financial screen, in addition to financial screens [is used] in order to exclude or target companies*”. Overall, obviously, the definitions are rather comprehensive. As a result, it is quite easy for an arbitrary investment to be called socially responsible.

With its increasing importance in recent decades socially responsible investing has attracted a lot of scientific attention. Typically, researchers have addressed the question whether SRI are able to provide financial performance similar to that of conventional investments. Starting with Moskowitz (1972) numerous studies have been conducted, analyzing different samples

for different time periods using different methodologies, finally leading to different results. With few exceptions all of the studies have analyzed existing investments, assuming that those are indeed socially responsible. Intuitively, the reasonability of such an assumption is rather questionable. With investors willing to give up a part of their return for social responsibility, and information asymmetries present, asset managers may readily pretend to pursue social responsibility rather than actually pursuing it. With stakes as high as they are, this type of behaviour may of course lead to large inefficiencies in resource allocation. Unfortunately, up to now it remains uncertain to what extent so called SRI actually differ from conventional investments in terms of some reasonable measures of social responsibility. As such research is virtually non-existent a serious knowledge gap tends to persist. In short, it is one of the main objectives of this thesis to start filling this gap. In addition, a lot of attention is also devoted to an almost traditional topic, which is the analysis of the relation between social responsibility and financial performance.

The thesis consists of three research studies. In the first study, based on existing social responsibility ratings particular indicators of social responsibility are developed. Then, using a large sample of equity mutual funds, socially responsible and conventional investments are compared with respect to those indicators. The second study addresses the rather traditional research question, exploring the relation between social responsibility and financial performance. In contrast to most earlier studies, however, it does not analyze existing investments. Instead, the indicators introduced in the first study are used to construct portfolios of most and least socially responsible companies. Then, financial performance of the respective portfolios is compared. Finally, in the third study, the effect of social responsibility on financial performance is addressed again, yet from a different perspective. In particular, costs of social responsibility are analyzed in a world, in which investors are perfectly informed about the probability distribution of future returns and rational enough to make optimal investment decisions. Overall, whether empirically or theoretically all three studies shed some additional light on the subject of socially responsible investing.

Chapter 1: How Much SR Do SRI Actually Deliver?¹

This study investigates how far, in terms of particular principles of social responsibility, so called socially responsible investments actually differ from conventional investments. First, particular indicators of social responsibility are introduced, based on specific information about existing socially responsible indexes. Then, achievement of single companies and consequently portfolios of companies with respect to those indicators is derived. Finally, resulting achievement values of socially responsible and conventional mutual funds are compared. With respect to all indicators a statistically significant difference in favor of socially responsible funds is observed. However, in absolute terms the difference turns out to be rather moderate. In fact, the majority of companies included in both types of funds tend to have comparable achievement with respect to the underlying indicators. This result clearly emphasizes the need for further research of this highly important yet poorly explored issue. It also indicates that, instead of relying on their label, evaluating the actual content of existing investments with respect to some well defined indicators of social responsibility may possibly enhance efficiency in resource allocation.

I. Introduction

According to the Social Investment Forum (SIF) socially responsible investing is defined as *“an investment process that considers the social and environmental consequences of investments, both positive and negative, within the context of rigorous financial analysis”*. Intuitively, referring to this rather imprecise definition it is relatively simple for an arbitrary investment to be called socially responsible. For example, consider an investment fund which excludes all companies with CO₂ emissions exceeding the industry average by at least five hundred percent from its investment portfolio. Admittedly, extensive CO₂ emissions do have both social as well as environmental consequences. Hence, the investment fund fits the above definition and it should therefore be classified as a socially responsible investment (SRI). In reality, of course, the actual portfolio holdings of the fund may hardly differ from those of an arbitrary conventional investment (CI). Unfortunately, such weak requirements may not be rare or exceptional. As environmentalist Paul Hawken states “the screening methodologies and exceptions employed by most SRI mutual funds allow practically any publicly-held corporation to be considered as an SRI portfolio company.” As a result, based on the above

¹ With minor revisions the study has been published in January 2011 under the title „How Much SR Is There In SRI?“ in *Schriftenreihe der Finance und Ethics Academy*, Band 4, pp. 100 – 128.

definition alone the difference in the actual portfolio holdings between SRI and CI may be negligible.

In reality, the distinction between a SRI and a CI is even less strict. Due to a lack of proper information it often remains undisclosed whether an investment process does actually consider social and environmental consequences or not. In practice, an investment is therefore often classified as a SRI based on what it is believed to do rather than on what it really does. In this regard, a crucial role seems to be attributed to the very description of the investment strategy. Referring to the above example, consider an investment fund defining its investment strategy by the following guideline: “Companies with CO₂ emissions exceeding the industry average by at least five hundred percent are excluded from the investment portfolio.” With a sufficient amount of confidence, obviously, the corresponding investment may be eventually classified as a SRI based on that statement alone. In this case, of course, it is even more questionable whether or to what extent the actual portfolio holdings of such an investment differ from those of an arbitrary CI. It is a possibility that some asset management companies (AMC) may just pretend to invest in a socially responsible way while not doing it at all. Like any other company, an AMC seeks to maximize its profit. In this regard, suppose on the one hand that labeling a particular investment as a SRI is expected to increase profit. On the other hand, suppose that investing according to the principles of SR stated in the investment strategy is expected to decrease profit. In such cases, obviously, the optimal investment strategy of an AMC should in fact be hypocritical: “Talk SRI, be CI!” In theory, behaving in a socially responsible way may be both profit increasing, e.g. McGuire et al. (1988) or Moir (2001), as well as profit decreasing, e.g. Cooper and Schlegelmilch (1993). A priori, none of the cases can really be excluded. Hence, there may in fact be SRI in the market which do only pretend to be socially responsible. Intuitively, this further strengthens the doubts raised above, related to the actual difference between SRI and CI.

Unfortunately, the problem is hardly mitigated by pertinent legislation. Except for general disclosure requirements with respect to the investment strategy imposed in some countries e.g. UK, Germany or Belgium, virtually no respective regulations exist. In general, the ethical aspects of the investment process of SRI are not regulated at all. Consequently, once an AMC denotes one of its investments as socially responsible the investment is basically treated as such. At most the AMC is required to disclose a description of the corresponding investment strategy. It stays unexplored, however, whether the principles stated in that strategy are

actually applied or not. More importantly, as no proper evaluation of the actual portfolio holdings exists, it is puzzling whether or to what extent do SRI actually differ from CI with respect to particular indicators of SR. In other words, it still remains a mystery whether SRI do really deserve their attractive label.

In this regard, it seems to be fully legitimate to ask the following questions: Do SRI actually have a higher achievement than CI with respect to particular indicators of SR? What is the actual magnitude of that extra achievement? This study attempts to answer these questions by exploring the exact content, i.e. the exact portfolio holdings, of investments. To be precise, first, particular indicators of SR of single companies are constructed, based on information from some of the existing corporate social responsibility (CSR) ratings. Then, those indicators are extended, in order to allow evaluation of investment portfolios. Finally, based on a relatively large sample of equity mutual funds the difference between SRI and CI with respect to the suggested indicators is analyzed.

In general, the economic rationale of such an analysis is quite obvious. Currently, around the world almost \$ 10 trillion are allocated in investments labeled as SRI.² Several investors may actually be willing to pay extra amounts because of that label alone. Hence, there is a serious need to look beyond the label and see how much it is actually worth. Of course, SR is a largely subjective issue. Different individuals may define SR differently, each pursuing a different set of SR criteria.³ Though whatever the exact set of SR criteria an individual might pursue, what matters is how well the actual content of an investment achieves those criteria. Hence, it is exactly that type of achievement which an individual needs to be informed about in order to make a correct investment decision. The label of an investment as such can in this regard be hardly considered a sufficient information source. To obtain proper information it is necessary to study the actual portfolio holdings. Indeed, this is what the underlying analysis actually does, as it investigates the actual content of investments with respect to particular indicators of SR. By doing so it may help to reduce possible information asymmetries, and hence decrease the potential for inefficiencies in resource allocation. Eventually, it may also motivate the introduction of standardized indicators of SR suitable to evaluate the actual

² See “Report on Socially Responsible Investing Trends in the United States 2010” by Social Investment Forum Foundation and “European SRI Study 2010” by Eurosif.

³ In general, the term “SR criterion” may denote any criterion with respect to which social or/and environmental consequences of an activity may be evaluated.

content of investments in general. In summary, the following analysis may have serious economic implications.

Interestingly, despite its importance the problem has hardly been addressed in academic literature so far. In fact, this study may eventually play a pioneering role in this regard. In existing research devoted to SRI the main focus seems to lie on financial performance. To be precise, most of the empirical studies seem to be concerned with the question whether or to what extent financial performance of SRI differs from that of CI. Essentially, the actual research object of those studies seems to be the relationship between financial performance and SR in general. This, however, is based on a simplistic assumption that somehow the actual content of SRI is indeed socially responsible. However, the relevance of such an assumption is rather questionable, since the actual achievement of investments with respect to particular indicators of SR has not yet been investigated. Nonetheless, the existing empirical studies have provided interesting results, with potential implications for the difference between SRI and CI. While only few have found evidence on SRI to be less, e.g. Vance (1975) or Gregory et al. (1997), or even more, e.g. Mahonney and Roberts (2002) or Derwall et al. (2005), profitable than CI, most, e.g. Hamilton et al. (1993), Sauer (1997), Kreander et al. (2006) or Schröder (2007), could not observe any statistically significant difference in the financial performance of SRI and CI at all. On one hand, this may truly imply that investing according to particular principles of SR does not reduce financial performance. On the other hand, however, it may also indicate that the principles applied by SRI hardly differ from those applied by CI, causing the actual portfolio holdings of the two to be nearly identical.

The rest of the study is organized as follows. In section II, particular indicators of SR based on information from several existing CSR ratings are developed. Section III presents a theoretical model suitable to compare the achievement of SRI and CI with respect to the suggested indicators. Consequently, a particular sample of socially responsible and conventional equity mutual funds is described. Then, in section IV, based on the methodology and data defined in section III the difference of SRI and CI is analyzed. Also, a brief interpretation of the results is provided. In addition, particular model variations are presented, in order to test robustness of the results. Finally, in section V, the study concludes, discussing potential implications for future research.

II. Indicators of Social Responsibility

A. General Discussion and Potential Information Sources

As already mentioned above, SR has a considerably subjective nature. Different individuals may consider different types of behavior to be socially responsible. As a result, there may be as many different definitions of SR as there are individuals. For SR to be measured according to each particular definition, a different indicator may be required, thus leaving the set of possible indicators comparably wide. Of course, in order to allow for a tractable analysis, certain generalization is unavoidable. More precisely, particular indicators of SR need to be selected.⁴

In recent years several reasonable indicators have been developed, such as the Environmental and Sustainable Value Added, see Figge and Hahn (2002), Social Return on Investment, see New Economics Foundation, or so called Social Footprint, see Center for Sustainable Innovation, just to name a few. There have also been particular international standards introduced, such as ISO14000 provided by the International Organization for Standardization (ISO) or SA8000 overseen by Social Accountability International (SAI). On demand such standards may be accredited to companies, which prove to satisfy the prescribed requirements. In addition, based on a promise to meet an exactly defined set of principles, for-profit as well as non-profit organizations are invited to join various platforms, such as the well known Global Compact run by the UNO or an alternative framework provided by the Global Sullivan Foundation.

Unfortunately, while all of the above indicators and frameworks do constitute valuable sources of information on SR, they are hardly suitable for the intended analysis. The reason for this is simple. In each case, information about only a relatively small number of companies is available. However, in order to evaluate investments, especially equity mutual funds, which are the main object of this analysis, information on thousands of companies is needed. There are indeed institutions, so called corporate social responsibility (CSR) rating agencies that deal with evaluation of hundreds and sometimes even thousands of companies

⁴ Further, the terms „indicator of SR“ and „indicator“ may be used interchangeably.

with respect to particular SR criteria.⁵ As a result, CSR rating agencies provide so called CSR ratings, sometimes referred to simply as “social ratings”. By doing so, as Chatterji et al. (2007) argue, “... social ratings aim to provide social investors accurate information that makes transparent the extent to which firms’ behaviors are socially responsible”.

Usually, information from CSR ratings can not be accessed directly but via so called SR indexes, provided by several securities index providers.⁶ As any other stock market index, each SR index measures the price changes of a particular portfolio of stocks. In contrast to other types of indexes, however, a SR index has an important special feature. In particular, the companies whose stock is included in the index portfolio are selected according to particular principles of SR. To be precise, in order to construct a SR index portfolio a universe of eligible companies is evaluated with respect to a set of SR criteria. For this purpose the index providers usually use information from particular CSR ratings. Finally, companies which do best fit the set of given SR criteria are selected, and thus become constituents of the SR index portfolio. In this respect, each SR index, especially the list of constituents of its eligible universe, the list of constituents of the index portfolio as well as the underlying selection methodology, may provide valuable information for the intended analysis. Intuitively, collecting this type of information about several SR indexes one may construct particular indicators of SR suitable to evaluate a considerable number of companies. When slightly extended, the same indicators may then be applied to evaluate portfolios of the very same companies.

The primary information source for further analysis is the set of SR indexes listed in table 1. In aggregate, 9212 companies are eligible for at least one index from table 1.⁷ Of course, some companies may be eligible for several indexes. Overall, 2059 companies are included in at least one index from table 1. Again, of course, some companies may be included in several indexes. Intuitively, the selection methodologies, in particular the SR criteria applied for the evaluation of companies, may differ among indexes. The list of SR criteria considered in the selection methodology of each particular index is reported in table 1. A brief description of

⁵ Currently, there are a few dozens of CSR rating agencies around the world, e.g. KLD Research & Analytics, Oekom Research, etc.

⁶ Some of the most famous SR indexes are for example the traditional Domini 400 Index, indexes from the FTSE4Good or the DJSI family, just to name a few.

⁷ For convenience, further, the term „SR index portfolio“ may be referred to simply as „index“. Furthermore, a company is referred to as „eligible for an index“ if and only if it is included in the eligible universe of that index.

each SR criterion, including a list of possible sub-criteria, is provided in table 2.⁸ In summary, 11 negative and 5 positive SR criteria are considered.⁹

Consequently, particular indicators of SR are suggested based exclusively on information about the indexes listed in table 1. First, the indicators are designed to evaluate the achievement of single companies. Then, in order to allow for an analysis of portfolios of companies, the indicators are extended accordingly.¹⁰

B. Defining Particular Indicators of SR

Suppose that the set of all indexes used as an information source is denoted by J .¹¹ Furthermore, suppose that the set of all criteria considered in the selection of constituents for at least one index from set J is denoted by C .¹² Basically, for each $j, j \in J$, a set of companies E_j , so called eligible universe of index j , is screened with respect to a set of criteria C_j , $C_j \subseteq C$. As a result, a set of companies $I_j, I_j \subseteq E_j$, is selected to constitute index j . In general, E_j, I_j and C_j are the only information available about index j used in the analysis. For notation purposes, the overall information set, $\{E_j, I_j, C_j\}$, is further denoted by $\mathfrak{I}_j$.

By intuition, $\mathfrak{I}_j$ allows to make simple statements about each company i eligible for index j , i.e. $i \in E_j$. Basically, if company i is included in index j , i.e. $i \in I_j$, it is considered “socially responsible” according to the definition of SR applied in index j , i.e. with respect to the set of criteria C_j .¹³ In contrast, each company i eligible for yet not included in index j , i.e. $i \in E_j \wedge i \notin I_j$, is considered “not socially responsible” according to the very same definition

⁸ A SR criterion is contained in the list if it is considered in the selection methodology of at least one index from table 1. For simplicity, some of the [too specific] SR criteria have been aggregated into groups creating a more general SR criterion.

⁹ For convenience, further, the terms „SR criterion“ and „criterion“ may be used interchangeably. Whenever the term „criterion“ should have a meaning other than „SR criterion“ it is noted accordingly.

¹⁰ Further, if not stated differently, the term “portfolio” always denotes a portfolio of companies, more precisely, a portfolio of stock of companies.

¹¹ In general, J may represent an arbitrary set of indexes. For further analysis, however, J refers to the set of indexes listed in table 1.

¹² In accordance with footnote 8, for further analysis C refers to the set of criteria listed in table 2.

¹³ Note that more precisely the term “definition of SR applied in index j ” denotes the definition of SR based on which constituents for index j are selected.

of SR.¹⁴ In general, deriving equivalent statements based on information about all indexes included in set J various indicators of SR may be constructed. Consequently, four particular indicators are suggested.¹⁵

First, for notation purposes two binary variables, e_{ij} and x_{ij} , are introduced. The former is defined as $e_{ij} = 1 \Leftrightarrow i \in E_j$, and hence it measures whether company i is eligible for index j or not. Similarly, the latter is defined as $x_{ij} = 1 \Leftrightarrow i \in I_j$, and hence it measures whether company i is included in index j or not. Furthermore, for convenience reasons e_i and x_i are introduced, measuring the number of indexes from set J , for which company i is eligible and in which company i is included respectively. Formally

$$e_i \equiv \sum_{j \in J} e_{ij} \quad \text{and} \quad x_i \equiv \sum_{j \in J} x_{ij}$$

The first indicator of SR, also referred to as “indicator I”, is designed to measure whether a company is included in at least one index from set J or not. In accordance with the notation introduced above, the achievement of company i with respect to indicator I, denoted by a_i^I , can formally be expressed as¹⁶

$$a_i^I = \min(1, x_i) \quad \forall i : e_i > 0 \quad (1)$$

¹⁴ Note that, unfortunately, as C_j may include two or more criteria, based on $\mathfrak{S}_j$ alone one can not make exact statements about the achievement of company i with respect to a single criterion k , $k \in C_j$. In consequence, if based on $\mathfrak{S}_j$ all statements made about a particular company do always relate to the definition of SR represented by the entire set of criteria C_j . Also note that according to the above statements all companies included in index j and, equivalently, all companies eligible for yet not included in index j are treated equally. Although this may seem as a very simplistic view, it is consistent with the way how companies included in an index are actually treated in reality. In fact, SR indexes are weighted either equally or by market capitalization, hence independent on how well the constituent companies achieve the imposed SR criteria. By doing so, the index providers do actually manifest that all of the constituent companies can be considered as having comparable achievement with respect to those criteria.

¹⁵ In all four cases, each definition of SR applied in any index from set J is treated as equally relevant. Hence, in a sense, all indicators relate to a collective definition of SR, in which each set of criteria C_j , $\forall j \in J$, takes an equal weight.

¹⁶ Note that a_i^I is only defined for companies eligible for at least one index from set J . In fact, about any other company there is no information available at all. Therefore, reasonably, all other companies must be excluded from the evaluation. This is also true for all indicators suggested further.

Obviously, indicator I is highly simplistic, dividing companies in two different categories only. Of course, based alone on a_i^I one cannot exactly distinguish in how many indexes company i is actually included. Also, a_i^I does not account for the exact number of cases where company i is eligible for yet not included in an index. As a result, in terms of indicator I companies included in a high number of indexes as well as companies eligible for only a small number of indexes may be relatively disadvantaged.¹⁷

To mitigate this problem an alternative indicator is suggested. In particular, denoted as “indicator II”, it determines in what percentile of indexes for which a company is eligible it is actually included. Hence, the achievement of company i with respect to indicator II, denoted by a_i^{II} , is formally defined as

$$a_i^{II} = \frac{x_i}{e_i} \quad \forall i : e_i > 0 \quad (2)$$

Obviously, in comparison to indicator I indicator II allows a more flexible evaluation. Also, as a_i^{II} does account for both x_i and e_i it has a weaker tendency to favor or disfavor particular companies. Yet, although being less probable and eventually less serious, some cases of discrimination may still occur. For better illustration, consider two companies i and i' such that $e_i > e_{i'}$. Now, imagine the following two cases. First, each company is included in all indexes for which it is eligible, i.e. $x_i = e_i \wedge x_{i'} = e_{i'}$. Second, each company is included in no index at all, i.e. $x_i = x_{i'} = 0$. Obviously, in terms of indicator II in each case both companies are evaluated equally. As a result, in the first case company i and in the second case company i' is slightly disadvantaged.

As an alternative, a third indicator of SR is constructed. In particular, among all indexes for which a company is eligible it is assigned a value of [+1] for each case when it is included in an index and a value of [-1] for each case when it is not included in an index. In consequence, the sum of all corresponding values is what constitutes “indicator III”. Formally, the achievement of company i with respect to indicator III, denoted by a_i^{III} , can be expressed as

¹⁷ For example, a company included in ten indexes would be graded equally as a company included in only one index. Also, a company eligible for ten indexes and not included in any of them would be graded equally as a company eligible for and not included in only one index.

$$a_i^{III} = x_i - (e_i - x_i) = 2x_i - e_i \quad \forall i : e_i > 0 \quad (3)$$

In contrast to a_i^{II} , in case of a_i^{III} the marginal impact of being or not being included in an additional index is constant and not decreasing in e_i . As a result, indicator III seems to treat companies eligible for different numbers of indexes more evenly than indicators I and II.

A majority of the indexes do not impose an absolute but rather a relative evaluation of the eligible companies, an approach often called “best-in-class”. Accordingly, it may be easier for a company to be included in an index with a relatively large number of constituents and/or a relatively small eligible universe. In other words, the ratio between the size of an index and the size of its eligible universe may indicate whether it is more or less easy for an arbitrary company to be included in that index. In order to account for this property, in addition, a fourth indicator is suggested. As already noted above, whenever a company is eligible for an index it is actually compared with all other companies in the eligible universe with respect to the underlying selection criteria. Depending on whether the company is included in the index or not, one may determine what percentile of the eligible companies it does in expectation surpass with respect to those criteria.¹⁸ In consequence, “indicator IV” is given as an average of the corresponding values computed among all indexes for which the company is eligible. Formally, the achievement of company i with respect to indicator IV, denoted by a_i^{IV} , is defined as

$$a_i^{IV} = \frac{1}{e_i} \sum_{j \in J \wedge e_{ij}=1} x_{ij} \frac{1+\theta_j}{2} + (1-x_{ij}) \frac{\theta_j}{2} \quad \forall i : e_i > 0 \quad \text{where} \quad \theta_j \equiv 1 - \frac{|I_j|}{|E_j|} \quad (4)$$

Verbally, θ_j simply determines what percentile of all companies eligible for index j is not included in index j . In other words, it measures the percentile of companies which are, according to the set of criteria C_j , less socially responsible than any company included in index j . Alternatively, after a few algebraic steps a_i^{IV} may be rewritten as

¹⁸ In order to derive the corresponding value it is assumed here that the actual achievement of all companies in the eligible universe is uniformly distributed. For example, suppose 10 % of the companies eligible for a particular index are actually selected for the index. In such case, if a company is included in the index on average it is assumed to surpass $(90 \% + 100 \%) / 2 = 95 \%$ of the eligible companies. If it is not included in the index on average it is assumed to surpass $(0 \% + 90 \%) / 2 = 45 \%$ of the eligible companies.

$$a_i^{IV} = \frac{1}{2}(a_i^{II} + \psi_i) \quad \text{where} \quad \psi_i \equiv \frac{1}{e_i} \sum_{j \in J \wedge e_{ij}=1} \theta_j \quad (5)$$

From equation (5) it is obvious that a_i^{IV} is equivalent to a_i^{II} plus some sort of a correction term ψ_i . Obviously, ψ_i is defined as the average value of θ_j among all indexes for which company i is eligible. In a sense, it actually captures whether company i is on average confronted with a more or less intense competition during the selection process for an index.¹⁹ Reasonably, ψ_i has an increasing effect on a_i^{IV} . Indeed, with higher competition one would expect that company i has to meet higher requirements in order to be included in an index.²⁰

In general, indicators I, II, III and IV are designed to evaluate the achievement of an arbitrary company eligible for at least one index from set J . In order to evaluate the achievement of a particular portfolio of companies, basically, the corresponding values of all companies included in the portfolio need to be aggregated. In consequence, the values are aggregated in two different ways. In both cases, the achievement of the portfolio is derived as a weighted sum of the achievement values of all relevant companies.²¹ In each case, however, different weights are used. First, the weighting is based on the actual portfolio holdings. Second, alternatively, each company is attributed an equal weight. Further, the two aggregation methods may be referred to as “actual weighting” and “equal weighting” respectively. By intuition, both yield the achievement of a typical monetary unit and a typical company included in a portfolio respectively.²²

In order to formally express the achievement of portfolio ω with respect to indicators I, II, III and IV, some additional notation needs to be introduced. The set of companies included in portfolio ω is denoted by N_ω . Furthermore, the set of companies included in portfolio ω and at the same time eligible for at least one index from set J is denoted by N_ω^e , i.e.

¹⁹ To be precise, a_i^{IV} would have to be interpreted as the average of a_i^{II} and ψ_i instead of as a sum of the two terms. However, note that multiplication by a positive constant has no effect on a relative comparison of two expressions.

²⁰ Note that none of the indicators I, II, III and IV strictly dominates the remaining ones. Rather they can be considered as some kind of complements each being differently related to potential sources of bias. Of course, as each of the indicators is characterized by a different definition it must also be interpreted differently.

²¹ This seems to be fully reasonable as each portfolio is actually a linear combination of stocks.

²² Note that, as already mentioned above, companies not eligible for any index from set J are excluded from the evaluation. In consequence, when deriving the achievement of a particular portfolio, only companies eligible for at least one index from set J are considered in the aggregation. The corresponding weights are adjusted accordingly.

$i \in N_\omega^e \Leftrightarrow i \in N_\omega \wedge e_i \geq 1$. Finally, the weight of company i in portfolio ω is denoted by $\gamma_{i\omega}$.²³ In consequence, using either actual or equal weighting, the achievement of portfolio ω with respect to indicators I, II, III, and IV, denoted by a_ω^I , a_ω^{II} , a_ω^{III} and a_ω^{IV} respectively, can formally be expressed as

$$a_\omega^z = \frac{1}{\Gamma_\omega} \sum_{i \in N_\omega^e} \gamma_{i\omega} a_i^z \quad \text{or alternatively} \quad a_\omega^z = \frac{1}{|N_\omega^e|} \sum_{i \in N_\omega^e} a_i^z \quad (6)$$

where $z \in \{I, II, III, IV\}$ and the terms Γ_ω and $|N_\omega^e|$ are defined as

$$\Gamma_\omega = \sum_{i \in N_\omega} \gamma_{i\omega} \min(1, e_i) \quad \text{and} \quad |N_\omega^e| = \sum_{i \in N_\omega} \min(1, e_i) \quad (7)$$

Obviously, Γ_ω and $|N_\omega^e|$ respectively measure the total weight and number of companies included in portfolio ω which are eligible for at least one index from set J .²⁴ Since companies not eligible for any index are ignored, the original weights have to be normalized by Γ_ω . Equivalently, in case of equal weighting, normalizing with $|N_\omega^e|$ is required.

III. Methodology and Data

A. Model

The aim of the analysis is to compare the achievement of SRI and CI with respect to indicators I, II, III and IV, further referred to simply as “SR achievement”.²⁵ Probably the easiest way to do it would be to perform respective statistical tests for the difference of means. Alternatively, one may regress SR achievement of investments on a dummy variable set up to distinguish whether an investment is a SRI or a CI. Of course, in reality SR achievement of an

²³ Note that $\gamma_{i\omega} = 0 \Leftrightarrow i \notin N_\omega$.

²⁴ Note that each company i with $e_i = 0$ is excluded from the evaluation of portfolio ω .

²⁵ To be precise, the term “SR achievement” of an investment generally denotes the achievement of that investment with respect to one of the indicators I, II, III or IV.

investment may be influenced by several factors.²⁶ In this regard, the latter approach dominates the former, as it enables to control for other factors as well. Hence, in consequence, the latter approach is preferred.

In order to distinguish whether investment ω is classified as a SRI or a CI, a dummy variable, denoted by s_ω , is introduced. Formally, s_ω is defined as

$$s_\omega \equiv \begin{cases} 1 & \omega \in S \\ 0 & \omega \notin S \end{cases} \quad (8)$$

where S denotes the set of all investments classified as SRI. Further, s_ω may be referred to as “SR category” of investment ω .

In general, the relation between SR achievement, SR category and other potential factors may be expressed in terms of the following model

$$a_\omega = \beta_0 + \beta s_\omega + \sum_{r=1}^m \beta_r f_{r\omega} + \varepsilon_\omega \quad \text{where} \quad a_\omega \in \{a_\omega^I, a_\omega^{II}, a_\omega^{III}, a_\omega^{IV}\} \quad (9)$$

where $f_{r\omega}$ denotes the value of investment ω with respect to factor r , $r \in \{1, \dots, m\}$.²⁷

Intuitively, in order to answer the underlying research question the actual properties of β need to be investigated. In consequence, using a particular sample of investments described further in subsection B and referring to a set of factors (control variables) defined further in subsection C, the regression coefficients of the above model are estimated.²⁸ As a result, the null hypothesis, $H_0 : \beta = 0$, is tested against the alternative, $H_1 : \beta > 0$. Also, the actual magnitude of β is discussed.

²⁶ Possible factors may be for example particular characteristics of an investment such as investment volume, number of companies included in the investment portfolio, geographical investment strategy etc.

²⁷ Note that in general investment ω may refer to an arbitrary portfolio of companies.

²⁸ The actual set of control variables is defined in subsection C.

