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## **Green is Good in Indian Stock Market**

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### **Abstract**

Over the past few years the concept of green investing has received considerable attention and has led to the formation of different forms of green investment avenues / portfolios, mutual funds, index, etc. This paper examines whether green stocks portfolio outperforms non-green stocks portfolios and market portfolio in Indian stock market. We use absolute rate of return as well as risk adjusted measures viz Sharpe ratio, Treynor ratio and Jensen's Alpha to evaluate the performance of green and non-green stocks portfolios. The study period spans from 1st April 2000 to 31st March 2012 and is further divided into three sub periods – before financial crisis (2004 – 2007), during financial crisis (2007 – 2009), and after financial crisis (2009 – 2012). We find that although green stocks portfolio underperformed (but not significantly) non-green stocks portfolios during pre-crisis period; it significantly outperformed non green stocks portfolio as well as market portfolio during crisis period. Green stocks portfolio provided an average monthly return of 0.14% as compared to -0.59% on market portfolio during the recent financial crisis. Moreover, green stocks portfolio is also found to have lower systematic risk as well as total risk than other portfolios. Green non blue chip stocks portfolio has shown the highest return per unit of total risk as well as systematic risk in the post crisis period. This lends support to the case of green investing in Indian stock market. These findings have important implications for companies, regulators, policy makers and investors at large. It proves that green stocks can be used to build up defensive and better performing portfolios by socially responsible investors in India. The regulators and policy makers can take steps to ensure socially responsible allocation of scarce resources and companies can very well understand the positive effects of being green, especially in times of crisis.

*Keywords:* Socially Responsible Investing, Green Investing, Indian Stock Market, GREENEX, Sharpe Ratio, Treynor Ratio, Performance Evaluation

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## **1. Introduction**

Over the past two decades, there has been an increasing awareness about environmental, social and governance factors in measuring the sustainability of company. The environmental parameters pertain to climate change and related risks, measures adopted by companies to reduce toxic releases and wastes etc. Social parameters include behavior of a company towards stakeholders, workplace health and safety norms. Governance parameters include board structure and accountability etc. Though this concept of sustainable investing is already prevalent in developed countries; it is now gathering momentum towards emerging markets (EDHEC-Risk Institute, 2010).

New policies and issues, socially responsible mutual funds, green index, sustainability index, introduction of United Nations principles for responsible investments (UNPRI), Global reporting initiative (GRI) and National action plan for climate change (NAPCC) are consequences of growing concern for environmental protection. In fact, many large investment management firms have created groups specialized in analyzing environmental and other extra financial information. Investment managers and institutional investors have agreed on principles and created action groups to push green investing forward. There are three types of approaches for investors to undertake green investment: the thematic approach, screening, and engagement. The thematic approach focuses on specific sectors such as clean energy, clean technology, water and wastewater management, and so on. Screening implies including (positive screening) or excluding (negative screening) companies on environmental criteria. Finally, engagement focuses on a long-term relationship with companies, establishing a dialogue on environmental and sustainability issues, in the interest of inciting companies to change their practices in favour of the environment. These three approaches are not, of course, mutually exclusive.

Bhanumurthy (2007) argued that over the years the gap between business and society has reduced significantly. Hence there is a need for business to be more socially responsible and reflect the values of society. It is evidenced that business ethics and social responsibility are not unrelated. Further, there is a need to distinguish between business philosophy and philosophy of business. Business philosophy may or may not include ethical dimensions while philosophy of business is concerned with ethical foundations. There is paradigm shift in the philosophy of business and this shift leads to a framework wherein a new perspective on business ethics and social responsibility emerges. It is coined as Corporate Responsibility and it consists of (a) good corporate governance, (b) corporate social responsibility, and (c) environmental accountability.

Environment accountability is the core focus of green investing because if companies are expected to make conscious efforts to protect the environment and ensure sustainable development, the investors are also required to be more socially responsible and ensure adequate flow of funds towards green companies.

Developed in western economies since 1980s, Sustainable investing and green investing is still in the nascent stages of development in India, one of the advanced emerging markets. The reasons range from lack of awareness amongst investors to lack of publicly available Environmental, Social and Governance (ESG) information on companies for investors to make financial decision on. For promoting green investing in India, recently Bombay Stock Exchange (BSE) has launched “BSE-GREENEX” on 22nd February, 2012. It is the 25th dynamic index hosted on the Bombay Stock Exchange.

It is a first veritable step in creating an inclusive market based mechanism for the promotion of energy efficient practices amongst the largest business entities in India. It is a new index of sustainability stocks that help investors looking for green companies. GREENEX comprises of 20 companies from the broader BSE 100 index that meet energy efficient norms, allowing investors to derive benefit from the related cost savings. The index allows investors to track companies that invest in energy efficient practices. It allows asset managers to create products to help investors put their money in green enterprises and make green investments. GREENEX is targeted at retail as well as institutional investors such as pension funds looking for investment in companies with strong long-term prospects and develop green financial products (The Hindu, February 23, 2012).

The presence of a separate index to measure performance of energy efficient companies in stock market is useful as the investors can make a better and informed investment decision. It could also help the government to gauge investors' sentiment regarding the implementation of environmental policies and their acceptance in terms of energy usage and efficiency measures. And it could also help asset managers create various products to encourage more "green" investments in India.

The main objective of this paper is to empirically examine the relative performance of a green stocks portfolio vis-a-vis non-green portfolios in the Indian stock market especially during and after the period surrounding the financial crisis. Using monthly data on GREENEX, blue chip companies, non-green companies, and market index for the period April 2000 to March 2012, this empirical study finds that the green stocks portfolio outperformed other portfolios (blue chip, non-green mimicking, and market portfolio) during the recent financial crisis. It also attempts to verify that green stocks portfolio is more resilient in troubled times, as compared to other portfolios.

