Philosophica 80 (2007) pp. 71-103

BUILDING A SOCIALLY RESPONSIBLE EQUITY PORTFOLIO USING DATA ENVELOPMENT ANALYSIS[1]

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ABSTRACT

This paper uses two techniques to build a socially responsible portfolio of U.S. equities and examines prospective performance using publicly available data. The first technique eliminates stocks from consideration using categorical exclusions with a restrictive Environment, Social and Governance (ESG) screen. The paper shows that stocks surviving the screen have a significantly higher average projected Value Line alpha and are more likely to have a Morningstar 5-star rating. Using categorical exclusions, however, introduces a sector bias in that the ESG screen is more likely to restrict stocks from the manufacturing sector than the service sector. The second technique does not introduce a sector bias because it uses a best-in-class optimization approach in place of screening. The paper introduces a linear programming model called Data Envelopment Analysis (DEA) to the application of SRI portfolio development to find the best financially and socially performing companies within each industry sector. When compared to a categorical exclusions portfolio, a DEA portfolio is rated significantly higher by Morningstar and Value Line. Depending on the specific needs of a socially responsible investor, the DEA technique could be a better tool in developing a financially and socially balanced equity portfolio.

1. Introduction

This paper analyzes the available stock universe before and after an investor screens for unacceptable companies while practicing Socially Responsible Investing (SRI). This paper also introduces a technique

[1] The author would like to thank Mark Bateman, Kirk Davidson, Dan Porter, David Myers, Tom Ryan, and two anonymous referees for useful comments on earlier drafts.

called Data Envelopment Analysis (DEA) to the application of SRI portfolio development to help identify the best companies for socially conscious investor portfolios. The DEA model finds companies that have the greatest social impact while at the same time have the best investment potential.

Socially conscious investors want their financial capital to have a positive effect on the world and to generate optimal returns. While SRI is conducted in numerous ways, one popular technique is to build a socially responsible equity portfolio. Companies that violate environment, social and corporate governance (ESG) factors are screened out of the investor's portfolio.

Critics of screening claim that adding a social constraint to the investment process necessarily leads to a sub-optimal result. Blodget (2007) argues that keeping tobacco company Philip Morris out of an equity portfolio during the last half of the twentieth century would have been costly to an investor. By definition, screening will reduce the size of an investor's stock universe and will undoubtedly eliminate eventual high performing stocks. While there may always be a Blodget-type story about one high performing stock being eliminated in an investment process that considers ESG factors, an aim of this paper is to examine whether the investment potential of a socially responsible portfolio is significantly hampered.

Numerous studies examine how SRI portfolios perform relative to the market and to conventional portfolios. Myers and Anderson (2007) use over forty investment screens and analyze a wide variety of equity portfolios to show that shareholders are no worse off when investing according with their social beliefs when compared to market benchmarks. Bauer, Otten, Rad (2006), Bello (2005), Schröder (2004), Statman (2000), and Hamilton, Hoje, Statman (1993) all compare the risk-adjusted returns of various socially responsible mutual funds to that of conventional funds and find no significant difference between them. Abramson and Chung (2000) show that an SRI approach can provide competitive returns relative to benchmarks using both value and growth style investment strategies.

Chong, Her, and Phillips (2006) examine the performance of an SRI fund versus a socially irresponsible fund from 2002 to 2005 and find that that the irresponsible fund outperformed the SRI fund. However, the authors note that the study was conducted during a market downturn

when an SRI fund is more likely to be outperformed. Similarly, Hong and Kacperczyk (2005) show that companies involved in producing alcohol, tobacco and gambling, outperformed the market by 9.1% per annum over the same period. Shank, Manullang, and Hill (2005) find the opposite result as they show that a 'nice' firm portfolio outperformed a 'naughty' firm portfolio over a five and ten-year horizon.

Other studies examine specific corporate policies and their effect on investment returns. Gompers (2003) shows that companies with corporate governance policies that favor management and stockholders had higher stock returns during the 1990s than those companies that did not have these policies. Orlitzky, Schmidt, and Rynes (2003) conduct a meta-analysis to show that there is a strong positive correlation between a company's social performance and its financial performance.

Other research examines how SRI affects the investment universe. Glassman (1999) contends that while the screening process will decrease the choice set, the reduction may not be substantial enough to cause inadequate diversification. Barnett and Solomon (2006) examine this notion further and find that SRI funds with fewer screens have a larger universe to select from and are more likely to be diversified and achieve a high risk-adjusted return. The authors find that as screening increases, diversification and risk-adjusted returns decrease. However, the authors also show that as social screening increases, there is a point where risk-adjusted returns improve again as investment managers are more likely to invest in better-managed, more stable firms.

DiBartolomeo & Kurtz (1999) find that SRI funds can carry substantial sector and economic biases, thus increasing nonsystematic risk, because the portfolios are confined to a smaller subset of investment choices. However, Elton and Gruber (1977) find that unsystematic risk may be substantially offset with as few as 10 stocks. While strict social standards may prevent an SRI fund from investing in some companies, there may be enough other companies that do meet the social criteria to allow the investor to diversify away unsystematic risk.

This paper expands on this literature by using two techniques to build socially responsible portfolios of U.S. equities and by examining prospective performance using publicly available data. The first technique eliminates stocks from consideration using categorical exclusions with a restrictive Environment, Social and Governance (ESG) screen. The second technique uses a best-in-class optimization approach

in place of screening. A linear programming model called Data Envelopment Analysis (DEA) is introduced to the application of SRI portfolio development to find the best financially and socially performing companies within an industry sector.

2. The Stock Universe

This paper addresses the effects of ESG screening by assembling a stock universe of 978 U.S. equities. These companies are used because their future returns are forecasted by two popular investment services, Morningstar and Value Line. The companies are also evaluated by the IW Financial Corporation across a spectrum of ESG issues. These stocks represent 79% of the market capitalization in the U.S. equity market.[2] The sample of companies serves as the universe of stocks from which an investor in this study would select a portfolio.

Investors use numerous valuation techniques, financial ratios and forecasted performance measures to predict a stock's future return, and this paper utilizes two simple proxies of these measures to gauge future performance. The first is the Morningstar star rating available at www.morningstar.com. Morningstar, Inc. estimates the future valuation of about 1,900 publicly traded U.S. companies using a five-year projected cash-flow model and then publishes a one-star to five-star rating for each of these companies. A one star stock trades at a high price relative to Morningstar's risk-adjusted estimate of its value, while a five star stock trades at a considerable discount. Stocks that trade very close to Morningstar's value estimates receive a three star rating.

