Indian Stock Market Movements and Responsiveness of Sustainability Indices: A Risk Adjusted Analysis

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[Abstract] Measuring and managing climate change impact, the concept of carbon accounting and green investing has grabbed attention all over the world nowadays. The climate change impact and green performance of companies is measured and reflected as sustainability indices constructed by stock exchanges around the world. In India, BSE introduced two sustainability indices in 2010 as BSE Carbonex and BSE Greenex for measuring the climate change risk, carbon emissions performance, and promotion of energy efficient practices. The present study attempts to explore the behavior of sustainability indices to market indices. The study examines the movement of BSE Carbonex and BSE Greenex performance in respect to market indices (Sensex & BSE 500) from September 2010 to June, 2019. The performance is evaluated and tested by using the mean of the monthly return and through risk adjusted measures, i.e. Sharpe's ratio, Treynor's ratio, and Jensen's alpha. The study finds that the Carbonex index performance is similar to the BSE Sensex and BSE 500. Greenex index performance is slightly lower than both BSE Sensex and BSE 500. The study suggests that sustainability indices can be used by investors as better performing indices to satisfy the urge of green investment.

[Keywords] stock market, market movement, sustainability indices, Carbonex, Greenex, carbon emissions, indices performance, risk adjusted measures, green investment, India

Introduction

In the past few decades, concern about the environment and its governance has been increased to a huge level all over the world. The performance of companies is governed by various environmental factors like toxic release, usage of environmental resources, measures adopted to curb destruction of environment, etc. Corporations are governed by societal factors, as well, like its health norms towards workers and society. Sustainability has become a buzz word in the corporate world, and almost every company has started to build its sustainable image in society for long-term survival.

Stock exchanges and evolving market structures both contributes to economic growth and development. Stock exchanges play a very significant role in the development of sustainable indices through which investors can shift their investments from dirty companies to green companies. The engagement approach focuses on undertaking green investment by establishing favorable practices on the environment and sustainability. Per the World Economic Forum Report (2005), "Responsible investing is most commonly understood to mean investing in a manner that takes into account the impact of investments on wider society and the natural environment in sustainable way." Socially responsible investing includes investment in fewer toxic-producing firms, engagement in environmentally sustainable firms, and investment in clean technologies.

BSE introduced two sustainability indices. First, BSE Greenex was launched by BSE for measuring carbon emission performance and promoting energy efficient practices in large companies. Second, for measuring the climate change risk, opportunities and companies' ability to reduce carbon emissions, BSE Carbonex was launched in 2010. "Indian stock market developed tremendously from every aspect such as market capitalization, volumes, investors and indices as well" (Singh, P., 2014). The presence of sustainability indices provides investors broad support for investing in green companies and, moreover, helps the government to measure the sentiments of investors on sustainable policies.

The present study examines the behavior of two sustainability indices, Carbonex and Greenex, in comparison with two market indices, BSE 500 & Sensex. Using monthly data on Carbonex, Greenex, and market indices for the period September 2010 to June 2019, the present study attempts to analyze the performance of sustainability indices by using mean monthly returns and risk adjusted measures. The present study discusses the background and literature review on socially responsible investing and the relationship of green investing and traditional investing. The study concludes that investing in green indices can expect similar benefits as investing in non-green companies' indices, so investing in Carbonex and Greenex might be the better choice to satisfy an investor's urge.

Literature Review

Initially, the studies have explored different aspects of socially responsible investing. Rangotra Rahul (2016) compared socially responsible investing with traditional investments and found that there is no difference between the two investments, but there is one exception index (energy index) whose risk is significantly higher than the others. Giannarakis et al. (2016) examined 102 companies and saw the effects of environmental performance on disclosure of company's environmental score and found that a positive relationship exists between the performance and disclosure scores on the environment. Maji and Mondal (2015) analyzed that more than 50% of green companies under-performed and found that investment decisions of companies are not affected by its eco-friendly decisions.

Later on, a number of research studies have tried to find the relationship of green investing with traditional investing and financial performance. Some studies found that there is a positive significant return when sustainable firms get compared with other firms in terms of return and risk (Chan & Walter, 2014; Bensen et al., 2010; Lesser et al., 2014). The studies (Chang et al., 2012; Climent & Soriano, 2011; Silva & Cortez, 2016) found that green indices under-performed when compared to market indices.

However, there are also some studies which resulted in a neutral effect, and investors gets similar returns whether they invest in green indices or market indices. Results argued that if green investing would increase returns, then it would increase risk as well (Mallet & Michelson, 2014; Dixon, 2010). The details of the study are given in Table 1.