B. Data

The initial sample consists of all equity mutual funds with European domicile included in the database of software-systems.at as of 31.03.2009.²⁹ It includes 9609 funds with total net assets of € 473.5 bn, which corresponds to approx. 43 % of the European equity mutual fund market.³⁰ In particular, there are 363 and 9246 socially responsible and conventional funds respectively.³¹ Since software-systems.at specializes on SRI data, the relative market coverage of socially responsible funds included in the database may slightly exceed their relative share among all equity mutual funds in the market. With € 13,4 bn of net assets socially responsible funds account for approx. 2,8 % of the database. In comparison, in 2006 SRI made up 1,5 % of the European equity mutual fund market. However, their relative importance may have increased since then, as the recent trend suggests.³² Unfortunately, the exact numbers as of March 2009 are not available, thus a reliable comparison of the data coverage is not possible. Nevertheless, the sample seems to be large enough, in order to allow for a reliable analysis of the European equity mutual fund market.

Due to some undesirable properties the initial sample requires certain filtering. In particular, some of the funds are present multiple times in form of different classes. To eliminate this duplicity for each fund with n , $n > 1$, classes included in the sample, the auxiliary $n - 1$ classes are excluded. Doing this at the primary level a fund class with higher asset volume is preferred to one with lower volume. Furthermore, in case of equal asset volume, at the secondary level a fund class with an earlier launch date is preferred. If two classes of the same fund are identical with respect to both criteria the selection is carried out randomly. In addition, each fund with incomplete information about its portfolio holdings as well as each fund investing less than 50 % of its volume in common stock is also excluded.³³

The resulting sample indicates considerable differences between socially responsible and conventional funds with respect to the investment strategy, especially in terms of geographical region and industry segment. In particular, while 98 % of funds in the former group use either

²⁹ software-systems.at is a provider of investment fund data located in Diex, Austria.

³⁰ According to the Quarterly Statistical Release of EFAMA (May 2009) total net assets managed in equity mutual funds with European domicile was € 1.097 bn as on 31.03.2009. Note that further the terms “equity mutual fund” and “fund” are used interchangeably.

³¹ A particular fund is referred to as socially responsible if it is labeled that way by the corresponding asset management company. Otherwise, it is referred to as conventional.

³² See Feruz, Marco and Ortiz (2007) and the Quarterly Statistical Release of EFAMA (May 2009)

³³ The reason for such exclusions is quite obvious. In fact, it is the actual portfolio holdings of company stock which are the solely object of further analysis.

a global investment strategy or restrict their portfolio only to European stocks, most funds in the latter group use some other regional investment strategy.³⁴ Furthermore, while none of the funds in the former group is specialized in one particular industry segment, this is true for almost one in three funds in the latter group.³⁵ Intuitively, differences of this kind may have a considerable influence on further analysis, requiring the introduction of several control variables. To address this problem one may possibly attempt to align the two groups of funds ex ante. In particular, referring to the relative size of both groups it is reasonable to filter the latter such that it will finally match the characteristics of the former more properly. In consequence, all funds using other than a global or a European investment strategy as well as all funds specialized in one particular industry segment are excluded. As a result, the final sample contains 108 and 789 socially responsible and conventional funds respectively.³⁶

C. Control Variables

In general, several factors other than SR category may be related to SR achievement. Such factors, if not accounted for accordingly, may considerably distort the analysis. In order to isolate potential distortions, two types of control variables are considered. First, particular fund characteristics with potential influence on SR achievement and, second, technical variables related to the formal definition of indicators I, II, III and IV. The former group includes the following variables: geographical strategy of a fund, fund age, fund volume, minimum investment requirement and fund domicile. The latter consists of the following control variables: weight of a fund invested in companies, which are eligible for at least one index from table 1, the average number of indexes, for which a typical company included in a fund is eligible and finally the total number of companies included in a fund. In consequence,

³⁴ A fund is referred to as regionally specialized in a particular country if stocks of companies of that particular country account for more than 90 % of its asset holdings. Similarly, a fund is referred to as regionally specialized in a particular continent if stocks of companies of that particular continent account for more than 90 % of its asset holdings. Furthermore, a fund is considered to use a global investment strategy if it is regionally specialized neither in a particular country nor in a particular continent.

³⁵ A fund is considered to be specialized in a particular industry segment if stocks of companies of that particular industry segment account for more than 90 % of the fund's asset holdings. The list of industry segments actually considered, corresponding to the first-level branch segmentation of the software-systems.at database, is depicted in table 3. Accordingly, each company is categorized in one particular industry segment based on the activity of its primary focus. Detailed information about the exact subcategories of the main industry segments listed in table 3 or further methodological issues can be provided on demand.

³⁶ The numbers of socially responsible funds in the sample considering a particular SR criterion are depicted in the penultimate column of table 2. In addition, the final column of table 2 contains the relative importance for each criterion as it is on average considered among all 108 socially responsible funds in the sample, derived from the values of the preceding column. Obviously, the resulting distribution of relative importance among SR criteria is nearly identical to that derived for the set of indexes listed in table 1. This considerably justifies the suitability of indicators I, II, III and IV to evaluate the achievement of funds included in the sample.

the intuition behind introducing each of the control variables is briefly discussed, along with a proper specification.

Of course, a fund's investment strategy sets constraints on the feasible set of companies in which the fund may invest. In this regard, the strategy applied with respect to the geographical region is not an exception. To control for it, a dummy variable is defined to have a value of 0 if a global strategy is applied, i.e. if the geographical region of a fund is not restricted at all, and a value of 1 if it is restricted to only European stocks. As none of the funds in the sample ex ante limits its investment portfolio to particular industry segments, no control variable is needed in this regard. The age of a fund may be a good proxy measure for experience and information availability. As a result, it may substantially affect the ability of fund managers to evaluate companies. The marginal impact of age on experience is considered to be falling with time. Hence, instead of the age itself, defined as the time elapsed from a fund's launch date until 31.03.2009 in years, its natural logarithm is used as a corresponding control variable. Similar effects may be induced by the amount of resources available. Being a reasonable proxy in this respect, fund volume in millions of EUR is employed as an additional control variable. Due to identical reasons as in case of fund age a logarithmic form is preferred.³⁷ Furthermore, the awareness and abilities of investors may influence the actual portfolio selection of fund managers. In this regard, based on the minimum investment amount required from a single investor one may distinguish whether a fund is available to broad public or institutional investors only. In consequence, a dummy variable is defined to have a value of 0 if the minimum investment requirement does not exceed 10.000 EUR and 1 otherwise. Finally, different legislative rules may influence the portfolio selection of a fund. To control for this effect, a dummy variable is introduced for each country serving as a domicile for at least 30 funds included in the sample.³⁸ Referring to the formal definition of indicators I, II, III and IV the intuition behind introducing the remaining control variables should be self evident.³⁹

For the final sample described in subsection B descriptive statistics, in particular mean, median, standard deviation, minimum and maximum, of all control variables are provided in table 4. Similarly, table 5 offers a separate view for both socially responsible and

³⁷ In robustness tests, alternatively, both fund age as well as fund volume are considered directly, i.e. not in form of natural logarithms.

³⁸ In aggregate, there are five countries which do satisfy this condition, in particular, Austria, Belgium, Germany, Ireland and Luxemburg.

³⁹ Note that the formal definitions of the remaining control variables have already been provided above.

conventional funds. In addition, descriptive statistics on SR achievement with respect to indicators I, II, III and IV, derived by actual and equal weighting respectively, is provided in tables 6a and 6b. Finally, for actual weighting figures 1 to 4 depict the corresponding sample distributions.⁴⁰

IV. Results

The analysis is based on the methodology described in section III.A, in particular the theoretical model defined by equation (9). For this purpose, all socially responsible and conventional funds in the sample are treated as SRI and CI respectively.⁴¹ As the dependent variable SR achievement with respect to indicators I, II, III and IV, derived by both actual and equal weighting, is used. Accordingly, eight different cases are considered. Initially, no control variables are taken into account, i.e. SR achievement is regressed on SR category alone. The method of ordinary least squares (OLS) is used to estimate the regression coefficients. In fact, this is equivalent to a simple statistical test for the difference of mean SR achievement between SRI and CI. The results for all eight cases are reported in table 7. Of course, in each case the coefficient of SR category corresponds to the difference in mean SR achievement between SRI and CI reported earlier in tables 6a and 6b.⁴² Obviously, referring to the resulting p-values, that difference in fact turns out to be highly statistically significant. However, as already mentioned above, much of that difference may eventually be attributable to factors other than SR category. In addition, the relatively low R-squared values suggest that there is a high potential for SR achievement to be related to factors not considered so far, which may considerably distort the results.

Hence, in order to isolate some of the eventual distortions, consequently, particular control variables as defined in section III.C are considered. To be precise, for each of the eight cases

⁴⁰ Since the distribution of SR achievement among funds using equal weighting is almost identical, its depiction is omitted. Referring to figures 1 to 4, note that in the final sample socially responsible funds seem to show a somewhat higher SR achievement than conventional funds. Nevertheless, the actual difference seems to be relatively limited. Indeed, interestingly, referring to figures 1 to 4 many conventional (socially responsible) funds in the sample are characterized by a higher (lower) SR achievement than particular socially responsible (conventional) funds.

⁴¹ To be precise, referring to the methodology defined in section III.A, if fund ω is denoted as socially responsible then $\omega \in S$. Otherwise, $\omega \notin S$.

⁴² Also note that the constant term in each regression simply corresponds to mean SR achievement of CI with respect to the applied indicator.

the set of control variables is chosen in accordance with the Akaike criterion.⁴³ In consequence, once again, the OLS method is applied to derive the corresponding regression coefficients. The results are reported in table 8. Obviously, R-squared increases substantially indicating that a considerable part of the variations of SR achievement may be possibly attributed to changes in the explanatory variables. Although not reported in detail, for each regression a Kolmogorov-Smirnov test for normality of the residuals is performed. With p-values varying from 0.003 to 0.170 in some of the cases normality is rejected while in others it is not. However, as most of the dependent variables have a bounded domain deviations from normality of that extent are not particularly surprising.⁴⁴

Obviously, the coefficients for most of the control variables are statistically significant. *Ceteris paribus*, an investment restricted to European stocks has in expectation a somewhat higher SR achievement than one with a global investment strategy. In this regard, European companies seem to slightly surpass the world average. Similarly, in expectation SR achievement of larger investments does to some extent exceed that of smaller ones. Also, investments available to broad public are more likely to have a somewhat higher SR achievement. Furthermore, in each case considered at least one of the five domicile dummies is significant. *Ceteris paribus*, German investments have in expectation a slightly lower SR achievement than the rest. Interestingly, the opposite is true for Austrian investments. In absolute terms, however, expected SR achievement varies only modestly among different values of the above factors. Finally, the technical control variables behave more or less as expected. Not surprisingly, in most cases the corresponding regression coefficients are highly significant.

Turning to the main variable of interest, i.e. SR category, the preliminary results, derived with no control variables, are more or less affirmed. Obviously, whatever indicator used, the coefficient of SR category is different from zero with an overwhelming statistical significance. In particular, even in the least significant case the corresponding p-value lies somewhere around $4 \cdot 10^{-34}$.⁴⁵ Hence, the hypothesis that in expectation SR achievement of SRI and CI is equal can be easily rejected. To be precise, in terms of all four indicators,

⁴³ To be precise, for each case a model with an optimal set of control variables is selected. For this purpose, models with all possible combinations of control variables defined in section III.C are compared with respect to the Akaike criterion.

⁴⁴ To control for such deviations in robustness tests the actual empirical distributions of the residuals are used, in order to test statistical significance of SR category more properly.

⁴⁵ Note that the significance is even much higher than in the preliminary case, when it amounted to approx. $2 \cdot 10^{-8}$.

derived by both actual as well as equal weighting, SRI are actually found to have a higher SR achievement than CI. The size of that extra achievement differs only slightly from that derived in the preliminary case, with no control variables considered. Referring to the exact definitions of indicators I, II, III and IV, the obtained results can be summarized as follows.⁴⁶ First, in comparison to a CI, the weight of a SRI invested in companies which are included in at least one index from table 1 is in expectation 10.3 percentage points higher. Second, when both a typical company included in a SRI and a CI respectively are eligible for a particular set of indexes the former is included in an index in additional 11.7 percent of the cases.⁴⁷ Third, on average the former company is included in 0.643 more indexes than the latter.⁴⁸ Fourth, when compared with other eligible companies with respect to a typical set of SR criteria, the expected percentile of companies surpassed by the former company is 4.3 percentage points higher than that surpassed by the latter. For better illustration, besides the difference it may be useful to view mean SR achievement for both SRI and CI separately, adjusted for the considered control variables. The corresponding values are depicted in the last two rows of table 8.⁴⁹

Overall, the obtained results clearly demonstrate that there really is a difference between SRI and CI in terms of SR achievement. However, expressed solely in terms of the original units of measurement and without an appropriate scale, it is hard to see the actual magnitude of that difference. To cope with this problem, consequently, a particular scale is defined. To be precise, for each indicator two artificial portfolios, one with a minimum and one with a maximum SR achievement, are constructed. For this purpose, all 9212 companies eligible for at least one index from table 1 are used. Each portfolio is constructed as an equally weighted portfolio of 133 companies with the lowest and highest SR achievement respectively.⁵⁰ Finally, the scale is defined as the distance between the SR achievement values of the

⁴⁶ Note that the subsequent interpretation refers exclusively to the results derived by actual weighting as depicted in table 8. Although omitted here, similar statements may be made when referring to the results derived by equal weighting. As it is obvious from table 8, however, the results for actual and equal weighting are almost identical.

⁴⁷ Note that a “typical company” included in an investment portfolio is said to have the same characteristics as the company which one would obtain in expectation if picking randomly among all companies included in that investment portfolio, provided that the probability of each company to be picked would be equal to its portfolio weight.

⁴⁸ Note that this comparison is based on the fact that on average a typical company included in an investment portfolio is eligible for 5.651 indexes. Also note that in order to derive the value of 0.643 the respective regression coefficient had to be divided by 2, since turning from not being to being included in an index would in fact increase SR achievement of the respective company with respect to indicator III by 2.

⁴⁹ In order to derive the adjusted values, for both SRI and CI each control variable is set to its sample mean. Being identical with respect to all controls, the resulting values are directly comparable. Of course, for each model their difference is equal to the corresponding coefficient of SR category. Note that after being adjusted for all controls the values do only slightly differ from the original values reported in tables 6a and 6b.

⁵⁰ Note that 133 is the average number of companies included in a sample fund.

respective portfolios, minimum and maximum. In reference to that particular scale an additional view at the obtained results can be provided. In particular, with respect to indicators I, II, III and IV respectively, expressed in percentage of the predefined scale, it finally turns out that if mean SR achievement of SRI was diminished by 8.92 %, 10.77 %, 13.34 % and 6.19 % or more the difference between SRI and CI would no longer be statistically significant.⁵¹

Of course, it is neither the aim nor the competence of this study to judge whether a difference of such a magnitude is small or large. This is preferably left to the reader. In the author's opinion, however, the difference is small enough to deserve further attention. In fact, with respect to all indicators used, the results clearly indicate that SRI and CI are far from being viewed as two opposite ends of a hypothetic scale of SR. In fact, a lot of what may be called "socially responsible" seems to be included in a typical CI, and similarly, a lot of what may be called "conventional" seems to be included in a typical SRI. In this respect, the obtained results highlight the need to study the actual content of investments if one has the objective to make proper investment decisions.

Finally, to test robustness of the results several model variations are performed. In particular, each of the models is run with all control variables included, not just those optimal with respect to the Akaike criterion. As the results turn out to be nearly identical for all variables of interest, they are not reported here. Also, alternatively, fund volume and fund age are considered in their pure form, not as logarithms, again with a negligible influence on the results. Furthermore, the potential of the residuals to deviate from normality is addressed. In particular, for each model the actual empirical distribution of the residuals is used to test whether the coefficient of SR category is equal to zero. With 10.000 simulations each the corresponding p-values turn out to be markedly below the usual significance levels. Hence, the original results are affirmed even if residuals are not assumed to be normally distributed. In addition, as an alternative, the analysis is conducted multiple times with a slightly modified definition of SR each. Especially, instead of the entire set of indexes J particular subsets of J are used to define indicators I, II, III and IV.⁵² In all cases, despite minor differences the main

⁵¹ The values are derived as an arithmetic average of the corresponding amounts determined for 10 %, 5 % and 1 % significance level, one-tailed.

⁵² To be precise, in each case set J is substituted by a subset J_k , while a particular index j is part of subset J_k if and only if criterion k is considered in the selection of constituents for index j , i.e. $j \in J_k \Leftrightarrow k \in C_j$. With major focus on criterion k , accordingly, only those socially responsible funds in the sample which do consider criterion

properties of the original results are confirmed. In summary, the results seem to be sufficiently robust to all conducted variations.

V. Conclusion

In practice, an investment may be called socially responsible based on almost no requirements. As a result, serious doubts can be raised about whether or to what extent so called SRI have a higher achievement than their conventional counterparts with respect to particular principles of social responsibility (SR). As no appropriate evaluation of the actual portfolio holdings exists, at present the answer remains considerably blurred. Unfortunately, academic research seems to have ignored the issue so far. This pioneering study has analyzed the difference between SRI and CI with respect to particular indicators of SR, based on information from a particular set of existing CSR ratings.

With respect to all suggested indicators a statistically significant difference between SRI and CI has been detected. In particular, SRI have been found to actually surpass CI. The actual magnitude of that difference, however, seems to be rather limited. In fact, to a large extent companies with comparable CSR ratings seem to be included in both SRI and CI. As a result, the relationship between the two is by no means one of a “black and white” or a “good and bad” type.

Although the obtained results seem to be robust to several model variations, they should be interpreted with caution. In fact, there are some weaknesses and limitations in the approach applied. Most importantly, as SR is a subjective phenomenon, the representativeness of the respective indicators may be doubted. In particular, one may dispute the reliability of the information source used, i.e. the particular set of SR indexes. Furthermore, as no information about the achievement of companies with respect to single criteria could be extracted, the analysis has only referred to some kind of a collective definition of SR. In this regard, further research would be needed, conducting similar analyses with reference to particular SR criteria.

k in their investment strategy are treated as SRI. All remaining funds in the sample are treated as CI. Note that such a separate analysis is carried out for criteria 8, 9, 10, 12, 13, 14 and 16 listed in table 2.

In general, despite obvious limitations the results clearly indicate that the achievement of investments with respect to particular principles of SR would deserve further investigation. Indeed, at present, although a considerable portion of investors do focus on particular SR criteria, too little is known about how particular investments do actually fit those criteria. In this regard, there is a serious need to introduce standardized procedures suitable to evaluate the actual content of investments, instead of just reading their label. Hopefully, this study will stimulate further research to be focused on the issue, so poorly explored nowadays.

Appendix

Table 1: List of SR indexes each with the set of SR criteria considered in the respective selection methodology*

j	Name of index j \ No. of criterion k	Consideration of criterion k in the selection of constituents for index j															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Domini 400 Social (KLD)	1	1	1			1	1						1	1		1
2	KLD Global Sustainability Index													1	1	1	1
3	Ethibel Sustainability Index	1	1	1	1	1	1	1	1					1	1	1	
4	Global Challenges Index						1	1	1	1	1	1	1	1	1		
5	Green Tech Climate 30	1				1	1	1	1	1	1		1	1			
6	HVB Nachhaltigkeitsindex	1	1	1	1	1	1	1	1		1	1		1	1		
7	ASPI													1	1		
8	Calvert Social Index	1	1	1	1		1	1						1	1		1
9	DAX Global Sarasin Sustainability Index	1			1		1	1	1					1	1		1
10	Renixx World												1	1			
11	Jantzi Social Index	1	1	1	1		1	1	1		1			1	1		
12	NAI Natur-Aktien-Index					1	1	1	1	1	1	1		1	1	1	1
13	UBAI Umweltbank Index						1	1		1	1		1	1			
14	VÖNIX	1	1	1			1	1	1					1	1		1
15	CEERIUS	1	1	1			1	1	1					1	1		1
16	DAXglobal Alternative Energy						1						1	1			
17	DJSI Stoxx									1	1	1		1	1	1	1
18	DJSI Stoxx ex AGTF	1	1	1				1		1	1	1		1	1	1	1
19	FTSE4Good Global	1					1	1						1	1	1	
	Number of indexes considering criterion k	11	8	8	5	4	14	14	9	6	8	5	5	19	15	6	9
	Relative importance of criterion k (in %)	7,53	5,48	5,48	3,42	2,74	9,59	9,59	6,16	4,11	5,48	3,42	3,42	13,01	10,27	4,11	6,16

* A description of each SR criterion is provided in table 2

Table 2: List of SR criteria with a brief description

k	Name of Criterion <i>k</i>	Brief Description of Criterion <i>k</i> and possible subcriteria	# funds*	in % **
1	Tobacco	Production and distribution of tobacco	44	6,59
2	Alcohol	Production and distribution of alcoholic beverages	26	3,89
3	Gambling	Provision of services in the gambling industry	30	4,49
4	Pornography	Production and distribution of pornography, activities in the sex-industry	30	4,49
5	Animal Experiments	Execution of experiments with animals, maltreatment of animals	25	3,74
6	Nuclear Power	Production and distribution of atomic energy, extraction or processing of uran	48	7,19
7	Arms	Production and distribution of armaments of all kinds	57	8,53
8	Genetic Engineering	Production and distribution of genetically modified organisms (GMOs), genetic engineering of animals or plants, ownership of patents on animals or plants changed by means of genetic engineering	32	4,79
9	Environmental Pollution	Several types of activities harmful to the environment, e.g. unsustainable fishing, unsustainable forestry, acceleration of climate change	34	5,09
10	Violation of Human Rights	Several types of activities offending human rights, e.g. discrimination of minorities, discrimination of women, exploitation of employees or society in general, insufficient social protection of employees, children's work, support to repressive regimes or business connection to countries where human rights are offended	43	6,44
11	Controversial Business Practices	Several types of activities violating ethical business principles, e.g. corruption and bribery, manipulation of business deals	15	2,25
12	Environmental Awareness (Active)	Activities which help to improve environmental conditions, e.g. production or distribution of renewable energies, research and development of new environmental technologies, involvement in reduction of CO ₂ , reuse and recycling, energy-efficient production and transport	54	8,08
13	Environmental Awareness (Passive)	Several types of an environmentally friendly behavior, e.g. efforts of a company to reduce the negative environmental impact of its products, i.e. reduction of emissions into air, water and soil, respect for the environment in general, presence of environmental management systems (EMS), efficiency with respect to consumption of energy and raw materials	106	15,87
14	Social Engagement	Providing good working conditions, equal opportunities for minorities and women, fair remuneration practices, training of employees, relations with unions, relations with local communities, support of societal initiatives, commitment to respect indigenous peoples' rights, commitment to respect ILO labor standards, membership in Global Compact, standards as SA 8000	69	10,33
15	Transparency	Transparency of a company for its stakeholders in general, i.e. disclosure of information to the stakeholders, responsiveness to requests for information	21	3,14
16	Responsibility towards Customers	The degree to which a company pays attention its customers, product quality and product safety, information provided to customers, complaint management	34	5,09

* number of funds in the final sample which claim to consider criterion *k* in their investment strategy

** relative importance of criterion *k* among all criteria, as derived by the numbers of funds in the sample considering particular criteria in their investment strategy

Table 3: List of industry segments with brief description each

#	Name of Industry Segment	Brief Description of Industry Segment
1	Energy	Production and distribution of energy
2	Finance	Banking, insurance, financial services in general, e.g. asset management, venture capital etc.
3	Health Industry	Provision of health care, pharmaceuticals, biotechnology in both medicine and agro-sector
4	Retail	Retailing such as store sales and warehouses, internet trade, transportation services, hotels, restaurants, media and commercial services in general in several industries
5	Manufacturing	Car industry, production of weapons and military equipment, machine construction in general, building industry, recycling etc.
6	Consumption Goods	Production of consumption goods in general, e.g. consumer electronics, household appliances, leisure products and services, food and beverages, tobacco, textiles etc.
7	Raw Materials	Extraction and processing of raw materials e.g. oil, gas and minerals in general, production of chemicals, packaging, forestry, in particular processing of wood
8	Technology and Telecommunication	Development and production of hardware and software, office electronics, IT services, fixed network as well as mobile telecommunication services

Table 4: Descriptive statistics of the control variables for the final sample

Description of the control variable	mean	median	stdev	min	max
Weight of the fund eligible for at least one index	0,946	0,080	0,975	0,513	1
Average number of indexes for which a typical company incl. in the fund is eligible	5,651	1,266	5,980	1,503	8,339
Number of companies the fund invests in	133,186	220,922	70	12	2714
Regional investment strategy; 1 if restricted on European stocks only, 0 if global *	0,506				
ln (fund volume)	3,548	1,752	3,561	-3,507	8,656
ln (fund age)	1,830	0,929	2,049	-1,088	4,374
Minimum investment requirement (MIR); 1 if MIR > € 10.000, 0 otherwise *	0,104				
Domicile Dummies					
Belgium; 1 if fund domicile is in Belgium, 0 otherwise *	0,037				
Germany; 1 if fund domicile is in Germany, 0 otherwise *	0,182				
Ireland; 1 if fund domicile is in Ireland, 0 otherwise *	0,060				
Luxemburg; 1 if fund domicile is in Luxemburg, 0 otherwise *	0,538				
Austria; 1 if fund domicile is in Austria, 0 otherwise *	0,090				

* For all binary variables only the mean is reported, all other descriptive statistics are omitted. Note that the mean of a binary variable corresponds to the percentage of cases where the variable takes a value of 1. Accordingly, '1 - the mean' represents the percentage of cases where the corresponding variable takes a value of 0.

Table 5: Descriptive statistics of the control variables for both socially responsible and conventional funds in the sample, denoted as SRI and CI respectively

Description of the control variable	SRI					CI				
	mean	median	stdev	min	max	mean	median	stdev	min	max
Weight of the fund eligible for at least one index	0,957	0,974	0,056	0,636	1	0,945	0,975	0,083	0,513	1
Average number of indexes for which a typical company incl. in the fund is eligible	5,702	5,883	1,032	2,616	7,770	5,644	5,987	1,295	1,503	8,339
Number of companies the fund invests in	83,139	68,500	51,879	20	400	140,03	233,96	7	12	2714
Regional investment strategy; 1 if restricted on European stocks only, 0 if global	0,194					0,549				
ln (fund volume)	3,311	3,205	1,551	0,087	7,826	3,580	3,604	1,776	-3,507	8,656
ln (fund age)	1,373	1,522	0,855	-0,788	2,918	1,893	2,091	0,922	-1,088	4,374
Minimum investment requirement (MIR); 1 if MIR > € 10.000, 0 otherwise	0,093					0,105				
Domicile Dummies										
Belgium; 1 if fund domicile is in Belgium, 0 otherwise	0,083					0,030				
Germany; 1 if fund domicile is in Germany, 0 otherwise	0,083					0,195				
Ireland; 1 if fund domicile is in Ireland, 0 otherwise	0,019					0,066				
Luxemburg; 1 if fund domicile is in Luxemburg, 0 otherwise	0,657					0,522				
Austria; 1 if fund domicile is in Austria, 0 otherwise	0,120					0,086				

Tables 6a and 6b: Descriptive statistics of SR achievement for both socially responsible and conventional funds in the sample derived by actual and equal weighting respectively

Indicator	SRI					CI				
	mean	median	stdev	min	max	mean	median	stdev	Min	max
I	0,842	0,863	0,122	0,395	1,000	0,732	0,778	0,196	0,082	1,000
II	0,442	0,441	0,086	0,137	0,695	0,326	0,339	0,097	0,014	0,539
III	-0,316	-0,393	0,845	-3,042	2,297	-1,482	-1,537	0,590	-3,430	0,720
IV	0,608	0,612	0,046	0,479	0,709	0,568	0,572	0,047	0,408	0,674

Indicator	SRI					CI				
	mean	median	stdev	min	max	mean	median	stdev	min	max
I	0,788	0,822	0,140	0,364	1,000	0,690	0,739	0,188	0,042	1,000
II	0,419	0,419	0,086	0,146	0,674	0,306	0,322	0,090	0,007	0,547
III	-0,426	-0,480	0,734	-2,857	1,766	-1,542	-1,572	0,482	-3,303	0,853
IV	0,599	0,607	0,045	0,482	0,708	0,558	0,562	0,042	0,395	0,675

Table 7: Results of the model defined by equation (9) with no control variables considered. Respectively SR achievement with respect to indicators I, II, III and IV, derived by actual and equal weighting, is used as the dependent variable. SR category is the only explanatory variable. The method of OLS is used to estimate the regression coefficients, p-values are reported in parentheses; *, ** and *** indicate significance at the 10%, 5% and 1% level respectively

Independent variable	actual weighting				equal weighting			
	a_{ω}^I	a_{ω}^{II}	a_{ω}^{III}	a_{ω}^{IV}	a_{ω}^I	a_{ω}^{II}	a_{ω}^{III}	a_{ω}^{IV}
(Constant)	0,732*** (0,000)	0,326*** (0,000)	-1,482*** (0,000)	0,568*** (0,000)	0,690*** (0,000)	0,306*** (0,000)	-1,542*** (0,000)	0,558*** (0,000)
SR category of a fund ¹	0,110*** (0,000)	0,116*** (0,000)	1,167*** (0,000)	0,040*** (0,000)	0,098*** (0,000)	0,112*** (0,000)	1,116*** (0,000)	0,041*** (0,000)
Number of observations	896	896	896	896	896	896	896	896
R-Squared	0,035	0,134	0,269	0,072	0,030	0,142	0,330	0,090
Adj.R-Squared	0,034	0,133	0,268	0,071	0,029	0,141	0,329	0,089
F-Statistic	32,274	139,005	329,796	69,056	27,550	147,807	440,109	88,640

¹ 1 if the fund is a SRI, 0 otherwise

Table 8: Results of the model defined by equation (9) with control variables considered. In each case based on the Akaike criterion the optimal subset of control variables is selected from the set of control variables defined in section III.C. Respectively SR achievement with respect to indicators I, II, III and IV, derived by actual and equal weighting, is used as the dependent variable. The method of OLS is used to estimate the regression coefficients, p-values are reported in parentheses; *, ** and *** indicate significance at the 10%, 5% and 1% level respectively

