Portfolio performance and environmental risk

Rickard Olsson[1]

Umeå School of Business
Umeå University
SE-90187, Sweden
Email: rickard.olsson@usbe.umu.se

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MISTRA

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Abstract
This paper examines the performance of US stock portfolios constructed and rebalanced to have different environmental (EV) risk. EV risk is proxied by EV risk ratings from GES Investment Services. Portfolios with high EV risk generate higher raw returns than low EV risk portfolios, but when risk and other factors are controlled for using the three Fama-French factors and a momentum factor, the risk-adjusted returns of both high and low EV risk portfolios are not statistically different from zero. The evidence thus indicate that a portfolio of stocks with low EV risk, intended to be more responsible, neither underperform or outperform on a risk-adjusted basis.

Keywords: Socially responsible investment, environmental risk, portfolio performance evaluation.

1.1 *Introduction*

Social Responsible Investment (SRI) – also called sustainable or ethical investing - is an important investment strategy. In the US, the world's largest market for professional money management, 2.3 trillion USD, or almost 10% of all managed assets, are as of the end of 2005 involved in SRI (Social Investment Forum, 2006). SRI is closely related to Corporate Social Responsibility (CSR), which "includes issues such as environment, health and safety, diversity and human resources policies, and human rights and the supply chain." SRI is a process of identifying and investing in companies that meet certain standards of CSR. It comprises analyzing corporate social and environmental risks, and engaging corporations to better their CSR policies and practices (Social Investment Forum, 2006).

What about the investment performance of SRI? In a recent literature review, Kurtz (2005) concludes that the empirical evidence indicates that SRI neither underperforms nor outperforms on a risk-adjusted basis. Derwall *et al*. (2005), however, point out that studies involving SRI funds have some issues, including that factors not directly related to SRI, such as management skills and costs, might bias results. They also note that the performance evaluation models used in most studies are single-factor models, whereas research by, e.g., Fama and French (1993) and Carhart (1997), has demonstrated the superiority of multi-factor models. In response to the said issues, Derwall *et al*. (2005) adopt a different approach, which this study also follows. Based on eco-efficiency scores for a sample of individual US stocks, Derwall *et al*. construct one high-ranked and one low-ranked cap(italization)-weighted portfolio, with mutually exclusive holdings. The performances of the portfolios are evaluated using multi-factor models. Derwall *et al*. find that the high-ranked and environmentally responsible portfolio produced significantly positive abnormal returns.

This study contributes to the SRI literature by providing evidence on the performances of stock portfolios designed to have distinctly different environmental (EV) risk. Based on EV risk ratings from GES Investment Services, a low EV risk (LoEVR) portfolio and high EV risk (HiEVR) portfolio are constructed. The LoEVR portfolio is intended to be a more responsible investment than the HiEVR portfolio. All US stocks in the MSCI World Index with EV risk ratings - around 440 - are included in the study. The portfolios are revised twice a year, following the publication of new ratings. Six sets of EV risk ratings from the period 200312-200606 are used. Due to the fairly short time span of the ratings data, daily returns are used to increase the power of the portfolio performance tests. The period studied is one when sectors with high environmental risk have performed relatively well; actually, among the MSCI US Sectors, Energy, Utilities, and Materials recorded the highest returns. This could be important given the critique of Entine (2003) which says that the observed performance of SRI is overly positive, because many studies have examined particular periods in which SRI have performed abnormally well relative to non-SRI.

According to standard financial theory, expected return is determined by risk, and any observed return difference between the HiEVR and LoEVR portfolios should thus be attributable to differences in risk. An interesting feature of the GES Risk Ratings is that they explicitly are risk ratings. Some studies use non-risk measures, e.g., eco-efficiency scores. If a return difference is observed, it may be the case that the EV risk ratings reflect a priced environmental risk factor. Alternatively, it may be that the EV risk ratings reflect other (non-environmental) risk factors. Non-risk or market inefficiency explanations are also possible, saying that observed return differences or premia are the result of mispricing instead of compensation for risk.