Table 1

Studies on Sustainable & Green Investing

Impact	Author	Method	Period	Country	Results
Positive Effects	Chan & Walter (2014)	See effect of socially responsible investment on stock returns, initial public offerings and seasoned equity offerings	1990-2012	Australia	Environmentally friendly firms have positive significant return and IPOs & SEOs underperformed.
	Bensen et al. (2010)	Analyzed and compared the financial performance of sustainable firms with typical firms and moreover, compared the possible risk differential.	1999-2009	France	Sustainable firms have lower risk and higher returns than other comparable firms. And they provide stable long term growth in returns.
	Lesser et al. (2014)	Find green equities relationship with Socially Responsible Investments in terms of financial performance and firm's features.	2003-2012	Germany	Green equities perform better during 2003-2007 and underperform during 2008-2012.
Negative Effects	Chang et al. (2012)	Financial performance comparison of green mutual funds and traditional mutual funds.	1996-2012	USA	Showed that green mutual funds have lower return than traditional mutual funds, while the risk is similar in both.
	Climent & Soriano (2011)	Performance and risk of green mutual funds with others and relative performance to socially responsible investment.	1987-2009	USA	Environmental mutual funds underperformed as compared to others and there is no significant difference between returns of green mutual funds and socially responsible investment.
	Silva & Cortez (2016)	Analyzed the performance of US mutual funds and Europe green mutual funds by using conditional model.	1996-2014	USA & Europe	Green funds underperform during non- crisis period and well performed during crisis period, especially Europe.
Neutral Effect	Mallett & Michelson (2014)	Compared the performance of green funds, sustainable investment funds and Index funds using parametric and non-parametric tests.	1998-2008	USA	Using parametric and non-parametric tests, there is neither performance difference between socially responsible funds & green funds nor with index funds.
	Dixon (2010)	Sustainability investing performance analysis in terms of risk and return	2010	USA	Sustainability investing improved returns but it also increases risk also for investors.

Source: Review of previous studies

Research Gap

After reviewing previous studies, it can be said that there are mixed results on sustainable and green investing all over the world. This study focuses on sustainability indices launched by BSE and studies the behavior of sustainability indices (BSE Carbonex & BSE Greenex) with respect to market indices (Sensex and BSE 500); it also attempts to find out whether investing in sustainability indices generates better returns than investing in other market indices, and it evaluates risk measures of these indices.

Objectives of the Study

The study is conducted to evaluate the performance of selected sustainability indices. The objectives of the present study are 1) to analyze the behavior of S&P BSE Carbonex index in respect to return and risk in association with market indices; 2) to analyze the behavior of the S&P BSE Greenex index in respect to return and risk in association with market indices.

Hypothesis

To examine the behaviour of two sustainability indices, the following two null hypotheses have been formulated: **$H_0$1**: Performance of the S&P BSE Carbonex Index is the same as the S&P BSE 500 and S&P BSE Sensex. **$H_0$2:** Performance of the S&P BSE Greenex Index is the same as the S&P BSE 500 and the S&P BSE Sensex.

Significance of the Study

Stock indices are barometers that show the investing patterns of a country's investors, and they also reveal the potential for economic wealth. This study evaluated the performance of selected sustainability indices from many dimensions. Moreover, performance evaluation of sustainability indices (BSE Carbonex and BSE Greenex) may give significant information to investors and other stakeholders in investment funds and to policy makers in mapping paths for a sustainable future. The present study helps to provide valuable insights to researchers, stakeholders, and the government.

Research Methodology

The sustainability indices selected for the study are the S&P BSE Carbonex and Greenex for the period September 2010 to June 2019. The performance of the two indices is compared by using mean monthly returns and, moreover, the adjusted risk measures, i.e. Sharpe's ratio, Treynor's ratio, and Jensen's alpha. Returns of the indices are calculated as [Pt-(Pt-1)]/ Pt-1. The data from Carbonex and Greenex is sourced from the BSE website, and the 91-day Treasury bill rate over the study period has been taken as the risk free rate. Returns of the sustainability indices and market indices are tested for significance using two-tailed t-tests for both Carbonex and Greenex to verify whether the mean returns of sustainability indices are similar to market indices or not. Risk-adjusted performances are checked by using Sharpe's ratio, Treynor's ratio, and Jensen's alpha.

Sharpe's Ratio: It considers standard deviation as the measure of total risk while adjusting to excess returns over the risk free rate. The greater the ratio, the better it is.

Sharpe's ratio = Portfolio return- risk free rate/ standard deviation of portfolio returns

Treynor's Ratio: It considers only systematic risk, which is non-diversifiable, while adjusting to

excess return over the risk- free rate.