Independent variable	actual weighting				equal weighting			
	a_{ω}^I	a_{ω}^{II}	a_{ω}^{III}	a_{ω}^{IV}	a_{ω}^I	a_{ω}^{II}	a_{ω}^{III}	a_{ω}^{IV}
(Constant)	-0,161*** (0,000)	-0,067*** (0,002)	-2,359*** (0,000)	0,379*** (0,000)	-0,14*** (0,000)	-0,007 (0,449)	-1,771*** (0,000)	0,411*** (0,000)
SR category of a fund ¹	0,103*** (0,000)	0,117*** (0,000)	1,286*** (0,000)	0,043*** (0,000)	0,108*** (0,000)	0,118*** (0,000)	1,159*** (0,000)	0,046*** (0,000)
Weight of the fund eligible for at least one index	0,141*** (0,000)	0,044* (0,059)		0,02* (0,072)	0,142*** (0,000)		-0,282 (0,147)	
Average number of indexes for which a typical company incl. in a fund is eligible	0,132*** (0,000)	0,061*** (0,000)	0,137*** (0,000)	0,029*** (0,000)	0,127*** (0,000)	0,059*** (0,000)	0,096*** (0,000)	0,027*** (0,000)
Number of companies a fund invests in				0,000 (0,137)	0,000*** (0,000)	0,000** (0,019)		0,000 (0,141)
Regional investment strategy	0,013** (0,016)	0,016*** (0,000)	0,385*** (0,000)	0,016*** (0,000)	-0,013*** (0,008)		0,155*** (0,000)	0,007*** (0,000)
ln (fund volume)	0,005*** (0,001)	0,001 (0,159)			0,005*** (0,000)		-0,016 (0,105)	
ln (fund age)								
Minimum investment requirement		-0,012** (0,045)	-0,136** (0,029)	-0,006** (0,038)		-0,011** (0,042)	-0,096* (0,086)	-0,004* (0,087)
Domicile dummies	***	***	***	***	***	**	***	**
Number of observations	896	896	896	896	896	896	896	896
R-Squared	0,847	0,760	0,431	0,739	0,864	0,764	0,402	0,739
Adj.R-Squared	0,845	0,758	0,425	0,736	0,863	0,761	0,394	0,736
F-Statistic	489,516	255,441	74,640	227,996	513,233	318,399	53,998	250,948
Mean SR of SRI adjusted for all controls	0,837	0,443	-0,211	0,611	0,797	0,424	-0,388	0,603
Mean SR of CI adjusted for all controls	0,733	0,325	-1,497	0,567	0,689	0,306	-1,547	0,558

¹ 1 if the fund is a SRI, 0 otherwise

Figure1: Distribution of a_{ω}^I for both SRI and CI in the sample

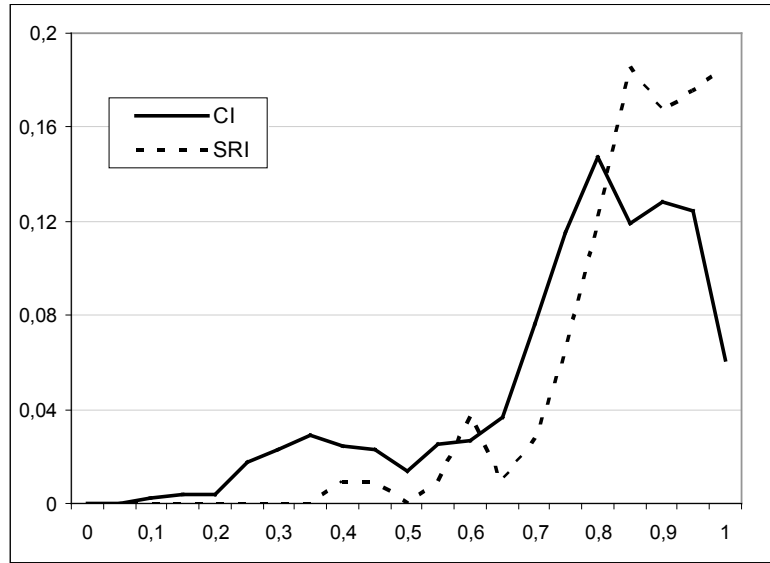


Figure 2: Distribution of a_{ω}^{II} for both SRI and CI in the sample

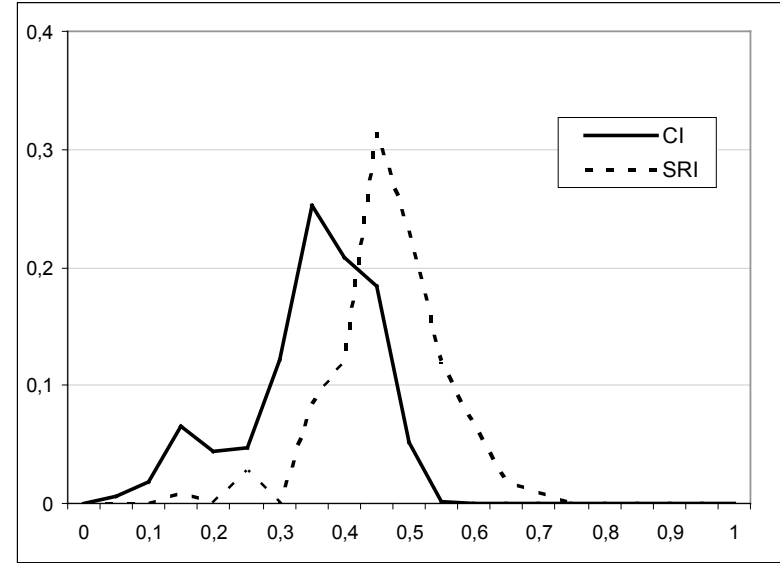


Figure 3: Distribution of a_{ω}^{III} for both SRI and CI in the sample

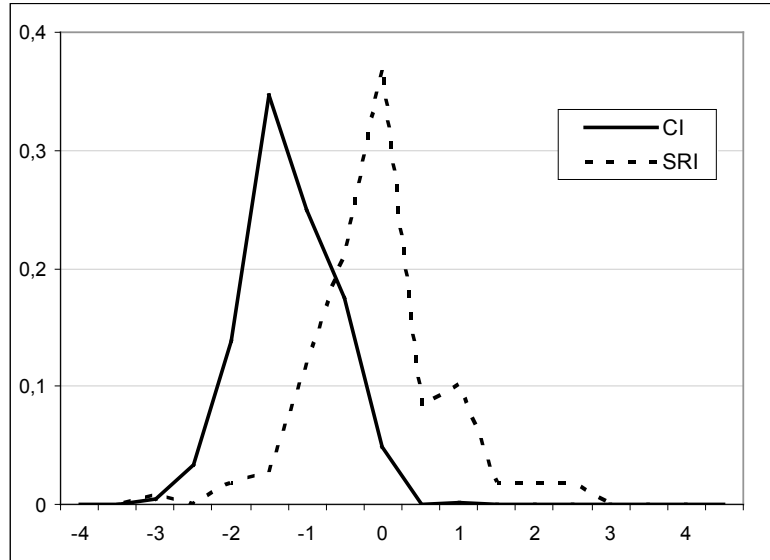
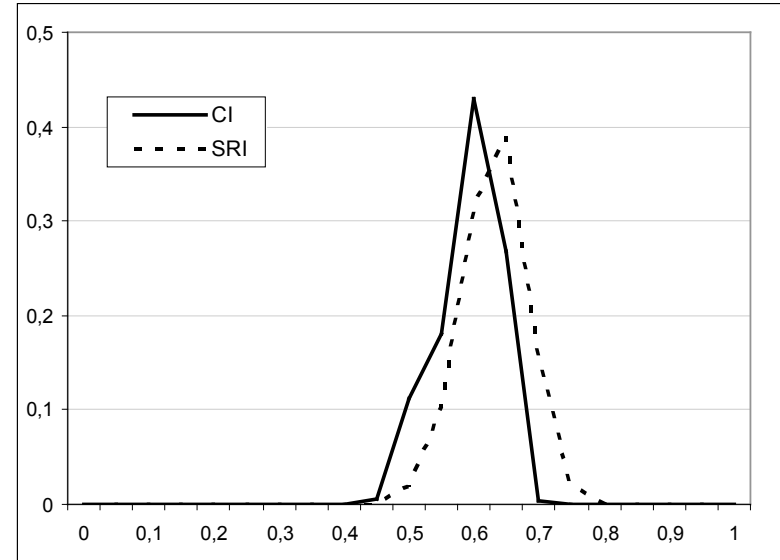


Figure 4: Distribution of a_{ω}^{IV} for both SRI and CI in the sample



References

Center for Sustainable Innovation, 2007, “The Social Footprint: Introduction and the Proof of Concept”.

Chatterji, A. K., Levine, D. I., Toffel, Michael W., 2007, “How Well Do Social Ratings Actually Measure Corporate Social Responsibility?”, Working paper of the *Corporate Social Responsibility Initiative*.

Cooper, M, Schlegelmilch, B. B., 1993, „Key Issues in Ethical Investment“, *Business Ethics: A European Review*, Vol. 2 (4), 213 – 227.

Derwall, J., Guenster, N., Bauer, R., Koedijk, K., 2005, „The Eco-Efficiency Premium Puzzle“, *Financial Analysts Journal*, Vol. 61, pp. 51 – 63.

European Fund and Asset Management Association, 2009, “Quarterly Statistical Release: May 2009”.

Eurosif, 2010, “European SRI Study 2010”, Revised Edition.

Ferruz, L., Marco, I., and Ortiz, C., 2007, “Socially Responsible Investment: Mutual Funds. Global and Local Trends”, *The International Journal of Applied Economics and Finance*, Vol. 1, pp. 120-125.

Figge, F., Hahn, T., 2004, “Sustainable Value Added – Measuring Corporate Contributions to Sustainability beyond Eco-Efficiency”, *Ecological Economics*, Vol. 48, pp. 173 – 187.

Gregory, A., Matatko, J., Luther, R., 1997, “Ethical Unit Trust Financial Performance: Small Company Effects and Fund Size Effects”, *Journal of Business Finance & Accounting*, Vol. 24, pp. 705 – 725.

Hamilton, S., Jo, H., Statman, M., 1993, “Doing Well While Doing Good? The investment Performance of Socially Responsible Mutual Funds, *Financial Analysts Journal*, Vol. 46, pp. 62 – 66.

Hawken, P., 2004, „Socially Responsible Investing“, *The Natural Capital Institute*.

Kreander, N., Gray, R. H., Power, D. M., Sinclair, C. D., 2005, “Evaluating the Performance of Ethical and Non-ethical Funds: A Matched Pair Analysis”, *Journal of Business Finance & Accounting*, Vol. 32, pp. 1465 – 1493.

Mahonney, L., Roberts R., 2002, “Corporate Social and Environmental Performance and Their Relation to Financial Performance and Institutional Ownership: Empirical Evidence on Canadian Firms”, Working Paper.

McGuire, J., Sundgren, A., Schneeweis, T., 1988, "Corporate Social Responsibility and Firm Financial Performance", *Academy of Management Journal*, Vol. 31, 854 – 872.

Moir, L., 2001, “What Do We Mean by Corporate Social Responsibility?”, *Corporate Governance*, Vol. 1, pp. 16 – 22.

New Economics Foundation, 2007, “Measuring Real Value: A DIY Guide to Social Return on Investment”.

Richardson, B. J., 2008, “Socially Responsible Investment Law: Regulating the Unseen Polluters”, *Oxford University Press*.

Sauer, D. A., 1997, “The Impact of Social-Responsibility Screens on Investment Performance: Evidence from the Domini 400 Social Index and Domini Equity Mutual Fund”, *Review of Financial Economics*, Vol. 6. No. 2., pp. 137 – 149.

Schröder, M., 2007, “Is there a Difference? The Performance Characteristics of SRI Equity Indices”, *Journal of Business Finance & Accounting*, Vol. 34, pp. 331 – 348.

Social Investment Forum Foundation, 2010, “Report on Socially Responsible Investing Trends in the United States 2010”.

Vance, S. C., 1975, “Are Socially Responsible Corporations Good Investment Risks”, *Management Review*, Vol. 64, 18 – 24.

Chapter 2: Is Social Responsibility Rewarded or Penalized?

This study provides further insight on the relation between social responsibility and financial performance. In particular, it explores whether in terms of financial performance socially responsible behavior is rewarded, penalized or none of both. The analysis is carried out by comparing financial performance of particular portfolios of stocks, using the CAPM, the Fama-French and the Carhart model. For the purpose of constructing the portfolios, several stocks are evaluated with respect to some well defined indicators of social responsibility. Then, the portfolios are constructed of stocks with the highest and lowest scores respectively. This is in contrast to most other studies, which usually compare existing investment funds and/or indexes. The relation between social responsibility and financial performance turns out to be rather complex. Although the most socially responsible companies achieve returns which are comparable to the market, they tend to be outperformed by the least socially responsible companies. In particular cases, this result is also statistically significant. In addition, time is found to play an important role in the relation between social responsibility and financial performance.

I. Introduction

For many investors financial performance by far is not the only criterion when making investment decisions. More than € 5 trillion allocated in so called socially responsible investments (SRI) in Europe alone suggest that social responsibility (SR) is also an issue. Of course, applying social screens in the process of portfolio selection may have substantial implications on financial performance. To put it simply, doing good may possibly but not necessarily be associated with doing well. In this respect, it is fully legitimate to ask whether doing good provides an extra reward or an extra penalty in terms of financial performance. So far in academic research it has become almost a tradition to study the relation between SR and financial performance. In the last decades numerous studies have analyzed whether investing in a socially responsible way is actually rewarded or penalized. In summary, all of the existing studies can be divided in three main categories.

First and most frequently, SRI and conventional mutual funds have been compared, e.g. Hamilton et al. (1993), Bauer et al. (2004) or Kreander et al. (2005). Here, it has been assumed that somehow the content of SRI mutual funds is what actually defines a socially responsible way of investing. However, the reasonability of such an assumption is more than questionable, since so far it has hardly been investigated to what extent do SRI and

conventional mutual funds actually differ. As the first study has shown, with respect to some particular indicators of SR, there is indeed a statistically significant difference between the two groups of funds. However, in absolute terms this difference turns out to be rather moderate. In fact, it seems that a majority of companies included in a typical SRI fund are also included in a typical conventional fund, and vice versa. In this regard, a comparison of existing SRI and conventional mutual funds may not allow for a proper analysis of the actual relation between SR and financial performance. In addition, as social screening may involve an extra cost the results of all such analyses may be considerably biased.

Second, financial performance of SRI and conventional stock indexes has been compared, e.g. Sauer (1997) or Schröder (2007). Of course, for studies in this category, possible biases due to additional costs of screening are no longer an issue. Also, it seems to be more reasonable to consider as socially responsible the constituents of an SRI index portfolio rather than those of an SRI mutual fund. Typically, in the former case a more transparent methodology is provided and portfolio return is not the primary motivating factor as it is in the latter case. Moreover, SRI index portfolios are usually constructed using existing CSR ratings, which are based on several standardized indicators of SR. Unfortunately, as Statman and Glushkov (2009) have pointed out “there is much overlap in the list of stocks in socially responsible indexes and conventional indexes”. As a consequence, the corresponding analyses do not compare financial performance of the most socially responsible companies with that of the rest or the least socially responsible companies. Much more do they compare financial performance of portfolios which to a large extent consist of the very same companies.

Third and most reasonably, a few studies have analyzed financial performance of portfolios, which have been constructed explicitly for that purpose based on particular indicators of SR. In general, studies in this category seem to be the most accurate to analyze the relation between SR and financial performance, as they actually compare portfolios of distinct companies with distinct achievement with respect to the applied indicators. While earlier studies, e.g. Diltz (1995), have used indicators related to one single SR criterion recent studies, e.g. Kempf and Ostoff (2007) or Manescu (2010), have applied broader CSR ratings, especially those provided by the KLD Research & Analytics, thus referring to multiple SR criteria. In general, studies in this category provide rather different results in comparison to studies in the above two categories. Applying indicators with several SR criteria Kempf and Ostoff (2007) find a statistically significant difference in financial performance between the

most and the least socially responsible companies. In contrast, with few exceptions no difference between the two is found whenever the analysis is based on existing investment portfolios.

In principle, this study fits the properties of the third category. More precisely, first, a large set of companies is evaluated with respect to a well defined indicator of SR. As a result, each company is attributed a particular score. Basically, a higher score suggests that a company behaves more properly in accordance with certain principles of SR, i.e., roughly speaking, it is more socially responsible. Then, portfolios of companies with the highest and lowest scores respectively are constructed. Finally, financial performance of those portfolios is compared, using the CAPM, the Fama-French as well as the Carhart model. The main difference of this study relative to other studies in the third category is the actual indicator, with respect to which SR of companies is evaluated.

The rest of the study is organized as follows. In section II., the methodology is described. More precisely, in section II.A the underlying indicator of SR is defined and a description of the data is provided. In section II.B artificial portfolios of companies are constructed, based on the indicator introduced in section II.A. Then, in section II.C, measures of financial performance are defined and all relevant hypotheses are formulated. Finally, in section III., the obtained results are presented and interpreted. Section IV. concludes, summarizing the main results and discussing implications for future research.

II. Methodology

A. Social Responsibility and Data

So called “indicator III” introduced in the first study, further referred to simply as “SR indicator”, is used to evaluate SR of companies in further analysis.⁵³ Accordingly, referring to the notation introduced in the first study the value of parameter a_i^{III} , i.e. the achievement of

⁵³ For robustness purposes later the analysis is also conducted using indicators I, II and IV introduced in the first study in order to evaluate SR of companies.

company i with respect to “indicator III”, measures the “SR achievement” of company i , further denoted simply by a_i .⁵⁴

Of course, referring to the definition of SR indicator, SR achievement is only defined for companies eligible for at least one index contained in table 1 reported in the first study.⁵⁵ Overall, there are 9212 companies with this particular property. On average a company is eligible for approximately two indexes. However, the number of indexes for which a company is eligible varies considerably among companies. While almost one half of the companies are eligible for only one single index, approx. ten percent are eligible for five or more indexes. Intuitively, the higher the number of indexes for which a company is eligible the more reliably its SR achievement is expected to measure how socially responsible the company actually is. In order to enhance the reliability of further analysis, not all 9212 companies are taken into account. In consequence, only companies which are eligible for a number of indexes higher or equal than the 90th percentile are considered.⁵⁶ Overall there are 962 companies, which do satisfy this condition, and hence do constitute the final set of companies relevant for further analysis, formally denoted by Ω .

B. Construction of Portfolios

First, the entire set Ω is divided into subsets of companies with different SR achievement. For this purpose, an upper and a lower threshold, denoted by U and L , are defined as the mean SR achievement plus and minus one standard deviation respectively.⁵⁷ Further, the subset of companies with SR achievement above U and below L respectively is referred to as the set of “best-rated” and “worst-rated” companies, denoted by Ω_B and Ω_W .⁵⁸ Then, for each of the two sets, Ω_B and Ω_W , an equally weighted and a value weighted portfolio is constructed. More precisely, for the entire time interval to be analyzed, at the beginning of each month t all currently traded companies from the respective set are included in the portfolio. The weight of

⁵⁴ The exact definition of a_i^{III} is provided in section II.B of the first study.

⁵⁵ Furthermore the term “index” refers to any SRI index contained in table 1 reported in the first study.

⁵⁶ Referring to the underlying distribution a company must be eligible for at least five indexes in order satisfy this condition.

⁵⁷ Formally, $U = \mu + \sigma$ and $L = \mu - \sigma$, where μ and σ are the mean and the standard deviation of SR achievement among all companies from set Ω . For robustness purposes later alternative definitions of U and L are used, in particular, adding and subtracting multiples of σ to and from μ respectively.

⁵⁸ Formally, $i \in \Omega_B \Leftrightarrow i \in \Omega \wedge a_i > U$ and $i \in \Omega_W \Leftrightarrow i \in \Omega \wedge a_i < L$. Table 1 reports some descriptive statistics on both the overall set Ω as well as the two subsets Ω_B and Ω_W .

a particular company i in the value weighted portfolio is based on the absolute difference between SR achievement of company i , a_i , and mean SR achievement, μ . Formally, the simple gross return of both the equally weighted and that of the value weighted portfolio constructed from set Ω_z , s.t. $z \in \{B, W\}$, in month t , denoted by $R_{z,t}^{[eq]}$ and $R_{z,t}^{[val]}$ respectively, can be expressed as

$$R_{z,t}^{[eq]} = \frac{1}{|\Omega_{z,t-1}|} \sum_{i \in \Omega_{z,t-1}} R_{i,t} \quad \text{and} \quad R_{z,t}^{[val]} = \sum_{i \in \Omega_{z,t-1}} \gamma_{i,t-1} R_{i,t} \quad \text{with} \quad \gamma_{i,t-1} \equiv \frac{|a_i - \mu|}{\sum_{j \in \Omega_{z,t-1}} |a_j - \mu|}$$

where $\Omega_{z,t-1}$ consists of all companies from set Ω_z traded at the beginning of month t , i.e. at time $t-1$, and $R_{i,t}$ is the simple gross return of the stock of company i in month t .⁵⁹

In addition, four more portfolios are constructed, two for each type of weighting, by going long and short in the portfolio of best-rated and worst-rated companies respectively, and vice versa. Formally, the simple gross return of the resulting portfolios in month t , denoted by $R_{B-W,t}^{[eq]}$, $R_{W-B,t}^{[eq]}$ and $R_{B-W,t}^{[val]}$, $R_{W-B,t}^{[val]}$ for each type of weighting respectively, can be expressed as $R_{B-W,t}^{[eq]} = 1 + R_{B,t}^{[eq]} - R_{W,t}^{[eq]}$, $R_{W-B,t}^{[eq]} = 1 + R_{W,t}^{[eq]} - R_{B,t}^{[eq]}$ and $R_{B-W,t}^{[val]} = 1 + R_{B,t}^{[val]} - R_{W,t}^{[val]}$, $R_{W-B,t}^{[val]} = 1 + R_{W,t}^{[val]} - R_{B,t}^{[val]}$.⁶⁰

⁵⁹ Formally, $R_{i,t} \equiv \frac{P_{i,t}}{P_{i,t-1}}$, where $P_{i,t-1}$ and $P_{i,t}$ is the stock price of company i at the beginning and at the end

of month t respectively. The stock exchange used as an information source for price data is selected in the following way: For US stocks primarily the NYSE or NASDAQ quotes are considered. If a stock is not traded on NYSE or NASDAQ, the most preferred stock exchange selected by yahoo.finance.uk is used as an information source. For non-US stocks prices from the home exchange selected by yahoo.finance.uk are considered, unless NYSE or NASDAQ offer a longer price series. Of course, the price series is adjusted for stock splits. Furthermore, if a stock pays a dividend, the price series is adjusted accordingly, as if the dividend was reinvested in the stock. Finally, if a stock is withdrawn from the stock exchange before the end of a particular month t the closing price of the last trading day is considered as the actual selling price for the stock.

⁶⁰ It may be argued that studying the reversed long-short strategy is redundant as the return of the corresponding portfolio is simply equal to the negative of the original one. However, it is the excess return and not the actual return of a portfolio which is finally regressed on possible benchmark assets in order to derive its financial performance. Of course, if the risk free rate is different from zero the excess return of one portfolio is not equal to the negative return of the other using a reversed strategy. As a result, studying both strategies may provide additional insights on the relation between SR and financial performance.

C. Measures of Financial Performance

Typically, studies which analyze the relation between SR and financial performance define the latter as the excess return of an asset after compensating for systematic risk. Depending on how systematic risk is defined, an asset's excess return is regressed on the excess return of particular benchmark assets. In this respect, three approaches are commonly used. In the classical CAPM approach the return of a market portfolio is used as a single regression factor. In the approach of Fama and French (1993), additionally, the return of a small-large cap portfolio and that of a high-low book-to-market portfolio are considered. Finally, in the approach of Carhart (1997) further the return of a momentum portfolio is included. In all three cases, financial performance of an asset is defined as the constant term in the corresponding regression model. This study is not an exception. Yet, to be as little restrictive as possible, all three approaches are applied. Formally, denoted by α_j^I , α_j^{II} and α_j^{III} , financial performance of portfolio j is derived by using OLS to solve the following regression models respectively

$$\begin{aligned} R_{j,t} - R_{f,t} &= \alpha_j^I + \beta_{MAR,j}^I (R_{MAR,t} - R_{f,t}) + \varepsilon_{j,t}^I \\ R_{j,t} - R_{f,t} &= \alpha_j^{II} + \beta_{MAR,j}^{II} (R_{MAR,t} - R_{f,t}) + \beta_{CAP,j}^{II} r_{CAP,t} + \beta_{BTM,j}^{II} r_{BTM,t} + \varepsilon_{j,t}^{II} \\ R_{j,t} - R_{f,t} &= \alpha_j^{III} + \beta_{MAR,j}^{III} (R_{MAR,t} - R_{f,t}) + \beta_{CAP,j}^{III} r_{CAP,t} + \beta_{BTM,j}^{III} r_{BTM,t} + \beta_{MOM,j}^{III} r_{MOM,t} + \varepsilon_{j,t}^{III} \end{aligned}$$

over the entire time interval starting with April 2004 until August 2010, or alternatively, over one of the subintervals from April 2004 until March 2009 and from April 2009 until August 2010.⁶¹ To be precise, $R_{MAR,t}$ is the gross return of the market portfolio in month t , $r_{CAP,t}$ is the excess return of a portfolio of companies with small capitalization relative to a portfolio of

⁶¹ The following intuition underlies the choice of the respective time intervals. Of course, behaving in a socially responsible way may have implications on current as well as on future financial performance of a company. Since the information about all SRI indexes used in the analysis refers to the status as of the end of March 2009, SR achievement as defined in section II.A basically evaluates the behaviour of companies in the period before March 2009. Accordingly, studying financial performance for the first subinterval, i.e. from April 2004 until March 2009, is meant to explore the contemporary relation between SR and financial performance. Alternatively, doing so for the second subinterval, i.e. from April 2009 until August 2010, is meant to explore a possible time lagged relation between SR and financial performance. Obviously, considering financial performance for the entire time interval, i.e. from April 2004 until August 2010, allows for an aggregate analysis. The choice of April 2004 as a starting month is to a large extent arbitrary, as, unfortunately, it is rather ambiguous how far in history the SR index providers actually look when monitoring and evaluating companies' behaviour. After being asked most of them have not provided a clear explanation. Referring to those who have, a five year time span seems to be one of the most reasonable choices. Nonetheless, due to the problems just mentioned the reasonability of that choice may of course be doubted. In order to cope with this problem, later, the analysis is also carried out using any month from January 2000 until April 2008 as a possible starting period. Note that August 2010 is used as the last month simply because the price data for all stocks has been collected in September 2010, and hence, more recent data was not yet available.

companies with large capitalization in month t , $r_{BTM,t}$ is the excess return of a portfolio of companies with high book-to-market ratio relative to a portfolio of companies with low book-to-market ratio in month t , and $r_{MOM,t}$ is the excess return of a portfolio of companies with high past returns relative to a portfolio of companies with low past returns in month t .⁶² Finally, $R_{f,t}$ is the gross return of a risk free asset in month t , in particular it is defined as one plus the monthly yield on a US Treasury Bill at the beginning of month t .

In summary, the aim of this study is to test whether financial performance of any of the portfolios defined in section II.B is equal to or different from zero. Formally, the null hypothesis $H_0 : \alpha_j^h = 0$ is tested against the alternative $H_1 : \alpha_j^h \neq 0$, where α_j^h is the constant term derived from running regression model h , s.t. $h \in \{I, II, III\}$, with the excess return of portfolio j , $R_{j,t} - R_{f,t}$, s.t. $R_{j,t} \in \{R_{B,t}^{[eq]}, R_{W,t}^{[eq]}, R_{B-W,t}^{[eq]}, R_{W-B,t}^{[eq]}, R_{B,t}^{[val]}, R_{W,t}^{[val]}, R_{B-W,t}^{[val]}, R_{W-B,t}^{[val]}\}$, as a dependent variable.

III. Results

A. Default Settings

Initially, for all eight portfolios financial performance across the entire time interval from April 2004 until August 2010 is derived. The results are reported in tables 2a, 2b and 2c, each referring to one of the three models defined in section II.C. Obviously, independent on the model used excess return of all long-only portfolios shows a positive linear relationship with excess return of the market.⁶³ More precisely, the corresponding coefficients are slightly higher than one, indicating higher return fluctuations compared to the market portfolio. Not surprisingly, the portfolios seem to be less well diversified than the market portfolio. In all cases the coefficients are statistically significant even at extremely low significance levels. For long-short portfolios no linear relationship with the market return is observed. Probably, due to their highly positive correlation the returns of the respective long-only portfolios are

⁶² Note that the monthly return series for all four benchmarks used in further analysis are the ones downloaded from the official Kenneth R. French online data library. Exact definitions for the corresponding benchmark assets are given in Fama and French (1993). For robustness purposes, later, the analysis is also run with alternative benchmark assets.

⁶³ The term „long-only portfolio“ refers to a portfolio which does not apply any short selling in its investment strategy. Further, any other portfolio is referred to as a “long-short portfolio”.

cancelled out to a large extent when combined in a long-short strategy. Further results in tables 2b and 2c suggest that best-rated companies tend to be smaller than worst-rated companies. This difference becomes most apparent when exploring the long-short portfolios. Obviously, it turns out to be statistically significant in all cases considered. In terms of value and growth categorization best-rated and worst-rated companies differ less substantially. For all long-only portfolios the ratio of value stocks seems to be slightly higher in comparison to the market.⁶⁴ However, none of the differences is statistically significant. In contrast, momentum factor turns out to be statistically significant for all eight portfolios. To be precise, it seems that all long-only portfolios are characterized by an excessive ratio of companies with lower past returns. As the results for the long-short portfolios suggest, this pattern is even stronger for the best-rated portfolio, independent on the actual weighting used.