The performances of the portfolios are evaluated on basis of abnormal or risk-adjusted returns estimated using the established Carhart (1997) 4-factor model, which controls for the portfolios' exposures to (risk) factors known to explain returns. The Carhart model contains the three well-known factors of Fama and French (1993), and a fourth momentum factor. These factors are not all themselves fundamental risk factors, and should rather be viewed as proxies for such factors. The 4-factor model is also augmented by three industry factors derived by principal components analysis. The explanatory power of the 4-factor model is substantial as it often explain as much as 90% of the return variation. Any remaining return difference between the HiEVR and LoEVR portfolios after the influences of the common return factors are controlled for, could then in principle represent risk premia or mispricing.

In the next section, the data are described. Section 1.3 presents the method and Section 1.4 the results. The study is concluded in Section 1.5.

1.2 *Data*

Daily factor data were downloaded from the Kenneth French Data Library.[2] This was also the source for daily value-weighted returns for 30 US industry portfolios. Data for calculating daily stock and MSCI US Sector returns, adjusted for dividends and corporate actions, were retrieved from Thomson Datastream, as were market capitalizations.

GES assigns stocks a specific and a general EV risk rating. A firm's general EV risk rating (A, A-, B+, B, B-, C+, C) is intended to reflect the EV risk of the firm's industry. The specific EV risk rating (a, a-, b+, b, b-, c+, c) indicates the particular EV risk of a given firm. The specific EV risk rating is derived through analysis of the company along more than 60 dimensions based on international standards for environmental management and industry-specific key indicators for environmental performance, among other things. Information sources used in the analysis process include official company documents, dialogue with companies, non-governmental organizations, the media and GES partners in the SiRi Group (www.ges-invest.com and private communication with GES representatives). GES rates approximately the 1000 largest firms in the MSCI World Index. This objective selection of which firms to rate, is a strength of GES rating system.

Figure 1 illustrates the EV risk ratings as presented by GES. The combined general and specific ratings Aa indicates the lowest EV risk, while Cc indicates the highest combined EV risk. Ba is riskier than Aa, as is Ab, and so on. (Note that Figure 1 is simplified in that not all combinations of specific and general EV risk ratings are depicted.)

Figure 1 suggests that a total measure of a firm's specific and general EV risk ratings could be derived as the distance from the origin to the point of the firm's combined rating. The distance is calculated using the theorem of Pythagoras, and with equal weight given to the general and specific risk ratings, so that the distance from the origin to, for example, Bc equals that to Cb. This total EV risk measure is used as the basis for portfolio construction.

[2] Thanks to Kenneth French for supplying the data. Details on and the actual data could be found at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/.

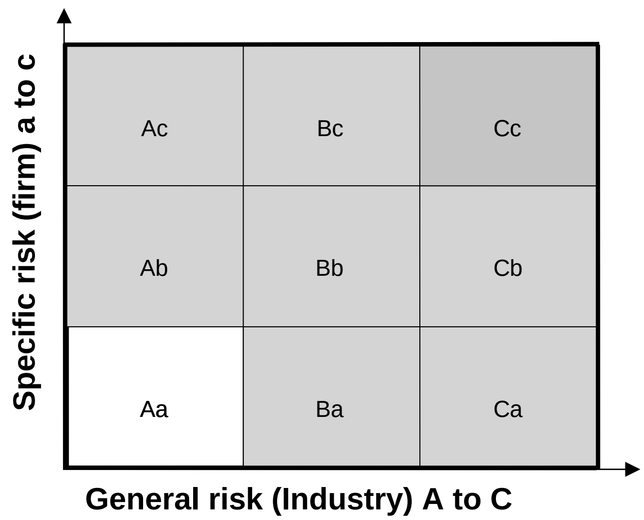

Figure 1. GES Risk Ratings (Source: GES Invest, slightly modified)

1.3 *Method*

Portfolio construction and rebalancing

The construction of the portfolios for the performance tests is standard. At the end of Dec. 2003, the first set of GES EV Risk Ratings is published. Let one month pass to avoid look-ahead bias. At the end of Jan. 2004, when the ratings are assumed publicly known, allocate the 30% stocks with the highest (lowest) EV risk into the HiEVR (LoEVR) portfolio. The cap-weight return on the, initially cap-weight, portfolios are calculated each day the coming 6 months, until the end of Jul. 2004, when a fresh set of ratings is assumed publicly known. Deleted holdings are assumed sold at the last closing price and proceeds reinvested in the remaining stock in proportion to current weights. The above procedure is repeated until the data set is exhausted. This way, the number of return observations for each portfolio becomes 735.