The Morningstar Mutual Fund star rating is used in previous research examining mutual fund performance. Hale (2002) shows that SRI mutual funds rated by Morningstar are predicted to perform as well as other funds without social objectives. Research on the Morningstar mutual fund rating system indicates that investors pay attention to the star ratings. Del Guercio and Tkac (2002) find that the Morningstar star

[2] On September 5, 2007 the 978 stocks in this paper had a market capitalization of $14.38 trillion while the Dow Jones Wilshire 5000 index, representing the entire U.S. equity market, had a market capitalization of $18.14 trillion. See http://www.wilshire.com/Indexes/Broad/Wilshire5000/Characteristics.html

rating has a significant effect on fund flows. They find that when a fund receives a five star rating for the first time, the fund receives inflows of 53 percent above the normal flow. They also show that funds with rating downgrades experience significant outflows beyond what would normally be expected.

Research indicates that Morningstar's current mutual fund rating system can accurately predict future performance.[3] While there is no research yet conducted on the predictive power of individual equity ratings, Morningstar's success with predicting mutual fund performance is a good indicator that their equity ratings would be useful in this study.[4]

The second future performance measure used in this paper is a risk-adjusted annual return, alpha, generated from Value Line forecasts. Value Line's analysts forecast a three to five year projected annual return for almost 1,600 stocks in the Value Line Investment Survey available at www.valueline.com. Ramnath, Rock, and Shane (2001) find, on a set of 550 companies, that the median absolute error for Value Line's four-year projected earnings forecasts is 4.59%. While the authors argue that Thompson Financial Corporation's *International Brokerage Estimate System* (I/B/E/S) earnings forecasts are significantly better, the difference between them is only 0.33%. An earlier study by Philbrick and Ricks (1991) concludes that Value Line and I/B/E/S were comparable in terms of the accuracy of their forecasts. Because of the reasonableness of the Value Line's forecast error and because Value Line's data is

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[3] Although two previous studies by Blake and Morey (2000) and Morey (2002) determine that the Morningstar rating system does not predict well, an updated study by Morey and Gottesman (2006) finds otherwise. The discrepancy, according to Morey and Gottesman, is due to changes that were made in 2002 to the way Morningstar determines its ratings. Morey and Gottesman find that currently the Morningstar rating system accurately predicts future mutual fund performance. They also find that higher rated funds, for the most part, significantly outperform lower rated funds. Morey (2007) cautions, however, that receiving a five star rating may not be an indicator of future success. He shows that some funds realize increased inflows as a result of a high rating and then subsequently alter their portfolios. These funds end up performing poorly in future years.

[4] On September 5, 2007 the Morningstar star ratings for 1,871 available companies were retrieved from www.morningstar.com.

economically accessible to any investor, its data is used in this study.[5] Using projected return estimates from Value Line and the Capital Asset Pricing Model (CAPM), an alpha is calculated for each of the companies using the following method:

$$\alpha_i = R_{VLi} - R_f - \beta_i(K_m - R_f)$$

where:
R_{VLi} is the Value Line 3-5yr projected annual return for stock *i*;
R_f is the Risk Free Rate of Return. The rate of a three year Treasury bill on September 5, 2007 at 4.5% is used;
β_i is the current beta coefficient for stock *i*; and
K_m is the Value Line 3-5yr projected annual return for the S&P 500. This value on September 5, 2007 was 11.16%.

Table 1: Characteristics of the 978 stock universe

Distribution of Morningstar Star Ratings:

Rating	Stocks	% of total
5	146	14.93%
4	225	23.01%
3	450	46.01%
2	63	6.44%
1	94	9.61%
	978	100.00%

[5] On September 5, 2007 the projected returns for 1,577 stocks were downloaded from Value Line, and 1,056 of these companies had also been rated by Morningstar.

Distribution of Value Line Projected Alpha:

Alpha	Stocks	% of total
Above 10		8.28%
0 to 10	437	44.68%
-10 to 0	408	41.72%
Below -10	52	5.32%
	978	100.00%

Distribution of Market Capitalization:

		Stocks	% of total
Large Cap	> $5 billion	465	47.55%
Mid Cap	$1 to $5 billion	428	43.76%
Small Cap	< $1 billion	85	8.69%
		978	100.00%

Distribution of Beta

	Beta	Stocks	% of total
Low Risk	< 0.85	152	15.54%
Moderate Risk	0.85 - 1.15	479	48.98%
High Risk	> 1.15	347	35.48%
		978	100.00%

Of the 1,056 companies rated by both Morningstar and Value Line, 978 are in IW Financial Corporation's database and are evaluated on ESG issues. Because each of these 978 stocks has a Morningstar star rating, a Value Line generated projected alpha, and an appraisal conducted by IW Financial, these companies make up the universe of stocks that an investor will use to build a portfolio in this study. Table 1 provides a detailed description of the 978 companies.

3. The Screened Stock Universe

Using IW Financial's online Workstation tool, each of the 978 companies in the stock universe is profiled based on the criteria listed in

Tables 2, 3 and 4.[6] The data from IW Financial is processed to generate three scores for each company that reflects its ESG track record: one for environmental protection (E Score), one for socially acceptable business involvement (S Score), and one for corporate governance practices (G Score). The higher the scores, the more socially unacceptable the company is. Every criterion in Tables 2, 3, and 4 is given a score between zero and one hundred such that a zero represents a perfect socially responsible business practice. Many criteria allow only a binary response, so a company with no involvement in an unacceptable business practice receives a zero while a company involved in the practice would score one hundred. In other cases, a score of zero, one hundred, or a number in-between is assigned. This exact score represents precise involvement in an undesirable business practice with respect to the company's total revenue or with respect to its position compared to other companies. The numbered criteria with sub-criteria in the tables are scored by averaging the sub-criteria scores. A final score is determined by averaging the scores for each of the numbered criteria. Statistics describing the E, S, and G Scores for all of the 978 companies appear in Table 5.

Table 2: Criteria used for IW Financial Environment score

1. Number of Superfund sites the company has been deemed responsible for per billion dollars of revenue.
2. Pounds of toxic chemical the company releases per million dollars of revenue.
3. Percent change in the company's 4-year trend in toxic chemical releases.
4. Pounds of toxic chemical production waste (including chemicals released, treated, transferred, or impounded) per million dollars of revenue.
5. Percent change in the company's 4-year trend in toxic waste.
6. Number of oil spills for which company is responsible for per billion dollars of revenue.
7. Percent change in the company's 3-year trend in oil spills.

[6] IW Financial's Workstation tool allows the user to select from a menu of issues to develop a customized scoring system: www.iwfinancial.com.

8. Amount of environmental fines per million dollars in revenue.
9. Percent change in the company's 3-year trend in environmental fines.