Interestingly, although portfolio returns seem to be related to the additional benchmark factors, financial performance differs only negligibly across the models. Also, both types of weighting yield more or less the same results. Obviously, independent on the model or type of weighting used, both the best-rated as well as the worst-rated portfolio do outperform the market.⁶⁵ In particular, they provide an extra return of approx. 6.2 % and 8.7 % p.a. respectively. However, while for the worst-rated portfolio the outperformance turns out to be statistically significant, this is not the case for the best-rated portfolio. Despite that fact, as both portfolios yield a positive alpha it is reasonable to explore the long-short strategies, in order to analyze the relative difference in their performance. Obviously, the difference is rather moderate as none of the long-short portfolios is able to actually beat the market. However, while going long in the worst-rated and short in the best-rated portfolio is neither rewarded nor penalized the latter is true for the reversed strategy. In particular, an extra penalty of approx. -4.7 % p.a. is realized.

Alternatively, financial performance for the two subintervals, in particular from April 2004 until March 2009 and from April 2009 until August 2010, is derived. The results are reported

⁶⁴ Possibly, this may have been caused by the fact that only companies with a relatively high eligibility for the underlying SRI index portfolios have been considered in the analysis. As value stocks may satisfy this criterion more easily than growth stocks, it may have slightly deformed the distribution among the constructed portfolios in favour of the former. Similarly, this may have also affected the ratios of small and large cap companies in the portfolios. Here, however, probably in favour of the latter.

⁶⁵ For simplicity, further interpretation refers to financial performance as derived by the Carhart model for the value weighted portfolios. Of course, due to the high similarity of the results across models and types of weighting it is also relevant for all the remaining cases.

in tables 3a, 3b, 3c and 4a, 4b, 4c respectively.⁶⁶ For what regards the benchmark factors, with minor variations the above results are more or less confirmed in both subintervals.⁶⁷ Referring to financial performance, obviously, again the results do vary only moderately across the models and different types of weighting.⁶⁸ Not surprisingly, the results for the first subinterval are similar to those for the entire time interval. In fact, the former constitutes a major part of the latter. Nonetheless, two main differences are observed. First, the extra return of the best-rated portfolio turns out to be statistically significant as well. Second, the difference in financial performance between the best-rated and the worst-rated portfolio is almost non-existent. In the second subinterval, in contrast, none of the two portfolios does outperform the market. The difference between the two, however, becomes even more apparent. In particular, it is sufficiently large such that going long in the worst-rated and short in the best-rated portfolio respectively does actually beat the market. As in all other cases, applying the reverse strategy leads to an extra penalty. Although only at a 10 % significance level both the extra reward and the extra penalty are statistically significant. Per annum the values account for approx. 7.4 % and 7.0 % additional gain and loss respectively.⁶⁹

The obtained results suggest that time may play an important role in the relation between SR and financial performance. In particular, if the former has an effect on the latter it probably becomes apparent with certain time lag, possibly in the scale of years. More precisely, one may argue that socially responsible behaviour rather than having a contemporary effect on financial performance leads to an extra loss in the future. However, it may as well be the future behaviour itself or any other factor which is responsible for the obtained result. Hence, without further information it is hardly possible to make more specific statements in this regard.

⁶⁶ Note that the tables have the same form as tables 2a, 2b and 2c.

⁶⁷ Note that, although it only becomes apparent in the second subinterval, best-rated companies tend to have a lower book-to-market ratio than worst-rated companies. In other words, relative to the latter the former are more likely to be categorized as growth stocks. Along with a relatively higher ratio of small companies among the former group, already observed above, this result seems to be consistent with existing literature.

⁶⁸ Again, for simplicity, further interpretation refers to financial performance as derived by the Carhart model for the value weighted portfolios. To a large extent, it is also relevant for all the remaining cases. However, note that here the differences across models and types of weighting are slightly higher than in the above case, when the entire time interval was considered. The exact results for each particular case can of course be found in tables 3a – 4c.

⁶⁹ Note that in this case one of the values is almost equal to the negative of the other. This is due to the fact that the average risk free rate over the second subinterval was only slightly higher than zero.

B. Alternative Settings, Robustness

In order to test robustness of the above results, the analysis is carried out with alternative settings. In particular, different compositions of the best-rated and worst-rated portfolio, different time intervals and a different set of benchmark factors are used. Finally, instead of “indicator III” alternative indicators of SR are used. In all cases, for capacity reasons the results reported further always refer to the Carhart model and the value weighted portfolios only.⁷⁰

First, two alternative definitions of U and L , i.e. the thresholds in reference to which companies are classified as best-rated, worst-rated or none of both, are applied. More precisely, in contrast to the original definition, 1.25, or alternatively 1.5, standard deviations are added to and subtracted from mean SR achievement in order to derive U and L respectively. As a result, the corresponding sets Ω_B and Ω_W consist of 93 and 70, or alternatively 67 and 57, companies respectively.⁷¹ Of course, increasing the absolute difference in U and L does further strengthen the difference in SR achievement between the resulting best-rated and worst-rated portfolios. Accordingly, one may expect the original results to be confirmed or even enhanced for the alternative settings. In fact, this is what actually seems to occur. Tables 5a, 5b and 5c report the results for the two alternative definitions of U and L in comparison to the original one, for the entire time interval as well as the two subintervals respectively. Obviously, in all cases financial performance of the respective portfolios follows similar patterns.⁷² Moreover, the discrepancies across the two subintervals, already observed in the original results, are further enhanced. While in the first subinterval the difference in financial performance between the best-rated and the worst-rated portfolio actually disappears, the outperformance of the latter relative to the former in the

⁷⁰ Note that the differences relative to the other two models and an equal weighting are mostly negligible. The intuition behind preferring the Carhart model and value weighted portfolios is simple. In comparison to the CAPM model or the French and Fama model the Carhart model does control for the maximum number of factors. As the above results show return of the analyzed portfolios seems to be related to the momentum factor as well. Value weighting is preferred as it allows for the actual SR achievement of companies to be accounted for more properly in the portfolio structure.

⁷¹ Note that adding and subtracting higher multiples of the standard deviation to derive U and L is omitted, as it would respectively decrease the numbers of companies in Ω_B and Ω_W to 9 and 14 or even lower.

⁷² To some extent the patterns may seem to be even surprisingly similar. In fact, increasing the gap in SR achievement between the best-rated and the worst-rated portfolio hardly has any effect on the relative difference in their financial performance. Accordingly, it seems that whether SR and financial performance are related or not, small changes in the former will hardly cause noticeable changes in the latter. This observation is fully consistent with the more or less negligible difference between the results for equally weighted and value weighted portfolios, observable in tables 2a – 4c.

second subinterval increases. Besides, as a special case, it seems important to note that for the most stringent definition of U and L in the second subinterval the negative alpha of the best-rated portfolio becomes statistically significant, i.e. the portfolio actually underperforms the market.

Second, the starting month of the entire time interval, and hence of the first subinterval as well, is varied. In particular, each month from January 2000 to March 2009 is used as a possible starting month.⁷³ For all portfolios respectively figures 1a – 1d depict the resulting values of financial performance derived for the entire time interval with varying starting month. Again, the original results turn out to be relatively robust to the different settings applied. Obviously, in all cases both the best-rated as well as the worst-rated portfolio do outperform or at least do not significantly underperform the market. Also, the latter portfolio seems to be slightly more profitable than the former, whatever the time interval considered. Referring to the long-short portfolios the original results are confirmed as well. While it is mostly penalized to go long in the best-rated and short in the worst-rated portfolio, the reversed strategy is mostly indifferent from the market and eventually it may be also rewarded. Similarly, figures 2a – 2d depict financial performance in dependence of the starting month referring to the first subinterval, i.e. an interval ending with March 2009. Also here the original results seem to be confirmed. In principle, the above argumentation is valid for figures 2a – 2d as well.

Third, an alternative set of benchmark assets together with an alternative risk free asset is used. In particular, gross returns of the MSCI World Index, the difference in returns between the MSCI World Small Cap Index and the MSCI World Large Cap Index, and the difference in returns between the MSCI World Value Index and the MSCI World Growth Index in month t are used as $R_{MAR,t}$, $r_{CAP,t}$ and $r_{BTM,t}$ respectively. In addition, the monthly return of 1M US Dollar LIBOR is used as the risk free rate. Relative to the original settings, the corresponding results for all portfolios are reported in tables 6a, 6b and 6c for the entire time interval and the two subintervals respectively. Obviously, despite minor differences the original results are again confirmed.

⁷³ Note that for the first subinterval each month from January 2000 until April 2008 is used as a possible starting month, as for later starting months the time series would become too short.

Finally, instead of “indicator III” the analysis is carried out using “indicator I”, “indicator II” and “indicator IV” introduced in the first study.⁷⁴ The corresponding results are reported in table 7. Overall, whatever indicator is used similar patterns can be observed. In summary, the original results seem to be robust to all variations applied.

IV. Conclusion

The aim of this study was to provide further insights on the relation between social responsibility (SR) and financial performance. In particular, it has attempted to explore whether in terms of financial performance socially responsible behaviour is rewarded, penalized or none of both. Many studies have analyzed this issue before. This study is among the few, which compare financial performance of portfolios constructed explicitly for that purpose, based on their achievement with respect to some particular indicators of SR. It differs from other studies in that group as well, mainly by using a different indicator to measure SR of companies.

In summary, the relation between SR and financial performance turns out to be rather complex. Both, the most as well as the least socially responsible companies are able to beat the market, the latter even more than the former. When compared to each other, the most socially responsible companies are slightly outperformed by the least socially responsible companies. In particular cases, the respective difference is also statistically significant. In general, it seems that whatever return is achieved by the most socially responsible companies an equal or even higher return is achieved by the least socially responsible companies. Thus, strictly speaking, in terms of opportunity costs socially responsible behaviour is actually penalized. Although investing in a socially responsible way may not be necessarily unprofitable, for investors interested in profit alone applying the opposite strategy turns out to be a better choice. Implicitly, for any rational investor who nonetheless invests in a socially responsible way social responsibility itself must have positive utility.

The relation between SR and financial performance seems to be considerably dependent on time. In particular, it seems that if SR affects financial performance it does so with certain

⁷⁴ Accordingly, instead of a_i^{III} the value of a_i is set to be equal to a_i^I , a_i^{II} and a_i^{IV} respectively. The exact definitions of a_i^I , a_i^{II} and a_i^{IV} are provided in section II.B of the first study.

time lag, probably in the scale of years. However, in order to make proper statements in this respect, further research is required. In particular, similar analyses need to be conducted for longer time intervals, including information on how companies' behaviour changes over time. Finally, it should be noted that this study has referred to SR only in a general way. Of course, the relation between SR and financial performance may differ when SR is defined in terms of different criteria. In fact, in reality different individuals often use different criteria when defining SR. Thus, in order to provide relevant information for particular investors, similar analyses based on more specific definitions of SR are needed.

Appendix

Table 1: Descriptive statistics of the overall set Ω as well as the two subsets Ω_B and Ω_W

set	n	Eligibility				SR achievement			
		avg	stdev	min	max	avg	stdev	min	max
Ω	963	6,00	1,13	5	10	-2,13	2,78	-9	7
Ω_B	199	6,26	1,23	5	10	1,94	1,23	1	7
Ω_W	248	6,12	1,22	5	9	-5,56	0,96	-9	-5

Table 2a, 2b and 2c: Regression results for all eight portfolios for the time interval from April 2004 until August 2010 using a) the CAPM, b) Fama-French and c) Carhart model respectively. Each column contains the results obtained when excess return of a particular portfolio j , $R_{j,t} - R_{f,t}$, is used as a dependent variable. *, ** and *** refer to statistical significance at 10 %, 5 % and 1 % significance level. Standard errors of the regression coefficients are reported in parentheses.

a)

$R_{j,t}$	$R_{B,t}^{[eq]}$	$R_{W,t}^{[eq]}$	$R_{B-W,t}^{[eq]}$	$R_{W-B,t}^{[eq]}$	$R_{B,t}^{[val]}$	$R_{W,t}^{[val]}$	$R_{B-W,t}^{[val]}$	$R_{W-B,t}^{[val]}$
α_j^I	0,005 (0,004)	0,007** (0,003)	-0,004** (0,002)	0,000 (0,002)	0,005 (0,004)	0,007** (0,003)	-0,004** (0,002)	0,000 (0,002)
$\beta_{MAR,j}^I$	1,305*** (0,077)	1,294*** (0,069)	0,010 (0,032)	-0,012 (0,032)	1,339*** (0,078)	1,305*** (0,070)	0,033 (0,032)	-0,035 (0,032)
R^2	0,795	0,825	0,001	0,002	0,795	0,821	0,014	0,016
F	290,591	353,053	0,098	0,139	291,277	343,739	1,082	1,200

b)

$R_{j,t}$	$R_{B,t}^{[eq]}$	$R_{W,t}^{[eq]}$	$R_{B-W,t}^{[eq]}$	$R_{W-B,t}^{[eq]}$	$R_{B,t}^{[val]}$	$R_{W,t}^{[val]}$	$R_{B-W,t}^{[val]}$	$R_{W-B,t}^{[val]}$
α_j^{II}	0,005 (0,004)	0,007** (0,003)	-0,004** (0,002)	0,000 (0,002)	0,005 (0,004)	0,007** (0,003)	-0,004** (0,001)	0,000 (0,001)
$\beta_{MAR,j}^{II}$	1,256*** (0,091)	1,278*** (0,082)	-0,025 (0,037)	0,019 (0,037)	1,291*** (0,093)	1,292*** (0,084)	-0,004 (0,036)	-0,002 (0,037)
$\beta_{CAP,j}^{II}$	0,081 (0,171)	-0,057 (0,154)	0,149** (0,070)	-0,127* (0,070)	0,097 (0,175)	-0,059 (0,158)	0,166** (0,068)	-0,144** (0,069)
$\beta_{BTM,j}^{II}$	0,136 (0,151)	0,118 (0,137)	0,016 (0,062)	-0,020 (0,062)	0,118 (0,155)	0,108 (0,140)	0,009 (0,061)	-0,012 (0,061)
R^2	0,798	0,827	0,061	0,047	0,798	0,823	0,089	0,073
F	96,111	116,136	1,588	1,210	96,083	112,806	2,385	1,910

c)

$R_{j,t}$	$R_{B,t}^{[eq]}$	$R_{W,t}^{[eq]}$	$R_{B-W,t}^{[eq]}$	$R_{W-B,t}^{[eq]}$	$R_{B,t}^{[val]}$	$R_{W,t}^{[val]}$	$R_{B-W,t}^{[val]}$	$R_{W-B,t}^{[val]}$
α_j^{III}	0,005 (0,004)	0,007** (0,003)	-0,004** (0,001)	0,000 (0,001)	0,005 (0,004)	0,007** (0,003)	-0,004*** (0,001)	0,000 (0,001)
$\beta_{MAR,j}^{III}$	1,188*** (0,091)	1,233*** (0,084)	-0,049 (0,038)	0,039 (0,038)	1,224*** (0,093)	1,247*** (0,086)	-0,028 (0,037)	0,017 (0,038)
$\beta_{CAP,j}^{III}$	0,114 (0,164)	-0,034 (0,151)	0,161** (0,069)	-0,137* (0,069)	0,129 (0,169)	-0,037 (0,155)	0,178*** (0,067)	-0,154** (0,068)
$\beta_{BTM,j}^{III}$	0,036 (0,150)	0,051 (0,138)	-0,020 (0,063)	0,010 (0,063)	0,020 (0,155)	0,042 (0,142)	-0,026 (0,061)	0,017 (0,062)
$\beta_{MOM,j}^{III}$	-0,185*** (0,069)	-0,124* (0,063)	-0,067** (0,029)	0,055* (0,029)	-0,181** (0,071)	-0,122* (0,065)	-0,065** (0,028)	0,053* (0,029)
R^2	0,817	0,836	0,128	0,093	0,815	0,831	0,153	0,114
F	80,102	91,461	2,645	1,841	79,190	88,471	3,255	2,327

Table 3a, 3b and 3c: Regression results for all eight portfolios for the time interval from April 2004 until March 2009 using a) the CAPM, b) Fama-French and c) Carhart model respectively. Each column contains the results obtained when excess return of a particular portfolio j , $R_{j,t} - R_{f,t}$, is used as a dependent variable. *, ** and *** refer to statistical significance at 10 %, 5 % and 1 % significance level. Standard errors of the regression coefficients are reported in parentheses.

a)

$R_{j,t}$	$R_{B,t}^{[eq]}$	$R_{W,t}^{[eq]}$	$R_{B-W,t}^{[eq]}$	$R_{W-B,t}^{[eq]}$	$R_{B,t}^{[val]}$	$R_{W,t}^{[val]}$	$R_{B-W,t}^{[val]}$	$R_{W-B,t}^{[val]}$
α_j^I	0,007 (0,004)	0,009** (0,004)	-0,004** (0,002)	-0,001 (0,002)	0,008* (0,004)	0,009** (0,004)	-0,004** (0,002)	-0,001 (0,002)
$\beta_{MAR,j}^I$	1,314*** (0,096)	1,323*** (0,087)	-0,017 (0,040)	0,000 (0,040)	1,352*** (0,097)	1,332*** (0,089)	0,011 (0,039)	-0,028 (0,039)
R^2	0,762	0,798	0,003	0,000	0,770	0,795	0,001	0,009
F	185,540	229,515	0,181	0,000	193,715	224,918	0,079	0,532

b)

$R_{j,t}$	$R_{B,t}^{[eq]}$	$R_{W,t}^{[eq]}$	$R_{B-W,t}^{[eq]}$	$R_{W-B,t}^{[eq]}$	$R_{B,t}^{[val]}$	$R_{W,t}^{[val]}$	$R_{B-W,t}^{[val]}$	$R_{W-B,t}^{[val]}$
α_j^{II}	0,006 (0,004)	0,008** (0,004)	-0,004** (0,002)	-0,001 (0,002)	0,007* (0,004)	0,008** (0,004)	-0,004** (0,002)	-0,001 (0,002)
$\beta_{MAR,j}^{II}$	1,197*** (0,106)	1,250*** (0,098)	-0,064 (0,045)	0,043 (0,045)	1,233*** (0,107)	1,259*** (0,100)	-0,037 (0,043)	0,016 (0,043)
$\beta_{CAP,j}^{II}$	0,318 (0,211)	0,152 (0,195)	0,180** (0,089)	-0,152* (0,088)	0,336 (0,212)	0,153 (0,199)	0,197** (0,086)	-0,169* (0,086)
$\beta_{BTM,j}^{II}$	0,338* (0,175)	0,266 (0,162)	0,068 (0,074)	-0,077 (0,073)	0,326* (0,177)	0,267 (0,165)	0,054 (0,071)	-0,063 (0,071)
R^2	0,785	0,809	0,084	0,067	0,791	0,806	0,095	0,085
F	67,989	79,246	1,709	1,336	70,776	77,557	1,967	1,729

c)

$R_{j,t}$	$R_{B,t}^{[eq]}$	$R_{W,t}^{[eq]}$	$R_{B-W,t}^{[eq]}$	$R_{W-B,t}^{[eq]}$	$R_{B,t}^{[val]}$	$R_{W,t}^{[val]}$	$R_{B-W,t}^{[val]}$	$R_{W-B,t}^{[val]}$
α_j^{III}	0,008* (0,004)	0,009** (0,004)	-0,004** (0,002)	-0,001 (0,002)	0,009** (0,004)	0,009** (0,004)	-0,003* (0,002)	-0,002 (0,002)
$\beta_{MAR,j}^{III}$	1,112*** (0,104)	1,206*** (0,101)	-0,106** (0,042)	0,082* (0,043)	1,157*** (0,107)	1,219*** (0,104)	-0,074* (0,042)	0,050 (0,042)
$\beta_{CAP,j}^{III}$	0,391* (0,199)	0,190 (0,194)	0,216** (0,081)	-0,186** (0,082)	0,401* (0,204)	0,188 (0,198)	0,229*** (0,080)	-0,198** (0,081)
$\beta_{BTM,j}^{III}$	0,252 (0,167)	0,221 (0,163)	0,025 (0,068)	-0,037 (0,069)	0,249 (0,171)	0,226 (0,166)	0,017 (0,067)	-0,029 (0,068)
$\beta_{MOM,j}^{III}$	-0,318*** (0,109)	-0,165 (0,106)	-0,157*** (0,044)	0,149*** (0,045)	-0,283** (0,112)	-0,151 (0,108)	-0,137*** (0,044)	0,128*** (0,044)
R^2	0,813	0,817	0,253	0,223	0,813	0,813	0,231	0,206
F	59,970	61,561	4,664	3,940	59,842	59,623	4,119	3,562

Table 4a, 4b and 4c: Regression results for all eight portfolios for the time interval from April 2009 until August 2010 using a) the CAPM, b) Fama-French and c) Carhart model respectively. Each column contains the results obtained when excess return of a particular portfolio j , $R_{j,t} - R_{f,t}$, is used as a dependent variable. *, ** and *** refer to statistical significance at 10 %, 5 % and 1 % significance level. Standard errors of the regression coefficients are reported in parentheses.

a)

$R_{j,t}$	$R_{B,t}^{[eq]}$	$R_{W,t}^{[eq]}$	$R_{B-W,t}^{[eq]}$	$R_{W-B,t}^{[eq]}$	$R_{B,t}^{[val]}$	$R_{W,t}^{[val]}$	$R_{B-W,t}^{[val]}$	$R_{W-B,t}^{[val]}$
α_j^I	-0,002 (0,007)	0,002 (0,006)	-0,004 (0,003)	0,003 (0,003)	-0,003 (0,008)	0,002 (0,007)	-0,005 (0,003)	0,005 (0,003)
$\beta_{MAR,j}^I$	1,340*** (0,131)	1,274*** (0,114)	0,066 (0,057)	-0,066 (0,057)	1,383*** (0,143)	1,292*** (0,119)	0,091 (0,058)	-0,091 (0,058)
R^2	0,875	0,893	0,082	0,081	0,862	0,888	0,141	0,141
F	104,659	125,590	1,335	1,329	93,724	118,435	2,469	2,456

b)

$R_{j,t}$	$R_{B,t}^{[eq]}$	$R_{W,t}^{[eq]}$	$R_{B-W,t}^{[eq]}$	$R_{W-B,t}^{[eq]}$	$R_{B,t}^{[val]}$	$R_{W,t}^{[val]}$	$R_{B-W,t}^{[val]}$	$R_{W-B,t}^{[val]}$
α_j^{II}	-0,002 (0,007)	0,002 (0,006)	-0,004 (0,003)	0,004 (0,003)	-0,004 (0,008)	0,002 (0,006)	-0,006* (0,003)	0,006* (0,003)
$\beta_{MAR,j}^{II}$	1,557*** (0,171)	1,425*** (0,147)	0,133* (0,072)	-0,132* (0,073)	1,614*** (0,188)	1,468*** (0,151)	0,146* (0,075)	-0,146* (0,075)
$\beta_{CAP,j}^{II}$	-0,161 (0,258)	-0,329 (0,221)	0,168 (0,109)	-0,167 (0,110)	-0,140 (0,284)	-0,319 (0,228)	0,180 (0,113)	-0,179 (0,113)
$\beta_{BTM,j}^{II}$	-0,430 (0,296)	-0,186 (0,254)	-0,245* (0,125)	0,244* (0,126)	-0,474 (0,326)	-0,252 (0,262)	-0,223 (0,129)	0,221 (0,130)
R^2	0,902	0,919	0,322	0,319	0,890	0,916	0,345	0,342
F	39,891	48,980	2,061	2,033	35,050	47,295	2,286	2,254

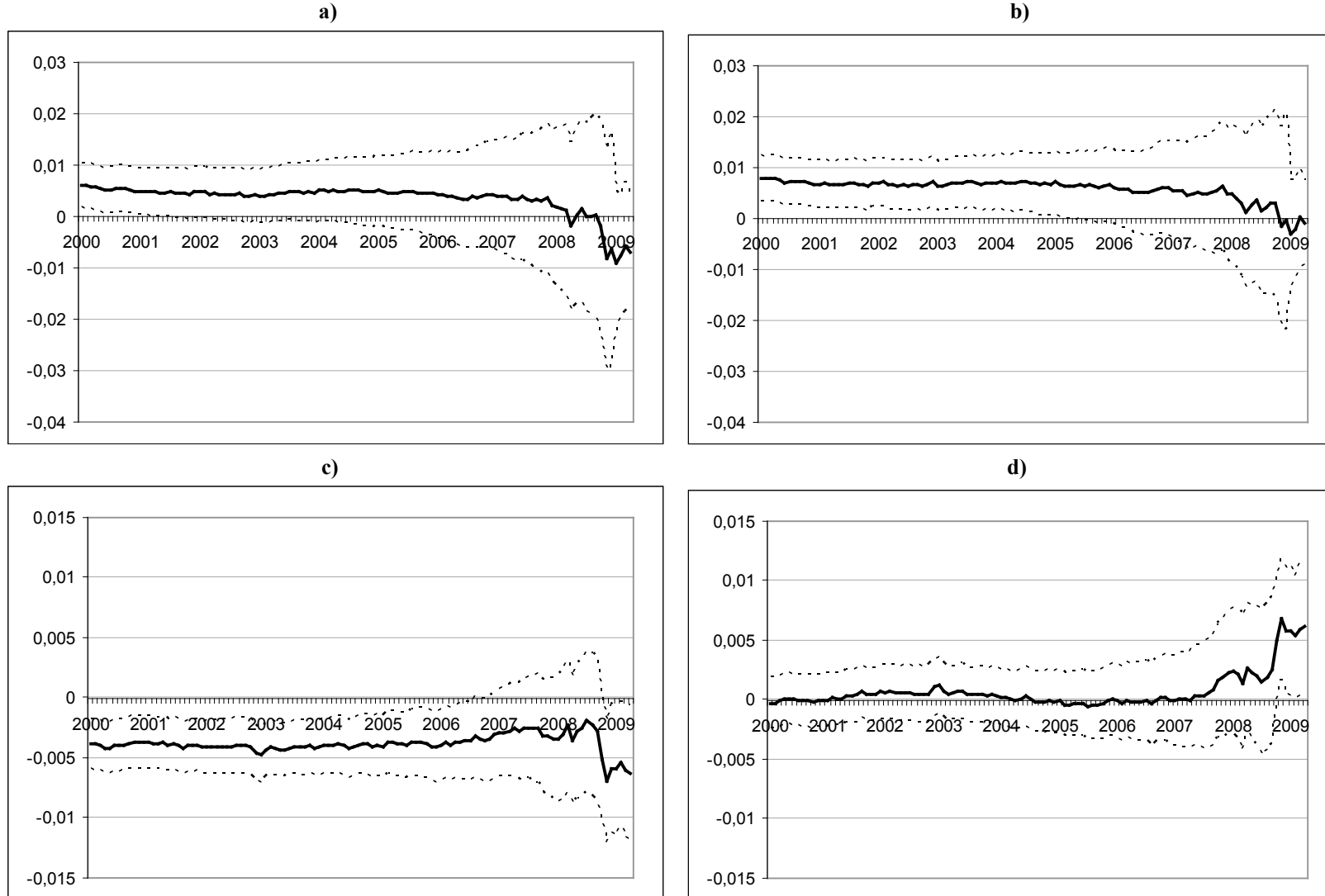
c)

$R_{j,t}$	$R_{B,t}^{[eq]}$	$R_{W,t}^{[eq]}$	$R_{B-W,t}^{[eq]}$	$R_{W-B,t}^{[eq]}$	$R_{B,t}^{[val]}$	$R_{W,t}^{[val]}$	$R_{B-W,t}^{[val]}$	$R_{W-B,t}^{[val]}$
α_j^{III}	-0,005 (0,006)	0,000 (0,005)	-0,004 (0,003)	0,004 (0,003)	-0,007 (0,006)	-0,001 (0,005)	-0,006* (0,003)	0,006* (0,003)
$\beta_{MAR,j}^{III}$	1,491*** (0,135)	1,365*** (0,111)	0,126 (0,075)	-0,126 (0,076)	1,538*** (0,145)	1,404*** (0,111)	0,135 (0,076)	-0,134 (0,076)
$\beta_{CAP,j}^{III}$	-0,094 (0,202)	-0,269 (0,166)	0,175 (0,113)	-0,174 (0,113)	-0,064 (0,218)	-0,255 (0,167)	0,191 (0,114)	-0,191 (0,114)
$\beta_{BTM,j}^{III}$	-0,659** (0,242)	-0,392* (0,199)	-0,268* (0,136)	0,267* (0,136)	-0,733** (0,261)	-0,471** (0,200)	-0,262* (0,137)	0,262* (0,137)
$\beta_{MOM,j}^{III}$	-0,196*** (0,064)	-0,176*** (0,052)	-0,019 (0,036)	0,020 (0,036)	-0,222*** (0,069)	-0,188*** (0,053)	-0,034 (0,036)	0,034 (0,036)
R^2	0,945	0,958	0,338	0,336	0,941	0,959	0,390	0,388
F	51,598	68,642	1,534	1,520	47,869	70,536	1,921	1,904

Table 5a, 5b, 5c: Regression results of the Carhart model for all four value weighted portfolios, constructed for each of the three definitions of U and L , for the time intervals a) April 2004 - August 2010, b) April 2004 - March 2009 and c) April 2009 - August 2010 respectively. Each column contains the results obtained when excess return of a particular portfolio j , $R_{j,t} - R_{f,t}$, is used as a dependent variable. *, ** and *** refer to statistical significance at 10 %, 5 % and 1 % significance level.

