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ABSTRACT

Empirical evidence to date on the financial consequences of investing socially responsible (SRI) has been inconclusive. In this paper, we overcome the methodological deficiencies that are encountered in previous related literature. Using the well-established Innovest eco-efficiency scores, we compose two equity portfolios that differ in environmental responsibility and assess their investment performance by means of elaborate performance attribution frameworks. After controlling for risk and investment style we find that our high-ranked portfolio outperforms the low-ranked counterpart. This performance gap widens considerably and becomes statistically significant once industry-effects are accounted for as well. We interpret our results as evidence of an "eco-efficiency premium" in the U.S. equity market. We evaluate how the premium can be exploited in a practical setting via a best-in-class stock selection strategy. The results remain significant under practical conditions and various levels of transactions cost, thus indicating that the incremental benefits of SRI can be substantial.

Introduction

In recent decades a large number of investors has embraced the concept of socially responsible investing (SRI). Currently, nearly 12% of assets under management are invested according to ethical criteria[1]. However, despite the increasing popularity of SRI, there is an ongoing debate over whether adding an ethical dimension to the stock selection process adds value. At the security investment level it has been argued frequently that incorporating ethical criteria into investment decisions will come at the cost of poorer portfolio performance. Traditional investors stress that portfolios constrained by ethical considerations suffer from limited diversification benefits. Another popular perception among skeptics is that ranking stocks on the ethical performance spectrum can be a costly practice that may ultimately affect net return.

At the firm level it is often believed that businesses cannot resort to their financial resources to improve social or environmental performance without decreasing shareholder value. One common line of reasoning is that a firm's costs of adhering to ethical standards will translate into higher product prices, a competitive disadvantage and lower profitability (e.g. Walley and Whitehead (1994)). Alternatively, it has been argued that improved social or environmental performance can lead to enhancements in a company's input-output efficiency or generate new market opportunities. Porter and van der Linde (1995) argue that active policies to improve environmental performance can lead to a competitive advantage resulting from more cost-efficient use of resources. Therefore, if the benefits of social or environmental initiatives outweigh their costs, investors holding responsible portfolios may earn incremental financial returns.

The central empirical question arising from this debate is whether corporate social or environmental responsibility is associated with financial performance. If there is a premium associated with social responsibility then research should investigate a variety of methods to exploit the premium in a practical setting. Most investment literature has investigated the social-financial performance link empirically by comparing the historical returns of socially responsible mutual funds with those of conventional funds or market indexes (e.g. Bauer, Koedijk and Otten (2002), Hamilton, Jo and Statman (1993), and Statman (2000)). Although this approach provides useful evidence on the financial consequences of SRI in a practical context, the method has some limitations. Results from mutual fund studies might be biased due to non-quantifiable aspects such as management skill, unknown portfolio holdings and screening methods. Furthermore, mutual fund studies cannot establish whether a social or environmental responsibility premium exists given that social and conventional fund holdings are not mutually exclusive.

In this study, we avoid these difficulties by using the Innovest rating database, to build stock portfolios. Despite being well established in the investment community, these ratings have not been used previously in the literature. Focusing exclusively on the environmental element of social responsibility, this study investigates if a long-run premium or penalty exists for holding environmentally responsible companies. In the first part of this research, we construct two mutually exclusive portfolios with distinctive 'eco-efficiency' scores. We then apply performance attribution models to test whether any performance differential between the portfolios is significant and attributable to the environmental component. The method allows us to examine the long-term benefits of including environmental criteria in the investment process. Using Carhart's (1997) multifactor performance attribution model to control for non-environmental factors known to determine stock performance, we methodologically improve prior related studies, which usually only accounted for volatility or market risk. The major benefit of our approach, as also empirically confirmed by Fama and French (1993) and Carhart (1997), is that we additionally control for the presence of style tilts in stock portfolios (e.g. size, value versus growth or momentum effects). This is particularly important given mounting evidence that environmentally and socially screened portfolios in the United States tend to be more biased towards large caps and growth stocks than unscreened portfolios; see for example Bauer *et al.* (2002).