Table 3: Criteria used for IW Financial Socially Acceptable Business Involvement Score

1. Adult Entertainment:
    a. Company is involved in adult media
    b. Company is involved in sexually explicit internet operations
    c. Company is involved in adult software or video games
    d. Company is involved in sexually explicit live performance
2. Alcohol: Percentage of revenue the company derives from the manufacture, branding, and distribution of alcohol
3. Animal testing: The company is on the USDA's list of companies that use live animals for product testing.
4. Bioethics:
    a. Company is involved in adult, umbilical or placenta stem cell research
    b. Company is involved in embryonic stem cell or fetal tissue research
5. Firearms: Company is involved in firearms or ammunition manufacturing
6. Gambling: Percentage of revenue the company derives from gambling operations or the manufacture of gaming equipment
7. Human Rights:
    a. Company has ties to oppressive regimes
    b. Company is involved in Maqulladora operations in Mexico
8. Life/Choice:
    a. Company is involved in abortifacient manufacturing
    b. Company is involved in emergency contraceptive manufacturing
    c. Company is involved in non-emergency contraceptive manufacturing
    d. Company is involved in contraceptive/abortifacient marketing
    e. Company is involved in abortion services

9. Military: a. Percentage of revenue the company derives from defense contracting b. Total dollar value of conventional weapons contracts a company holds per millions of dollars of revenue c. Total dollar value of nuclear weapons contracts a company holds per millions of dollars of revenue 10. Nuclear Power: The percentage of nuclear power the compan generated or sold relative to other companies 11. Tobacco: The percentage of a company's revenue derived from the production, processing, or distribution of tobacco or tobacco products

Table 4: Criteria used for IW Financial Corporate Governance Practices Score[7]

1. Auditing Practices: The percentage of the total fees paid to the company's auditors not related to the auditing of the company's financial statements. 2. Board Accountability: a. Company does not have a formal governance policy b. Company does not have an ethics policy c. Company has rotating elections rather than annual elections d. Company does not hold non-executive director meetings e. Company requires cause for director removal 3. Board Composition: a. The percentage of directors with tenure greater than 15 years b. The percentage of directors older than seventy years of age c. The percentage of directors that are also active CEOs of any company

[7] The data in items 1-4, 6, and 7 are provided to IW Financial by The Corporate Library.

d. The percentage of directors that serve on more than four boards
e. The percentage of directors that attend less than 75% of meetings
f. The percentage of directors identified as "problem directors" by The Corporate Library

4. Board Independence:
   a. Company does not have a majority of outside, independent board members
   b. Company does not have an independent audit committee
   c. Company does not have an independent compensation committee
   d. Company does not have an independent nominating committee
   e. Company does not have a separate chair and CEO
5. CEO Compensation: The percentage of the company CEO's compensation that is incentive-based pay
6. Diversity:
   a. The percentage of minorities on the board of directors
   b. The percentage of women on the board of directors
7. Shareholder Rights
   a. The percentage of votes required to call a special meeting of shareholders
   b. The percentage of votes required to act by written consent in lieu of a meeting
   c. The percentage of votes required to approve a merger or other significant transaction
   d. The percentage of votes required to amend the company's charter
   e. The percentage of votes required to amend the company's bylaws
8. Takeover Defenses
   a. The company does not have a poison pill in place
   b. The company does not have a fair price provision in place

Table 5: Descriptive Statistics of IW Financial Scores

	E	S	G
Max	100.00	100.00	100.00
Min	0.00	0.00	8.00
Median	1.50	21.00	37.00
Average	17.72	18.52	37.74
SD	23.13	16.41	9.85

Of the 978 companies, exactly one-half (489) have no environmental concerns based on the criteria used, and they receive a perfect score of zero on their E Score. Less than one-quarter of the companies (232) have no socially unacceptable business involvement based on the criteria used, and these companies receive a perfect score of zero on their S Score. However, no company in the set of 978 companies receives a perfect score on the corporate governance rating due to the rather stringent list of criteria in this category. Therefore, an ESG screen requiring a perfect score in all three categories yields an empty universe of stocks to invest in.

To develop an ESG screen that would yield a reasonably-sized group of stocks, the top 232 companies in the corporate governance ranking, scoring a 30 or below, are considered. Of these companies, 48 have both a perfect E Score and a perfect S Score. These 48 companies are the screened stock universe in this analysis.

4. Comparison of the Screened Stock Universe with the Excluded Stock Universe

The ESG screen applied to the 978 companies is restrictive. It includes almost every one of the possible screening options available in IW Financial's Workstation tool and it reduces the available stock universe to 48 companies.[8] In order to determine whether an investor is hindered

[8] IW Financial also includes criteria that are biased toward larger companies. For example, larger companies are more likely to be on "watch lists" from various organizations. Conversely, larger companies are more likely to be signatures on

by this SRI screen, the smaller set of stocks is compared to the larger stock universe. If no systematic biases appear as a result of this restrictive screen, it can be assumed that less restrictive screens will also generate a viable set of potential investments.

Table 6: Comparison of stocks included in the ESG screen to stocks excluded by the ESG screen

Morningstar Star Rating

Rating	Stocks Excluded	Percent to Total Excluded	Stocks Included	Percent to Total Included
5	134	14.41%	12	25.00%
4	217	23.33%	8	16.67%
3	428	46.02%	22	45.83%
2	62	6.67%	1	2.08%
1	89	9.57%	5	10.42%
Total	930	100.00%	48	100.00%

Value Line Projected Alpha

Alpha	Stocks Excluded	Percent to Total Excluded	Stocks Included	Percent to Total Included
Avg.	0.64		3.10	
>10	73	7.85%	8	16.67%
0-10	414	44.52%	23	47.92%
-10-0	393	42.26%	15	31.25%
<-10	50	5.38%	2	4.17%
Total	930	100.00%	48	100.00%

pacts to protect human rights. These types of criteria are not used to avoid a bias in either direction. Also, in order to not bias against larger companies, the relative percentage of a company's revenue, not absolute revenue, is considered for many criteria.