a)													
	$U = \mu + \sigma$ and $L = \mu - \sigma$				$U = \mu + 1.25\sigma$ and $L = \mu - 1.25\sigma$				$U = \mu + 1.5\sigma$ and $L = \mu - 1.5\sigma$				
$R_{j,t}$	$R_{B,t}^{[val]}$	$R_{W,t}^{[val]}$	$R_{B-W,t}^{[val]}$	$R_{W-B,t}^{[val]}$	$R_{B,t}^{[val]}$	$R_{W,t}^{[val]}$	$R_{B-W,t}^{[val]}$	$R_{W-B,t}^{[val]}$	$R_{B,t}^{[val]}$	$R_{W,t}^{[val]}$	$R_{B-W,t}^{[val]}$	$R_{W-B,t}^{[val]}$	
α_j	0,005	0,007**	-0,004***	0,000	0,006	0,008**	-0,005***	0,001	0,006	0,008*	-0,004**	0,000	
$\beta_{MAR,j}$	1,224***	1,247***	-0,028	0,017	1,313***	1,304***	0,004	-0,014	1,336***	1,285***	0,046	-0,056	
$\beta_{CAP,j}$	0,129	-0,037	0,178***	-0,154**	0,134	-0,066	0,212***	-0,188**	0,208	-0,048	0,268***	-0,244***	
$\beta_{BTM,j}$	0,020	0,042	-0,026	0,017	-0,029	-0,005	-0,029	0,019	-0,021	0,023	-0,049	0,039	
$\beta_{MOM,j}$	-0,181**	-0,122*	-0,065**	0,053*	-0,167**	-0,105	-0,068**	0,056	-0,170**	-0,120	-0,056	0,044	
R^2	0,815	0,831	0,153	0,114	0,799	0,792	0,172	0,141	0,795	0,792	0,233	0,203	
b)													
α_j	0,009**	0,009**	-0,003*	-0,002	0,010**	0,010**	-0,003*	-0,002	0,011**	0,010**	-0,002	-0,003	
$\beta_{MAR,j}$	1,157***	1,219***	-0,074*	0,050	1,260***	1,270***	-0,022	-0,002	1,301***	1,249***	0,040	-0,064	
$\beta_{CAP,j}$	0,401*	0,188	0,229***	-0,198**	0,415*	0,179	0,251**	-0,221**	0,480**	0,164	0,331***	-0,301***	
$\beta_{BTM,j}$	0,249	0,226	0,017	-0,029	0,244	0,259	-0,021	0,010	0,247	0,272	-0,031	0,019	
$\beta_{MOM,j}$	-0,283**	-0,151	-0,137***	0,128***	-0,193	-0,073	-0,123**	0,115**	-0,190	-0,116	-0,078	0,070	
R^2	0,813	0,813	0,231	0,206	0,805	0,778	0,187	0,179	0,801	0,777	0,251	0,254	
c)													
α_j	-0,007	-0,001	-0,006*	0,006*	-0,011	-0,002	-0,009*	0,009*	-0,014*	-0,004	-0,010**	0,010**	
$\beta_{MAR,j}$	1,538***	1,404***	0,135	-0,134	1,667***	1,568***	0,100	-0,099	1,657***	1,567***	0,091	-0,090	
$\beta_{CAP,j}$	-0,064	-0,255	0,191	-0,191	-0,051	-0,244	0,193	-0,192	0,031	-0,153	0,185	-0,184	
$\beta_{BTM,j}$	-0,733**	-0,471**	-0,262*	0,262*	-0,950**	-0,843***	-0,108	0,107	-0,909**	-0,819***	-0,091	0,090	
$\beta_{MOM,j}$	-0,222***	-0,188***	-0,034	0,034	-0,279***	-0,231***	-0,048	0,048	-0,298***	-0,229***	-0,068	0,068	
R^2	0,941	0,959	0,390	0,388	0,927	0,954	0,311	0,310	0,929	0,939	0,363	0,363	

Figures 1a – 1d: Financial performance (vertical axis), including 90 % confidence intervals, of all four value weighted portfolios in dependence of the starting month (horizontal axis), with the last month being August 2010 in each case. In particular, all months from January 2000 until April 2009 are used as a possible starting month. The figures a), b), c) and d) depict the results as derived by the Carhart model with excess returns of portfolio j , $R_{j,t} - R_{f,t}$, used as a dependent variable, where $R_{j,t}$ refers to $R_{B,t}^{[val]}$, $R_{W,t}^{[val]}$, $R_{B-W,t}^{[val]}$ and $R_{W-B,t}^{[val]}$ respectively.



Figures 2a – 2d: Financial performance (vertical axis), including 90 % confidence intervals, of all four value weighted portfolios in dependence of the starting month (horizontal axis), with the last month being March 2009 in each case. In particular, all months from January 2000 until April 2008 are used as a possible starting month. The figures a), b), c) and d) depict the results as derived by the Carhart model with excess returns of portfolio j , $R_{j,t} - R_{f,t}$, used as a dependent variable, where $R_{j,t}$ refers to $R_{B,t}^{[val]}$, $R_{W,t}^{[val]}$, $R_{B-W,t}^{[val]}$ and $R_{W-B,t}^{[val]}$ respectively.

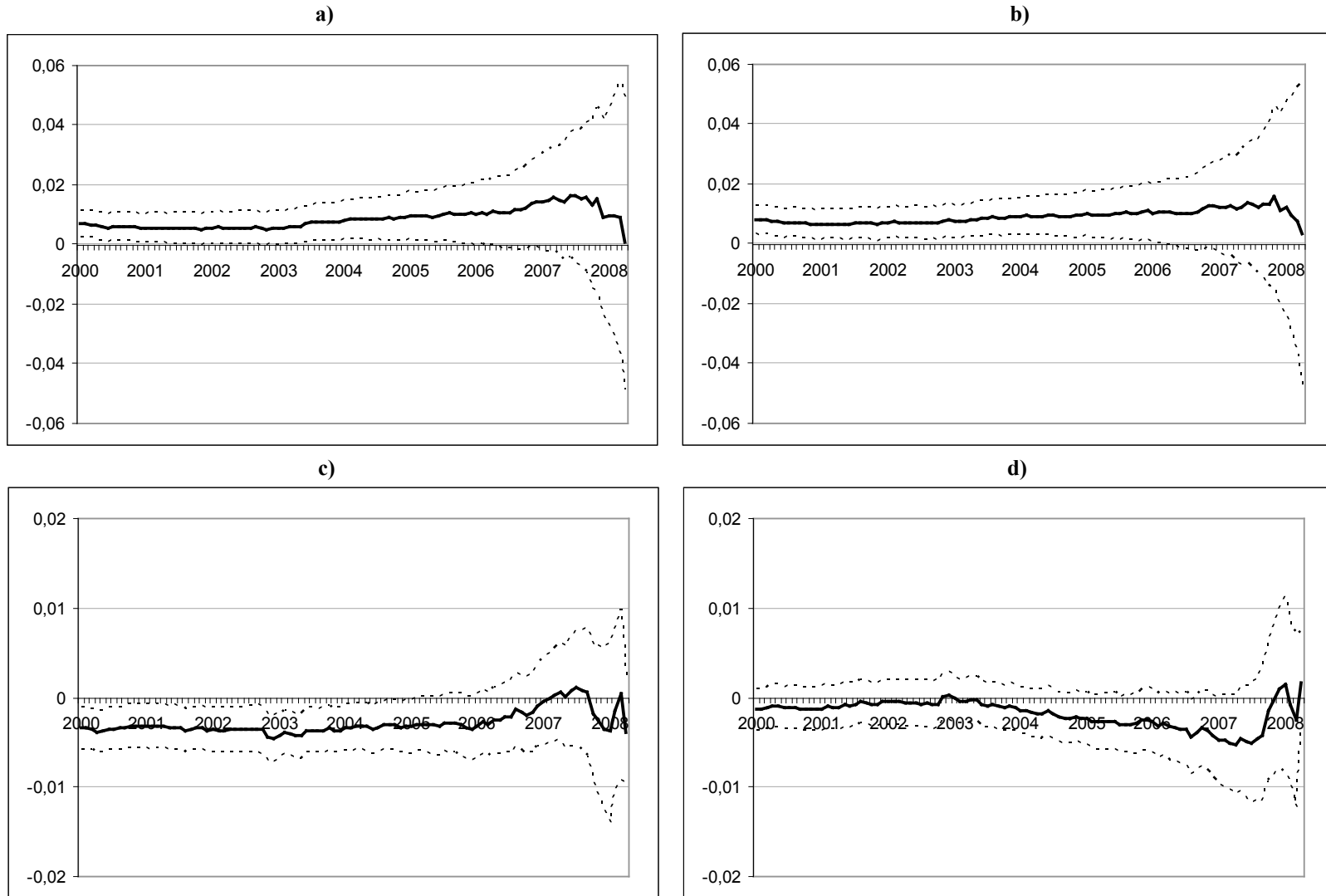


Table 6a, 6b, 6c: Regression results of the Carhart model for all four value weighted portfolios, using each set of benchmark assets and the corresponding risk free asset, for the time intervals a) April 2004 - August 2010, b) April 2004 - March 2009 and c) April 2009 - August 2010 respectively. Each column contains the results obtained when excess return of a particular portfolio j , $R_{j,t} - R_{f,t}$, is used as a dependent variable. *, ** and *** refer to statistical significance at 10 %, 5 % and 1 % significance level.

$R_{j,t}$	Kenneth French Database, T-Bill				MSCI Indexes, Libor			
	$R_{B,t}^{[val]}$	$R_{W,t}^{[val]}$	$R_{B-W,t}^{[val]}$	$R_{W-B,t}^{[val]}$	$R_{B,t}^{[val]}$	$R_{W,t}^{[val]}$	$R_{B-W,t}^{[val]}$	$R_{W-B,t}^{[val]}$
α_j	0,005	0,007**	-0,004***	0,000	0,007*	0,009***	-0,004***	-0,001
$\beta_{MAR,j}$	1,224***	1,247***	-0,028	0,017	1,213***	1,213***	-0,004	-0,005
$\beta_{CAP,j}$	0,129	-0,037	0,178***	-0,154**	0,093	0,155	-0,039	0,085
$\beta_{BTM,j}$	0,020	0,042	-0,026	0,017	-0,036	-0,016	-0,027	0,013
$\beta_{MOM,j}$	-0,181**	-0,122*	-0,065**	0,053*	-0,199**	-0,136**	-0,070**	0,057*
R^2	0,815	0,831	0,153	0,114	0,819	0,858	0,077	0,060
b)								
α_j	0,009**	0,009**	-0,003*	-0,002	0,011**	0,011***	-0,004**	-0,002
$\beta_{MAR,j}$	1,157***	1,219***	-0,074*	0,050	1,142***	1,177***	-0,046	0,024
$\beta_{CAP,j}$	0,401*	0,188	0,229***	-0,198**	0,433	0,426*	0,033	0,021
$\beta_{BTM,j}$	0,249	0,226	0,017	-0,029	0,113	0,088	0,023	-0,026
$\beta_{MOM,j}$	-0,283**	-0,151	-0,137***	0,128***	-0,404***	-0,281***	-0,129***	0,116**
R^2	0,813	0,813	0,231	0,206	0,804	0,839	0,138	0,121
c)								
α_j	-0,007	-0,001	-0,006*	0,006*	-0,002	0,005	-0,007*	0,006
$\beta_{MAR,j}$	1,538***	1,404***	0,135	-0,134	1,337***	1,234***	0,103	-0,103
$\beta_{CAP,j}$	-0,064	-0,255	0,191	-0,191	-0,145	-0,168	0,024	-0,023
$\beta_{BTM,j}$	-0,733**	-0,471**	-0,262*	0,262*	-0,640	-0,225	-0,414	0,416
$\beta_{MOM,j}$	-0,222***	-0,188***	-0,034	0,034	-0,202*	-0,137	-0,064	0,065
R^2	0,941	0,959	0,390	0,388	0,939	0,960	0,253	0,256

Table 7a, 7b, 7c: Regression results of the Carhart model for all four value weighted portfolios, constructed based on “indicator I”, “indicator II” and “indicator IV” from the first study for the time intervals a) April 2004 - August 2010, b) April 2004 - March 2009 and c) April 2009 - August 2010 respectively. Each column contains the results obtained when excess return of a particular portfolio j , $R_{j,t} - R_{f,t}$, is used as a dependent variable. *, ** and *** refer to statistical significance at 10 %, 5 % and 1 % significance level.

a)													
	“Indicator I”				“Indicator II”				“Indicator IV”				
$R_{j,t}$	$R_{B,t}^{[val]}$	$R_{W,t}^{[val]}$	$R_{B-W,t}^{[val]}$	$R_{W-B,t}^{[val]}$	$R_{B,t}^{[val]}$	$R_{W,t}^{[val]}$	$R_{B-W,t}^{[val]}$	$R_{W-B,t}^{[val]}$	$R_{B,t}^{[val]}$	$R_{W,t}^{[val]}$	$R_{B-W,t}^{[val]}$	$R_{W-B,t}^{[val]}$	
α_j	0,005	0,006**	-0,003***	-0,001	0,005	0,006**	-0,003*	-0,001	0,004	0,006*	-0,004**	0,000	
$\beta_{MAR,j}$	1,216***	1,203***	0,008	-0,019	1,253***	1,203***	0,045	-0,055	1,222***	1,186***	0,031	-0,041	
$\beta_{CAP,j}$	0,044	-0,024	0,079	-0,055	0,159	-0,024	0,194**	-0,170**	0,089	0,034	0,067	-0,043	
$\beta_{BTM,j}$	0,054	0,040	0,010	-0,020	0,032	0,040	-0,013	0,003	0,050	0,029	0,016	-0,026	
$\beta_{MOM,j}$	-0,180***	-0,109*	-0,076***	0,064***	-0,178**	-0,109*	-0,074**	0,062*	-0,180**	-0,122*	-0,064*	0,052	
R^2	0,843	0,842	0,216	0,188	0,813	0,842	0,236	0,202	0,819	0,829	0,113	0,094	
b)													
α_j	0,007**	0,008**	-0,003***	-0,002	0,009**	0,008**	-0,002	-0,003*	0,007*	0,009**	-0,004**	-0,001	
$\beta_{MAR,j}$	1,148***	1,182***	-0,046	0,022	1,193***	1,182***	-0,001	-0,023	1,151***	1,151***	-0,012	-0,012	
$\beta_{CAP,j}$	0,324*	0,168	0,171***	-0,141**	0,427**	0,168	0,274***	-0,244**	0,357*	0,242	0,130	-0,100	
$\beta_{BTM,j}$	0,285*	0,199	0,080	-0,092*	0,268	0,199	0,063	-0,074	0,281*	0,197	0,078	0,090	
$\beta_{MOM,j}$	-0,274***	-0,119	-0,160***	0,151***	-0,253**	-0,119	-0,138***	0,130**	-0,256**	-0,163	-0,097*	0,089	
R^2	0,840	0,822	0,401	0,400	0,813	0,822	0,299	0,292	0,816	0,809	0,120	0,118	
c)													
α_j	-0,002	-0,001	-0,001	0,001	-0,009	-0,001	-0,008*	0,008*	-0,006	-0,001	-0,004	0,004	
$\beta_{MAR,j}$	1,488***	1,337***	0,151**	-0,151**	1,573***	1,337***	0,236**	-0,236**	1,548***	1,365***	0,183	-0,182	
$\beta_{CAP,j}$	-0,188	-0,215	0,027	-0,027	-0,028	-0,215	0,187	-0,187	-0,107	-0,154	0,048	-0,047	
$\beta_{BTM,j}$	-0,652***	-0,403*	-0,249**	0,248**	-0,753**	-0,403*	-0,350*	0,349*	-0,718**	-0,466***	-0,253	0,252	
$\beta_{MOM,j}$	-0,211***	-0,176***	-0,035	0,036	-0,241***	-0,176***	-0,065	0,066	-0,228**	-0,172**	-0,056	0,056	
R^2	0,963	0,958	0,440	0,438	0,932	0,958	0,481	0,479	0,927	0,950	0,288	0,287	

References

- Bauer, R., Otten, R., Tourani, R. A., 2004, “Ethical Investing in Australia: Is there a Financial Penalty?”, *EFA 2004 Maastricht Meetings Paper, EFMA 2004 Basel Meetings Paper*.
- Carhart, M. M., 1997, “On Persistence in Mutual Fund Performance”, *The Journal of Finance*, Vol. 52 (1), pp. 57 – 82.
- Diltz, J. D, 1995, “Does Social Screening Affect Portfolio Performance?”, *The Journal of Investing*, Vol. 4 (1), pp. 64 – 69.
- Eurosif, 2010, “European SRI Study 2010”, Revised Edition.
- Fama, E., French, K. R., 1993, “Common Risk Factors in the Returns on Stocks and Bonds”, *Journal of Financial Economics*, Vol. 33, pp. 3 – 56.
- Hamilton, S., Jo, H., Statman, M., 1993, “Doing Well while Doing Good? The Investment Performance of Socially Responsible Mutual Funds”, *Financial Analysts Journal*, Vol. 49 (6), pp. 62-66.
- Kempf, A., Ostoff, P., 2007, “The Effect of Socially Responsible Investing on Portfolio Performance”, *European Financial Management*, Vol. 13 (5), pp. 908 – 922.
- Kreander, N., Gray, R. H., Power, D. M., Sinclair, C. D., 2005, “Evaluating the Performance of Ethical and Non-Ethical Funds: A Matched Pair Analysis”, *Journal of Business Finance & Accounting*, Vol. 32 (7) & (8), pp. 1465 – 1493 .
- Manescu, C., 2010, “Stock Returns in Relation to Environmental, Social and Governance Performance: Mispricing or Compensation for Risk?”, *Working Papers in Economics from Göteborg University*.

Sauer, D. A., 1997, “The Impact of Social-Responsibility Screens on Investment Performance: Evidence from the Domini 400 Social Index and Domini Equity Mutual Fund” *Review of Financial Economics*, Vol. 6 (2), pp. 137 – 149.

Schröder, M., 2007, “Is there a Difference? The Performance Characteristics of SRI Equity Indices”, *Journal of Business Finance & Accounting*, Vol. 34 (1) & (2), pp. 331 – 348.

Statman, M., Glushkov, D., 2009, “The Wages of Social Responsibility”, *Financial Analysts Journal*, Vol. 65 (4), 33 – 46.

Chapter 3: Costs of Social Responsibility in a Mean-Variance World

This study investigates the costs of socially responsible investing in a world, in which investors are perfectly informed about the probability distribution of future returns, rational enough in order to make optimal investment decisions and have mean-variance preferences. For this purpose, a socially responsible investor is considered to select his or her optimal investment portfolio from a set of investment portfolios, which satisfy a given social responsibility constraint i.e. achieve some minimal degree of social responsibility. As the constraint is strengthened i.e. the minimal degree of social responsibility is increased, the effect on financial performance of the investor's optimal investment portfolio is analyzed. With social responsibility measured in terms of the indicators introduced in the first study, the observed effect is hardly negligible. In fact, even if only an average degree of social responsibility among all risky assets is required a part of the return has to be sacrificed. Moreover, increasing the minimal degree of social responsibility by one times the standard deviation among all risky assets, typically, a considerable drop in financial performance is induced. With some exceptions, this drop may account for one tenth up to one fifth of financial performance achieved by a conventional investor. Finally, the effect of social responsibility on financial performance seems to depend strongly on the exact form of the applied social responsibility constraint.

I. Introduction

Consider an investor, who wants to find an investment portfolio, which offers him or her a maximum level of financial performance, represented by some well defined measure. In addition, suppose the investor adheres to certain principles of social responsibility. In particular, he or she requires that the investment portfolio achieves some minimal degree of social responsibility, which the investor is able to measure in some way. Under these circumstances the investor faces an optimization problem, where the objective is to maximize a particular measure of financial performance, while the minimal requirement of social responsibility provides an additional constraint, which in some way restricts the feasible set of investment portfolios. In general, when searching for the solution of an arbitrary optimization problem with a given objective function, imposing an additional constraint can never lead to an improvement in the result.⁷⁵ In fact, whenever an additional constraint is imposed, it will either have no effect on the result or it will eventually make it worse. In analogy, whatever the

⁷⁵ Note that here a constraint would be said to 'improve the result' if the optimal solution satisfying the constraint would perform better with respect to the given objective function than the optimal solution of an otherwise identical problem, in which the constraint is not considered.

particular measure of financial performance, in terms of that measure imposing an arbitrary social responsibility constraint to portfolio selection will at best leave the investor equally satisfied or it will eventually make him or her worse off.⁷⁶

There is abundant scientific literature studying the relation between social responsibility and various measures of financial performance. Typically, most studies have compared financial performance of so called socially responsible and conventional investment funds or indexes. Studying different samples for different time periods and applying different methodologies, not surprisingly, different results have been obtained. While some have found socially responsible investments to be outperformed by conventional investments, e.g. White (1995), Gregory et al. (1997), others have found no difference at all, e.g. Sauer (1997), Kreander et al. (2005), and eventually, in some analyses socially responsible investments have even turned out to perform better than conventional investments, e.g. Mahoney and Roberts (2002), Garz et al. (2002). As a result, it has been concluded that applying principles of social responsibility in portfolio selection may respectively decrease, leave it unaffected or even increase financial performance.

Of course, this type of argumentation is only reasonable if investors are either not perfectly informed about the probability distribution of future returns or if they are not rational enough, in order to make optimal decisions with respect to their objectives. In fact, if investors were both sufficiently informed and rational an investment portfolio constructed optimally from a feasible set, which would be constrained in some way, could never perform better than a portfolio constructed optimally from the very same feasible set, which would not be constrained at all.⁷⁷ Under these circumstances, social responsibility could never have an improving effect on financial performance. At best it could leave it unaffected and eventually it may even decrease it.

It is the aim of this study to analyze the effect of social responsibility on financial performance in a world, where investors know the probability distribution of future returns

⁷⁶ provided that the investor is perfectly informed and rational enough to make optimal investment decisions; Note that here the investor is said to be 'equally satisfied' or 'worse off' if respectively the optimal investment portfolio satisfying the imposed constraint performs equally well or worse with respect to the investor's objective function than the optimal investment portfolio of an otherwise identical problem, in which the constraint is not considered. The exact effect will of course depend on the form of the investor's objective function, the form of the imposed constraint and possibly several other factors.

⁷⁷ Note that here, an investment portfolio would be said to 'perform better' if it achieved a higher value with respect to the underlying objective function.

and are able to find their optimal investment portfolio. As mentioned above, in this kind of world, applying principles of social responsibility in portfolio selection can never induce additional profits yet it can very well induce additional costs. The aim of this study is to explore the magnitude of these costs. In particular, the analysis is carried out for investors with mean-variance preferences, with social responsibility being measured in terms of the indicators introduced in the first study.

The rest of the study is organized as follows. In Section II., a theoretical model is set up, with social responsibility constraints considered in three different ways. Furthermore, in Section III., all relevant data are described and the applied methodology is specified. In Section IV., the results are reported and interpreted, along with a number of robustness tests. Finally, in Section V., the study concludes. All tables, figures and theoretical proofs are provided in the Appendix.

II. Model

Consider a market with one risk free and n risky assets. Let the gross return of the risk free asset and the gross return of risky asset i in period t be denoted by R_{ft} and $\tilde{R}_{it}$ respectively. Also, suppose that the degree of social responsibility of the risk free asset as well as that of an arbitrary risky asset i can be measured explicitly and let it be denoted by a_f and a_i respectively.⁷⁸

Furthermore, consider an investor with mean-variance preferences of the following form

$$V(\tilde{q}) = E(\tilde{q}) - k \cdot Var(\tilde{q})$$

where $V(\tilde{q})$ is the personal value (utility) which the investor derives from holding an arbitrary lottery $\tilde{q}$.⁷⁹ Suppose at time t the investor is endowed with an initial wealth amount w_t and

⁷⁸ Note that the time index has been omitted here, since in the model the degree of social responsibility of an arbitrary asset will not change over time.

⁷⁹ According to Eeckhoudt and Gollier (1995), given mean-variance preferences, it is sufficient to consider this type of value function „for all questions concerning portfolio management“.

that he or she is willing to invest this amount in the above market for the next time period, i.e. period $t+1$.

Denoting the relative weight of the investor's initial wealth to be invested in risky asset i by x_i , formally, the optimization problem faced by the investor may be expressed as

$$\max_{x_1, \dots, x_n} \{E(\tilde{w}_{t+1}) - k \cdot Var(\tilde{w}_{t+1})\}$$

$$\text{where } \tilde{w}_{t+1} = w_t R_{f,t+1} + w_t \sum_{i=1}^n x_i (\tilde{R}_{i,t+1} - R_{f,t+1})$$

Obviously, an investor facing this type of problem can be referred to as a 'conventional investor', i.e. an investor who does not adhere to any principles of social responsibility.

As an extension, let us now assume the above investor becomes socially responsible. In particular, suppose the investor requires that his or her investment portfolio achieves some minimal degree of social responsibility. Accordingly, the above optimization problem has to be extended by an appropriate constraint. In order to allow for different forms of the investor's requirement, in consequence, three different cases are distinguished.

In case 1, suppose the investor requires that his or her investment portfolio including all assets, i.e. including the risk free asset as well, achieves some minimal degree of social responsibility, denoted by b . Formally, the investor faces the above optimization problem subject to the following constraint

$$\sum_{i=1}^n x_i a_i + \left(1 - \sum_{i=1}^n x_i\right) a_f \geq b$$

In case 2, suppose the investor requires that his or her investment portfolio of risky assets achieves some minimal degree of social responsibility, denoted by b . In this case, the investor faces the above optimization problem subject to the following constraint

$$\sum_{i=1}^n \hat{x}_i a_i \geq b \quad \text{where} \quad \hat{x}_i \equiv \frac{x_i}{\sum_{j=1}^n x_j}$$

In case 3, suppose the investor requires every risky asset included in his or her investment portfolio per se to achieve a minimal degree of social responsibility, denoted by b . Here, the investor faces the above optimization problem subject to the following constraint

$$\forall i, i : a_i < b \Rightarrow x_i = 0$$

Of course, in all three cases an increase in b , i.e. a strengthening of the respective social responsibility constraint, will either have no effect or a negative effect on the optimal value of the investor's objective function, i.e. it will either leave the investor equally satisfied or it will make him or her worse off. The exact analytical solution of the optimization problem for each of the three cases is provided in the Appendix, part A, B and C respectively. In each case the effect of an increase in b on the optimum is provided as well. It is the main objective of this study to quantify the respective effect for a given set of assets available in the real market. Thus, in the next two sections, first, a particular set of assets is defined, along with all necessary measures and parameters, and subsequently, the respective effect is assessed.

III. Data and Methodology

The set of risky assets, from which the investor is allowed to construct his or her investment portfolio in further analysis, is the same as the one used to construct portfolios of “best-rated” and “worst-rated” companies in the second study.⁸⁰ Hence, it consists of all companies, more precisely common stock of companies, which are eligible for at least five of the socially responsible indexes listed in table 1 in the first study.⁸¹ Overall, 962 companies satisfy this condition. Thus, referring to the notation introduced above, $n = 962$.

⁸⁰ Formally, the set corresponds to set $\mathcal{Q}$ defined in section II.A in the second study.

⁸¹ Note that a company is said to be ‘eligible’ for an index if it is part of the eligible portfolio of that index as of the end of March 2009.

In order to measure social responsibility of an asset, the indicators introduced in the first study are applied.⁸² The analysis is conducted separately using each of the four indicators, indicator I, II, III and IV, as the relevant measure of social responsibility. Accordingly, referring to the above notation, a_i is defined as the achievement of asset i with respect to indicator I, II, III or IV, depending on which one is actually used to measure social responsibility.

Since the measurement of social responsibility is based on information as of March 31st 2009, it is reasonable to consider the moment of stock exchange opening on April 1st 2009 as the start of the relevant investment period. In particular, the investor is said to make his or her investment decision before the stock exchanges open on April 1st 2009, and consequently, he or she constructs his or her investment portfolio at the respective opening prices.⁸³ The default length of the investment period is set to one month. To be precise, the investment is terminated at closing prices as of April 30th 2009.⁸⁴ Hence, the investment period, formally referred to as the $t+1$ -th period, is the time from stock exchange opening on April 1st 2009 until stock exchange closing on April 30th 2009.

The actual return of asset i realized in the time from April 1st 2009 until April 30th 2009 is used as an unbiased estimator of $E(\tilde{R}_{i,t+1})$, i.e. the expected return of asset i during the investment period. Furthermore, Bessel's corrected sample covariance between returns of asset i and asset j is used as an unbiased estimator of the covariance between returns of the two assets. However, in order to allow for the resulting covariance matrix to be invertible, the sample used for its estimation needs to contain at least $n+1$, i.e. 963, observations. Since so many observations are needed, preferably, daily returns are used for this purpose. In particular, a series of 963 daily returns ending with the return achieved on April 30th 2009 is used as a relevant sample.⁸⁵ Formally, covariance between daily returns of asset i and asset j is estimated as

⁸² For exact definitions of the indicators see section II.B in the first study.

⁸³ The stock exchange used as an information source for price data is selected the same way as in the second study. All prices are adjusted for splits and dividends and converted to US dollars.

⁸⁴ For robustness purposes, later the analysis is also conducted with investment length of two up to twelve months.