Our empirical results provide evidence that environmental responsibility is rewarded in the market. Performance evaluation results from the multifactor framework indicate that the high-ranked portfolio considerably outperformed its low-ranked counterpart on a risk- and style-adjusted basis. This performance gap widens and becomes statistically significant once industry-effects are accounted for as well. We interpret this result as evidence of an "eco-efficiency premium" in the U.S. equity market. Finally, we find that the premium is exploitable under practical conditions and various levels of transactions costs.

Environmental responsibility and investment performance

Over the past decades a large body of literature has investigated the relationship between environmental and financial performance. Unfortunately, the empirical results to date have been inconsistent. As pointed out by Ullman (1985) and Griffin and Mahon (1997), the conflicting results in prior research are mainly attributable to differences in methodology and in the choice of financial and environmental performance indicators. However, for studies using stock returns as a financial performance measure, Wagner (2001) identified three different categories: portfolio studies, event studies, and (multivariate) regression studies.

Examples of portfolio studies include Cohen, Fenn and Konar (1997), Yamashita, Sen and Roberts (1999) and White (1996). Cohen *et al.* (1997) constructed industry-balanced portfolios with different environmental responsibility characteristics to investigate the financial performance difference between low-polluter and high-polluter companies in the United States. Their findings suggest that there is neither a premium nor a penalty for investing in environmental leader companies. However, a comparison by Yamashita *et al.* (1999) of 10-year returns showed that their environmentally highest ranked stocks performed significantly better than lowest ranked stocks after adjusting for market risk. Finally, White (1996) examined the performance of "green", "oatmeal" and "brown" equity portfolios. He demonstrated that the green portfolio provided a significantly positive Jensen alpha while the other two alternatives failed to outperform the market.

Event studies to date provide more pronounced evidence of a linkage between environmental and stock market performance. Shane and Spicer (1983) documented that companies experienced abnormal declines in stock prices two days prior to their pollution figures being reported by the Council on Economic Priorities. Moreover, on the day of publication, negative returns were significantly larger for companies with a relatively poor pollution control record than for companies with better rankings. Hamilton (1995) reported a significantly negative abnormal return for publicly traded companies following the first release of their TRI pollution figures. Consistent with previous results, Klassen and McLaughlin (1996) found evidence suggesting that positive corporate events, measured by environmental awards given to companies by third parties, are associated with positive subsequent abnormal returns. Significantly negative returns tend to follow environmental crises. Similarly, Rao (1996) reported that the performance of companies after pollution reports by the Wall Street Journal between 1989 and 1993 was significantly below their expected market adjusted returns. Only Yamashita *et al*. (1999) did not find significant stock market responses to environmental conscientiousness scores published in July 1993's Fortune Magazine.

A third category of literature primarily used regression or correlation analysis to examine whether a long-term relation exists between corporate environmental responsibility and stock performance. Taken as a whole, these studies provide only limited support for the notion of a relationship between environmental and stock market performance. Spicer (1978) documented that companies in the US pulp and paper industry with better pollution control records have a higher profitability and a lower stock beta. Chen and Metcalf (1980), on the other hand, replicated Spicer (1978) and put his findings in doubt after controlling for the impact of firm size on environmental performance. Using a nearly similar method, Mahapatra (1984) also found no evidence to support the notion that pollution control initiatives are rewarded with improved stock performance.

Most prior research, being implicitly underpinned by Sharpe's (1964) CAPM-framework, merely corrected portfolio performance or observed relationships for a single-risk factor loading[2]. More recent evidence by Fama and French (1993) and Carhart (1997) has pointed out that a single-factor environment is insufficiently capable of explaining the cross-sectional variation in equity returns. Therefore, the relationship between environmental and financial performance observed in studies to date may have been driven by latent factors that were not considered as control variables in the research method. Focusing on portfolio analysis, we will extend prior research by considering a more elaborate performance attribution framework.

Measuring Environmental Performance

To assess corporate environmental performance we obtain rating data from Innovest Strategic Value Advisors (from hereon Innovest). The main benefits of these scores are their comprehensiveness. Using over twenty information sources, both quantitative and qualitative in nature, Innovest's analysts evaluate a company relative to its industry peers via an analytical matrix. The resultant rating is a monthly composite score comprising over sixty factors that are collectively expected to be useful indicators of corporate ‘eco-efficiency’. Broadly speaking, the analytical modeling platform addresses five fundamental types of environmental factors[3]:

- Historical liabilities: involves risk resulting from preceding actions.
- Operating risk: risk exposure from recent events.
- Sustainability and eco-efficiency risk: future risks initiated by the weakening of the company’s material sources of long-term profitability and competitiveness.
- Managerial risk efficiency: the ability to handle environmental risk successfully.
- Environmentally-related strategic profit opportunities: business opportunities, such as a competitive advantage, available to the firm relative to industry peers).