The remainder of this paper is organized as follows. Section 2 contains the background and brief review of literature regarding green investing. Section 3 describes the collection of data and methodology of the research work. Section 4 provides the empirical evidence and discussion of results while Section 5 concludes our research. It concludes that investors can expect some financial benefit by undertaking green investing in comparison with non-green investing and passive investing in market portfolio.

## **2. Background and Review of Literature**

With the increasing focus on environmental protection, there have been growing calls, whether from the media, government, or corporations (Boulatoff & Boyer, 2009), to make responsibility for the environment an integral part of investment decision making.

To cater to the demand for environmentally responsible or green investment, the investment management industry began providing specific green funds in late 1980s. India's first and only retail-socially-responsible mutual fund so far, was launched by ABN AMRO in March 2007 and raised approximately US \$12 Million. Now the fund is managed by BNP Paribus Management.

The reasons for investing green can be categorized in four groups. First, investors may be driven by ethical considerations. Second, they may be interested purely in advantageous return profiles. Third, by making an environmental dimension an integral part of their investment decisions, investors may simply be responding to legal or regulatory constraints. Finally, investors may be looking to improve their reputation by making a public showing of their concern for the environment.

Ethical considerations may be the most basic force behind these types of investments. Lewis and Mackenzie (2000) and Lewis (2001) argue that, when structuring their investment portfolios, investors derive utility from behaving in ways consistent with ethical considerations. Such utility gains may mean that investors would even be willing to sacrifice some financial returns. Scheuth (2003) notes that although they are looking to generate returns, some investors may also want their investments to do well.

Taking information on environmental criteria into consideration while investing may also provide investors with attractive risk and return properties. For several reasons, green investing may be attractive from a purely financial point of view. Dunn (2009) points out that decreased costs through removal of environmental inefficiencies may lead to increased firms earnings and higher returns. Many consumers are also willing to pay higher prices for green products (Coddington, 1990; Suchard & Polonsky, 1991). Therefore, paying more attention to the environment could lead to higher profitability. Through better management of future environment risks, green investments may be subject to lower risk overall (Konar & Cohen, 2001; Dunn, 2009). Green investments may provide convenient hedging properties. In particular, investing in resource saving should serve as a hedge against resource price spikes. Investments in companies that exploit alternative energy sources or that allow energy savings, for example, benefit when energy prices rise (Greenstein, 2008; Preston & Martel, 2008).

A number of research studies have also attempted performance evaluation of green stocks portfolios especially in developed markets. Table 1 summarises the results of a few of such studies. It can be noted that most of these studies are from U.S. market.

Mahapatra (1984) finds that pollution control expenditures had a negative impact on the financial performance of US companies in the 1970s. By contrast, Erfle and Fratantuano (1992) conclude that there is a significant positive relationship between firm's environmental performance and financial performance. White (1991) finds that the mutual funds that use social responsibility screening criteria slightly underperformed the S&P 500 Index on both a nominal and risk-adjusted basis.

Diltz (1995) studies the daily returns for twenty eight common stocks portfolios over the period from 1981 to 1991 that have good environmental performance and finds that social screening did not improve portfolio performance significantly, whereas environmental performance did. At the same time Cohen, Fenn and Konar (1997) examine the difference in financial performance of heavy polluters and light polluters and suggest that investing in companies that are leaders in environmental protections would neither improve nor reduce portfolio returns.

Semenova and Hassel (2008) find that in a low-risk industry, the effect of environmental performance on market value is greater than in a high-risk industry. Derwall, Guenster, Bauer & Koedijk, (2005) compared the financial performance of high environmental rating stocks to that of low ones and find that portfolios consisting of stocks with high environmental ratings provided substantially higher average returns than those of stocks with low ratings. Olsson (2007) by contrast, analyzed the returns of thirty US industry portfolios and find that environmental score of portfolios had no statistically significant impact on returns.

There are also studies that report neutral results. Boulatoff and Boyer (2009) studied the performance of more than three hundred environmental firms and find that the performance of environmental stocks is sector dependent. King and Lenox (2001) examined more than six hundred US manufacturing firms and concluded that the financial performance of companies in cleaner

industries is good. Dixon (2010) discussed the potential impact of sustainability-themed investing on the performance of a global equity portfolio. The study argues that sustainability-themed investing could improve returns but would also mean higher risk.

**Table 1: Studies on Green Investing**

<b>Form</b>	<b>Author</b>	<b>Method</b>	<b>Time-Period</b>	<b>Country</b>	<b>Results</b>
Negative results	Mahapatra (1984)	Compared pollution control expenditures across six industries to the average market returns in those industries	1967-1978	U.S.	Pollution control expenditure limits the financial performance of company
	White (1991)	Compared the performance of six environmental mutual funds to S&P 500 on both a nominal and risk adjusted basis	One year period ending 28th June 1991	U.S.	SRI funds underperformed
	Olsson (2007)	Returns of 30 US industry portfolios are analyzed	Jan.2004-July2006	U.S.	The environmentally "riskiness" of portfolios has no significant impact on returns
Neutral results	Cohen, Fenn and Konar (1997)	Two portfolios with heavy and light polluters were constructed and their performances were compared	1987-1989, 1990 and 1991	U.S.	No penalty or positive return given to green investor's convictions
	King and Lenox (2001)	652 US manufacturing firms were analyzed	1987-1996	U.S.	Association of pollution reduction and financial gain, but no direction of causality
	Boulatoff and Boyer (2009)	Analyzed 310 global green investing socks	2003-2007	U.S.	The performance of the environmental stocks is sector dependent
	Dixon (2010)	Analyzed the performance of sustainability-themed investing	Before 31st May 2010	U.S.	Sustainability-themed investing could improve returns but with increased risk also

Table contd.