Beta

		Stocks Excluded	Percent to Total Excluded	Stocks Included	Percent to Total Included
	Avg.	1.12		108	
Low Risk	< 0.85	145	15.59%	7	14.58%
Moderate Risk	0.85 - 1.15	455	48.92%	24	50.00%
High Risk	> 1.15	330	35.48%	17	35.42%
	Total	930	100.00%	48	100.00%

Market Capitalization

		Stocks Excluded	Percent to Total Excluded	Stocks Included	Percent to Total Included
	Avg.	15,214		4,772	
Large Cap	> $5 billion	455	48.92%	10	20.83%
Mid Cap	$1 to $5 billion	396	42.58%	32	66.67%
Small Cap	< $1 billion	79	8.49%	6	12.50%
	Total	930	100.00%	48	100.00%

Industry Sector

	SIC	Stocks Excluded	Percent to Total Excluded	Stocks Included	Percent to Total Included
Mining/ Constr	0 to 1999	50	5.38%	7	14.58%
Manufac turing	2000 to 3999	396	42.58%	6	12.50%
Trans/ Comm/ Energy Svcs	4000 to 4999	116	12.47%	2	4.17%

Whole-sale and Retail Trade	5000 to 5999	108	11.61%	7	14.58%
Services	6000 to 8999	260	27.96%	26	54.17%
	Total	930	100.00%	48	100.00%

Table 6 compares the 48 stocks included in the screened stock universe with the 930 stocks excluded by the ESG screen. A chi square contingency test is used to determine whether the screened stock universe is distributed differently than the excluded stocks across the five Morningstar Star Ratings. The chi square test examines whether the treatment of the screen caused a shift in the distribution of ratings between the included and excluded groups. In this case, the test confirms that there is not a statistically significant difference in the distribution of the five ratings categories between the two groups: $\chi^2(4, N=978) = 5.83$, $p=0.21$. However, 25% of the stocks found by the ESG screen are rated with five stars compared to 14% in the excluded group. When the chi square contingency test is conducted on two categories – five star rating or no five star rating – the screen is significantly more likely to select five star stocks. The result is significant to the 5% level: $\chi^2(4, N=978) = 4.03$, $p=0.03$.

The 48 stocks have a higher average alpha at 3.10 than the 930 excluded stocks at 0.64. An analysis of variance confirms that this result is significant at the 95% level: $F(1,976)=5.48$, $p=0.02$. Table 6 shows a distribution of alphas over four categories of potential performance. Although the categories were selected arbitrarily to display the distribution of the companies over different values of alpha, the distribution is not significantly different between the included and excluded groups of stocks: $\chi^2(3, N=978) = 5.85$, $p=0.12$.

While the screened stocks have a lower average beta at 1.08 than the excluded stocks at 1.12, an analysis of variance confirms that this result was not significant: $F(1,976)=0.79$, $p=0.37$.[9] Table 6 shows a distribution of betas over three categories, again selected arbitrarily, and

[9] The market comparison used for beta is the S&P 500.

this distribution was not significantly different between the included and excluded groups of stocks: $\chi^2(2, N=978) = 0.04$, $p=0.98$.

Additional significant differences between the included and excluded stocks appear when the size of the companies and the industry distributions are examined. The 48 stocks have a lower average market capitalization at $4,772 million than the 930 excluded stocks at $15,214 million. An analysis of variance confirms that this result is significant at the 5% level: $F(1,976)=4.28$, $p=0.04$. Table 6 shows how the stocks are distributed over small, mid and large cap companies. The excluded group of companies has almost 49% in the large cap category, while the included group only has about 21% in the large cap group. This difference is also significant when analyzed by a chi square contingency test: $\chi^2(2, N=978)= 14.47$, $p<0.01$.

The most significant difference between the included and excluded stocks is in the distribution of industry classification. The 48 stocks are much more concentrated in the service sector and much less concentrated in manufacturing. More than half (54%) of the stocks that met the requirements of the ESG screen are in the service sector compared to only 28% of the excluded stocks. The shift came primarily from the manufacturing sector where only 12.5% of included stocks are in the manufacturing sector compared to 43% of the excluded stocks. This shift is significant when analyzed by a chi square contingency test: $\chi^2(4, N=978)= 30.36$, $p<0.01$.

The 48 stocks that survived the ESG screen are more likely to be five star stocks and have a significantly higher average alpha than the stocks excluded by the screen. The screened stocks are also more likely to be from the service sector and less likely to be from the manufacturing sector. They also contain a significantly less number of large cap stocks. The analysis does not find a significant difference between the screened stocks and the excluded stocks in their volatility with respect to the market. Both groups have a similar average value of beta.

An investor developing a portfolio with these 48 stocks would likely choose to buy shares in companies with high Morningstar star ratings and positive values of alpha. Within the set of 48 companies there are 28 that have a star rating of three, four or five and a positive projected alpha. These 28 companies serve as a basis of comparison in the next section and will be called the Screened Portfolio.

While the SRI investor may be encouraged that the potential performance of the smaller group of stocks is positively affected by the screen, the difference in industry diversity could be troubling. The screening technique also does not use all of the information that is available to an investor. Screening does not consider the degree to which a company has ESG problems and it does not compare a company within its industry. Using a binary in-or-out approach limits the investor's possibilities. In the next section, Data Envelopment Analysis (DEA) is used to remove the sector bias and to eliminate the information problem. DEA is applied to the entire stock universe and finds the best financially and socially performing companies within each industry sector. Maintaining industry diversity may be achieved by revealing those companies that are the most responsible within their industry.

5. Best-in-Class Optimization using the Data Envelopment Analysis Technique

Data Envelopment Analysis was introduced to measure the relative efficiency of decision-making units (DMUs) that change inputs into outputs (Charnes, Cooper, & Rhodes, 1978). The DEA model is a linear programming technique that compares the levels of inputs and outputs of one DMU with the rest of its peer group. The DMUs that produce the highest outputs with their inputs are deemed efficient and these efficient DMUs form a piecewise linear frontier. The frontier surface is a hyperplane with as many dimensions as there are inputs and outputs. All inefficient DMUs are evaluated relative to the efficient surface.

In the context of developing a socially responsible portfolio, DEA can find the set of companies that have the greatest potential return with the least objectionable business practices. The Morningstar star ratings and the Value Line projected alphas serve as the output variables in DEA model, while the IW Financial environment, social and governance scores serve as the model's inputs. A company on the efficient frontier should have a high star rating, a high alpha and low IW Financial scores. The objective of the *input-oriented* DEA model pioneered by Charnes, Cooper, and Rhodes (CCR) is to minimize inputs while satisfying at least the given output levels. Using linear programming, the model compares a "test" DMU to its peers. The program searches the data set to determine

if some linear combination of the peer DMUs uses lower levels of inputs to produce at least the level of output of the test DMU.