The Innovest database contains scores on more than 1200 firms globally. In this paper we only consider U.S. companies. The number of companies is about 180 at the end of May 1997 and increases steadily to approximately 450 at the end of May 2002.

Empirical Analysis

Portfolio construction. We construct two mutually exclusive stock portfolios with distinctive eco-efficiency characteristics.[4] After having matched all firms in the Innovest universe with the CRSP stock database, we annually rank the companies on most recent eco-efficiency ratings.[5] Covering 30% of total capitalization, the ‘high-ranked’ (‘low-ranked’) portfolio consists of companies rated highest (lowest) by Innovest. The annual re-ranking and portfolio re-balancing occurs at the end of June. When constructing the portfolios, we take into account a one-month lag for the ranking data to avoid look-ahead bias. Companies for which no rankings were available at the rebalancing date are excluded automatically for the subsequent twelve-month period. End-of-month return data are observed for the period July 1997-December 2002.

Table 1 presents an overview of descriptive statistics on the two extreme portfolios. Mean returns, standard deviations and Sharpe ratios are annualized. These basic statistics suggest that the portfolio consisting of highly eco-efficient companies performed better than the eco-inefficient counterpart, particularly when adjusting for volatility.

[Insert Table 1]

Portfolio Performance in a CAPM-Framework. To account for differentials in the portfolios' market risk, we measure portfolio performance via the well-established CAPM-framework. Specifically, for all portfolios we employ a (OLS) regression to estimate the model of the form:

$$R_{it} - R_{ft} = a_i + ß_i(R_{mt} - R_{ft}) + e_{it}, \qquad (1)$$

where

R_{it}	=	the return on portfolio i in month t,
R_{ft}	=	the one-month T-Bill rate at t,
R_m	=	the return on a value-weighted market proxy in month t,
e_{it}	=	an error term.

The value-weighted market proxy and the risk-free rate were provided by the Kenneth French Data Library[6]. The model- $ß_i$ ('beta') is interpreted as measuring a portfolio's market risk exposure and a_i (Jensen's 'alpha') represents the average abnormal return in excess of the return on the market proxy. Hence, in this scenario it is implicitly assumed that the difference between the return on a portfolio and the return on the single-factor benchmark according to an estimated CAPM provides an accurate estimate of risk-adjusted performance.

Table 2 reports performance evaluation results obtained from the CAPM-framework. We present results for the portfolios comprising high-ranked and low-ranked firms. Since the primary focus of the research is examining the performance differential between the high-ranked portfolio and the low-ranked portfolio, we also investigate the returns on a long-short portfolio, the *difference* portfolio, which is constructed by subtracting the high-ranked portfolio returns from the returns on the low-ranked stock portfolio. The influence of environmental screening on investment performance is derived from the difference in the observed alpha between the high-ranked portfolio and the low-ranked portfolio.

[Insert Table 2]

According to the reported alpha estimates and corresponding t-statistics, both long portfolios did not perform significantly different from the market proxy. Furthermore, a comparison of the betas of the two extreme portfolios reveals that the high-ranked portfolio exhibited substantially more exposure to the market factor. The most important observation is that the alpha of the *difference* portfolio is positive (i.e. 2.47% annually), which suggests that the high-ranked portfolio provided a higher market risk-adjusted return than its low-ranked counterpart. Consistent with Cohen *et al.* (1997), the performance difference is not statistically significant. This suggests that there is no significant premium or penalty associated with holding stocks of eco-efficient companies.