Treynor's ratio = Portfolio return- risk free rate/ Beta of portfolio returns

Jensen's Alpha: It indicates the excess return from a portfolio rather than the return predicted from the capital asset pricing model.

Jensen's alpha = Portfolio return – CAPM return

CAPM = Risk free rate + Beta of portfolio returns (market returns – risk free rate)

The capital asset pricing model was developed by William Sharpe; it indicates the required rate of return by considering systematic risk.

Results and Analysis

Results of the study are shown in Tables 2, 3, and 4. Table 3 indicates the degree of connection between the behaviour of the sustainability indices, i.e. Carbonex and Greenex, and market indices. i.e. S and P BSE 500 and Sand P BSE Sensex. It shows that Carbonex has nearly perfect correlation with BSE 500 and Sensex during the study period. It is statistically significant at 1% significance level. The table shows that Greenex, also, has a high degree of positive correlation with BSE 500 and Sensex during the study period. It is also statistically significant at the 1% significance level. Both the sustainability indices have slightly higher degrees of relationship with the broader index, BSE 500, than to Sensex. It can be seen in the table that Carbonex has a higher degree of correlation with market indices (BSE 500 and Sensex) than Greenex. Thus, it can be said that volatility in one index can be used to outline the movement in another index. Moreover, Greenex has a slightly less degree of correlation coefficients with market indices when compared with Carbonex.

Table 2
Correlations between Sustainability Indices and Market Indices

		Carbonex	Greenex	BSE 500	Sensex
Carbonex	Pearson Correlation	1	.964**	**.992****	**.987****
	Sig. (2-tailed)	-	.000	.000	.000
	N	105	105	105	105
Greenex	Pearson Correlation	.964**	1	**.960****	**.952****
	Sig. (2-tailed)	.000	-	.000	.000
	N	105	105	105	105
BSE 500	Pearson Correlation	**.992****	**.960****	1	.967**
	Sig. (2-tailed)	.000	.000	-	.000
	N	105	105	105	105
Sensex	Pearson Correlation	**.987****	**.952****	.967**	1
	Sig. (2-tailed)	.000	.000	.000	-
	N	105	105	105	105

Source: BSE India Ltd. ** Significance level at 0.01 (2-tailed)

Figure 1 and Figure 2 depict the clear trend of the sustainability index, Carbonex, and the two market indices, i.e. BSE 500 and Sensex. It shows that the trend of Carbonex returns in the last 9 years has a high degree of similarity with the returns of the market indices BSE 500 and Sensex.

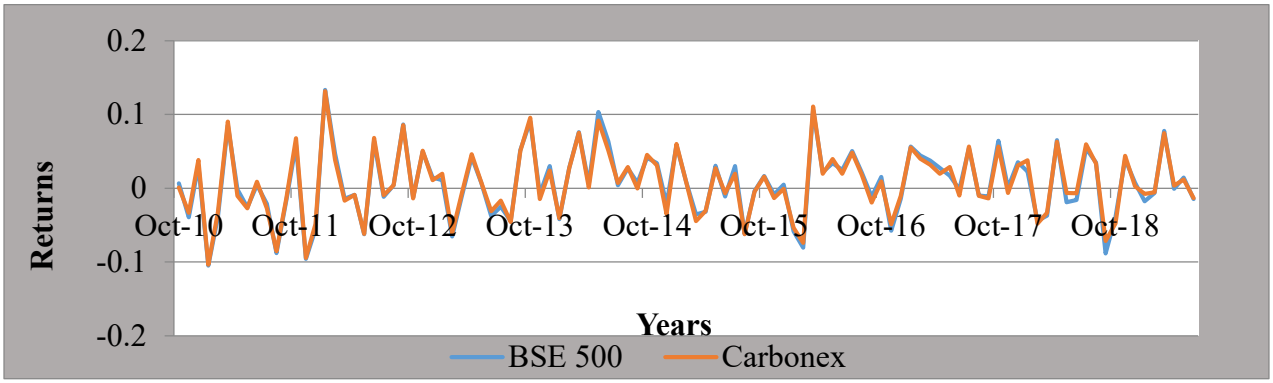

Figure 1. Trend of BSE 500 and Carbonex

Sources: Calculated from the data BSE India Ltd.

It has been observed that 56 times Carbonex shows positive returns in last 105 months (September 2010 to June 2019) and BSE 500 and Sensex have 58 and 56 times, respectively, which shows that there is consistency between the returns of the Carbonex index and the BSE 500 and Sensex indexes. Thus, it is suggested that investors should invest in sustainability indices to meet the urge of investing in clean companies for a sustainable future.