Form	Author	Method	Time-Period	Country	Results
Positive results	Erfle and Fratantuono (1992)	Analyzed 49 companies in environmental performance	Before 1989	U.S.	Positive correlation between environmental performance and return
	Diltz (1995)	Analyzed daily returns of 28 common stock portfolios	1981-1991	U.S.	Environmental performance has significantly positive impact on portfolio returns
	Derwall et al.(2005)	Compared the performance of high environmental rating stocks to that of low ones	1995-2003	Netherlands	High rating stocks provided higher average returns than low rating stocks
	Semenova and Hassel (2008)	Compared the industries on the basis of low and high risk	2003-2006	Europe	Market value of low risk industries is greater than high risk industries

Source: EDHEC-Risk Institute 2010

Hence overall it can be said that the results of the previous studies are mixed especially for markets. For developed markets, especially U.S market, the studies show that green stocks outperform non green stocks but at the same time might have higher risks too.

Given the limited empirical evidence on Green investing especially in emerging markets this study will be a significant contribution in Indian context. The launch of GREENEX may be taken as a signal that even Indian investing community is being sensitized towards environmentally conscious investment decisions. The study will be of immense use for regulators, policy makers, institutional investors as well as retail investors.

The institutional investors in the world have become more conscious in using green investing practices. In fact in developed countries, many large investment firms have created groups specialized in analyzing environmental and other extra financial information. Investment managers and institutional investors have agreed on principles and created action groups to push green investing forward. For example, more than eight hundred institutions worldwide with more than \$22 trillion of assets under management have endorsed the “Principles for Responsible Investments” drafted by UN Environment Programme Finance Initiative (Rohrbein, 2010). Focusing a more specific issue, global warming, institutional investors have formed important action groups to develop common initiatives such as the Institutional Investors’ Group on Climate Change (IIGCC) which currently has more than fifty members representing assets of Euro 5 trillion (IIGCC, 2009). Such an attempt may also be planned by domestic as well as foreign institutional investors in India. The results of the study regarding performance of green stocks in India will be of significant use by retail investors as they may plan out their investment decisions accordingly.

### 3. Methods and Data

The study evaluates seven portfolios (viz. green stocks portfolios, green blue chip stocks portfolio, green non blue chip stocks portfolio, non – green mimicking stocks portfolio, blue-chip stocks portfolio, blue-chip- non green stock portfolio and market portfolio) over the period 2000-2012. Green stocks portfolio comprises of all the companies forming part of GREENEX (there are 20 companies in GREENEX), the green companies' index on BSE (Bombay Stock Exchange). Non-green mimicking stocks portfolio is constructed by using the same sectoral composition as that of GREENEX but selecting 20 non green companies at random. The blue-chip stocks portfolio comprises of all 30 companies forming part of SENSEX while blue-chip non green portfolio comprises of all those 15 stocks which are in SENSEX but not in GREENEX. 15 common stocks included GREENEX as well as SENSEX comprise of the green blue chip stocks portfolio. Five stocks which are in GREENEX but not in SENESX comprise of Green non blue chip stocks portfolio. A more comprehensive and broad based BSE 100 INDEX is used as the proxy for market portfolio. The composition of all these portfolios is given in Annexure 1.

Monthly closing adjusted share prices of the companies in respective portfolios during the period 1st April 2000 to 31st March 2012 are collected from PROWESS database of CMIE (Centre for monitoring Indian economy). The stock prices are then converted into simple percentage returns<sup>1</sup> as  $(P_t - P_{t-1})/P_{t-1}$  and equally weighted portfolio returns are calculated. Since the risk free rate should reflect real changes in the market interest rate level, the proxy for risk free rate is monthly implicit yield on 91 days T-bills over the study period. Next we calculated Karl Pearson's coefficient of correlation among these portfolios, descriptive statistics, portfolio beta and the following risk adjusted measures for performance evaluation.

#### *Sharpe Ratio*

It is calculated as the excess return per unit of total portfolio risk. Since Sharpe ratio uses standard deviation as a measure of risk, it does not assume the portfolio is well diversified. In effect, the index standardizes the returns in excess of the risk free rate by the variability of the return. It is also termed as Reward to Variability ratio. If  $AR_p$  is the average monthly portfolio return,  $R_F$  the monthly risk free return and  $\sigma_p$  portfolio total risk then Sharpe ratio can be calculated as-

$$\text{Sharpe ratio} = (AR_p - R_F) / \sigma_p \quad (1)$$

#### *Treynor Ratio*

It is calculated as the excess return per unit of portfolio systematic risk, indicated by portfolio beta ( $\beta_P$ ). Note that Treynor index uses the portfolio's beta, which assumes the portfolio is well diversified. In effect, it standardizes the return in excess of the risk-free rate by the volatility of the return.

$$\text{Treynor ratio} = (AR_p - R_F) / \beta_P \quad (2)$$

#### *Jensen's Alpha*

It is used to determine the abnormal return of a security or portfolio of securities over the theoretical expected return. The theoretical return is predicted by a market model, most commonly the capital assets pricing model (CAPM). A portfolio with a consistently positive excess return (adjusted for risk) will have a positive alpha and vice-versa. It can be calculated as;

$$\alpha_j = R_i - [R_F + \beta_{lm}(R_M - R_F)] \quad (3)$$

Since the measures of risk used in the Sharpe and Treynor indices differ, it is possible for the two indices to rank performance differently. If a portfolio is perfectly diversified, the two measures will give similar rankings because total risk is then equivalent to systematic risk. However, if the portfolio is poorly diversified, it is possible for it to show a high ranking on the Treynor index, but a lower ranking on the Sharpe index. The difference is due to the low level of portfolio diversification.