However, we additionally investigated whether these results tend to be industry-sensitive. Specifically, we computed industry-adjusted portfolio returns using 12 industry-grouped portfolio returns provided by the Kenneth French Data Library. Based on its SIC-code, each company in the dataset was allocated to one of twelve industry categories.[7] Then, again for each company, the product of the industry return and the firm's industry beta was deducted from the company return. After having replicated the two extreme portfolios we repeated the regression described earlier to obtain an industry bias-free alpha estimate. The results are reported in the final row of Table 2. The return on the zero-investment portfolio increases noticeably to 7.79% per annum and becomes statistically significant at the 10% level, indicating that the performance estimates reported previously were adversely affected by industry exposures.

Performance in a Multifactor Framework. In spite of the widespread use of the single-factor performance model, it has been repeatedly argued that the model is insufficiently capable of explaining the cross-section of expected stock returns. Fama and French (1993) empirically established the inefficiency of the CAPM-framework and introduced a three-factor model that includes the factors SMB and HML in addition to excess market return. Essentially, SMB represents a 'small-versus-large' cap return spread and HML is defined as the return on a 'value-versus-growth' stock portfolio. Although the benefits of the 3-factor model are nowadays acknowledged, the model is subject to further improvement. In examining persistence in U.S. mutual fund performance, Carhart (1997) demonstrated that the 3-factor model fails to explain the Jegadeesh and Titman (1993)-momentum strategy and proposed the addition of a momentum factor to existing performance models.

In this section we therefore analyze the historical monthly return distribution of the two portfolios by means of the multifactor performance model by Carhart (1997). In doing so, we mitigate potentially severe biases resulting from the presence of style tilts in stock portfolios (e.g. size, value versus growth or momentum effects).[8] This is particularly important given mounting evidence that the returns on style investment strategies account for a considerable portion of SRI-portfolio performance; see for example Bauer *et al.* (2002) and Gregory *et al.* (1997).

Formally, the approach to performance assessment entails estimation of the following equation:

$$R_{it} - R_{ft} = \quad a_i + ß_{0i}(R_{mt} - R_{ft}) + ß_{1i}\, SMB_t + ß_{2i}\, HML_t + ß_{3i}\, MOM_t + e_{it}, \qquad (2)$$

where

SMB_t = the return difference between a small cap portfolio and a large cap portfolio in month t,

HML_t = the return difference between a value (high B/M) portfolio and a growth (low B/M) portfolio in month t,

MOM_t = the return difference between a portfolio of past 12-month winners and a portfolio of past 12-month losers in month t,

SMB and HML were obtained from the Kenneth French Data Library. The momentum factor (MOM) was provided by Carhart.

Table 3 reports performance estimates resulting from estimation of the four-factor model. Compared to the results in the previous section, the table displays several prominent differences. Notice that the adj. R-squared from the models has increased as compared to the adj. R-squared values reported in the previous section. This observation confirms the incremental explanatory power of a multivariate framework. By and large, factor loadings on the additional determinants SMB, HML and MOM are statistically significant. For both the high-ranked portfolio and the low-ranked portfolio, we observe a significantly negative coefficient on SMB, which implies a bias towards large capitalization stocks. Furthermore, factor loadings on HML indicate that the high-ranked portfolio was growth stock-oriented during the examined period, whereas the low-ranked portfolio was somewhat tilted towards value stocks. We also notice a rather counterintuitive loading on MOM. The significantly negative coefficients on the momentum factor suggest that both companies with a relatively bad and those with good historical stock performance record tend to have relatively poor eco-efficiency rankings. Since prior related studies revealed evidence of a positive relation between financial performance and subsequent social performance (Chung, Eneroth and Schneeweis (2003) for instance) we expected the high-ranked portfolio to be positively related to the momentum factor.

[Insert Table 3]

Results with regard to the *difference* portfolio show that the performance differential between the two portfolios equals 3.98% per annum after adjusting for multiple factor loadings. Once industry effects are controlled for the difference increases sharply to 9.55% per annum and becomes statistically significant at the 5% level. As for the factor loadings, the results confirm the conjecture that there are significant differences in styles or risk sensitivities between the two extreme portfolios. Contrary to the outcomes within the CAPM-framework, the two portfolios do not significantly differ in exposure to market risk. The *difference* portfolio exhibits significant exposure to HML. After industry-adjustment, the portfolio loads heavily on SMB.