Portfolio performance evaluation

Ordinary least squares regression analysis is used to estimate abnormal return α_i and factor sensitivities β_{1i}–β_{4i} of the portfolios in the following 4-factor model (Carhart, 1997):

$$r_{it} - r_{ft} = \alpha_i + \beta_{1i}(r_{mt} - r_{ft}) + \beta_{2i} smb_t + \beta_{3i} hml_t + \beta_{4i} umd_t + u_{it}, \qquad (1)$$

where

- r_{it} = daily return on portfolio i,
- r_{ft} = the simple daily rate that compounds to the one-month Treasury bill rate,
- r_{mt} = daily market return = the value-weight return on all NYSE, AMEX, and NASDAQ stocks,
- smb_t = the size factor = daily return difference of a small-cap and a big-cap stock portfolio,
- hml_t = the value/growth factor = daily return difference of a high book-to-market (value) and a low book-to-market (growth) stock portfolio,
- umd_t = momentum factor (or up minus down) = daily return difference between portfolios of return winners and losers during day -250 to -21, and
- u_{it} = error term.

Following Derwall *et al.*, (1) is also estimated for a difference (DIF) portfolio, whose daily return equals the return difference between the LoEVR and the HiEVR portfolio. This gives direct evidence on any performance differences between the two portfolios. t-tests, based on Newey and West (1987) heteroscedasticity and autocorrelation robust standard errors considering six lags, are used to test whether the estimated coefficients in (1) are different from zero.

1.4 *Results*

The results of the portfolio performance evaluations are presented in Table 1. The HiEVR portfolio has higher average raw return and return standard deviation than the LoEVR portfolio. If the environmental risk ratings reflect risk this is what would be expected. The difference in return between the HiEVR and LoEVR portfolios is, however, not statistically different based on a paired t-test (not tabulated). The number of stocks in the portfolios suggests that the portfolios should be well diversified.

Table 1. Statistics on portfolios and results of performance evaluations.

$\overline{R}$ is the annualized average return on a given portfolio and σ(R) is the annualized return standard deviation. $\overline{N}$ is the average number of stocks in a given portfolio. Alpha, α, is the annualized abnormal performance of a given portfolio estimated in (1). Adj.R^2 is the coefficient of determination adjusted for degrees of freedom. σ(TE) is the annualized tracking error standard deviation. The tracking error is the daily return difference between a given portfolio and the market r_m. *, **, and *** denotes Significance at the 10%, 5%, and 1% level, respectively, based on two-sided t-tests computed with Newey and West (1987) heteroscedasticity autocorrelation consistent standard errors using 6 lags.

Portfolio	$\overline{R}$ %	σ(R) %	$\overline{N}$	α %	r_m-r_f	*smb*	*hml*	*umd*	Adj.R^2 %	σ(TE) %
HiEVR	16	13	130.4	1.6	1.04 ***	-0.20***	0.08 *	0.34 ***	87	4.6
LoEVR	10	11	130.3	-0.7	1.11 ***	-0.17***	-0.14***	-0.23 ***	91	3.4
DIF (LoEVR minus HiEVR)				-2.3	0.07 **	0.03	-0.22***	-0.57 ***	32	7.2

The 4-factor model is powerful in explaining returns, as indicated by the high adjusted coefficients of determination and the significant regression coefficients. As to the portfolio performance tests, no portfolio produced an abnormal return statistically different from zero at the 5% level or less. Disregarding statistical significance, the HiEVR portfolio exhibits a positive abnormal return of 1.6% per year, greater than that of the LoEVR portfolio. Once returns are adjusted for influences of common factors known to determine returns, there is however no compelling evidence that the LoEVR portfolio performs differently than the HiEVR portfolio, as indicated by the statistically insignificant α of –2.3% of the DIF portfolio.

For both the HiEVR and LoEVR portfolio, the coefficient on the market factor r_m-r_f is around one and significantly different from zero. The coefficient for the DIF portfolio suggests that the LoEVR portfolio has significantly higher exposure to the market than the HiEVR portfolio.

The portfolios, except the DIF portfolio, exhibit a statistically significant tilt towards big-cap stocks, as demonstrated by the negative coefficients on the *smb* factor. This reflects the fact that all the stocks are members of the MSCI World Index which is a big-cap index. Naturally then, for the DIF portfolio, the coefficients on this factor are not different from zero.