Mathematically, suppose there are n DMUs to be analyzed. Each DMU uses m inputs to produce s outputs. Let $\mathbf{X}$ be an $m \times n$ matrix that contains all of the DMUs' inputs. (An element in the matrix, x_{ij}, is the value of input i for DMU j.) Let $\mathbf{Y}$ be an $s \times n$ matrix that contains all of the DMUs' outputs. (An element in the matrix, y_{ij}, is the value of the output i for DMU j.) Let $\mathbf{x_0}$ represent a $1 \times m$ vector of inputs for the test DMU and let $\mathbf{y_0}$ represent a $1 \times s$ vector of outputs for the test DMU. The linear program finds the efficiency factor θ. This is the factor by which the test DMU's inputs are equiproportionally reduced to emulate a linear combination of peer DMUs. The program also finds λ, an $n \times 1$ vector of multipliers that develops a linear combination of the peer DMUs. The CCR model is formulated as:

$$\text{Minimize } \theta \qquad (1)$$

$$\text{subject to: } \theta\mathbf{x_0} - \mathbf{X}\lambda \geq 0 \qquad (2)$$

$$\mathbf{Y}\lambda \geq \mathbf{y_0} \qquad (3)$$

$$\lambda \geq 0 \qquad (4)$$

To demonstrate the CCR model, consider a simple model in which a responsible efficiency frontier is developed using one input variable (the IW Financial environment score) and one output variable (the Value Line projected alpha). Figure 1 illustrates how the model establishes the efficiency frontier and measures the relative inefficiency of DMUs not on the frontier. Company B sets the best practice standard with the highest alpha per environment score ratio. The DEA model described in equations (1)-(4) is built upon the assumption of constant returns-to-scale. That is, if any input/output combination $(\mathbf{x},\mathbf{y})$ is on the efficient frontier, then for any positive scalar t, the input/output combination $(t\mathbf{x},t\mathbf{y})$ is also on the efficient frontier. So company B's alpha per environment score ratio defines the efficient frontier. When the linear program calculates franchise B's efficiency factor (θ_B), the program is unable to reduce company B's environment score to a level at which some combination of the other companies have a higher alpha than B with a lower environment score. Thus, the program sets $\theta_B=1$.

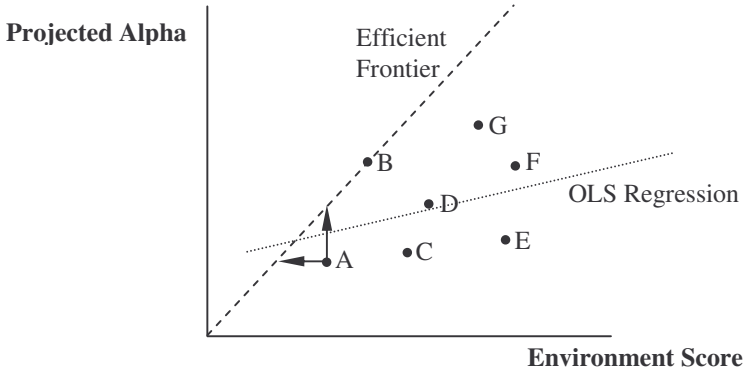

Figure 1:
The DEA Efficient Frontier compared to OLS Regression

In Figure 1, company A is not efficient even though it has the lowest environment score in the group. In this example the efficiency frontier is defined by the company with the highest alpha per environment score ratio. Company B does the least damage to the environment per percentage point of projected alpha than any other company. Ideally, the efficient frontier would be defined by the y-axis where a company would have a high projected alpha and an environment score of zero. In more complex DEA models, the efficiency frontier may also be characterized by companies that do not have the lowest ESG scores. The SRI investor should keep this in mind when building an SRI portfolio using DEA. Using the input-oriented approach, the DEA linear program measures the percentage of A's environment score that should have been necessary to reach A's alpha had company A been as efficient as company B. So, $\theta_A<1$ and the reduction of inputs is depicted in Figure 1 with the horizontal arrow.[10]

Figure 1 also presents a regression line passing through the data. This line measures the "average" ratio of alpha per environment score. DEA provides additional information that is not available from regression techniques (Seiford & Thrall, 1990). For example, one benefit of DEA over standard regression analysis is that it measures the "best practice" frontier and evaluates the deviation of all other data points from that frontier. DEA also does not compare each franchise with the average of *all* franchises. Instead, DEA compares an inefficient franchise only with efficient franchises that are similar to it (Charnes et al., 1989).[11]

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[10] There is another type of DEA model called the *output-oriented* model that tries to maximize outputs while keeping inputs at a given level. DEA indicates what level of alpha a company should achieve given its environment score (*output-orientation*) or how low the environment score should be given its projected alpha (*input-orientation*). The output-oriented DEA model measures the percentage by which the company potentially under-performs given its current environment score. The amount by which company A must increase its alpha (using the output-orientated approach) is shown by the vertical arrow in Figure 1.

[11] Data envelopment analysis has been used in many contexts (Seiford 1996, lists many applications in various fields). The technique has been used to measure management efficiency in hospitals (e.g. Banker et al. 1989; Byrnes & Valdmanis

The finance literature is rich with analyses of portfolio management and performance using DEA. Gregoriou and Zhu's (2005) book describes how DEA is used to assess the performance of hedge funds, the composition of hedge funds, and the success of commodity trading advisors. Eling (2006) expands this discussion by proposing that classic performance measures should be supplemented with DEA to fully capture hedge fund risk and return characteristics. Kirkham and Boussabaine (2005) use DEA to analyze the performance of the National Health Service estate portfolio in the United Kingdom. Haslem and Scheraga (2006) use DEA to examine the efficiency of mutual fund portfolio management using the Morningstar small-cap mutual funds database while Murthi, Choi, and Desai (1997) show that DEA is better than traditional methods in measuring portfolio performance. The approach in this paper to use DEA to identify the best financially and socially sound companies for an SRI portfolio is novel.

Table 7 exhibits the correlation coefficients between the variables used in the DEA model. There is a slight correlation between the environment and the socially acceptable business involvement scores. There is also a slight correlation between the projected alphas and the Morningstar star ratings. While these correlations are statistically significant, they are far from being perfectly correlated so it is appropriate to use these variables in the DEA model. The benefit of using the DEA method is to generate a multi-dimensional efficiency analysis beyond a simple two-dimensional ratio analysis. A company's responsible efficiency score is found by comparing it to all other companies to see if some other company (or a linear combination of companies) has a better projected alpha and star ratings with lower IW Financial responsibility scores.

1994; Chilingerian 1994; Fare et al. 1994). DEA has also been used to compare the effects of different operating strategies on efficiency in the airline industry (Banker & Johnston 1994). It has even been used to assess the impact of using information technology on firm performance (Wang et al. 1997).

Table 7: Correlation Coefficients Table of DEA data

	E	S	G	MS	Alpha
E					
S	0.358*				
G	80	0.114*			
MS	7	-21	-30		
Alpha	-0.106*	-9	23	0.314*	

* statistically significant, $p<0.01$

A Responsible Efficiency Score (RES) is calculated for each of the 978 companies in the stock universe relative to each company's industry sector. The RES is measured using a CCR data envelopment analysis model with three input variables (the IW Financial E, S, and G scores) and two output variables (the Value Line projected alpha and the Morningstar Star Rating).