However, it should be noted that the logical interpretation of performance evaluation results can be overly driven by various parameters in the measurement process that have been specified exogenously. Continuing with the analysis of industry-adjusted returns, we therefore also ‘endogenize’ some of these parameters by considering alternative portfolio construction methodologies and return calculations. Empirical results of the robustness checks are reported in Table 4.

[Insert Table 4]

In the first row of the table, we report the outcome of repeating our computations using equal-weighted industry-adjusted portfolio returns, instead of value-weighted returns. The performance gap between the high-ranked portfolio and its low-ranked counterpart narrows to 3.00%. This indicates that alpha relies more on large caps than on small caps. However, portfolio construction based on equal weighting is uncommon in practice.

Continuing with the analysis of value-weighted industry-adjusted returns, we furthermore find that the results are insensitive to changes in portfolio formation. Rows 2 and 3 in Table 4, reporting the results of using size deciles of 20% and 40% of total capitalization respectively, do not reveal substantially different outcomes compared to the initial scenario. The excess return remains economically large and statistically significant at the conventional levels.

Finally, we computed alphas for portfolios only comprising stocks from environmentally sensitive industries (e.g. electric utilities, chemistry, metal and mining, paper and forest products, aerospace and defense, petroleum). The last row in Table 4 shows that the industry-adjusted performance differential reduces considerably to a statistically insignificant level of 1.66%. This observation is remarkable given that environmental responsibility and compliance expenditures in these industries are usually substantial.

Overall, we find that companies performing relatively well along environmental dimensions collectively provide superior returns. The average return on the zero-investment strategy is economically large and statistically significant on a risk-, style-, and industry-neutral basis. The premium estimate is robust to variations in the methodology. Therefore, the results as a whole corroborate the notion that there are benefits to environmentally responsible investing.

Practical Implications: a Best-in-Class Strategy.

Previous sections showed that a portfolio comprising stocks of high-ranked firms outperformed its low-ranked counterpart after adjusting return for market risk, investment style and industry effects. However, obtaining evidence by adjusting return *after the fact* may not be very useful from an investor's perspective. In this section we therefore outline the economic implications of our findings by demonstrating how one can construct an environmentally responsible investment portfolio under practical conditions. To take into account our evidence that industry tilts influence portfolio performance greatly, we construct a SRI-portfolio based on 'best-in-class' analysis, an approach that is commonly applied in the socially responsible investment industry.

In each of our twelve industry groups all companies are first ranked on the eco-efficiency scores. Within each industry, we then construct a value-weighted portfolio of high-ranked stocks and a portfolio of low-ranked stocks. As a general rule the two portfolios are equal in size, namely 30% of total capitalization, and mutually exclusive. Occasionally, however, when the number of companies within an industry is limited, firms are assigned to both the high-ranked group and the low-ranked alternative. Based on the ratio of total industry capitalization to total market value of all firms in the Innovest universe, we compute twelve industry weights. We finally assign these weights to our sub-portfolios in order to obtain a best-in-class portfolio and a worst-in-class portfolio.

Summary statistics on the strategies are reported in table 5. The best-in-class portfolio, having earned an annual return of 5.76% in the absence of transactions costs, outperformed the worst-in-class portfolio, which only paid an average return of 0.84%. Corresponding Sharpe ratios indicate that the performance difference persists after adjusting for volatility. Notice that our worst-in-class portfolio comprises more companies and exhibits a higher turnover compared to the best-in-class portfolio.

[Insert Table 5]

Figure 1 displays the cumulative return over time for the two strategies. While the cumulative performance difference between the high-ranked portfolio and the low-ranked portfolio is substantial at the end of the observation period, i.e. approximately 30%, the return gap widened predominantly after 2001.

[Insert Figure 1]

Table 6 reports the results of performing the multivariate performance attribution analysis as defined by equation (2). In the absence of transactions costs, the best-in-class portfolio delivers an alpha of 5.36%. The alpha is statistically significant at the 5% level. The worst-in-class portfolio, on the other hand, clearly displays inferior performance. Its four-factor alpha of approximately -0.8% is statistically insignificant. Accordingly, the alpha computed for the *difference* portfolio is 6.10%, which is significant at the 5% level.