⁸⁵ In particular, the series of daily returns from August 1st 2005 until April 30th 2009 is used for this purpose. Only working days in the respective period are considered. To be precise, all weekends along with January 1st, Easter Friday as well as December 25th and 26th are ignored. Note that assets, for which price data in the respective period is incomplete, are excluded. More precisely, if for a particular stock price data for more than five subsequent working days are missing, the stock is excluded from the sample. Finally, at the end 882 assets are contained in the sample.

$$Cov(\tilde{R}_i^d, \tilde{R}_j^d) = \frac{1}{N-1} \sum_{l=1}^N (R_{il}^d - \bar{R}_i^d)(R_{jl}^d - \bar{R}_j^d)$$

where N , R_{il}^d and $\bar{R}_i^d$ is the number of observations (daily returns) in the sample, the return of asset i observed on day l and the sample mean of daily return of asset i respectively.

Finally, the covariance between daily returns of asset i and asset j is adjusted in order to obtain an estimate for the covariance between returns of asset i and asset j during the investment period. For this purpose it is assumed that returns have Markov property.⁸⁶ Under this assumption one can easily show that the covariance between returns of asset i and asset j achieved within k subsequent days can be derived as⁸⁷

$$\begin{aligned} Cov\left(\prod_{l=1}^k \tilde{R}_{il}^d, \prod_{l=1}^k \tilde{R}_{jl}^d\right) &= E(\tilde{R}_{ik}^d)E(\tilde{R}_{jk}^d)Cov\left(\prod_{l=1}^{k-1} \tilde{R}_{il}^d, \prod_{l=1}^{k-1} \tilde{R}_{jl}^d\right) + \\ &E\left(\prod_{l=1}^{k-1} \tilde{R}_{il}^d\right)E\left(\prod_{l=1}^{k-1} \tilde{R}_{jl}^d\right)Cov(\tilde{R}_{ik}^d, \tilde{R}_{jk}^d) + Cov(\tilde{R}_{ik}^d, \tilde{R}_{jk}^d)Cov\left(\prod_{l=1}^{k-1} \tilde{R}_{il}^d, \prod_{l=1}^{k-1} \tilde{R}_{jl}^d\right) \end{aligned}$$

where $\tilde{R}_{il}^d$ is the return of asset i on day l . Finally, starting with $k = 2$ and iterating until $k = T$, with T representing the number of working days during the investment period, one can easily derive an estimate for $Cov(\tilde{R}_{i,t+1}, \tilde{R}_{j,t+1})$, i.e. the covariance between returns of asset i and asset j during the investment period.

Furthermore, $R_{f,t+1}$, the return of the risk free asset during the investment period, is set to 1-Month USD Libor Rate as of April 1st 2009, adjusted accordingly until April 30th 2009. The value of a_f , the degree of social responsibility of the risk free asset, is estimated as the average value of a_i for all commercial banks and investment banks included in the set of assets.⁸⁸ Finally, by default the value of w_t , the investor's initial wealth, is set to 1000 USD and the value of k , the parameter capturing the investor's degree of risk aversion, is chosen

⁸⁶ To be precise, it is assumed that the conditional probability distribution of the return of asset i realized in a particular period is independent on the return of that asset or that of any other asset realized in any of the preceding periods. Alternatively, for robustness purposes later covariance between returns in the investment period is estimated based on the assumption of linear independence and lognormality of returns.

⁸⁷ The respective proof is provided in the Appendix, part D.

⁸⁸ For robustness purposes later only commercial banks are accounted for when computing the value of a_f .

such that in the unconstrained case the investor decides to invest one half of his or her initial wealth in the optimal portfolio of risky assets and the risk free asset respectively.⁸⁹

The value of b is set to be a function of the mean and the standard deviation of a_i among all risky assets i , denoted by μ_a and σ_a respectively. In particular, initially b is set to $\mu_a - 10\sigma_a$. Then, it is increased stepwise by adding $0.25\sigma_a$ to its previous value until it finally reaches the value of $\mu_a + 10\sigma_a$.⁹⁰ After each step, the optimal investment portfolio is computed. The respective results for all three cases, as defined in section II., with social responsibility being measured with respect to each of the four indicators, are reported and interpreted in the next section.

IV. Results

A. Results for Case 1

The results for case 1 are reported in figures 1.a, 1.b, 1.c and 1.d, referring to social responsibility measured in terms of the four indicators respectively. In particular, the figures depict the relation between the value of b and financial performance, represented by the [net] risk free return, which would make the investor equally satisfied, i.e. provide the investor the same utility, as investing in the optimal investment portfolio satisfying the respective social responsibility constraint.⁹¹

Obviously, for all four indicators the results are almost identical. In conformance with the theoretical result, as long as b is below a particular threshold, the social responsibility constraint is not binding, and hence it has no effect on financial performance. This threshold turns out to be approx. 0.323, 0.079, 0.087 and 0.038 times σ_a above μ_a for the four

⁸⁹ Accordingly, the value of k is set to approx. 2.557. Later the results are generalized for an arbitrary value of w_f and k .

⁹⁰ Note that by increasing b the respective social responsibility constraint is strengthened. Also note that in case 2, as defined in section II., even higher values of b are considered; the reason for this is provided later.

⁹¹ Note that the risk free return, which provides the investor the same utility as a given investment portfolio, i.e. which makes the investor indifferent between obtaining that risk free return and investing in a given investment portfolio, is a reasonable risk adjusted measure of financial performance of that investment portfolio. In consequence, as long as not mentioned differently, the term ‘financial performance’ will refer to this measure.

indicators respectively.⁹² Intuitively, investors requiring their investment portfolios to achieve a degree of social responsibility below this threshold would not have to sacrifice any return for being socially responsible. In contrast, once a higher degree of social responsibility is required, i.e. once b exceeds the respective threshold, being socially responsible becomes costly for the investor. In particular, on average an increase in b by σ_a causes financial performance to drop by approx. 2.13, 2.08, 2.11 and 2.14 percentage points respectively.⁹³ For better insight it is reasonable to view this effect in relative rather than in absolute terms. Accordingly, when b is increased by σ_a , on average the investor has to sacrifice approx. 11.42 %, 11.15 %, 11.33 % and 11.47 % of the financial performance achieved by a conventional investor.⁹⁴ The minimal degree of social responsibility, which the investor would need to require, in order for financial performance to drop to zero, i.e. such that it becomes more attractive for the investor not to invest at all, turns out to be rather high for each of the four indicators. In particular, the investor would have to require his or her investment portfolio to achieve a degree of social responsibility of approx. 9.083, 9.048, 8.911 and 8.759 times σ_a above μ_a respectively.

B. Results for Case 2

Equivalently to case 1, the results for case 2 are reported in figures 2.a, 2.b, 2.c and 2.d respectively. Again, the figures depict the relation between b and financial performance. In contrast to case 1, higher values of b up to $\mu_a + 50\sigma_a$ are considered as well. The reason for this is simple. Intuitively, the optimal portfolio of risky assets in case 2 is the portfolio with the highest absolute Sharpe ratio satisfying the respective social responsibility constraint. Assuming that two arbitrary portfolios on the minimum variance frontier have different degrees of social responsibility, in absolute value the slope of the asymptote to the minimum variance frontier provides a lower bound for the Sharpe ratio of the optimal investment

⁹² Note that the thresholds do actually correspond to the degree of social responsibility, measured in terms of the four indicators respectively, of an optimal investment portfolio selected from the unconstrained feasible set.

⁹³ The values are calculated by dividing the decrease in financial performance from its highest possible value, i.e. the optimum in the unconstrained case, to zero, i.e. the point, at which it becomes more attractive for the investor not to invest at all, by the increase in b , measured in multiples of σ_a , necessary to cause the respective decrease in financial performance. In reality, as figures 1.a to 1.d show, the respective effect is not constant, yet it does change in dependence of b . To be precise, referring to the expression of λ in part A of the Appendix, the respective effect is linear in b , rendering optimal financial performance to be a quadratic function of b , as long as the social responsibility constraint is binding.

⁹⁴ Note that financial performance achieved by a conventional investor does in fact correspond to financial performance achieved in the unconstrained case.

portfolio. Hence, as b goes to infinity, the Sharpe ratio of the optimal investment portfolio converges to a particular value and so does financial performance. In order to see this effect, higher values of b are considered.

Obviously, similar to case 1, using any of the four indicators to measure social responsibility, the obtained results differ only negligibly. Of course, again, as long as b is low enough, the social responsibility constraint has no effect on financial performance. Only as soon as b exceeds μ_a by approx. 0.105, 0.474, 0.381 and 0.665 times σ_a for the four indicators respectively, the social responsibility constraint becomes binding and the investor has to sacrifice part of his or her return for being socially responsible. However, in contrast to case 1, whatever the degree of social responsibility required, financial performance never falls to zero. In fact, for reasons mentioned above, financial performance is limited by a lower bound. In this case the lower bound is equal to a [net] risk free return of approx. 16.53 %. Thus, even if b was increased to infinity, financial performance would simply converge to this level. On the interval from the value, at which the constraint becomes binding, to the value $\mu_a + 10\sigma_a$, an increase in b by σ_a does on average decrease financial performance by approx. 0.15 percentage points, whatever the indicator of social responsibility.⁹⁵ In relative terms, this corresponds to a loss of less than 1 % of the amount of financial performance achieved by a conventional investor.⁹⁶ Obviously, in comparison to case 1 the respective effect is almost negligible. Overall, imposing a particular social responsibility constraint on the portfolio of risky assets turns out to be considerably weaker than imposing the respective constraint on the portfolio of both the risky as well as the risk free asset. Accordingly, the latter induces much higher costs for the respective investor.

C. Results for Case 3

Depicting the relation between the same variables as in case 1 and case 2 the results for case 3 are reported in figures 3.a, 3.b, 3.c and 3.d. Except for indicator I the results for the remaining three indicators are very similar again.⁹⁷ Of course, once more, for low enough values of b the

⁹⁵ Referring to the four indicators the exact values are approx. 0.157, 0.152, 0.155 and 0.153 respectively.

⁹⁶ Referring to the four indicators the exact values are approx. 0.844 %, 0.818 %, 0.833 % and 0.819 % respectively.

⁹⁷ Note that the results when using indicator I are different, since in contrast to the remaining indicators the degree of social responsibility with respect to indicator I can only take the values of 0 and 1. Accordingly, in

respective social responsibility constraint has no effect on financial performance. Compared to case 1 and case 2, however, the constraint becomes binding, i.e. being socially responsible becomes costly, even for lower degrees of social responsibility. To be precise, the respective thresholds turn out to be approx. 2.053, 1.395, 2.491 and 1.815 times σ_a below μ_a , referring to the four indicators respectively. Hence, not surprisingly, an investor would have to face additional costs even if he or she decided to exclude alone the assets with an under-average degree of social responsibility from the investment portfolio. What is much more surprising, however, is the magnitude of those costs. In fact, in such case the investor would have to sacrifice 27.82 %, 71.90 %, 72.48 % and 72.11 % of the amount of financial performance achieved by a conventional investor, referring to the four indicators respectively.

Obviously, in contrast to case 1 and case 2, the effect of an increase in b on financial performance is not smooth. This is of course caused by the fact that with each increase in b a different number of assets might be excluded from the feasible set leading to a decrease in financial performance of a different magnitude. Of course, once b exceeds the maximum degree of social responsibility among all risky assets, the feasible set becomes empty, and hence financial performance becomes equal to the return of the risk free asset. Obviously, this would occur for values of b much lower than those, which would induce a similar effect in case 1. To be precise, the respective values are only 0.487, 2.970, 3.280 and 2.711 times σ_a higher than μ_a , referring to the four indicators respectively. Furthermore, on the interval, in which strengthening the social responsibility constraint can induce additional costs, on average an increase in b by σ_a turns out to decrease financial performance by approx. 7.336, 4.268, 3.228 and 4.117 percentage points respectively. In relative terms, considering the amount of financial performance achieved by a conventional investor over the return of the risk free asset as the basis, this corresponds to a loss of approx. 39.38 %, 22.91 %, 17.33 % and 22.10 % for the socially responsible investor. Overall, obviously, a social responsibility constraint imposed on every single risky asset turns out to be the strongest among all cases considered. Accordingly, it does also induce the highest costs.

contrast to the remaining indicators it can only occur twice that an increase in b leads to a decrease in optimal financial performance.

D. Generalization with respect to Degree of Risk Aversion and Initial Wealth

The above results do all refer to an investor with default values of k and w_t , i.e. an investor with a default degree of risk aversion and default initial wealth.⁹⁸ Of course, for investors with different degree of risk aversion and different initial wealth different results may be obtained. Yet, in order to derive the results for investors with different characteristics, it is not necessary to repeat the analysis with different values of k and w_t . In fact, the results can be easily derived based on the results obtained for the default investor.

In general, consider an investor, whose degree of risk aversion or initial wealth is h times as high as that of the default investor. One can easily show that, as long as the social responsibility constraint is not binding, financial performance achieved by the respective investor will be h times as low as that achieved by the default investor.⁹⁹ Furthermore, once the social responsibility constraint becomes binding, relative to the default investor the slope of financial performance with respect to b will be h times higher in case 1 and h times lower in both case 2 and case 3.¹⁰⁰

As a result, while in case 1 the increase in b needed for financial performance to drop to zero will be h times as low as for the default investor, in case 2 and case 3 it will remain unaffected by k and w_t .¹⁰¹ Thus, in absolute terms, while in case 1 the average effect of an increase in b on financial performance will remain the same, in case 2 and case 3 it will be h times as low as for the default investor.¹⁰² In relative terms, however, the respective effect will remain the same in case 2 and case 3, while in case 1 it will be h times as high as for the default investor.

⁹⁸ As already mentioned above the respective default values were set as follows: $w_t = 1000$ and $k \approx 2.557$. Note that the results are also valid for every investor with arbitrary values of k and w_t such that $kw_t \approx 2557$.

⁹⁹ The respective proof is provided in part E of the Appendix. Note that the above statement is true for all case 1, case 2 and case 3

¹⁰⁰ The respective proof is provided in part F of the Appendix.

¹⁰¹ The respective proof is provided in part G of the Appendix. Note that, as already mentioned above, in case 2, financial performance can never drop to zero anyway. Also, to be precise, note that when referring to case 3 instead of zero a drop in financial performance to the net return of the risk free asset is considered.

¹⁰² Note that here the average effect is computed for the entire interval of b , in which the constraint is binding and optimal financial performance is higher than zero. Of course, in case 1 for values of b , at which both financial performance achieved by the respective investor and that achieved by the default investor is above zero, in absolute terms the effect of an increase in b on financial performance will be h times as high as for the default investor, consistently with the statement about the slope of financial performance with respect to b made above.

Finally, as already mentioned above, in case 2 the optimal investment portfolio is a linear combination of the risk free asset and the portfolio of risky assets with maximum absolute Sharpe ratio satisfying the respective social responsibility constraint. The same is true for case 3 as well. Accordingly, in case 2 and case 3 each investor, independent on his or her degree of risk aversion and initial wealth, in optimum invests in the same portfolio of risky assets. Since the social responsibility constraint in both cases only refers to risky assets, the threshold for b , at which the respective constraint becomes binding, must be the same for all investors. Hence, in both case 2 and case 3 for the investor with an h -fold degree of risk aversion or initial wealth the respective threshold will be the same as for the default investor. This is not true in case 1. In fact, referring to the theoretical result obtained in part A of the Appendix, in case 1 the respective threshold turns out to be dependent on k and w_i . In particular, referring to the four indicators respectively, for the investor, whose degree of risk aversion or initial wealth is h times as high as that of the default investor, the values can be derived as being approx. μ_a plus $(0.250, 0.211, 0.185, 0.247)^T + \frac{1}{h}(0.073, -0.132, -0.098, -0.209)^T$ times σ_a .

E. Robustness

First, as an alternative to the Markov assumption the estimation of $E(\tilde{R}_{i,t+1})$ and $Cov(\tilde{R}_{i,t+1}, \tilde{R}_{j,t+1})$ is based on the assumption of lognormality and linear independence of returns. In particular, it is assumed that the return of each asset i achieved in an arbitrary period is lognormally distributed and that it is linearly independent of the return of asset i or that of any other asset achieved in any other period. Defining $\tilde{q}_i \equiv \ln(\tilde{R}_{i,t+1})$, the logarithmic return of asset i actually achieved during the investment period is used as an unbiased estimator of $E(\tilde{q}_i)$.¹⁰³ In order to estimate $Cov(\tilde{q}_i, \tilde{q}_j)$, the same sample of returns is used as in the default case, yet in logarithmic form. In particular, the respective Bessel's corrected sample covariance multiplied with the number of working days in the investment period is used as an unbiased estimator of $Cov(\tilde{q}_i, \tilde{q}_j)$. Finally, since by definition $\tilde{R}_{i,t+1} \equiv \exp(\tilde{q}_i)$, $E(\tilde{R}_{i,t+1})$ and $Cov(\tilde{R}_{i,t+1}, \tilde{R}_{j,t+1})$ are derived as

¹⁰³ Note that due to normality of $\tilde{q}_i$ this is also consistent with maximum likelihood estimation of $E(\tilde{q}_i)$.

$$E(\tilde{R}_{i,t+1}) = \exp\left(\mu_i + \frac{1}{2}\sigma_{ii}\right) \quad \text{and}$$

$$Cov(\tilde{R}_{i,t+1}, \tilde{R}_{j,t+1}) = [\exp(\sigma_{ij}) - 1] \cdot \exp\left[\mu_i + \mu_j + \frac{1}{2}(\sigma_{ii} + \sigma_{jj})\right]$$

where for simplicity in the notation μ_i and σ_{ij} stand for $E(\tilde{q}_i)$ and $Cov(\tilde{q}_i, \tilde{q}_j)$ respectively.¹⁰⁴ The analysis is then carried out using the alternative estimates for $E(\tilde{R}_{i,t+1})$ and $Cov(\tilde{R}_{i,t+1}, \tilde{R}_{j,t+1})$. In all three cases and using any of the four indicators of social responsibility the obtained results turn out to be almost identical with the original results.

Furthermore, different values of $R_{f,t+1}$ and a_f are used. In particular, the yield on a US T-Bill with maturity of one month and the average degree of social responsibility among all commercial banks included in the set of risky assets are used as an estimate for $R_{f,t+1}$ and a_f respectively. Again, the obtained difference in the results is rather negligible.

Also, it is tested how robust the results are when the number of risky assets is varied. In particular, the analysis is carried out with subsets of 800, 700, 600, 500, 400, 300, 200 and 100 assets picked randomly from the original set of risky assets. To be precise, for each given number of assets, by simulation, one thousand random subsets are created. Then, the analysis is carried out separately with each particular subset and the results are averaged over all one thousand subsets containing the same number of assets. Finally, the results obtained for different numbers of assets contained in a subset are compared among each other. Of course, as the number of assets decreases financial performance tends to slightly decrease as well. Accordingly, in absolute terms the effect of an increase in b on financial performance does also slightly decrease. In relative terms, however, the effect turns out to be almost identical, whatever the number of assets contained in a subset.

In addition, different investment periods are analyzed. To be precise, the end of the investment period is set to the end of May 2009 and it is then increased stepwise in one month intervals up to the end of March 2010. Accordingly, the length of the investment period varies from two to twelve months respectively. While in some cases the respective results are almost

¹⁰⁴ See e.g. Tarmast (2001).

identical, in others a more articulate difference is obtained. Yet, overall the crucial patterns tend to be preserved, and hence, essentially the original results are confirmed again.

Finally, in case 2 and case 3, reasonably, the absolute Sharpe ratio of the optimal investment portfolio satisfying the respective social responsibility constraint is used as an alternative measure of financial performance. The respective results are reported in figures 4.a, 4.b, 4.c and 4.d for case 2 and 5.a, 5.b, 5.c and 5.d for case 3, referring to the four indicators respectively.¹⁰⁵ Obviously, although the obtained results are far from being a pure copy of the original results, the respective difference is hardly considerable. Hence, the original results turn out to be robust again.

V. Conclusion

Pursuing principles of social responsibility in portfolio selection poses a restriction to the feasible set of portfolios. As a result, from the perspective of a perfectly informed and rational investor social responsibility will either have no effect on financial performance or it will eventually decrease it. In other words, in a world of perfect information and rationality, while social responsibility used as a criterion when making investment decisions can never create additional profits, it can very well create additional costs. The underlying study can be seen as an attempt to analyze these costs for investors with mean-variance preferences.

Not surprisingly, the effect of social responsibility on financial performance seems to depend strongly on the exact form of the imposed social responsibility constraint. The effect turns out to be strongest, when each risky asset is required to achieve a minimal degree of social responsibility. In this case being socially responsible turns out to be costly even for relatively low degrees of social responsibility. In contrast, the respective effect seems to be weakest, when the social responsibility constraint is applied to the portfolio of risky assets. In this case even for extremely high degrees of social responsibility the respective effect is rather limited. This is not the case though, when the constraint is applied to the portfolio of both risky and the risk free asset. In this case, when a high enough degree of social responsibility is required, financial performance of the optimal investment portfolio may become as weakly attractive as

¹⁰⁵ Note that the respective results are relevant for all investors, independent on their degree of risk aversion or initial wealth.

not investing at all. Nevertheless, even in this case the drop in financial performance as the social responsibility constraint is strengthened is much lower than it is in the case, when the constraint is applied to each single asset.

Overall, the costs of social responsibility are hardly negligible. Typically, even if only an average degree of social responsibility, computed among all existing assets, is required compared to a conventional investor a socially responsible investor has to incur drops in financial performance. Moreover, in most cases, increasing the required degree of social responsibility by just one times the standard deviation, computed among all existing assets, a considerable decrease in financial performance is induced. Typically, around one tenth up to one fifth of the [net risk free] return achieved by a conventional investor has to be sacrificed.

In summary, the results show that if investors were both perfectly informed and rational socially responsible investment decisions would not be for free. In fact, investors would have to sacrifice a considerable part of their returns for being socially responsible.

Importantly, the results are more or less confirmed for investors with an arbitrary degree of risk aversion and initial wealth. Also, they seem to be highly robust to several model and parameter variations. Unfortunately, the analysis does only refer to investors with mean-variance preferences. Although under the assumption of normality of returns the results are also valid for all investors with constant absolute risk aversion, it would be reasonable to carry out similar analyses assuming different types of preferences. In fact, it may be useful to know, how the costs for being socially responsible would differ among different types of investors. This can be seen as a motivation for future research.

Appendix

A. Solution of the problem in Case 1

Here, the goal is to solve the following optimization problem

$$\begin{aligned} & \max_{x_1, \dots, x_n} \{E(\tilde{w}_{t+1}) - k \cdot Var(\tilde{w}_{t+1})\} \\ & \text{where } \tilde{w}_{t+1} = w_t R_{f,t+1} + w_t \sum_{i=1}^n x_i (\tilde{R}_{i,t+1} - R_{f,t+1}) \\ & \text{s.t. } \sum_{i=1}^n x_i a_i + \left(1 - \sum_{i=1}^n x_i\right) a_f \geq b \end{aligned}$$

Obviously, $E(\tilde{w}_{t+1})$ and $Var(\tilde{w}_{t+1})$ can be expressed as

$$\begin{aligned} E(\tilde{w}_{t+1}) &= w_t R_{f,t+1} + w_t \sum_{i=1}^n x_i [E(\tilde{R}_{i,t+1}) - R_{f,t+1}] \\ Var(\tilde{w}_{t+1}) &= w_t^2 \sum_{i=1}^n \sum_{j=1}^n x_i x_j Cov(\tilde{R}_{i,t+1}, \tilde{R}_{j,t+1}) \end{aligned}$$

Furthermore, note that the constraint can be rewritten as

$$\sum_{i=1}^n x_i \hat{a}_i \geq \hat{b} \quad \text{where} \quad \hat{a}_i \equiv a_i - a_f \quad \text{and} \quad \hat{b} \equiv b - a_f$$

Using matrix notation the problem may be rewritten as¹⁰⁶

$$\begin{aligned} & \max_{\vec{x}} \{w_t R_{f,t+1} + w_t \vec{x}^T \vec{R}_e - k w_t^2 \vec{x}^T S \vec{x}\} \\ & \text{s.t. } \vec{x}^T \vec{a}_e \geq \hat{b} \end{aligned}$$

¹⁰⁶ Note that in $\vec{R}_e$, $\vec{a}_e$ and S the time index has been omitted, since all the values refer to a single period.

$$\text{where } \vec{x} = \begin{pmatrix} x_1 \\ \vdots \\ x_n \end{pmatrix}, \vec{R}_e = \begin{pmatrix} E(\tilde{R}_{1,t+1}) - R_{f,t+1} \\ \vdots \\ E(\tilde{R}_{n,t+1}) - R_{f,t+1} \end{pmatrix}, \vec{a}_e = \begin{pmatrix} a_1 - a_f \\ \vdots \\ a_n - a_f \end{pmatrix} \text{ and}$$

$$S = \begin{pmatrix} Cov(\tilde{R}_{1,t+1}, \tilde{R}_{1,t+1}) & \cdots & Cov(\tilde{R}_{1,t+1}, \tilde{R}_{n,t+1}) \\ \vdots & \ddots & \vdots \\ Cov(\tilde{R}_{n,t+1}, \tilde{R}_{1,t+1}) & \cdots & Cov(\tilde{R}_{n,t+1}, \tilde{R}_{n,t+1}) \end{pmatrix}$$

Assuming w_t to be positive the problem is equivalent to

$$\begin{aligned} \max_{\vec{x}} & \{ \vec{x}^T \vec{R}_e - kw_t \vec{x}^T S \vec{x} \} \\ \text{s.t. } & \vec{x}^T \vec{a}_e \geq \hat{b} \end{aligned}$$

The respective Lagrangian is

$$L(\vec{x}, \lambda) = \vec{x}^T \vec{R}_e - kw_t \vec{x}^T S \vec{x} - \lambda (\vec{x}^T \vec{a}_e - \hat{b})$$

Taking the first derivative with respect to $\vec{x}$ and λ one obtains the following n+1 FOCs

$$\begin{aligned} \frac{\partial L}{\partial \vec{x}} &= \vec{R}_e - 2kw_t S \vec{x} - \lambda \vec{a}_e = \vec{0} \\ \frac{\partial L}{\partial \lambda} &= \vec{x}^T \vec{a}_e - \hat{b} \geq 0 \end{aligned}$$

where $\vec{0}$ is a column vector of zeros of order n .

Obviously, two cases need to be distinguished.¹⁰⁷ First, the optimal solution of the unconstrained problem, further denoted by $\vec{x}_u^*$, satisfies the constraint. In this case, the optimal solution of the constrained problem, further denoted by $\vec{x}^*$, is equal to $\vec{x}_u^*$. Second, the optimal solution of the unconstrained problem does not satisfy the constraint, i.e. the

¹⁰⁷ Note that $\lambda \frac{\partial L}{\partial \lambda} = 0$ needs to hold as well.

constraint becomes binding. In this case, the above linear problem of $n+1$ equations needs to be solved.

The solution of the unconstrained problem can easily be derived from

$$\vec{R}_e - 2kw_t S \vec{x}_u^* = \vec{0}$$

which immediately yields

$$\vec{x}_u^* = \frac{1}{2kw_t} S^{-1} \vec{R}_e$$

It is easy to show that at $\vec{x}_u^*$ the objective reaches a maximum. In fact, the respective Hessian is equal to $-2kw_t S$. Since S is a covariance matrix, it must by definition be positive-semidefinite. Thus, for a risk averse investor, i.e. $k > 0$, the Hessian turns out to be negative-semidefinite, and hence the obtained solution is a maximum.

If the constraint is binding, obviously, rewriting the first n FOCs yields

$$\vec{x}^* = \frac{1}{2kw_t} S^{-1} (\vec{R}_e - \lambda \vec{a}_e)$$

Plugging this expression into the $(n+1)$ -th FOC, i.e. into the binding constraint, one obtains

$$\frac{1}{2kw_t} \vec{a}_e^T S^{-1} (\vec{R}_e - \lambda \vec{a}_e) = \hat{b}$$

After a few simple algebraic steps one can express λ as

$$\lambda = \frac{\vec{a}_e^T S^{-1} \vec{R}_e - 2kw_t \hat{b}}{\vec{a}_e^T S^{-1} \vec{a}_e}$$

Substituting for λ in order to express $\vec{x}^*$ explicitly yields

$$\bar{x}^* = \frac{1}{2kw_t} S^{-1} \left(\bar{R}_e - \frac{a_e^T S^{-1} \bar{R}_e - 2kw_t \hat{b}}{a_e^T S^{-1} \bar{a}_e} \bar{a}_e \right)$$

Since the constraint is linear in $\bar{x}$ and the Hessian of the unconstrained problem is negative-semidefinite, on the constrained set the objective will be negative-semidefinite as well.¹⁰⁸ Hence, the solution of the constrained problem is also a maximum.

Finally, aggregating the terms, the maximization problem has the following solution

$$\bar{x}^* = \begin{cases} \frac{1}{2kw_t} S^{-1} \bar{R}_e & \text{if } \hat{b} \leq \frac{1}{2kw_t} \bar{a}_e^T S^{-1} \bar{R}_e \\ \frac{1}{2kw_t} S^{-1} \left(\bar{R}_e - \frac{\bar{a}_e^T S^{-1} \bar{R}_e - 2kw_t \hat{b}}{\bar{a}_e^T S^{-1} \bar{a}_e} \bar{a}_e \right) & \text{if } \hat{b} > \frac{1}{2kw_t} \bar{a}_e^T S^{-1} \bar{R}_e \end{cases}$$

B. Solution of the problem in Case 2

In this case, the following optimization problem has to be solved

$$\begin{aligned} & \max_{x_1, \dots, x_n} \{E(\tilde{w}_{t+1}) - k \cdot Var(\tilde{w}_{t+1})\} \\ & \text{where } \tilde{w}_{t+1} = w_t R_{f,t+1} + w_t \sum_{i=1}^n x_i (\tilde{R}_{i,t+1} - R_{f,t+1}) \\ & \sum_{i=1}^n \hat{x}_i a_i \geq b \quad \text{where} \quad \hat{x}_i \equiv \frac{x_i}{\sum_{j=1}^n x_j} \end{aligned}$$

¹⁰⁸ To be precise, in Gallier (2000) it is shown that the minimization of a quadratic function of the general form $\min_{\bar{y}} \left\{ \frac{1}{2} \bar{y}^T C \bar{y} - b^T \bar{y} \right\}$, where C is a symmetric positive-semidefinite matrix, subject to a set of linear constraints $A^T \bar{y} = f$ has a unique solution, i.e. on the constrained set the objective has a unique minimum. Note that the solution of $\max_{\bar{x}} \{ \bar{x}^T \bar{R}_e - kw_t \bar{x}^T S \bar{x} \}$ s.t. $\bar{x}^T \bar{a}_e = \hat{b}$, i.e. when the constraint is binding, is equivalent to the solution of $\min_{\bar{x}} \{ kw_t \bar{x}^T S \bar{x} - \bar{x}^T \bar{R}_e \}$ s.t. $\bar{x}^T \bar{a}_e = \hat{b}$. Since S is positive-semidefinite, the solution of the latter problem is a unique minimum, and hence, accordingly, the solution of the former problem must be a unique maximum.