The coefficient of the *hml* factor is negative and significant for the LoEVR and DIF portfolio. This indicates that the LoEVR portfolio has a greater exposure to growth stocks than the high risk portfolio, which appears tilted towards value stocks.

The coefficient on the momentum factor *umd* is positive (negative) and significant for the HiEVR (LoEVR) portfolio. Moreover, the same coefficient is significantly negative for the DIF portfolio. Compared to the LoEVR portfolio, the HiEVR portfolio thus appears to be more exposed to the momentum factor, that is, tilted towards the previously highest returning stocks. Given the high returns to stocks in environmentally challenging sectors in the period studied, this is a plausible finding.

Regarding investment styles, Derwall *et al.* find significant differences between the low-ranked and high-ranked eco-efficiency portfolios; specifically, the high-ranked portfolio has relatively less market, big-cap, and value exposure. Apart from the exposure to the *hml* factor, these style differences between a more and a less responsible investment are thus quite different than the style differences observed here between the LoEVR and HiEVR portfolios.

Tracking error is an important performance gauge and target for many portfolio managers. The LoEVR portfolio produces a lower tracking error standard deviation $\sigma(TE)$ than the HiEVR portfolio, but the levels are probably higher than most fund managers are comfortable with. It should be kept in mind that the portfolios analysed in this study are simply cap-weighted, and it is quite likely that optimization techniques could be successfully applied to improve the portfolios with regard to tracking error and other considerations.

Robustness tests

The results and conclusions of the study appear quite robust because they withstood the following sensitivity tests. In addition to allocating the 30% stocks with the highest (lowest) EV risk into the HiEVR (LoEVR) portfolio, 10% and 20% were used as a basis for the allocation. The portfolio formation rule used in Derwall *et al*., where the high (how) portfolio contained 30% of the total capitalization rated highest (lowest), was investigated. Portfolio returns were calculated as an equal-weighted average of the constituents' returns, which, in contrast to the cap-weighted averaging used above, implies daily rebalancing of the portfolios so as to keep the portfolios equal-weight. Following Derwall *et al*., the Carhart 4-factor model was extended with three industry factors derived by principal components analysis. Finally, in addition to the one-month lag between the release of new ratings and the portfolio, zero and two-month lags were tested.

1.5 *Conclusions*

This study contributes to the literature on SRI by providing empirical evidence on the performance of stock portfolios designed to have distinctly different EV risk. Using EV risk ratings from GES Investment Services, a high EV risk and low EV risk portfolio were constructed. The high EV risk portfolio had greater, but not statistically significantly greater, raw returns than the low EV risk portfolio. The high risk portfolio also had higher return standard deviation.

Performance evaluations using the Carhart 4-factor model indicated that neither the high nor the low EV risk portfolio produced abnormal returns statistically different from zero. The performance analysis also revealed systematic differences in investment styles between high and low EV risk portfolios. Relative to the high EV risk portfolio, the low EV risk portfolio exhibited higher exposure to former losers, the market, and growth stocks.

The overall conclusion is that a more responsible low EV risk portfolio does neither underperform nor outperform on a risk-adjusted basis, and this in a period when sectors with high environmental risk produced the highest returns.

References

Carhart MM. 1997. On the Persistence in Mutual Fund Performance. *Journal of Finance* **52**: 57-82.

Derwall J, Guenster N, Bauer R, Koedjik K. 2005. The Eco-Efficiency Premium Puzzle. *Financial Analysts Journal* **61**, 2, March/April: 51-62.

Entine J. (2003). The Myth of Social Investing. *Organization & Environment* **16**: 352-368.

Fama *EF*, French KF. 1993. Common Risk Factors in the Returns on Bonds and Stocks. *Journal of Financial Economics* **33**: 3-56.

Kurtz L. 2005. Answers to four questions. *The Journal of Investing* Fall: 125-137.

Newey W, West K. 1987. A simple positive semi-definite, heteroscedasticity and autocorrelation consistent covariance matrix. *Econometrica* **55**, 703–708.

Social Investment Forum. 2006. *2005 Report on Responsible Investing Trends in the United States: 10- year* Review. Washington, DC: Social Investment Forum (January 24).