[Insert Table 6]

Even in the presence of transactions costs, the excess return on the best-in-class portfolio remains statistically significant. The decrease in alpha is only minor as we increase the level of assumed transactions costs. For instance, in the 200bp-scenario we find that the annualized alpha of the best-in-class portfolio is still large, i.e. 4.5%, and statistically significant at the 10% level. In contrast, the decrease in alpha is more severe for the worst-in-class portfolio due to its higher turnover rate. Unsurprisingly, the factor-adjusted return on the *difference* portfolio is statistically significant in all scenarios. Our results therefore strongly suggest that the eco-efficiency premium is exploitable in a practical setting.

Concluding Remarks

Using the well-established Innovest database, which had not been used in the literature to date, we investigated whether holding a portfolio of stocks of highly eco-efficient companies provides a premium in the long run.

The results underscore the need for an elaborate performance evaluation framework. We find that the average excess return on a zero-investment strategy that buys the eco-efficient portfolio and sells short the eco-inefficient portfolio is most pronounced after adjusting for multiple factor sensitivities. The factor-adjusted return increases sharply and becomes statistically significant once industry effects are controlled for as well. Since the observed differential is neutral with respect to risk, investment style and industry exposures, we interpret this result as evidence of an "eco-efficiency premium" in the U.S. equity market. To address the practical value of our findings, we demonstrated how a best-in-class investment strategy yields significant excess returns under different transactions costs scenarios.

Overall, our findings provide evidence suggesting that the benefits of considering environmental criteria in the investment process can be substantial. Further research should concentrate on longer time-series data and present complementary evidence from different countries.

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Table 1. Descriptive Statistics on the Extreme Portfolios

The high-ranked portfolio consists of stocks of firms with the highest eco-efficiency ratings. The low-ranked portfolio comprises companies with the lowest eco-efficiency scores. The Sharpe ratio is the ratio of the mean excess return to the standard deviation of return. The mean return, the standard deviation and the Sharpe ratio are annualized. Sample period: 1997:07 – 2002:12

Portfolio	Mean Return	Std. Dev.	Sharpe	Maximum	Minimum
High-Ranked Companies	2.54	20.35	-0.08	13.06	-12.86
Low-Ranked Companies	0.19	18.18	-0.22	9.36	-11.48

Table 2. Empirical Results 1-Factor Regressions

This table reports the results of estimating CAPM-based regression models. For all portfolios we estimated the model formally defined by equation (1):

$$R_{it} – R_{ft} = a_i + ß_i(R_{mt} – R_{ft}) + e_{it}, \quad (1)$$

where $R_{it} – R_{ft}$ denotes the return on the portfolio in excess of the risk-free rate and $R_{mt} – R_{ft}$ is the excess return on the market portfolio. The *difference* portfolio is constructed by subtracting high-ranked portfolio returns from the returns on the low-ranked stock portfolio. The final row displays the results of comparing portfolio returns after industry adjustment. T-statistics (in brackets) are derived from Newey-West (1987) heteroskedasticity and autocorrelation consistent standard errors. Sample period: 1997:07 – 2002:12. Alphas are annualized percentages.

Portfolio	a	$(R_m – R_{ft})$	adj. Rsq.
High-Ranked Companies	-0.58	0.96***	0.82
	(-0.16)	(19.64)	
Low-Ranked Companies	-3.05	0.85***	0.81
	(-1.05)	(14.93)	
Difference	2.47	0.11*	0.03
	(0.72)	(1.94)	
Industry-Adjusted Difference	7.79*	-0.03	-0.01
	(1.90)	(-0.49)	

* *significant at 10% level*

** *significant at 5% level*

*** *significant at 1% level*

Table 3. Multifactor Regression Results

This table reports empirical results corresponding to the multifactor regressions formally defined by equation (2):

$$R_{it} - R_{ft} = a_i + ß_{0i}(R_{mt} - R_{ft}) + ß_{1i}\,SMB_t + ß_{2i}\,HML_t + ß_{3i}\,MOM_t + e_{it}, \quad (2)$$

$R_{mt} - R_{ft}$ represents the returns on the market proxy in excess of the risk-free rate, SMB denotes the difference in return between a small cap portfolio and a large cap portfolio, HML denotes the return spread between a value portfolio and a growth portfolio and MOM is the return difference between a prior 12-month winner portfolio and a prior 12-month loser portfolio. The *difference* portfolio is constructed by subtracting high-ranked portfolio returns from the returns on the low-ranked stock portfolio. The final row displays the results of comparing portfolio returns after industry adjustment. T-statistics (in brackets) are derived from Newey-West (1987) heteroskedasticity and autocorrelation consistent standard errors. Sample period: 1997:07 – 2002:12. Alphas are annualized percentages.