The professional version of the DEA-solver software provided in Cooper, Seiford, and Tone (2000) is used to compute the CCR model statistics. Every company *j*'s efficiency factor, θ_j^{978}, is calculated relative to the entire stock universe to allow for comparison across industry sectors. Every company *j*'s efficiency factor, θ_j^k, is also calculated within its own industry sector, *k*, where k represents one of the five industry sectors used in this paper. Each company is compared to its peers in its industry sector to determine whether it should have the same (or better) potential return with lower IW Financial scores. When the CCR model yields a responsible efficiency score (RES) of $\theta=1$, then the company is efficient. That is, no linear convex-combination of the other companies was found that has greater potential with better responsibility scores. When the CCR model yields an RES of $\theta<1$, then the company was found to be inefficient. A linear convex-combination of the other companies existed such that the inefficient company's input vector, $\mathbf{X}_j$, could be reduced to $\theta\mathbf{X}_j$.

Table 8 exhibits the characteristics of the efficient frontier when $\theta_j^{978}=1$ and when $\theta_j^k=1$, for each industry sector, *k*. All three of the companies that define the efficient frontier for the entire stock universe come from the Services Sector. These three companies are deemed efficient because all other companies in the stock universe have lower outputs with higher inputs when compared to one of these three

companies. Because of the multi-dimensional nature of this DEA model, these three companies are all efficient because no one of the three is distinctly better across all five dimensions. When compared to the other two efficient companies, the Engineering Services Company has the highest alpha and the lowest environment and social scores. However, it does not have the lowest governance score or the highest Morningstar star rating. The Financial Services Company has the highest Morningstar star rating, but it does not have the highest alpha. The Real Estate Company has the lowest Morningstar star rating and the lowest alpha, but it is efficient because it has the lowest governance score.

Because the DEA model determines efficiency relative only to the companies in the sample, one must be cognizant of the results. The model will deem a company efficient if it has a high projected return regardless of the cost. For example, note in Table 8 that a drug company is determined to be efficient in the Manufacturing Sector with relatively high environment, social, and governance scores. This company is the best in practice. That is, there is no other company at this level of high projected returns with lower responsibility scores. Even though this company is efficient, a portfolio manager may not be comfortable investing in this company. Certainly, a portfolio manager can combine the techniques and screen first and then apply the DEA technique to the remaining companies. In the next section, the screened portfolio is compared to a DEA portfolio that has been developed without doing any screening first to get a pure comparison between the two methods.

Table 8: The Efficient Frontier

Efficient Companies in entire 978 stock universe

Company	E	S	G	MS	Alpha	Sector
1	0	0	27	4	25.18	Services: Engineering Services
2	0	5	8	3	5.85	Services: Real Estate
3	0	0	18	5	16.52	Services: Financial Services

Efficient Companies in Mining/Construction Sector

Company	E	S	G	MS	Alpha	Industry
1	0	0	19	5	10.19	Construction
2	3	0	25	5	22.52	Construction
3	3	0	16	5	10.86	Construction

Efficient Companies in Manufacturing Sector

Company	E	S	G	MS	Alpha	Industry
1	0	21	26	3	20.51	Measuring Instruments
2	0	5	19	3	4.18	Measuring Instruments
3	37	25	22	4	15.51	Measuring Instruments
4	0	0	27	1	18.51	Electronic Equipment
5	0	25	18	4	8.18	Electronic Equipment
6	0	25	19	5	-0.48	Electronic Equipment
7	37	0	20	5	1.85	Stone, Clay, Glass and Metal Products
8	0	0	27	3	9.85	Rubber and Leather Products
9	42	49	26	5	21.18	Drugs
10	0	0	41	5	12.85	Printing and Publishing
11	0	0	35	5	2.85	Apparel

Efficient Companies in Transportation/Communications/Energy Services Sector

Company	E	S	G	MS	Alpha	Industry
1	0	0	27	5	-3.49	Electric, Gas, and Sanitary Services
2	0	0	43	3	9.85	Electric, Gas, and Sanitary Services
3	0	25	30	5	15.52	Communications
4	0	5	26	4	14.52	Communications
5	5	5	11	3	-4.15	Water and Air Transportation

Efficient Companies in the Wholesale and Retail Trade Sector

Company	E	S	G	MS	Alpha	Industry
1	0	25	25	5	9.85	Retail Trade - without Restaurants
2	0	0	42	5	34.85	Retail Trade - without Restaurants
3	0	0	25	5	14.18	Retail Trade - without Restaurants

Efficient Companies in the Service Sector

Company	E	S	G	MS	Alpha	Industry
1	0	0	27	4	25.18	Engineering Services
2	0	5	8	3	5.85	Real Estate
3	0	0	18	5	16.52	Financial Services

6. Comparison of a DEA Best-in-Class Portfolio with a Screened Portfolio

The Screened Portfolio developed previously contains twenty-eight companies. These companies have perfect IW Financial E and S scores, and their G Scores are less than thirty. Their projected performance is also such that they have positive alphas and their Morningstar star ratings are at least at three stars.

In order to make a comparison with the Screened Portfolio, a portfolio with 28 stocks is developed using the results of the DEA analysis and the companies' responsible efficiency scores. The RES is calculated for each company relative only to the other companies in each industry sector. To keep the distribution by industry sector equal to the stock universe, the top two companies with the highest RES are selected from the Mining and Construction Sector. Similarly, twelve companies are selected from the Manufacturing Sector; three companies are selected from the Transportation, Communications, and Energy Services Sector; three companies are selected from the Wholesale and Retail Trade Sector; and eight companies are selected from the Services Sector. This portfolio is denoted as DEA Portfolio1 .

Certainly, the SRI investor may wish to create a portfolio with a greater number of stocks. DEA Portfolio 2 and DEA Portfolio 3 were

created with 56 and 112 stocks respectively. These numbers are picked simply to double the size of each of the previously created DEA portfolios. The larger portfolios also keep the distribution by industry sector the same as the stock universe.

Table 9 displays a comparison of the Screened Portfolio with the three DEA Portfolios. The DEA technique finds the responsible companies in each industry sector that have the best projected return. Because there is no restriction on the level of social responsibility required to be included in the DEA portfolios, they contain some companies with higher ESG scores than the Screened Portfolio. The distributions of ESG scores for the companies in all of the portfolios appear in Table 10. When compared to DEA Portfolio 1, the Screened Portfolio has a statistically significant lower average E Score ($F(1,54)=4.62$, $p=0.04$) and a statistically significant lower average S Score ($F(1,54)=11.24$, $p<0.01$). The actual differences in these averages are 5.29 points and 8.25 points respectively. DEA Portfolio 1 has a higher average market capitalization, but the difference is not statistically significant. The DEA Portfolio 1 has a higher average alpha ($F(1,54)=6.86$, $p=0.01$) and a higher average RES ($F(1,54)=6.28$, $p=0.02$). The DEA Portfolio 1 also has 71% of its stocks with a Morningstar Star Rating of at least four stars, while the Screened Portfolio has 46%. DEA Portfolio 1 appears to have greater return potential with only a minor diminution of ESG objectives.