Further, we have used t-test to check whether the mean returns of green and non-green portfolios are significantly different or not.

#### 4. Empirical Results

The results of our study are shown in Table 2, 3 and 4. Table 2 shows Karl Pearson’s coefficients of correlation between different portfolios. It shows that green non blue chip stocks portfolio has lowest degree of correlation with all other portfolios. Hence, as per modern portfolio theory, the inclusion of green non blue chip stocks can provide diversification benefits to the investors and reduce their portfolio’s risk.

**Table 2: Cross Correlation Matrix of Different Portfolios Returns**

Portfolio	Green Blue Chip	Green Non Blue Chip	Mimicking	Blue Chip	Blue-Chip Non Green	Market
Greenex	0.992* *	.796**	.874**	.977**	0.906**	.947**
Green blue chip	1	.715**	.867**	.979**	0.900**	.941**
Green non blue chip		1	.679**	.731**	0.714**	.732**
Mimicking			1	.884**	0.843**	.891**
Blue chip				1	0.968**	.965**
Blue-chip non green					1	0.943**

\*significant at 5%, \*\* significant at 1% level

Table 3 shows portfolio return, total risk (standard deviation), coefficient of variation, beta, Sharpe ratio and Treynor ratio of all six portfolios. It shows that the green stocks portfolio has provided significantly higher return and only a marginally lower average return than that of non-green mimicking portfolio or Blue chip non green portfolio. Monthly average return on green stocks portfolio was 2% as compared to 2.19% of blue chip stocks portfolio and 1.16% of market portfolio. The mimicking portfolio provided highest monthly average return as 2.60% while green non blue chip stocks portfolio provided the least, 1.42% per month. However at the same time standard deviation or risk of green non blue chip portfolio was lower (7.23%) than all other portfolios. The beta of green non blue chip stocks portfolio is lowest (0.634) highlighting towards the fact that it is the most defensive portfolio among all six portfolios and contains lowest amount of systematic risk. During the entire study period (2000-2012) green stocks portfolio outperformed the market portfolio but underperformed non-green portfolios both in terms of Sharpe ratio and Treynor ratio.



When we divided the data into two sub periods of six years each we found that green stocks portfolio performed well in the second sub period and outperformed both the market portfolio and non-green stocks portfolio in terms of Sharpe ratio. The three year sub period results shows that the green stocks portfolio outperformed non-green stocks portfolio during the period 2006-09. During three year period (2009-12) green stocks portfolio has lower return than non-green portfolio as well as blue chip portfolio but at the same time green stocks portfolio also has lesser risk in comparison with non-green and blue chip portfolio. Overall, green stocks portfolio underperformed both the blue chip and non-green portfolios but it outperformed the market portfolio in terms of both the Sharpe ratio and Treynor ratio.

**Table 3: Return, Risk, Sharpe Ratios and Treynor Ratios of Portfolios**

Portfolios	12 Year	6 Year Period		3 Year Period			
	2000 – 12	2000-06	2006-12	2000-03	2003-06	2006-09	2009-12
<i>Average (%)</i>							
Greenex	2.00	2.68	1.31	0.234	5.13	0.30	2.33
Green	2.16	3.01	1.320	0.552	5.47	0.44	2.19
Bluechip							
Green Non	1.42	1.51	1.325	-0.73	3.75	-0.37	3.01
Bluechip							
Mimicking	2.60	3.69	1.50	0.89	6.48	-0.44	3.46
Bluechip	2.19	2.85	1.54	0.37	5.34	0.52	2.55
Bluechip	2.19	2.62	1.75	0.08	5.16	0.67	2.83
Non Green							
Market	1.16	1.30	1.01	-1.49	4.10	-0.03	2.06
<i>Std. Deviation (%)</i>							
Greenex	8.19	8.06	8.32	7.84	7.62	8.92	7.66
Green	8.84	8.63	9.02	8.46	8.19	9.59	8.45
Bluechip							
Green Non	7.23	7.55	6.94	7.97	6.45	7.88	5.46
Bluechip							
Mimicking	9.82	8.47	10.96	7.21	8.81	10.89	10.84
Bluechip	8.28	8.02	8.54	7.85	7.48	9.06	7.98
Bluechip	7.82	7.78	7.89	7.82	6.97	8.52	7.16
Non Green							
Market	8.35	7.95	8.79	8.03	6.89	9.50	8.01
<i>Coeff. of Variation</i>							
Greenex	4.098	3.006	6.32	33.40	1.48	30.03	3.28
Green	4.081	2.867	6.83	15.31	1.49	21.37	3.85
Bluechip							
Green Non	5.093	4.985	5.24	-10.94	1.71	-21.52	1.81
Blue Chip							
Mimicking	3.77	2.29	7.26	8.02	1.359	-24.47	3.13
Bluechip	3.765	2.805	5.547	20.9744	1.40	17.27	3.12
Bluechip	3.576	2.97	4.49	93.46	1.351	12.67	2.52
Non Green							
Market	7.175	6.071	8.62	-5.40	1.67	-364.52	3.88

Table contd.