Portfolio	a	$(R_m - R_f)$	SMB	HML	MOM	adj. Rsq.
High-Ranked Companies	2.31	0.88***	-0.23***	-0.12	-0.11***	0.88
	(0.80)	(20.51)	(-4.04)	(-1.47)	(-6.86)	
Low-Ranked Companies	-1.67	0.88***	-0.19***	0.06	-0.09***	0.88
	(-0.71)	(21.48)	(-4.03)	(1.46)	(-2.73)	
Difference	3.98	0.00	-0.05	-0.18*	-0.02	0.04
	(1.19)	(0.08)	(-0.51)	(-1.94)	(-0.68)	
Industry-Adjusted Difference	9.55**	-0.08	-0.23**	-0.13	-0.03	0.11
	(2.50)	(-1.12)	(-2.62)	(-1.46)	-0.95	

* *significant at 10% level*

** *significant at 5% level*

*** *significant at 1% level*

Table 4. Robustness Analysis: Results under Alternative Methodologies

The table reports the results of performing regression (2) when applying some changes to various parameters in the methodology. The first row presents the difference in alpha estimates between the high-ranked portfolio and the low-ranked portfolio derived from industry-adjusted equal-weighted portfolio returns. The second and third row reports the results of changing the size of the upper (lower) deciles of the industry-adjusted portfolios to 20% and 40% of total capitalization respectively. Finally, the last row reports the industry-adjusted performance difference when only companies belonging to environmentally sensitive industries are considered. T-statistics (in brackets) are derived from Newey-West (1987) heteroskedasticity and autocorrelation consistent standard errors. Sample period: 1997:07 – 2002:12. Alphas are annualized percentages.

	a	$(R_m - R_f)$	SMB	HML	MOM	adj. Rsq.
Using industry-adjusted returns: Equal - Weighting						
Industry-adjusted Difference portfolio	3.00	0.07	-0.12***	-0.13***	-0.00	0.06
	(1.44)	(1.50)	(-3.13)	(-2.33)	(0.21)	
Using industry-adjusted returns: 20% portfolios						
Industry-adjusted Difference portfolio	9.12***	-0.14**	-0.19***	-0.11	-0.07**	0.10
	(2.81)	(-2.07)	(-2.91)	(-1.37)	(-2.22)	
Using industry-adjusted returns: 40% portfolios						
Industry-adjusted Difference portfolio	8.25**	-0.09	-0.22***	-0.14*	-0.00	0.14
	(2.58)	(-1.37)	(-3.10)	(-1.78)	(-0.01)	
Using industry-adjusted returns: Sensitive sectors only						
Industry-adjusted Difference portfolio	1.66	0.01	-0.22***	0.13	0.02	0.25
	(0.43)	(0.10)	(-3.03)	(1.45)	(0.63)	

* *significant at 10% level*

** *significant at 5% level*

*** *significant at 1% level*

Table 5. Descriptive Statistics: Best-in-Class vs. Worst-in-Class Portfolio

The table reports summary statistics on the two extreme portfolios. The best-in-class (worst-in-class) portfolio comprises firms having the highest (lowest) eco-efficiency score in each industry group. The Sharpe ratio is the ratio of the mean excess return to the standard deviation of return.The mean return, the standard deviation and the Sharpe ratio are annualized. Sample period: 1997:07 – 2002:12

	Mean	StDev	Sharpe	Avg. Turnover	Avg # firms
Best-in-Class Portfolio	5.76	19.23	0.08	20.90%	88
Worst-in-Class Portfolio	0.84	20.72	-0.16	30.48%	163

Table 6. Factor-adjusted Returns under Different Transactions Costs Scenarios

The table reports the results of performing regression (2) under various levels of transactions costs (roundtrip). Four-factor alphas are presented for the best-in-class portfolio and for the worst-in-class portfolio. T-statistics (in brackets) are derived from Newey-West (1987) heteroskedasticity and autocorrelation consistent standard errors. Sample period: 1997:07 – 2002:12. Alphas are annualized percentages.