The Screened Portfolio contains six companies from the Banking Services industry and four companies from the Health Services industry while DEA Portfolio 1 has no companies in Banking Services and only one company in Health Services. The DEA method finds companies with higher expected financial returns in the Manufacturing sector, specifically in Electronic Equipment and Measuring Instruments, which were not included in the Screened Portfolio. It is also interesting to note that because of poor social and projected financial performance, no company in Education Services, Hotels, Wholesale Trade, Railroad Transportation, Industrial Machinery and Chemicals appear in any of the portfolios.[12]

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[12] A table detailing the distribution of stocks in each of the portfolios at the two-digit SIC level is available from the author on request.

The companies selected by the DEA method are the best practice companies in their industry sectors determined by both financial return and social responsibility. As the size of the DEA portfolio increases, the ESG scores are more likely to be higher. However, for all of the DEA portfolios, the technique identifies best practice companies that are among the top performers in corporate responsibility. A best-in-class optimization model also considers all of the information available to an investor on the ESG records of potential investments. Allowing investors to consider the degree to which a company has ESG problems with respect to other companies in its industry allows investors to make better investment decisions. If the SRI investor is comfortable with this approach, the DEA portfolios may be more attractive in that they have a higher average projected return, an appropriate distribution by industry sector, and an elimination of potential information problems.

Table 9: A Comparison of the DEA Portfolios

Average Values for Each Portfolio

	Screened Portfolio	DEA Portfolio 1	DEA Portfolio 2	DEA Portfolio 3
Number of Stocks	28	28	56	112
Average Alpha	7.03	12.40**	11.21	7.85
Average Beta	1.06	1.19	1.18	1.17
Average Market Capitalization	4596	7265	5991	6540
Average Environment Score	0	5.29**	5.09	7.86
Average Social Score	0	8.25*	6.91	10.64
Average Governance Score	25.18	24.93	28.13	28.73
Average RES (978)	0.59	0.73**	0.66	0.57

* Statistically significant from the Screened Portfolio, $p<0.01$

**Statistically significant from the Screened Portfolio, $p<0.05$

Distribution of Morningstar Star Ratings

Morningstar Star Rating	Screened Portfolio	DEA Portfolio 1	DEA Portfolio 2	DEA Portfolio 3
5	9	15	26	48
4	4	5	14	35
3	15	6	13	26
2	0	0	0	0
1	0	2	3	3

Industry Sector

	SIC	Screened Portfolio	DEA Portfolios
Mining/Construction	0 to 1999	14.29%	5.83%
Manufacturing	2000 to 3999	14.29%	41.10%
Trans/Comm/Energy Svcs	4000 to 4999	3.57%	12.07%
Wholesale and Retail Trade	5000 to 5999	10.71%	11.76%
Services	6000 to 8999	57.14%	29.24%

Table 10: Distribution of the ESG Scores

Stock Universe

Score	E	S	G
0	489	232	0
1-25	137	551	96
26-50	230	153	779
51-75	104	33	101
76-100	18	9	2

Screened Portfolio

Score	E	S	G
0	28	28	0
1-25	0	0	13
26-50	0	0	15
51-75	0	0	0
76-100	0	0	0

DEA Portfolio 1

Score	E	S	G
0	23	17	0
1-25	1	10	16
26-50	4	1	12
51-75	0	0	0
76-100	0	0	0

DEA Portfolio 2

Score	E	S	G
0	45	36	0
1-25	4	18	24
26-50	7	2	31
51-75	0	0	1
76-100	0	0	0

DEA Portfolio 3

Score	E	S	G
0	81	55	0
1-25	12	47	41
26-50	15	9	69
51-75	4	1	2
76-100	0	0	0

10. Conclusion

One aim of this study is to examine how a restrictive ESG screen affects a universe of potential stocks from which an investor would select from. The filtered stocks turn out to be more attractive than the original stock universe in terms of potential investment return according to predictions

by Morningstar and Value Line. However, the filtered stocks are not distributed by industry sector in the same manner as the stock universe. The filtered stocks are more likely to be from the Service sector.

The DEA technique is introduced to facilitate a best-in-class approach by determining the top financially and socially performing companies within each industry sector. The sector bias found in the Screened Portfolio is removed by selecting a portfolio of DEA best practice stocks that are distributed appropriately across industry sectors. The DEA Portfolios are also found to have better potential for higher returns than the Screened Portfolio, although they include a small relaxation of ESG targets.

This study uses a restrictive ESG screen to deal with the most conservative socially responsible investor. Depending on the environment, business involvement, and corporate governance issues that matter to an investor, the DEA technique may be a viable technique to build a responsible equity portfolio. Certainly, an investor could apply a screen first and then use the DEA technique on the filtered group to find the best practice companies within each industry.

This paper does not examine past performance to see how portfolios built using these techniques perform historically. This is left for future research. However, an investor has no guarantee that a technique will work in the future even when armed with evidence that a particular technique worked in the past. This study is an attempt to help the investor build a portfolio using publicly available prospective performance data. While the analysis is limited to one point in time, there is no indication that the results are isolated.

Building a socially responsible portfolio does not imply that an investor must give up potential returns. In fact, this study finds that a restrictive ESG screen is more likely to select stocks with greater performance potential. Also, this study shows that a portfolio put together using the best-in-class approach and Data Envelopment Analysis has even greater potential without industry sector bias.

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REFERENCES

Abramson, L. & Chung, D. (2000). Socially responsible investing: Viable for value investors? *Journal of Investing* 9(3), pp. 73-80.

Banker, R. D., Das, S., & Datar, S. M. (1989). Analysis of Cost Variances for Management Control in Hospitals. In J. L. Chan & J. M. Patton (Eds.) *Research in Governmental and Nonprofit Accounting*, 5, (pp. 269-291). Greenwich, CT: JAI Press.

Banker, R. D., & Johnston, H. (1994). Evaluating the Impacts of Operating Strategies on Efficiency in the U.S. Airline Industry. In A. Charnes, W. Cooper, A. Lewin, & L. Seiford (Eds.) *Data Envelopment Analysis: Theory, Methodology, and Applications*, Boston: Kluwer Academic Publishers.

Barnett, M. & Salomon, R. (2006). Beyond dichotomy: The curvilinear relationship between social responsibility and financial performance, *Strategic Management Journal* 27(11), pp. 1101-1122.

Bauer, R., Otten, R. & Rad, A. (2006) Ethical investing in Australia: Is there a financial penalty? *Pacific-Basin Finance Journal* 14(1), pp. 33-48.