Portfolios	12 Year	6 Year Period		3 Year Period			
	2000 – 12	2000-06	2006-12	2000-03	2003-06	2006-09	2009-12
<b>Sharpe Ratio</b>							
Greenex	0.179465	0.267011	0.094658	-0.03753	0.603355	-0.02601	0.235769
Green Bluechip	0.185148	0.287478	0.087666	0.002809	0.602925	-0.00836	0.196523
Green Non Bluechip	0.12319	0.130519	0.114587	-0.15772	0.50002	-0.1135	0.455420
Mimicking Bluechip	0.210736	0.373088	0.089356	0.051288	0.675758	-0.08945	0.27057
Bluechip	0.201685	0.290553	0.118349	-0.01965	0.643237	-0.00043	0.253843
Bluechip	0.211992	0.268718	0.155198	-0.05696	0.664056	0.016842	0.321921
Non Green Market	0.076035	0.098161	0.055727	-0.25091	0.51899	-0.05841	0.191513
<b>Beta</b>							
Greenex	0.929	0.929	0.927	0.870	1.026	0.916	0.941
Green Bluechip	0.996	0.977	1.008	0.906	1.107	0.991	1.039
Green Non Bluechip	0.634	0.738	0.549	0.749	0.700	0.569	0.484
Mimicking Bluechip	1.048	0.871	1.189	0.639	1.144	1.094	1.298
Bluechip	0.956	0.952	0.958	0.900	1.046	0.942	0.979
Bluechip	0.883	0.919	0.852	0.896	0.954	0.849	0.850
Non Green Market	1	1	1	1	1	1	1
<b>Treynor Ratio</b>							
Greenex	0.015834	0.023186	0.008499	-0.00338	0.044857	-0.00253	0.019212
Green Bluechip	0.016436	0.025416	0.0078464	0.000263	0.044648	-0.00081	0.015996
Green Non Bluechip	0.01405	0.013359	0.014505	-0.01680	0.04614	-0.01573	0.051411
Mimicking Bluechip	0.019766	0.036313	0.008244	0.005792	0.052059	-0.0089	0.022608
Bluechip	0.017477	0.024478	0.010556	-0.00172	0.046034	-0.000041	0.0207
Bluechip	0.018786	0.022773	0.014376	-0.00497	0.048543	0.001691	0.027131
Non Green Market	0.006352	0.007805	0.0049	-0.02017	0.035778	-0.00555	0.015352
<b>Jensen's Alpha</b>							
Greenex	0.08808	0.01429	0.003336	0.014604	0.009315	0.002765	0.003632
Green Bluechip	0.010043	0.017207	0.002969	0.018511	0.009819	0.0047	0.000669
Green Non Bluechip	0.00488	0.00409	0.005273	0.002523	0.00725	-0.00579	0.01745
Mimicking Bluechip	0.014058	0.02483	0.003975	0.016589	0.018625	-0.00367	0.009418
Bluechip	0.010635	0.015874	0.005418	0.016608	0.010727	0.00519	0.005235
Bluechip	0.010979	0.013756	0.008073	0.013617	0.012178	0.006149	0.010012
Non Green Market	0	0	0	0	0	0	0

Table 4 shows that green stocks portfolio generated an average monthly return of 2.65%, 0.14% and 2.33% in pre-crisis, during crisis and post crisis period while mimicking portfolio generated an average monthly return of 3.36%, -0.79% and 3.46% respectively. Blue-chip green stocks portfolio generated an average monthly return of 2.74%, 0.29% and 2.19% respectively, while Blue chip non green portfolio provided 2.87%, 0.36% and 2.83% return. The market portfolio generated 2.45%, -0.59% and 2.06% and green non blue chip portfolio provided 2.28%, -0.51% and 3.01% over the same period. We find that, during crisis as well as after crisis green stocks portfolio provided higher return than the market portfolio and had much lower risk. However green stocks portfolio did not outperform blue-chip stocks, mimicking stocks or blue chip non green stocks portfolios.

The risk (standard deviation as well as beta) of green non-blue chip portfolio was lowest among all other portfolios during crisis and after crisis. This portfolio outperformed all other portfolios after crisis with Sharpe ratio of 0.460 (as compared to 0.239, 0.199, 0.273, 0.257 and 0.195 for other portfolios) and Treynor ratio of 0.0520 (as compared to 0.0195, 0.0162, 0.0228, 0.0209 and 0.0156 for other portfolios). This proves that green non-blue chip portfolio becomes a safer bet in post financial crisis.

**Table 4: Performance of Different Portfolios in Pre Crisis, During Crisis & Post Crisis Periods**

Portfolios	Before Crisis	During Crisis	After Crisis
	1/04/04-31/03/07	1/04/07-31/03/09	1/04/09-31/03/12
<b>Average (%)</b>			
Greenex	2.65	0.14	2.33
Green Bluechip	2.74	0.29	2.19
Green Non Bluechip	2.28	-0.51	3.01
Mimicking	3.36	-0.79	3.46
Bluechip	2.78	0.31	2.55
Bluechip Non Green	2.87	0.36	2.83
Market	2.45	-0.59	2.06
<b>Std. Deviation (%)</b>			
Greenex	7.30	9.91	7.66
Green Bluechip	7.53	10.83	8.45
Green Non Bluechip	6.95	8.24	5.46
Mimicking	7.85	12.42	10.84
Bluechip	6.83	10.33	7.98
Bluechip Non Green	6.34	9.70	7.16
Market	6.54	10.77	8.01
<b>Coeff. of Variation</b>			
Greenex	2.747	67.70	3.28
Green Bluechip	2.743	36.57	3.85
Green Non Bluechip	3.048	-16.14	1.81
Mimicking	2.33	-15.70	3.13
Bluechip	2.451	32.88	3.12
Bluechip Non Green	2.209	26.69	2.52
Market	2.664	-17.96	3.88

Table Contd.