Using the same notation as introduced above and denoting by ∇ a column vector of ones of order n , in matrix form the problem can be written as

$$\begin{aligned} \max_{\vec{x}} \{ & w_t R_{f,t+1} + w_t \vec{x}^T \vec{R}_e - k w_t^2 \vec{x}^T S \vec{x} \} \\ \text{s.t. } & \frac{\vec{a}^T \vec{x}}{\nabla^T \vec{x}} \geq b \end{aligned}$$

Again, assuming w_t to be positive, equivalently one may solve

$$\begin{aligned} \max_{\vec{x}} \{ & \vec{x}^T \vec{R}_e - k w_t \vec{x}^T S \vec{x} \} \\ \text{s.t. } & \frac{\vec{a}^T \vec{x}}{\nabla^T \vec{x}} \geq b \end{aligned}$$

The Lagrangian of this problem may be written as

$$L(\vec{x}, \lambda) = \vec{x}^T \vec{R}_e - k w_t \vec{x}^T S \vec{x} - \lambda \left(\frac{\vec{a}^T \vec{x}}{\nabla^T \vec{x}} - b \right)$$

Hence the respective FOCs turn out to be

$$\begin{aligned} \frac{\partial L}{\partial \vec{x}} &= \vec{R}_e - 2k w_t S \vec{x} - \lambda \frac{(\nabla^T \vec{x}) \vec{a} - (\vec{x}^T \vec{a}) \nabla}{(\nabla^T \vec{x})^2} = \vec{0} \\ \frac{\partial L}{\partial \lambda} &= \frac{\vec{a}^T \vec{x}}{\nabla^T \vec{x}} - b \geq 0 \end{aligned}$$

Again, two cases need to be distinguished.¹⁰⁹ Either the optimal solution of the unconstrained problem satisfies the constraint or it does not, i.e. the constraint becomes binding.

Obviously, the solution of the unconstrained problem is identical to that in Case 1, i.e.

¹⁰⁹ Note that $\lambda \frac{\partial L}{\partial \lambda} = 0$ needs to hold as well.

$$\vec{x}_u^* = \frac{1}{2kw_t} S^{-1} \vec{R}_e$$

For the same reason as in case 1 the obtained solution is a maximum.

If the constraint is binding, one may rewrite it as

$$\vec{a}^T \vec{x} = b \nabla^T \vec{x}$$

Plugging in for $\vec{a}^T \vec{x}$ into the first n FOCs yields

$$\vec{R}_e - 2kw_t S \vec{x} - \lambda \frac{(\nabla^T \vec{x})(\vec{a} - b \nabla)}{(\nabla^T \vec{x})^2} = \vec{0}$$

Defining $\vec{a}_b \equiv \vec{a} - b \nabla$ this may be further rewritten as

$$\vec{x}^* = \frac{1}{2kw_t} S^{-1} \left(\vec{R}_e - \frac{\lambda}{\nabla^T \vec{x}^*} \vec{a}_b \right)$$

Plugging this expression into the binding constraint, i.e. into $\vec{a}_b^T \vec{x} = 0$, yields

$$\frac{1}{2kw_t} \vec{a}_b^T S^{-1} \left(\vec{R}_e - \frac{\lambda}{\nabla^T \vec{x}^*} \vec{a}_b \right) = 0$$

After a few steps one can express λ as

$$\lambda = \frac{\vec{a}_b^T S^{-1} \vec{R}_e}{\vec{a}_b^T S^{-1} \vec{a}_b} \nabla^T \vec{x}^*$$

And hence, explicitly

$$\vec{x}^* = \frac{1}{2kw_t} S^{-1} \left(\vec{R}_e - \frac{\vec{a}_b^T S^{-1} \vec{R}_e}{\vec{a}_b^T S^{-1} \vec{a}_b} \vec{a}_b \right)$$

As already shown above, if the constraint is binding it can be rewritten such that it is linear in $\vec{x}$. Hence, using the same argumentation as in case 1, the obtained result on the constrained set must be a maximum.

Aggregating the terms, finally

$$\vec{x}^* = \begin{cases} \frac{1}{2kw_t} S^{-1} \vec{R}_e & \text{if } b \leq \frac{\vec{a}^T S^{-1} \vec{R}_e}{\nabla^T S^{-1} \vec{R}_e} \\ \frac{1}{2kw_t} S^{-1} \left(\vec{R}_e - \frac{\vec{a}_b^T S^{-1} \vec{R}_e}{\vec{a}_b^T S^{-1} \vec{a}_b} \vec{a}_b \right) & \text{if } b > \frac{\vec{a}^T S^{-1} \vec{R}_e}{\nabla^T S^{-1} \vec{R}_e} \end{cases}$$

C. Solution of the problem in Case 3

Here, the goal is to solve

$$\begin{aligned} & \max_{x_1, \dots, x_n} \{E(\tilde{w}_{t+1}) - k \cdot Var(\tilde{w}_{t+1})\} \\ & \text{where } \tilde{w}_{t+1} = w_t R_{f,t+1} + w_t \sum_{i=1}^n x_i (\tilde{R}_{i,t+1} - R_{f,t+1}) \\ & \text{s.t. } \forall i, i : a_i < b \Rightarrow x_i = 0 \end{aligned}$$

Using matrix notation as introduced above and denoting by $\hat{\vec{x}}$, $\hat{\vec{R}}_e$ and $\hat{S}$ the subset of $\vec{x}$, $\vec{R}_e$, and S respectively containing all elements i , for which $a_i \geq b$ is true, the problem may be rewritten as

$$\max_{\hat{\vec{x}}} \left\{ w_t R_{f,t+1} + w_t \hat{\vec{x}}^T \hat{\vec{R}}_e - kw_t^2 \hat{\vec{x}}^T \hat{S} \hat{\vec{x}} \right\}$$

Once again, assuming w_t to be positive, the solution of this problem is equivalent to that of

$$\max_{\hat{\vec{x}}} \left\{ \hat{\vec{x}}^T \hat{\vec{R}}_e - kw_t \hat{\vec{x}}^T \hat{S} \hat{\vec{x}} \right\}$$

Obviously, the FOCs are

$$\hat{\vec{R}}_e - 2kw_t \hat{S} \hat{\vec{x}} = \vec{0}$$

And hence, finally

$$\hat{\vec{x}}^* = \frac{1}{2kw_t} \hat{S}^{-1} \hat{R}_e$$

Being a covariance matrix $\hat{S}$ is positive-semidefinite, and hence the respective Hessian must be negative-semidefinite, provided the investor is risk averse. As a result, the obtained solution is a maximum.

D. Covariance between (simple) returns of two assets within k subsequent periods

Consider two risky assets i and j . Furthermore, let the simple return of asset i and asset j in period t be denoted by $\tilde{R}_{it}$ and $\tilde{R}_{jt}$ respectively. In general, the covariance between returns of asset i and asset j achieved in two subsequent periods t and $t+1$ can be expressed as

$$Cov(\tilde{R}_{it}\tilde{R}_{i,t+1}, \tilde{R}_{jt}\tilde{R}_{j,t+1}) = E(\tilde{R}_{it}\tilde{R}_{i,t+1}\tilde{R}_{jt}\tilde{R}_{j,t+1}) - E(\tilde{R}_{it}\tilde{R}_{i,t+1})E(\tilde{R}_{jt}\tilde{R}_{j,t+1})$$

Suppose that for all t the conditional probability of $\tilde{R}_{i,t+1}$ as well as that of $\tilde{R}_{j,t+1}$ is independent on the realization of $\tilde{R}_{it}$ and $\tilde{R}_{jt}$. Under these circumstances, the above expression can be rewritten in the following way¹¹⁰

$$Cov(\tilde{R}_{it}\tilde{R}_{i,t+1}, \tilde{R}_{jt}\tilde{R}_{j,t+1}) = E(\tilde{R}_{it}\tilde{R}_{i,t+1}\tilde{R}_{jt}\tilde{R}_{j,t+1}) - E(\tilde{R}_{it})E(\tilde{R}_{i,t+1})E(\tilde{R}_{jt})E(\tilde{R}_{j,t+1})$$

This can be further rewritten as

$$\begin{aligned} Cov(\tilde{R}_{it}\tilde{R}_{i,t+1}, \tilde{R}_{jt}\tilde{R}_{j,t+1}) &= E(\tilde{R}_{it}\tilde{R}_{i,t+1}\tilde{R}_{jt}\tilde{R}_{j,t+1}) - E(\tilde{R}_{it})E(\tilde{R}_{i,t+1})E(\tilde{R}_{jt})E(\tilde{R}_{j,t+1}) = \\ &= E(\tilde{R}_{it}\tilde{R}_{i,t+1}\tilde{R}_{jt}\tilde{R}_{j,t+1}) - [E(\tilde{R}_{it}\tilde{R}_{jt}) - Cov(\tilde{R}_{it}, \tilde{R}_{jt})][E(\tilde{R}_{i,t+1}\tilde{R}_{j,t+1}) - Cov(\tilde{R}_{i,t+1}, \tilde{R}_{j,t+1})] = \\ &= E(\tilde{R}_{it}\tilde{R}_{jt}\tilde{R}_{i,t+1}\tilde{R}_{j,t+1}) - E(\tilde{R}_{it}\tilde{R}_{jt})E(\tilde{R}_{i,t+1}\tilde{R}_{j,t+1}) + E(\tilde{R}_{it}\tilde{R}_{jt})Cov(\tilde{R}_{i,t+1}, \tilde{R}_{j,t+1}) + \\ &\quad + E(\tilde{R}_{i,t+1}\tilde{R}_{j,t+1})Cov(\tilde{R}_{it}, \tilde{R}_{jt}) - Cov(\tilde{R}_{it}, \tilde{R}_{jt})Cov(\tilde{R}_{i,t+1}, \tilde{R}_{j,t+1}) \end{aligned}$$

¹¹⁰ Note that $E(\tilde{R}_{it}\tilde{R}_{i,t+1}) = E(\tilde{R}_{it})E(\tilde{R}_{i,t+1}) + Cov(\tilde{R}_{it}, \tilde{R}_{i,t+1})$. Since $Cov(\tilde{R}_{it}, \tilde{R}_{i,t+1}) = 0$ it follows that $E(\tilde{R}_{it}\tilde{R}_{i,t+1}) = E(\tilde{R}_{it})E(\tilde{R}_{i,t+1})$. Of course, the same is true for asset j .

Due to the independence assumption made above the first two elements of the expression, which are actually equal to $Cov(\tilde{R}_{it}\tilde{R}_{jt}, \tilde{R}_{i,t+1}\tilde{R}_{j,t+1})$, turn out to be zero. Hence,

$$Cov(\tilde{R}_{it}\tilde{R}_{i,t+1}, \tilde{R}_{jt}\tilde{R}_{j,t+1}) = E(\tilde{R}_{it}\tilde{R}_{jt})Cov(\tilde{R}_{i,t+1}, \tilde{R}_{j,t+1}) + E(\tilde{R}_{i,t+1}\tilde{R}_{j,t+1})Cov(\tilde{R}_{it}, \tilde{R}_{jt}) - Cov(\tilde{R}_{it}, \tilde{R}_{jt})Cov(\tilde{R}_{i,t+1}, \tilde{R}_{j,t+1})$$

which can be further rewritten as

$$Cov(\tilde{R}_{it}\tilde{R}_{i,t+1}, \tilde{R}_{jt}\tilde{R}_{j,t+1}) = [E(\tilde{R}_{it})E(\tilde{R}_{jt}) + Cov(\tilde{R}_{it}, \tilde{R}_{jt})]Cov(\tilde{R}_{i,t+1}, \tilde{R}_{j,t+1}) + [E(\tilde{R}_{i,t+1})E(\tilde{R}_{j,t+1}) + Cov(\tilde{R}_{i,t+1}, \tilde{R}_{j,t+1})]Cov(\tilde{R}_{it}, \tilde{R}_{jt}) - Cov(\tilde{R}_{it}, \tilde{R}_{jt})Cov(\tilde{R}_{i,t+1}, \tilde{R}_{j,t+1})$$

Multiplying out and summing up finally yields¹¹¹

$$Cov(\tilde{R}_{it}\tilde{R}_{i,t+1}, \tilde{R}_{jt}\tilde{R}_{j,t+1}) = E(\tilde{R}_{it})E(\tilde{R}_{jt})Cov(\tilde{R}_{i,t+1}, \tilde{R}_{j,t+1}) + E(\tilde{R}_{i,t+1})E(\tilde{R}_{j,t+1})Cov(\tilde{R}_{it}, \tilde{R}_{jt}) + Cov(\tilde{R}_{it}, \tilde{R}_{jt})Cov(\tilde{R}_{i,t+1}, \tilde{R}_{j,t+1})$$

Implicitly, the covariance between returns of asset i and asset j achieved in k subsequent periods can be expressed as

$$Cov\left(\prod_{t=1}^k \tilde{R}_{it}, \prod_{t=1}^k \tilde{R}_{jt}\right) = Cov\left(R_{ik} \prod_{t=1}^{k-1} \tilde{R}_{it}, R_{jk} \prod_{t=1}^{k-1} \tilde{R}_{jt}\right) = E(\tilde{R}_{ik})E(\tilde{R}_{jk})Cov\left(\prod_{t=1}^{k-1} \tilde{R}_{it}, \prod_{t=1}^{k-1} \tilde{R}_{jt}\right) + E\left(\prod_{t=1}^{k-1} \tilde{R}_{it}\right)E\left(\prod_{t=1}^{k-1} \tilde{R}_{jt}\right)Cov(\tilde{R}_{ik}, \tilde{R}_{jk}) + Cov(\tilde{R}_{ik}, \tilde{R}_{jk})Cov\left(\prod_{t=1}^{k-1} \tilde{R}_{it}, \prod_{t=1}^{k-1} \tilde{R}_{jt}\right)$$

which can be applied iteratively, in order to obtain the covariance between returns of asset i and j achieved within an arbitrary number of subsequent periods.¹¹²

¹¹¹ Note that as a special case, when $i = j$, the variance of the return of asset i achieved in two subsequent periods turns out to be $Var(\tilde{R}_{it}\tilde{R}_{i,t+1}) = [E(\tilde{R}_{it})]^2 Var(\tilde{R}_{i,t+1}) + [E(\tilde{R}_{i,t+1})]^2 Var(\tilde{R}_{it}) + Var(\tilde{R}_{it})Var(\tilde{R}_{i,t+1})$.

¹¹² Note that due to the Markov property $E\left(\prod_{t=1}^k \tilde{R}_{it}\right) = \prod_{t=1}^k E(\tilde{R}_{it})$.

E. Effect of k and w_t on financial performance in the unconstrained case

As already shown above, if the social responsibility constraint is not binding in all three cases the optimal investment portfolio is

$$\bar{x}^* = \frac{1}{2kw_t} S^{-1} \bar{R}_e$$

Plugging into the investor's value function, the respective optimum is

$$V(\tilde{w}_{t+1} | \bar{x}^*) = w_t R_{f,t+1} + w_t \frac{1}{2kw_t} \bar{R}_e^T S^{-1} \bar{R}_e - kw_t^2 \frac{1}{2kw_t} \bar{R}_e^T S^{-1} S \frac{1}{2kw_t} S^{-1} \bar{R}_e$$

This can be simplified as

$$V(\tilde{w}_{t+1} | \bar{x}^*) = w_t R_{f,t+1} + \frac{1}{4k} \bar{R}_e^T S^{-1} \bar{R}_e$$

Since financial performance, here denoted by r , is defined as the [net] risk free return providing the investor the same satisfaction as investing in $\bar{x}^*$, one can write

$$w_t(1+r) = w_t R_{f,t+1} + \frac{1}{4k} \bar{R}_e^T S^{-1} \bar{R}_e$$

Equivalently,

$$r = \frac{1}{4kw_t} \bar{R}_e^T S^{-1} \bar{R}_e + (R_{f,t+1} - 1)$$

Since in approximation $R_{f,t+1}$ is close to 1, one may eventually write¹¹³

$$r \approx \frac{1}{4kw_t} \bar{R}_e^T S^{-1} \bar{R}_e$$

¹¹³ Note that the actual value of $R_{f,t+1}$ is 1.0004125.

Hence, in approximation an h -fold increase in k or w_t will lead to an h -fold decrease in financial performance.¹¹⁴

F. Effect of k and w_t on the slope of financial performance with respect to b

Referring to the expression of λ derived in part A of the Appendix, in case 1 the slope of the investor's objective function with respect to b in optimum equals¹¹⁵

$$\frac{\partial V(\tilde{w}_{t+1}|\tilde{x}^*)}{\partial b} = \frac{\vec{a}_e^T S^{-1} \vec{R}_e - 2kw_t \hat{b}}{a_e^T S^{-1} \vec{a}_e} w_t$$

Of course, the above statement is true only for values of b , at which the respective social responsibility constraint is binding, i.e. only if $\hat{b} \geq \frac{1}{2kw_t} \vec{a}_e^T S^{-1} \vec{R}_e$.

Note that

$$\hat{b} \geq \frac{1}{2kw_t} \vec{a}_e^T S^{-1} \vec{R}_e \Leftrightarrow \hat{b} = \frac{1}{2kw_t} \vec{a}_e^T S^{-1} \vec{R}_e + c \wedge c \geq 0$$

Hence, $\frac{\partial V(\tilde{w}_{t+1}|\tilde{x}^*)}{\partial b}$ can be rewritten as

$$\frac{\partial V(\tilde{w}_{t+1}|\tilde{x}^*)}{\partial b} = \frac{\vec{a}_e^T S^{-1} \vec{R}_e - 2kw_t \left(\frac{1}{2kw_t} \vec{a}_e^T S^{-1} \vec{R}_e + c \right)}{a_e^T S^{-1} \vec{a}_e} w_t$$

which finally simplifies to

¹¹⁴ Note that the approximated value would deteriorate considerably from the exact value only for very high values of k or w_t .

¹¹⁵ Note that for simplicity during the optimization procedure the objective function has been divided by w_t . As a result, the value of λ derived in the optimization refers to the slope of the investor's objective adjusted respectively. Thus, in order to obtain the slope of the proper function, here the value of λ is multiplied with w_t .

$$\frac{\partial V(\tilde{w}_{t+1}|\bar{x}^*)}{\partial b} = -\frac{2kw_t^2c}{\bar{a}_e^T S^{-1} \bar{a}_e}$$

Since financial performance is defined as

$$r = \frac{V(\tilde{w}_{t+1}|\bar{x}^*)}{w_t} - 1$$

the slope of financial performance with respect to b must be

$$\frac{\partial r}{\partial b} = -\frac{2kw_t c}{\bar{a}_e^T S^{-1} \bar{a}_e}$$

Hence, in case 1 an h -fold increase in k or w_t will lead to an h -fold increase in the respective slope.

In parallel, referring to the expression of λ derived in part B of the Appendix, in case 2 the slope of the investor's objective function with respect to b in optimum equals

$$\frac{\partial V(\tilde{w}_{t+1}|\bar{x}^*)}{\partial b} = \frac{1}{2kw_t} \frac{\bar{a}_b^T S^{-1} \bar{R}_e}{\bar{a}_b^T S^{-1} \bar{a}_b} \nabla^T S^{-1} \left(\bar{R}_e - \frac{\bar{a}_b^T S^{-1} \bar{R}_e}{\bar{a}_b^T S^{-1} \bar{a}_b} \bar{a}_b \right) w_t$$

Hence, the slope of financial performance with respect to b must be

$$\frac{\partial r}{\partial b} = \frac{1}{2kw_t} \frac{\bar{a}_b^T S^{-1} \bar{R}_e}{\bar{a}_b^T S^{-1} \bar{a}_b} \nabla^T S^{-1} \left(\bar{R}_e - \frac{\bar{a}_b^T S^{-1} \bar{R}_e}{\bar{a}_b^T S^{-1} \bar{a}_b} \bar{a}_b \right)$$

Obviously, in case 2 an h -fold increase in k or w_t will lead to an h -fold decrease in the respective slope.

Finally, referring to the proof in part E of the Appendix, in case 3 for any value of b financial performance of an investor with an h -fold degree of risk aversion or initial wealth will be h

times smaller than that of a default investor.¹¹⁶ Hence, the effect caused by an increase in b , i.e. the difference in financial performance for two arbitrary values of b , must be h times smaller as well. In other words, similarly as in case 2, in case 3 an h -fold increase in k or w_t will lead to an h -fold decrease in the ‘slope’ of financial performance with respect to b .¹¹⁷

G. Effect of k and w_t on the increase in b needed for financial performance to drop to zero

In part F of the Appendix it is shown that in case 1 the slope of financial performance with respect to b is equal to

$$\frac{\partial r}{\partial b} = -\frac{2kw_t c}{\vec{a}_e^T S^{-1} \vec{a}_e}$$

where c is equal to the actual value of b in excess of the threshold of b , at which the respective social responsibility constraint becomes binding. Accordingly, one may write

$$\frac{\partial r}{\partial b} = -\frac{2kw_t (b - b_0)}{\vec{a}_e^T S^{-1} \vec{a}_e} \quad \text{with} \quad b_0 \equiv a_f + \frac{1}{2kw_t} \vec{a}_e^T S^{-1} \vec{R}_e$$

In order to simplify the notation, let us rewrite the expression further as

$$\frac{\partial r}{\partial b} = -\theta(b - b_0) \quad \text{with} \quad b_0 \equiv a_f + \frac{1}{2kw_t} \vec{a}_e^T S^{-1} \vec{R}_e \quad \text{and} \quad \theta \equiv \frac{2kw_t}{\vec{a}_e^T S^{-1} \vec{a}_e}$$

Obviously, once the constraint becomes binding, i.e. if $b \geq b_0$, financial performance of the default investor turns out to be a function of b . In particular,

$$r(b) = r_0 - \int_{b_0}^b \theta(t - b_0) dt$$

¹¹⁶ Note that in case 3 the statement from part E of the Appendix is relevant for any value of b , since in case 3 the optimal investment portfolio is always a solution of an unconstrained optimization problem. In fact, the respective social responsibility constraint, by which the feasible set of risky assets is restricted, is applied before the actual optimization procedure is run.

¹¹⁷ Note that since in case 3 the relation of financial performance and b is not smooth, it would be more accurate here to use the term ‘effect’ of an increase in b on financial performance rather than the ‘slope’ of the latter with respect to the former.

where r_0 represents the investor's financial performance in the unconstrained case. Computing the above integral $r(b)$ can be rewritten as

$$r(b) = r_0 - \frac{\theta(b - b_0)^2}{2}$$

Obviously, the value of b at which $r(b)$ will drop to zero must satisfy the following equation

$$r_0 = \frac{\theta(b - b_0)^2}{2}$$

Hence, finally

$$b = b_0 + \sqrt{\frac{2r_0}{\theta}}$$

In other words, starting from the threshold b_0 , i.e. the value of b at which the social responsibility constraint becomes binding, b has to be increased by $\sqrt{\frac{2r_0}{\theta}}$, in order for financial performance to drop to zero.

Referring to part E of the Appendix and the definition of θ , if k or w_i is increased h times, r_0 and θ are decreased and increased h times respectively. As a result, obviously, the expression $\sqrt{\frac{2r_0}{\theta}}$ is decreased h times. Hence, in case 1 for the investor with an h -fold degree of risk aversion or initial wealth the increase in b needed for financial performance to drop to zero will be h times as low as that of the default investor.

As already shown earlier, in case 2, financial performance can never drop to zero. Finally, in case 3 both financial performance in the unconstrained case as well as the slope of financial performance with respect to b will be h times as low as for the default investor. As a result, in case 3 the increase in b needed for financial performance to drop to zero will not depend on the investor's degree of risk aversion or initial wealth.