Bello, Z. (2005) Socially responsible investing and portfolio diversification, *The Journal of Financial Research* 28(1), pp. 41-57.

Blake, C. and Morey, M. (2000). Morningstar Rating and Mutual Fund Performance. *Journal of Financial and Quantitative Analysis* 35(3), pp. 451-83.

Blodget, H. (2007). The Conscientious Investor. *The Atlantic* 300(3), pp. 78-88.

Byrnes, P. & Valdmanis, V. (1994). Analyzing Technical and Allocative Efficiency of Hospitals. In A. Charnes, W. Cooper, A. Lewin, & L. Seiford (Eds.) *Data Envelopment Analysis: Theory, Methodology, and Applications*, Boston: Kluwer Academic Publishers.

Charnes, A., Cooper, W., Devine, D., Ruefli, T., & Thomas, D. (1989). Comparisons of DEA and existing ratio and regression systems for efficiency evaluation of regulated electric cooperatives in Texas. In J. L. Chan & J. M. Patton (Eds.) *Research in Governmental and Nonprofit Accounting*, 5, (pp. 187-210). Greenwich, CT: JAI Press.

Chilingerian, J. (1994). Exploring Why Some Physicians' Hospital Practices are More Efficient: Taking DEA Inside the Hospital. In A. Charnes, W. Cooper, A. Lewin, & L. Seiford (Eds.) *Data Envelopment Analysis: Theory, Methodology, and Applications*, Boston: Kluwer Academic Publishers.

Chong, J., Her, M. & Phillips, G. (2006) To sin or not to sin? Now that's the question, *Journal of Asset Management* 6(6), pp. 406-417.

Cooper, W., Seiford, L., & Tone, K. (2000). *Data Envelopment Analysis: A Comprehensive Text.* Boston: Kluwer Academic Publishers.

Del Guercio, D. & Tkac, P. A., (2002). The Effect of Morningstar Ratings on Mutual Fund Flows, Working Paper, University of Oregon Department of Finance.

diBartolomeo, D. & Kurtz, L. (1999) Managing Risk Exposures of Socially Screened Portfolios. *Northfield Information Services Working Paper*.

Eling, M. (2006). Performance measurement of hedge funds using data envelopment analysis. *Financial Markets and Portfolio Management* 20(4), pp. 442-471.

Elton, E. J., & Gruber, M. J. (1977) Risk Reduction and Portfolio Size: An Analytical Solution. *Journal of Business* 50(4), pp. 415-457.

Fare, R., Grosskopf, S., Lindgren, B., & Roos, P. (1994). Productivity Developments in Swedish Hospitals: A Malmquist Output Index Approach. In A. Charnes, W. Cooper, A. Lewin, & L. Seiford (Eds.) *Data Envelopment Analysis: Theory, Methodology, and Applications*, Boston: Kluwer Academic Publishers.

Glassman, J. K. (1999). Letting your Conscience be your Investment Guide. *Houston Chronicle*, February 8, p. 4.

Gompers, P., Ishii, J. & Metrick, A. (2003) Corporate governance and equity prices, *The Quarterly Journal of Economics* 118(1), pp. 107-155.

Gregoriou, G.N., & Zhu, J. (2005). *Evaluating Hedge Fund and CTA Performance: A Data Envelopment Analysis Approach*. New York: Wiley Publishers.

Hamilton, S., Hoje, J., & Statman, M. (1993). Doing Well While Doing Good? The Investment Performance of Socially Responsible Mutual Funds. *Financial Analysts Journal* 49(6), pp. 62–66.

Hale, J. (2002). Seeing Stars: Socially Responsible Mutual Fund Performance. In P. Camejo (Ed.) *The SRI Advantage: Why Socially Responsible Investing Has Outperformed Financially*. Gabriola Island, British Columbia, Canada: New Society Publishers.

Haslem, J.A., & Scheraga, C.A. (2006). Data Envelopment Analysis of Morningstar's Small-Cap Mutual Funds. *The Journal of Investing*,15 (1).

Hong, H. & Kacperczyk, M. (2005). The Price of Sin: the Effect of Social Norms of Markets, Working Paper: Princeton University.

Kirkham, R.J., & Boussabaine, A.H. (2005). The Application of Data Envelopment Analysis for Performance Measurement of the UK National Health Service Estate Portfolio. *The Queensland University of Technology Research Week International Conference Proceedings*. Australia: Queensland University of Technology Publishers.

Morey, M. (2007). The Kiss of Death: A 5-Star Morningstar Mutual Fund Rating? Working Paper. Department of Finance Pace University.

Morey, M., & Gottesman, A. (2006). Morningstar Mutual Fund Ratings Redux. Working Paper.

Morey, M. (2002) Rating the Raters: An Investigation into Mutual Fund Rating Services. *The Journal of Investment Consulting* 5(2), pp. 30-50.

Murthi, B., Choi, Y., & Desai, P. (1997). Efficiency of Mutual Funds and Portfolio Performance Measurement: A Non-Parametric Approach. *European Journal of Operational Research* 98, pp. 408-418.

Myers, D., & Anderson A., (2007). The Cost of Being Good. Forthcoming in the *Review of Business*.

Orlitzky, M., Schmidt, F. and Rynes, S. (2003). Corporate social and financial performance: A meta-analysis, *Organization Studies* 24(3), pp. 403-441.

Philbrick, D., & Ricks, W. (1991) Using Value Line and IBES Analyst Forecasts in Accounting Research. *Journal of Accounting Research* 29 (2), pp. 397-417.

Ramnath, S., Rock, S., & Shane, P. (2001).Value Line and I/B/E/S Earnings Forecasts. Working Paper.

Rudd, A. (1979). Divestment of South African Equities: How Risky? *Journal of Portfolio Management* 5(3), p. 5.

Seiford, L. M. (1996). Data Envelopment Analysis: The Evolution of the State of the Art (1978-1995). *Journal of Productivity Analysis* 7, pp. 99-137.

Seiford, L. M., & Thrall, R. M. (1990). Recent Developments in DEA: The mathematical programming approach to frontier estimation. *Journal of Econometrics* 46, pp. 7-38.

Schröder, M. (2004) The performance of socially responsible investments: Investment funds and indices, *Financial Markets and Portfolio Management* 18(2), pp. 122-142.

Shank, T., Manullang, D. & Hill, R. (2005). Is it better to be naughty or nice? *Journal of Investing* 14(3), pp. 82-87.

Statman, M. (2000). Socially Responsible Mutual Funds." *Association for Investment Management and Research*, p. 34.

Wang, C., Gopal, R. D., & Zionts, S. (1997). Use of Data Envelopment Analysis in Assessing Information Technology Impact on Firm Performance. *Annals of Operations Research* 73, pp. 191-213.