Portfolios	Before Crisis	During Crisis	After Crisis
	1/04/04-31/03/07	1/04/07-31/03/09	1/04/09-31/03/12
<b>Sharpe Ratio</b>			
Greenex	0.291536	-0.03857	0.235769
Green Bluechip	0.294256	-0.02148	0.196523
Green Non Bluechip	0.251959	-0.126120	0.455420
Mimicking	0.361327	-0.10624	0.27057
Bluechip	0.330416	-0.02077	0.253843
Bluechip Non Green	0.369081	-0.01705	0.321921
Market	0.294407	-0.10479	0.191513
<b>Beta</b>			
Greenex	1.074	0.903	0.941
Green Bluechip	1.111	0.992	1.039
Green Non Bluechip	0.925	0.490	0.484
Mimicking	1.094	1.110	1.298
Bluechip	1.034	0.948	0.979
Bluechip Non Green	0.937	0.850	0.850
Market	1	1	1
<b>Treynor Ratio</b>			
Greenex	0.019828	-0.00424	0.019212
Green Bluechip	0.019955	-0.00235	0.015996
Green Non Bluechip	0.018932	-0.02121	0.0514111
Mimicking	0.025958	-0.0119	0.022608
Bluechip	0.021837	-0.00227	0.0207
Bluechip Non Green	0.024981	-0.00195	0.027131
Market	0.019269	-0.01129	0.015352
<b>Jensen's Alpha</b>			
Greenex	0.000601	0.006365	0.003632
Green Bluechip	0.000762	0.008867	0.000669
Green Non Bluechip	-0.00031095	-0.004866	0.017452
Mimicking	0.007318	-0.00068	0.009418
Bluechip	0.002655	0.008551	0.005235
Bluechip Non Green	0.005352	0.007938	0.010012
Market	0	0	0

Table 5 shows the results of t-test conducted to check whether monthly average returns of green and non-green stocks portfolios returns are significantly different or not. We find that over the total study period, green stocks portfolio generated significantly higher return than market portfolio. Moreover, monthly average return of green portfolios and blue chip as well as mimicking portfolios are not significantly different. Hence, there is absolutely no penalty for investing in green stocks in Indian stock market. In pre-crisis period, various green and non-green portfolios did not generate significantly higher returns than market portfolio implying that it pays to go green in times of economic or financial crisis. Further, in post crisis period, we did not find significantly different mean monthly returns between green and non-green stocks portfolios. Similar results are obtained using weekly data (see Table 6) and hence these results are not discussed in detail in the paper.

**Table 5: Results of T-Test**

Pairs	Total Period		Pre Crisis		During Crisis		Post Crisis	
	Differential Mean (%)	t	Differential Mean (%)	t	Differential Mean (%)	t	Differential Mean (%)	t
Greenex-Market	0.835*	3.708	0.200	0.597	0.74	1.665	0.27	1.116
Greenex-Bluechip	-0.199	-1.354	-0.12	-0.452	-0.16	-0.421	-0.22	-1.268
Greenex-Mimicking	-0.600	-1.504	-0.71	-1.336	0.94	1.225	-1.12	-1.515
Green Bluechip-Market	1.001*	4.008	0.29	0.827	0.89*	2.445	0.12	0.501
Green Bluechip-Bluechip	-0.03	-0.219	-0.04	-0.146	-0.02	-0.044	-0.36	-1.744
Green Bluechip-Mimicking	-0.434	-1.063	-0.62	-1.167	-1.08	1.379	-1.27	-1.935
Green Non Bluechip-Market	0.255	0.530	-0.17	-0.306	0.09	0.052	0.95	1.013
Green Non Bluechip	-0.78	-1.621	-0.50	-0.871	-0.82	-0.517	0.46	0.513
Green Non Bluechip-Mimicking	-1.18	-1.958	-1.08	-1.510	0.28	0.167	-0.44	-0.318
Green Bluechip-Bluechip Non Green	-0.0217	-0.068	-0.1236	-0.223	-0.0673	-0.079	-0.644	-1.425

\*Significant at 5%

**Table 6 : Performance of Different Portfolios (Weekly Returns)**

Portfolios	12 Year	6 Year Period		3 Year Period			
	2000-12	2000-06	2006-12	2000-03	2003-06	2006-09	2009-12
<i>Average (%)</i>							
Greenex	0.455	0.611	0.299	0.101	1.125	0.118	0.481
Green Bluechip	0.492	0.683	0.300	0.174	1.195	0.162	0.440
Green Non Blue Chip	0.327	0.358	0.296	-0.120	0.839	-0.077	0.672
Mimicking	0.575	0.834	0.316	0.269	1.403	-0.082	0.717
Blue Chip	0.501	0.649	0.353	0.132	1.169	0.177	0.531
Bluechip Non Green	0.477	0.597	0.358	0.066	1.132	0.199	0.518
Market	0.253	0.290	0.217	-0.309	0.892	0.030	0.405
<i>Std. Deviation (%)</i>							
Greenex	3.43	3.21	3.64	3.46	2.87	4.22	2.94
Green Bluechip	3.71	3.42	3.97	3.64	3.11	4.58	3.26
Green Non Blue Chip	3.35	3.63	3.05	4.24	2.81	3.60	2.32
Mimicking	3.89	3.32	4.37	3.25	3.31	4.82	3.84
Blue Chip	3.53	3.29	3.75	3.56	2.90	4.38	3.00
Bluechip Non Green	3.51	3.45	3.57	3.89	2.85	4.23	2.76
Market	3.72	3.53	3.91	4.03	2.82	4.54	3.15

Table Contd.