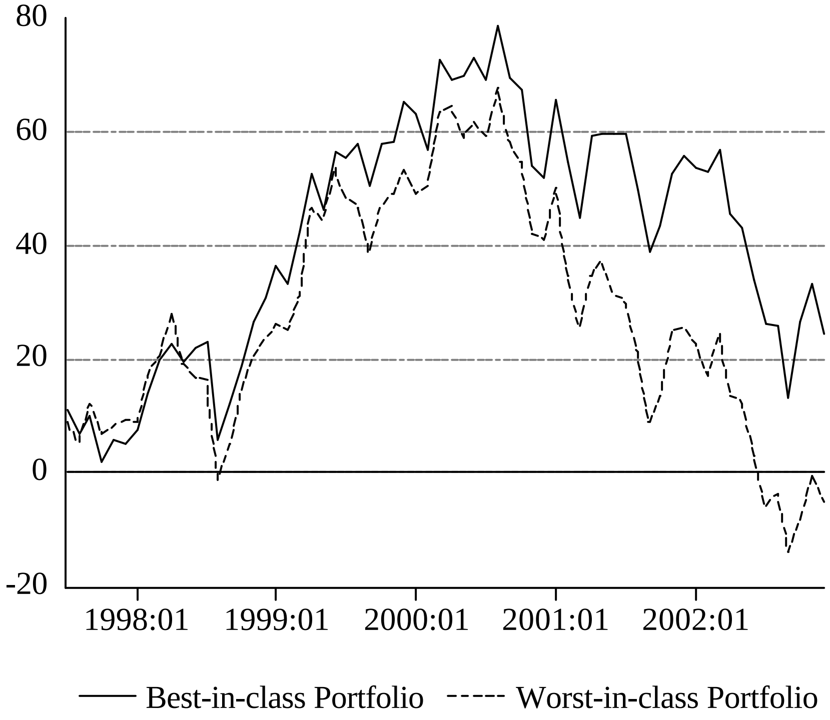
	a (0bp tc)	a (50 bp tc)	a (100 bp tc)	a (150 bp)	a (200bp tc)
Best-in-Class Portfolio	5.36**	5.15**	4.92**	4.71*	4.50*
	(2.17)	(2.08)	(2.00)	(1.91)	(1.81)
Worst-in-Class Portfolio	-0.79	-1.04	-1.34	-1.64	-1.95
	(-0.30)	(-0.39)	(-0.61)	(-0.62)	(-0.73)
Difference	6.10**	6.19**	6.27**	6.35**	6.44**
	(2.03)	(2.05)	(2.07)	(2.09)	(2.10)

* *significant at 10% level*

** *significant at 5% level*

*** *significant at 1% level*

Figure 1: Cumulative return (%)



Notes

[1] See Social Investment Forum (2001).

[2] Exceptions are some regression-based non-US studies. These include Thomas (2001; UK), who adds environmental policy dummies to a 2-factor model that controls for size effects in addition to market sensitivity, and Ziegler, Rennings and Schröder (2002; Europe) who control for market risk, firm size and book-to-market. Both find some evidence of a positive association between environmental responsibility and stock performance.

[3] Source: Innovest (2003)

[4] It should be noted that the sorting approach proposed in this study does not allow for an explicit judgment on the direction of causality between environmental and financial variables. We are merely concerned with the long-term benefits of incorporating environmental criteria into the investment process.

[5] Matching occurred by ticker, company name and CUSIP number. Since the CRSP database is survivor-bias free we are able to analyze the returns for firms that disappeared during the sample period, e.g. due to merger or bankruptcy.

[6] Available on: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

[7] Companies were assigned to one of the following industries: Consumer Durables, Consumer Non-Durables, Manufacturing, Energy, Chemical, Business Equipment, Telephone and Television, Utilities, Shops, Health, Money/Finance, and all remaining.

[8] Although there is an ongoing discussion about whether these additional factors proxy for risk, we will have no perception on the subject but merely use the factor mimicking portfolio returns as control variables in the performance estimation process.