Figure 1.a: Results for case 1 using Indicator I

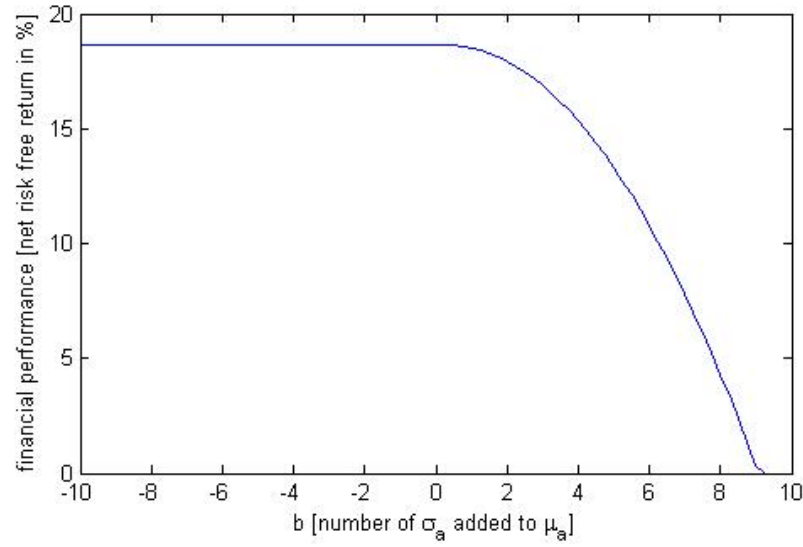


Figure 1.b: Results for case 1 using Indicator II

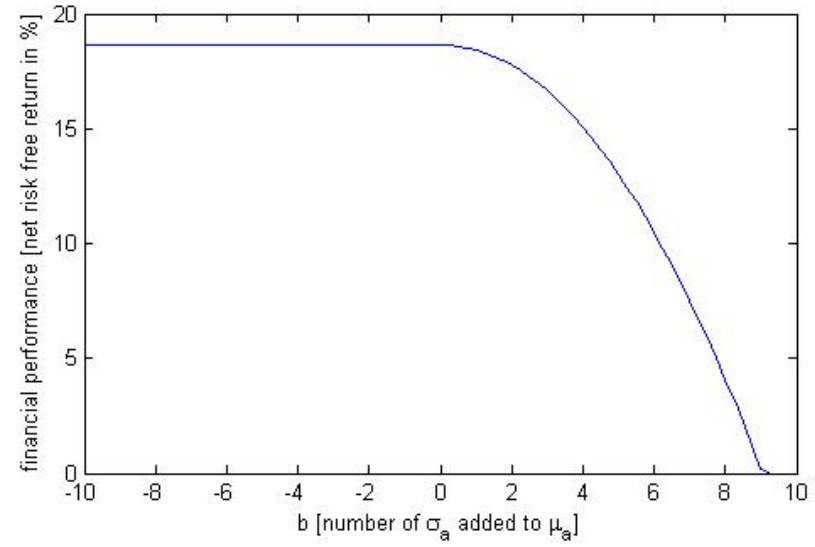


Figure 1.c: Results for case 1 using Indicator III

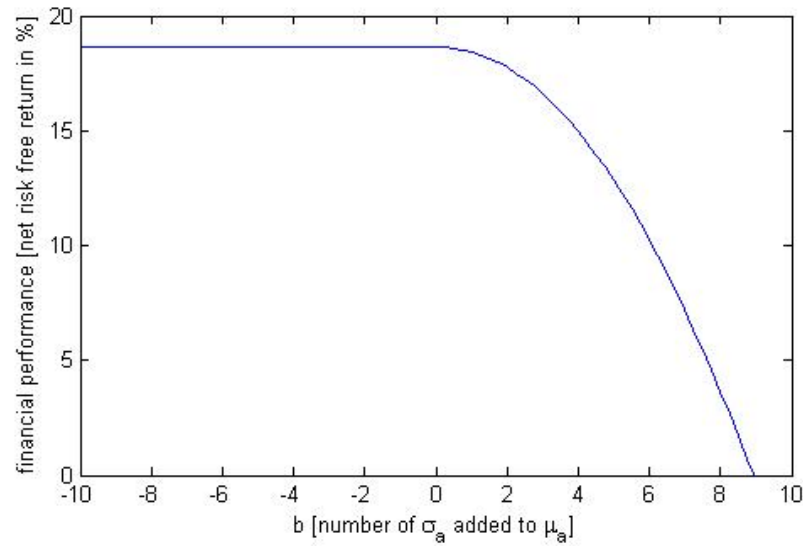


Figure 1.d: Results for case 1 using Indicator IV

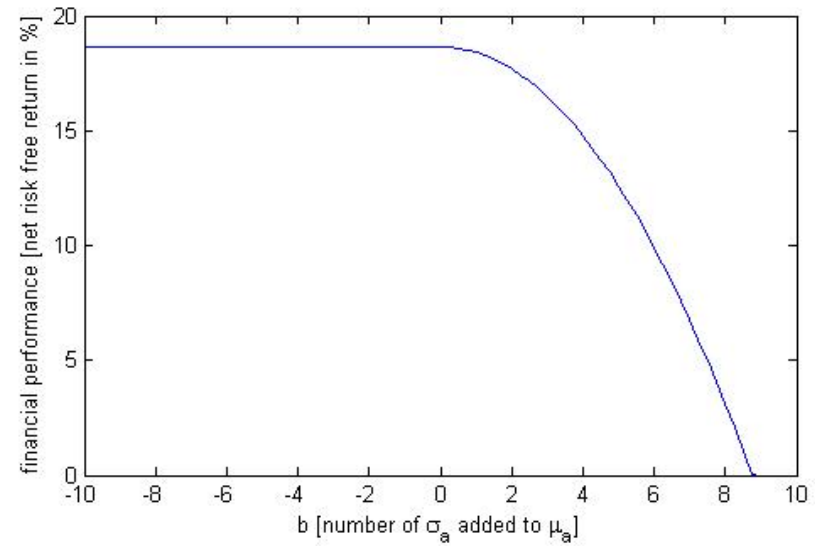


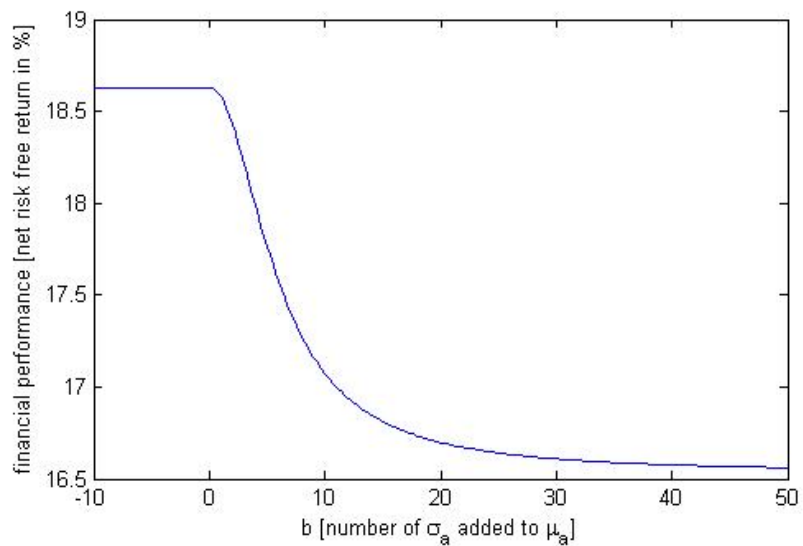
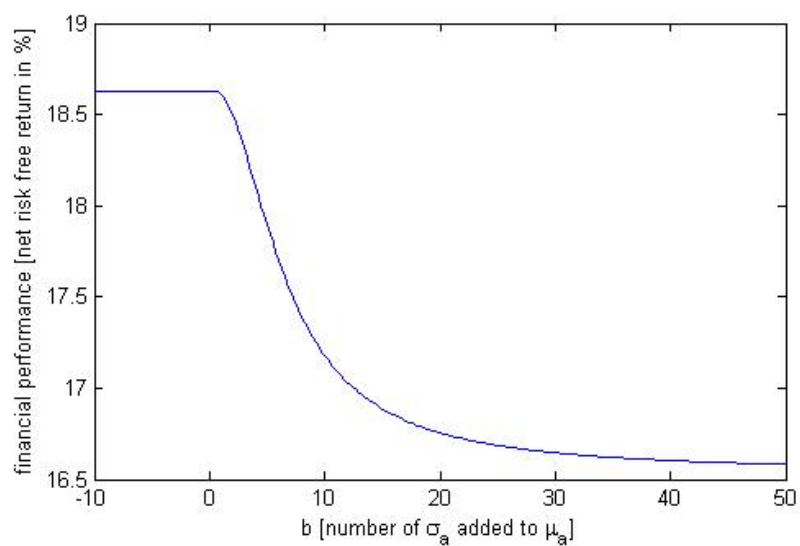
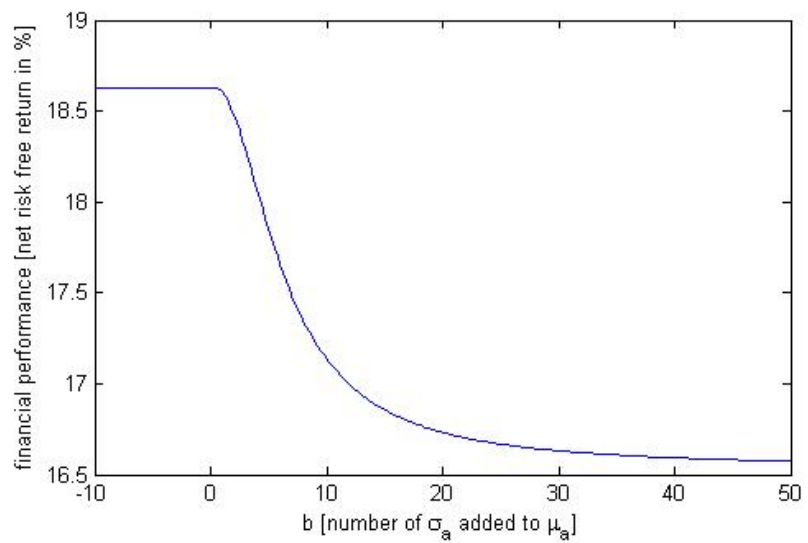
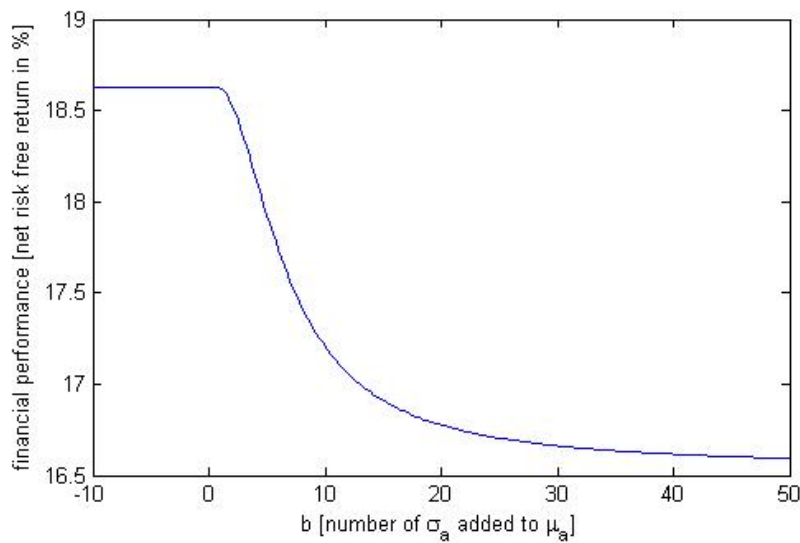
Figure 2.a: Results for case 2 using Indicator I**Figure 2.b:** Results for case 2 using Indicator II**Figure 2.c:** Results for case 2 using Indicator III**Figure 2.d:** Results for case 2 using Indicator IV

Figure 3.a: Results for case 3 using Indicator I

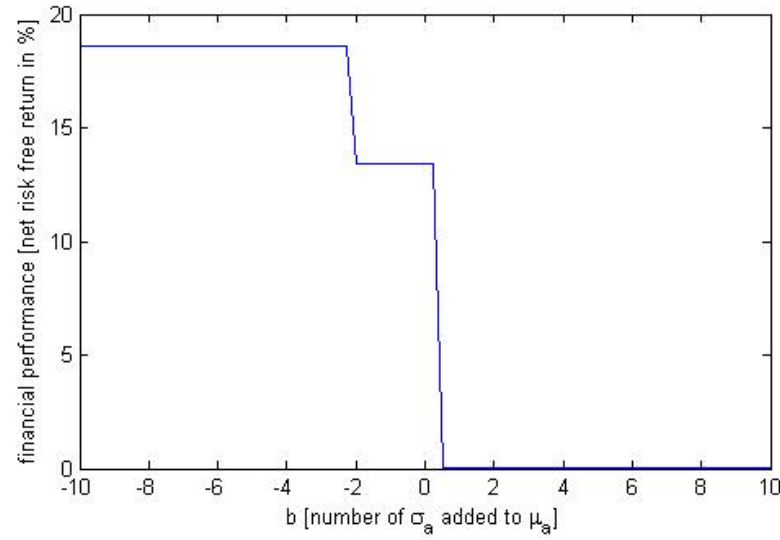


Figure 3.b: Results for case 3 using Indicator II

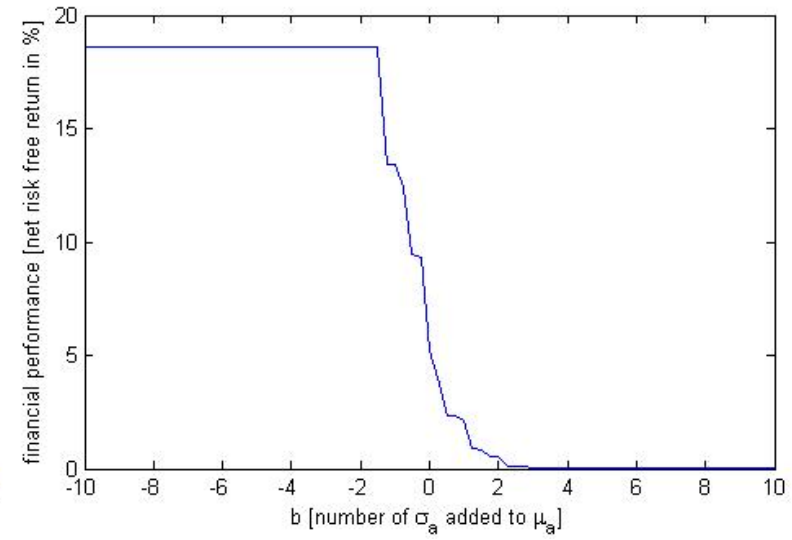


Figure 3.c: Results for case 3 using Indicator III

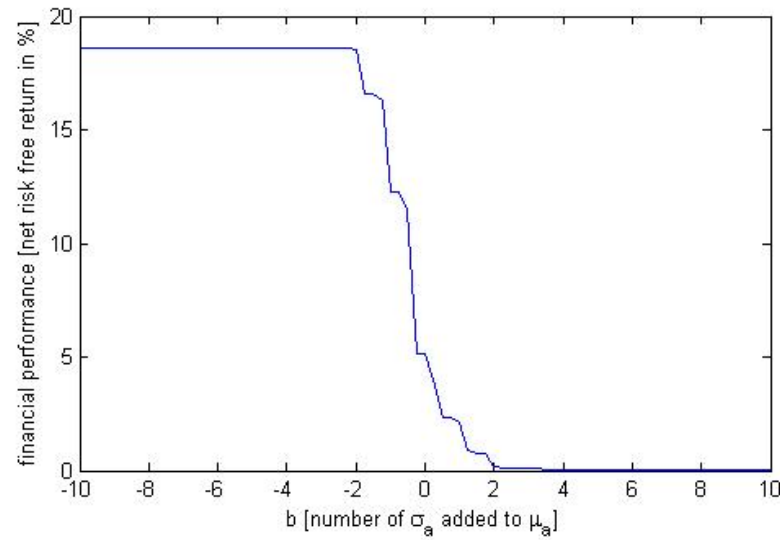


Figure 3.d: Results for case 3 using Indicator IV

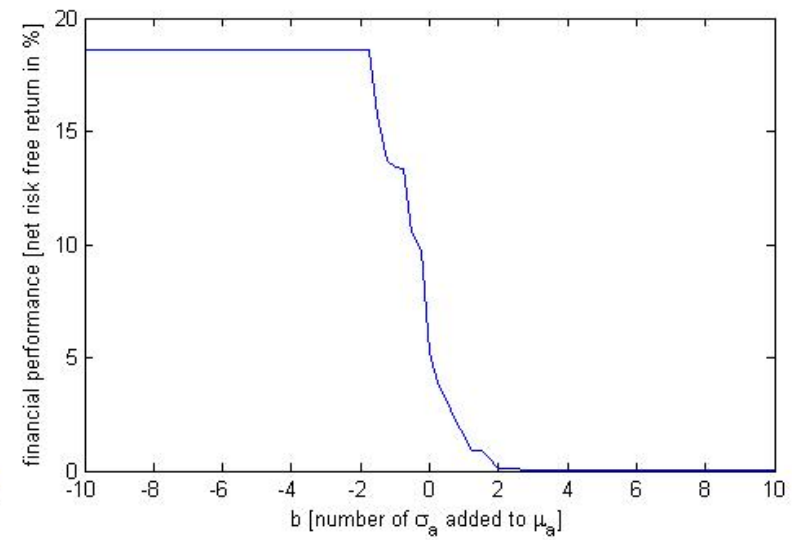


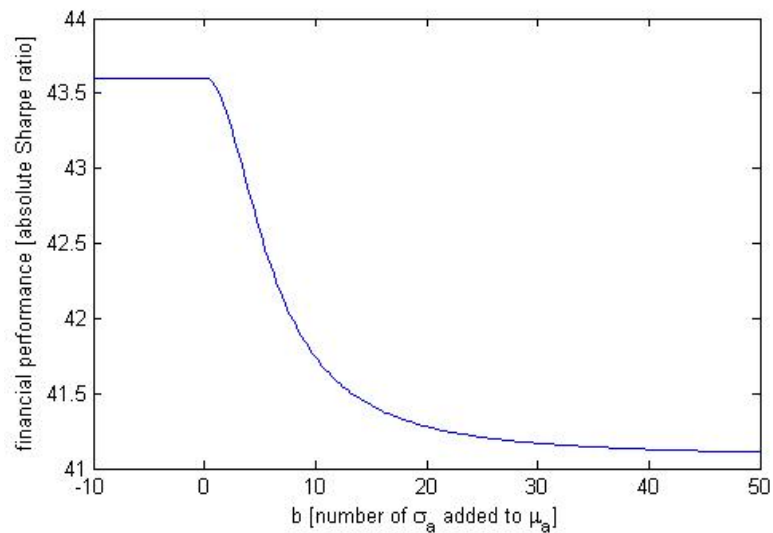
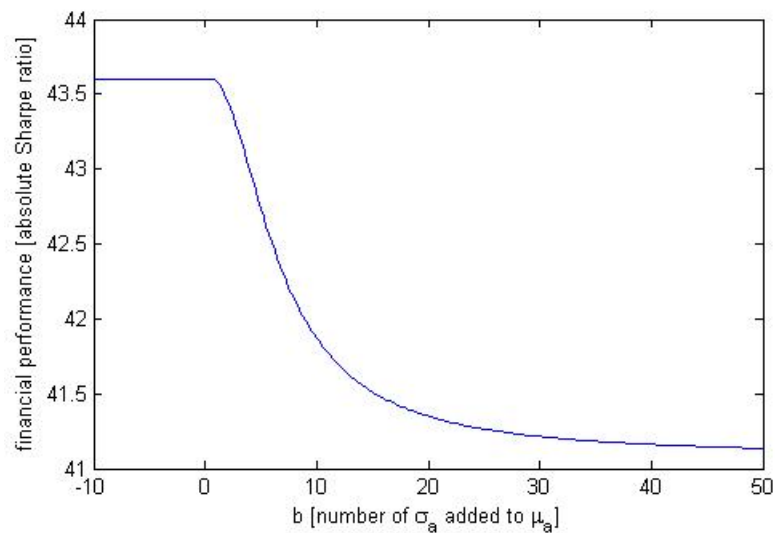
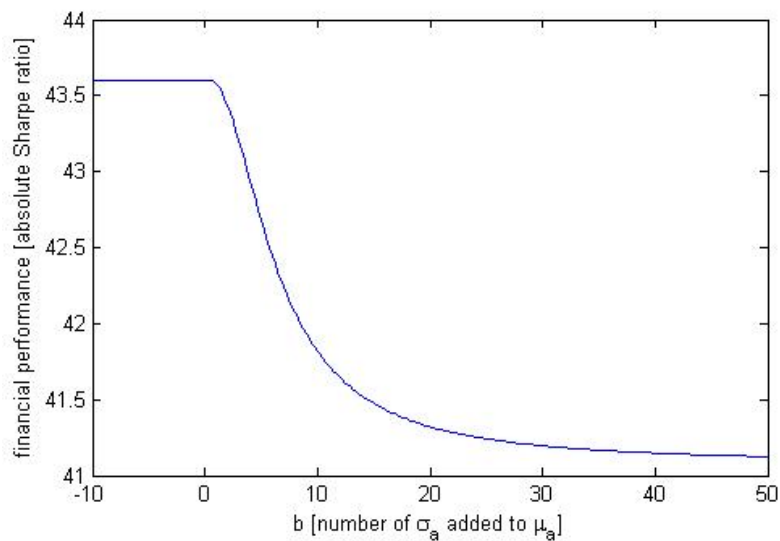
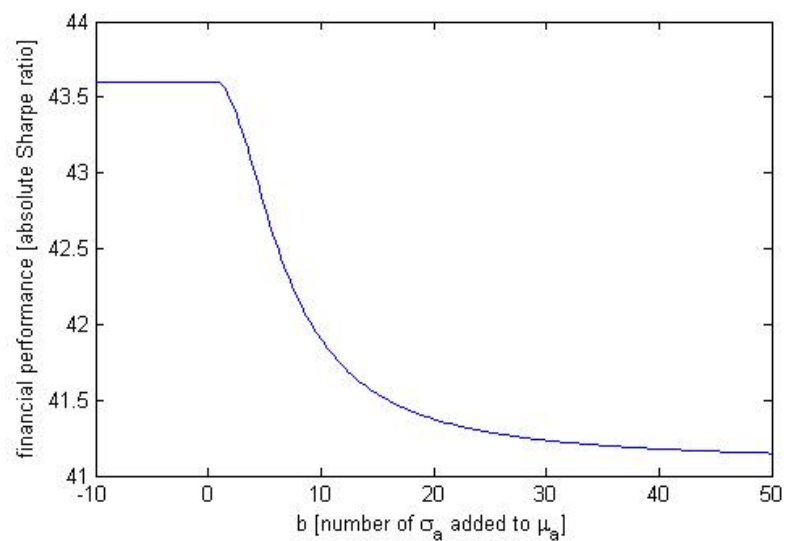
Figure 4.a: Results for case 2 using Indicator I**Figure 4.b:** Results for case 2 using Indicator II**Figure 4.c:** Results for case 2 using Indicator III**Figure 4.d:** Results for case 2 using Indicator IV

Figure 5.a: Results for case 3 using Indicator I

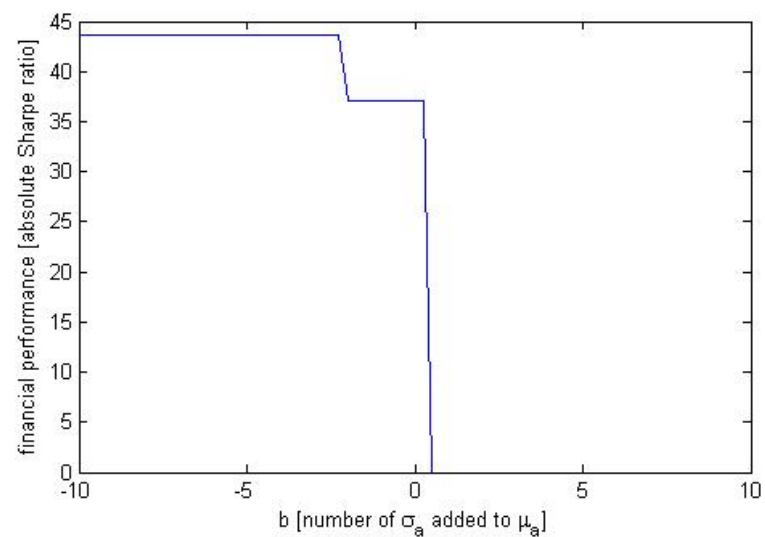


Figure 5.b: Results for case 3 using Indicator II

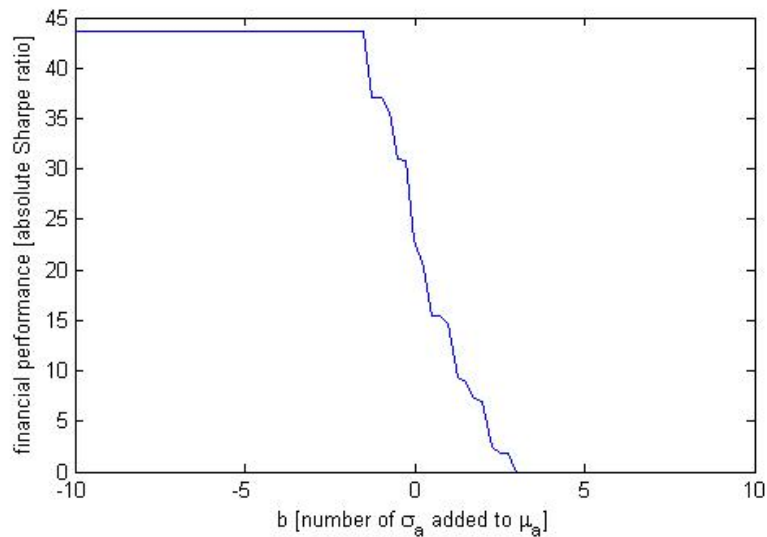


Figure 5.c: Results for case 3 using Indicator III

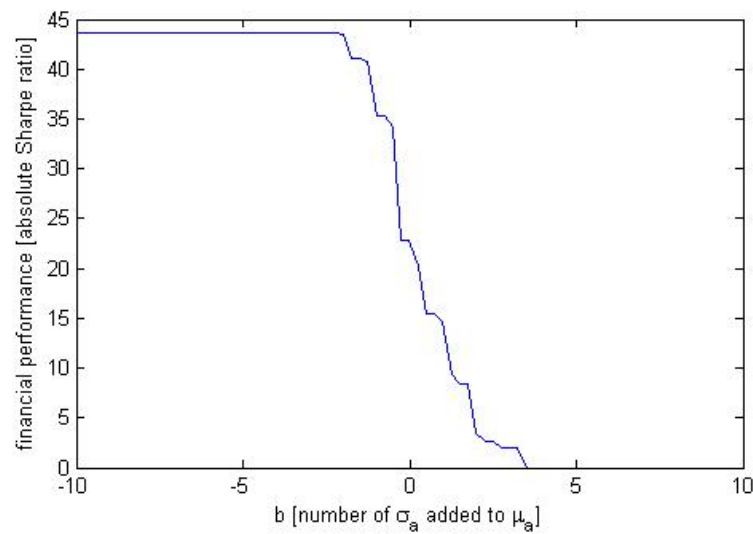
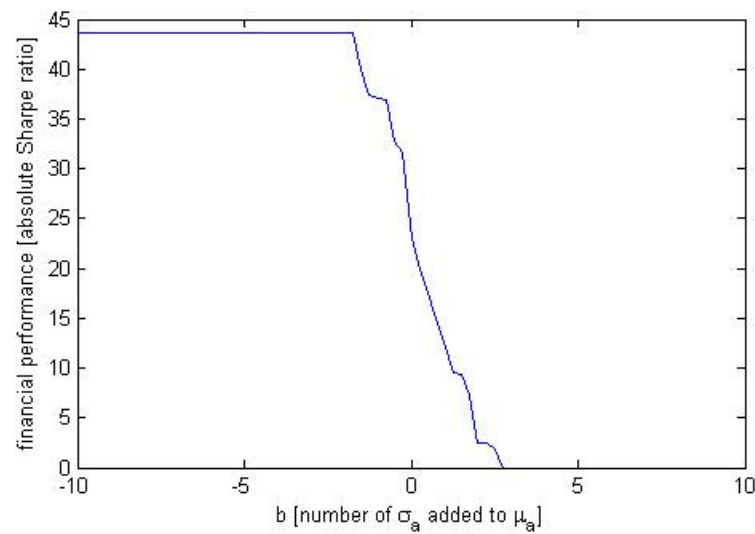


Figure 5.d: Results for case 3 using Indicator IV



References

- Eeckhoudt, L., Gollier, C., 1995, "Risk: Evaluation, Management and Sharing", *Harvester Wheatsheaf*, pp. 9 – 12.
- Gallier, J., 2000, „Geometric Methods and Applications: For Computer Science and Engineering“, *Springer-Verlag New York*, pp. 352 – 366.
- Garz, H., Volk, C., Gilles, M., 2002, "More Gain than Pain – SRI Sustainability Pays Off", *WestLB Panmure*.
- Gregory, A., Matatko, J., Luther, R., 1997, "Ethical Unit Trust Financial Performance: Small Company Effects and Fund Size Effects", *Journal of Business Finance & Accounting*, Vol. 24, pp. 705 – 725.
- Kreander, N., Gray, R. H., Power, D. M., Sinclair, C. D., 2005, "Evaluating the Performance of Ethical and Non-Ethical Funds: A Matched Pair Analysis", *Journal of Business Finance & Accounting*, Vol. 32, pp. 1465 – 1493.
- Mahoney, L., Roberts R., 2002, "Corporate Social and Environmental Performance and Their Relation to Financial Performance and Institutional Ownership: Empirical Evidence on Canadian Firms", Working Paper.
- Sauer, D. A., 1997, "The Impact of Social-Responsibility Screens on Investment Performance: Evidence from the Domini 400 Social Index and Domini Equity Mutual Fund", *Review of Financial Economics*, Vol. 6. No. 2., pp. 137 – 149.
- Tarmast, G., 2001, "Multivariate Log-Normal Distribution", *ISI Proceedings: Seoul 53rd Session*.
- White, M., 1995, "The Performance of Environmental Mutual Funds in the United States and Germany: Is There Economic Hope for 'Green' Investors?", *Research in Corporate Social Performance and Policy*, Supplement 1: pp. 323 – 344.

Deutsche Zusammenfassung

Die vorliegende Dissertation erweitert existierendes Wissen über sog. „Socially Responsible Investing“. Die Arbeit setzt sich aus drei eigenständigen jedoch zum Großteil inhaltlich verbundenen Studien zusammen. In der ersten Studie wird untersucht, inwieweit sich sog. Socially Responsible Investments von konventionellen Investments unterscheiden, im Bezug auf konkrete zu diesem Zweck entwickelte Indikatoren von Social Responsibility. Anhand eines relativ breiten Samples von Investmentfonds stellt sich heraus, dass die Socially Responsible Investments ihre konventionellen Kontrahenten in Bezug auf alle verwendeten Indikatoren übertreffen. Obwohl sich die entsprechende Differenz als statistisch signifikant erweist, erscheint diese absolut gesehen eher moderat. In Wirklichkeit scheinen nämlich beide Gruppen von Investments in Unternehmen mit vergleichbarem Grad von Social Responsibility zu investieren. Dementsprechend wird das Bedürfnis nach weiterer Forschung auf diesem sich schnell entwickelnden jedoch zurzeit kaum erforschten Gebiet bestätigt. In der zweiten Studie wird die Relation zwischen Social Responsibility und Rendite analysiert. Im Gegensatz zum Großteil der bereits durchgeführten Studien werden hierfür keine existierenden Investments herangezogen. Hingegen werden basierend auf den in der ersten Studie entwickelten Indikatoren von Social Responsibility Portfolios von den am meisten und den am wenigsten sozialverantwortlichen Unternehmen konstruiert. Anschließend wird die Rendite der so entstandenen Portfolios verglichen. Interessanterweise stellt sich heraus, dass sowohl die am meisten als auch die am wenigsten sozialverantwortlichen Unternehmen eine gleiche bzw. höhere Rendite als der Markt erzielen. Ein relativer Vergleich zeigt jedoch, dass die am meisten sozialverantwortlichen Unternehmen von den am wenigsten sozialverantwortlichen Unternehmen leicht übertroffen werden. Aus reiner Ertragsperspektive scheint es also besser zu sein, Social Responsibility zu meiden als diese zu verfolgen. Legen Investoren ihre Ressourcen trotzdem sozialverantwortlich an, muss Social Responsibility alleine für sie einen positiven Nutzenwert haben. Die Kosten von Social Responsibility stellen auch das Untersuchungsobjekt von der dritten Studie dar. Im Gegensatz zu der zweiten Studie werden diese jedoch ausschließlich aus der Sicht eines rationalen Investors mit Erwartungswert-Varianz Präferenzen unter der Annahme von perfekter Information über die Wahrscheinlichkeitsverteilung von künftiger Rendite analysiert. Zu diesem Zweck wird angenommen, dass der Investor sein optimales Investmentportfolio aus einer Menge von

Portfolios auswählt, welche einen von dem Investor bestimmten Mindestwert an Social Responsibility erreichen. Der Effekt von Social Responsibility auf die Ertragbarkeit des optimalen Investmentportfolios wird ermittelt, indem man den entsprechenden Mindestwert erhöht. Es wird wiederum bestätigt, dass man als Investor bereit sein muss, zusätzliche Kosten zu tragen, sofern man beim Investieren Prinzipien von Social Responsibility forcieren will.

Curriculum Vitae

Personal Information

Date of Birth: January 25th 1983

Nationality: Slovak

Status: Single

Education

1997 – 2001	Academy of Commerce, Bratislava
2001 – 2007	Master Studies of International Business Administration at University of Vienna
Since 2007	Doctoral Studies of Economic and Social Sciences at University of Vienna

Employment

2001 – 2007	Private Tutor of German and Mathematics at Elementary and High School Level, Bratislava
2007 – 2011	Research Assistant and Lecturer at the Department of Financial Services and Public Utility Management at University of Vienna
Since 2011	External Lecturer at the Department of Financial Services and Public Utility Management at University of Vienna
Since 2012	Participant in the Fast Track Program at Finance Trainer, Vienna

Publications

2011	„How Much SR Is There In SRI?“, <i>Schriftenreihe der Finance und Ethics Academy</i> , Band 4, pp. 100 – 128.
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