Portfolios	12 Year	6 Year Period		3 Year Period			
	2000-12	2000-06	2006-12	2000-03	2003-06	2006-09	2009-12
<b>Coeff. of Variation</b>							
Greenex	7.544	5.26	12.15	34.31	2.55	35.48	6.12
Green Bluechip	7.541	5.01	13.21	20.88	2.60	28.16	7.41
Green Non Blue Chip	10.24	10.15	10.29	-35.29	3.35	-46.76	3.45
Mimicking Blue Chip	6.765	3.99	13.84	12.04	2.36	-58.79	5.37
Blue Chip	7.044	5.07	10.63	26.87	2.48	24.76	5.66
Bluechip Non Green	7.352	5.77	9.98	58.63	2.52	21.28	5.33
Market	14.67	12.17	17.99	-13.06	3.16	151.28	7.76
<b>Sharpe Ratio</b>							
Greenex	0.09700	0.152105	0.048724	-0.00617	0.349086	-0.000753	0.121819
Green Bluechip	0.09971	0.163939	0.044998	0.014396	0.344717	0.008847	0.097446
Green Non Blue Chip	0.06118	0.064915	0.057142	-0.057069	0.254765	-0.055236	0.237042
Mimicking Blue Chip	0.11645	0.214121	0.044360	0.045454	0.386235	-0.042317	0.154571
Blue Chip	0.107385	0.160203	0.061576	0.002972	0.360088	0.012504	0.136085
Bluechip Non Green	0.101254	0.137750	0.066006	-0.014286	0.354284	0.018140	0.143245
Market	0.035353	0.047584	0.024355	-0.106843	0.272824	-0.02025	0.090080
<b>Beta Value</b>							
Greenex	0.853	0.791	0.904	0.719	0.934	0.901	0.909
Green Bluechip	0.911	0.816	0.987	0.721	1.009	0.978	1.008
Green Non Blue Chip	0.591	0.684	0.516	0.706	0.629	0.545	0.444
Mimicking Blue Chip	0.895	0.749	1.014	0.611	1.014	0.966	1.106
Blue Chip	0.907	0.861	0.944	0.803	0.981	0.948	0.937
Bluechip Non Green	0.883	0.907	0.863	0.894	0.936	0.881	0.826
Market	1	1	1	1	1	1	1
<b>Treynor Ratio</b>							
Greenex	0.00391	0.006184	0.001962	-0.0003	0.010738	-0.000035	0.003951
Green Bluechip	0.004062	0.006879	0.001812	0.000728	0.010639	0.000414	0.003156
Green Non Blue Chip	0.003471	0.003447	0.003382	-0.003434	0.011400	-0.003655	0.012402
Mimicking Blue Chip	0.005066	0.009516	0.001915	0.002420	0.012635	-0.002113	0.005380
Blue Chip	0.004182	0.006124	0.002451	0.000132	0.010675	0.000578	0.004366
Bluechip Non Green	0.004028	0.005241	0.002734	-0.000623	0.010788	0.000871	0.004796
Market	0.001316	0.001679	0.000952	-0.004308	0.007705	-0.000921	0.002838
<b>Jensen's Alpha</b>							
Greenex	0.00221	0.003563	0.000913	0.002884	0.002833	0.000797	0.001012
Green Bluechip	0.002502	0.004243	0.000848	0.003631	0.002960	0.001305	0.000321
Green Non Blue Chip	0.001274	0.001209	0.001253	0.000617	0.002324	-0.001490	0.004246
Mimicking Blue Chip	0.003357	0.005869	0.000976	0.004111	0.004999	-0.001152	0.002812
Blue Chip	0.002599	0.003827	0.001414	0.003566	0.002913	0.00142	0.001432
Bluechip Non Green	0.002394	0.003230	0.001537	0.003295	0.002886	0.001578	0.001617
Market	0	0	0	0	0	0	0

## 5. Conclusions and Implications of the Study

The concept of green investing has received considerable attention and has led to the formation of different forms of green investment avenues / portfolios, mutual funds, index etc. The most popular green theme is climate change and institutional investors have begun to coordinate efforts with prominent action groups on various environmental issues. United Nations has also specified some principles of responsible investing (UNPRI, 2006).

In this context, this paper examined whether green stocks portfolios outperform non-green stocks portfolios in Indian stock market. Using absolute rate of return we find that although green stocks portfolio generated a significantly higher return than market portfolio, it did not outperform mimicking stocks portfolio or blue chip non green stocks portfolio. However, mean monthly return on green stocks portfolios are not found to be significantly different than other non-green stocks portfolios. Hence there is absolutely no penalty for investing in green stocks in Indian market. In the pre-crisis period and post-crisis period again the returns of green and non-green stocks portfolios were not significantly different. However during crisis period (2007-09), we find that green blue chip stocks portfolio generated significantly higher returns than market returns implying that green investing was more rewarding during the crisis period. Using risk adjusted measures – Sharpe ratio and Treynor ratio, the results were more promising. We find that during the total study period although green stocks portfolio underperformed mimicking and blue chip stocks portfolio but it outperformed the market portfolio.

Mahapatra (1984), White (1991) and Olsson (2007) have also reported similar findings in US. Green stocks portfolio has lower systematic risk as compared to other non-green stocks portfolios. Further, green blue chip stocks portfolio outperformed non-green as well as market portfolios during financial crisis and especially post crisis. It shows that green stocks portfolio can be a safer bet for conservative investor during times of economic and financial crisis. These results are consistent with the findings of Diltz (1993) for US market. There is limited empirical evidence on the performance evaluation of green stocks portfolios especially in case of emerging markets. Hence this study contributes to the related literature by analyzing the performance of green stocks in Indian stock markets which is one of the advanced emerging markets.

The findings have important implications for investment decisions as investors may start investing in green firms (preferably non blue chip companies) to reap higher returns at lower risk. We expect that for green investment promotion, more and more socially responsible mutual funds or green mutual funds would be launched in India in near future.

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## Appendices

### 1. Green Stocks Portfolio

Company	Industry
HDFC Ltd.	Finance
Cipla Ltd.	Healthcare
Bharat Heavy Electricals Ltd.	Capital goods
State Bank of India	Finance
Dr. Reddy's Laboratories Ltd.	Healthcare
Lupin Ltd.	Healthcare
Reliance Infrastructure Ltd.	Power
Tata Power Ltd.	Power
Ambuja Cements Ltd.	Housing related
Tata Steel Ltd.	Metal
Larsen & Toubro Ltd.	Capital goods
Tata Motors Ltd.	Transport equipment
GlaxoSmithKline Pharma Ltd.	Healthcare
Hindustan Unilever Ltd.	FMCG
Sterlite Industries Ltd.	Metal
Sun Pharma Industries Ltd.	Healthcare
GAIL Ltd.	Oil & gas
ICICI Bank Ltd.	Finance
NTPC Ltd.	Power
DLF Ltd.	Housing related

### 2. Green Blue Chip Stocks Portfolio

Company	Industry
HDFC Ltd.	Finance
Cipla Ltd.	Healthcare
Bharat Heavy Electricals Ltd.	Capital goods
State Bank Of India	Finance
Tata Power Ltd.	Power
Tata Steel Ltd.	Metal
Larsen & Toubro Ltd.	Capital goods
Tata Motors Ltd.	Transport equipment
Hindustan Unilever Ltd.	FMCG
Sterlite Industries Ltd.	Metal
Sun Pharma Industries Ltd.	Healthcare
GAIL Ltd.	Oil & gas
ICICI Bank Ltd.	Finance
NTPC Ltd.	Power
DLF Ltd.	Housing related

### 3. Green Non Blue Chip Stocks Portfolio

Company	Industry
Dr. Reddy's Laboratories Ltd.	Healthcare
Lupin Ltd.	Healthcare
Reliance Infrastructure Ltd.	Power
Ambuja Cements Ltd.	Housing related
GlaxoSmithKline Pharma Ltd.	Healthcare

#### 4. Mimicking Portfolio

Company	Industry
Bajaj Auto Finance Ltd.	Finance
Ranbaxy Ltd.	Healthcare
Havell India	Capital Goods
Punjab National Bank	Finance
Orchid Chemical	Healthcare
Fortis Health	Healthcare
GMR Infra	Power
Suzlon Energy	Power
J.K. Cements Ltd.	Housing Related
Jindal Steel	Metal
BEML	Capital Goods
Maruti	Transport Equipment
Aurobindo Pharma Ltd.	Healthcare
Nestle Ltd.	FMCG
Hindalco Ltd.	Metal
Piramal Health	Healthcare
Indian Oil Corporation	Oil & Gas
Yes Bank	Finance
Crompton Greave	Power
Parsvnath Ltd.	Housing Related

#### 5. Blue Chip Stocks Portfolio

Company	Industry
HDFC Ltd.	Finance
Cipla Ltd.	Healthcare
Bharat Heavy Electricals ltd.	Capital goods
State Bank Of India	Finance
HDFC Bank Ltd.	Finance
Hero Motocorp Ltd.	Transport Equipment
Infosys Ltd.	Information technology
Oil & Natural Gas Corp. Ltd.	Oil & gas
Reliance Industries Ltd.	Oil & gas
Tata Power co. Ltd.	Power
Hindalco Industries Ltd.	Metal
Tata steel ltd.	Metal
Larsen & Toubro Ltd.	Capital goods
Mahindra & Mahindra Ltd.	Transport Equipment
Tata Motors Ltd.	Transport Equipment
Hindustan Unilever Ltd.	FMCG
ITC Ltd.	FMCG
Sterlite Industries Ltd.	Metal
Wipro Ltd.	Information technology
Sun Pharma Industries Ltd.	Healthcare
GAIL Ltd.	Oil & gas
ICICI Bank Ltd.	Finance
Jindal Steel & Power Ltd.	Metal
Bharti Airtel Ltd.	Telecom
Maruti Suzuki India Ltd.	Transport Equipment
Tata Consultancy Services Ltd.	Information technology
NTPC Ltd.	Power
DLF Ltd.	Housing related
Bajaj Auto Ltd.	Transport Equipments
Coal India Ltd.	Metal & mining

## **6. Blue Chip Non Green Stocks Portfolio**

<b>Company</b>	<b>Industry</b>
HDFC Bank Ltd.	Finance
Hero Motocorp Ltd.	Transport Equipments
Infosys Ltd.	Information technology
Oil & Natural Gas Corp. Ltd.	Oil & gas
Reliance Industries Ltd.	Oil & gas
Hindalco Industries Ltd.	Metal
Mahindra & Mahindra Ltd.	Transport Equipments
ITC Ltd.	FMCG
Wipro Ltd.	Information technology
Jindal Steel & Power Ltd.	Metal
Bharti Airtel Ltd.	Telecom
Maruti Suzuki India Ltd.	Transport Equipments
Tata Consultancy Services Ltd.	Information technology
Bajaj Auto Ltd.	Transport Equipments
Coal India Ltd.	Metal & mining