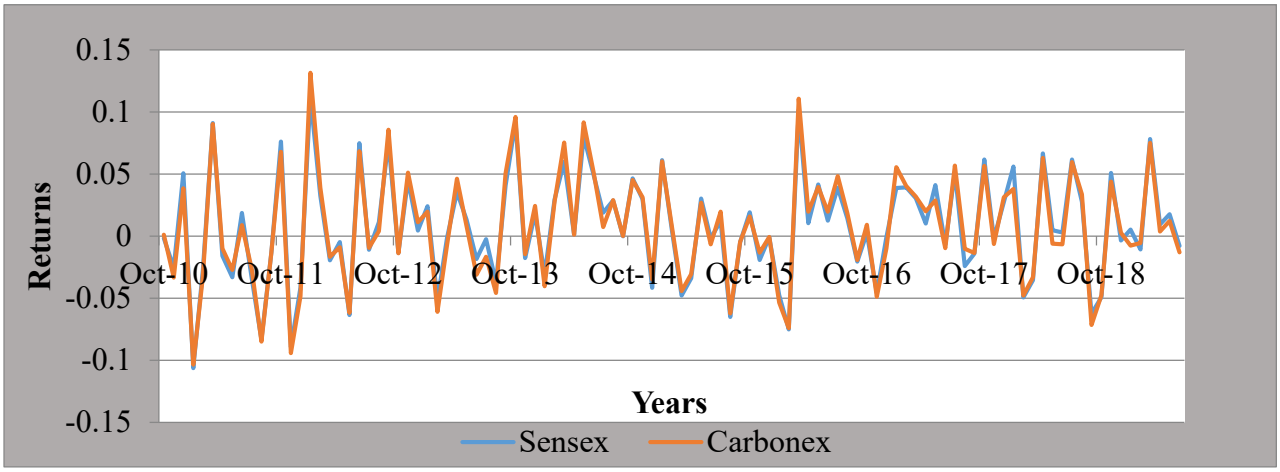

Figure: 2 Trend of Sensex and Carbonex

Sources: Calculated from the data BSE India Ltd.

Figure 3 and Figure 4 depict the clear picture of movements of sustainability index Greenex and the two market indices BSE 500 and Sensex. It shows that the trend of Greenex returns in last 9 years has a high degree of similarity with the returns of market indices BSE 500 and Sensex. It has been observed that 55 times Greenex shows positive returns in the last 105 months, and BSE 500 and Sensex have 58 and 56

times, respectively, which shows that there is consistency between the returns of the Greenex index and BSE 500 and Sensex.

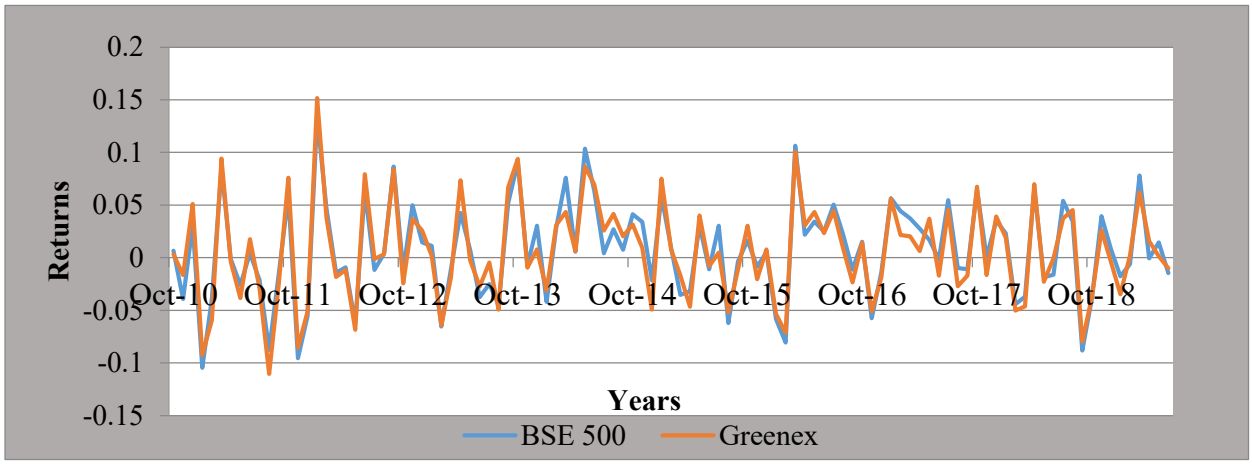

Figure 3. Trend of BSE 500 and Greenex

Sources: Calculated from the data BSE India Ltd.

Thus, we can say that the returns of Greenex are highly similar to the market indices, and investors can think of investing in green a company's index rather than making investments in a dirty company's index.

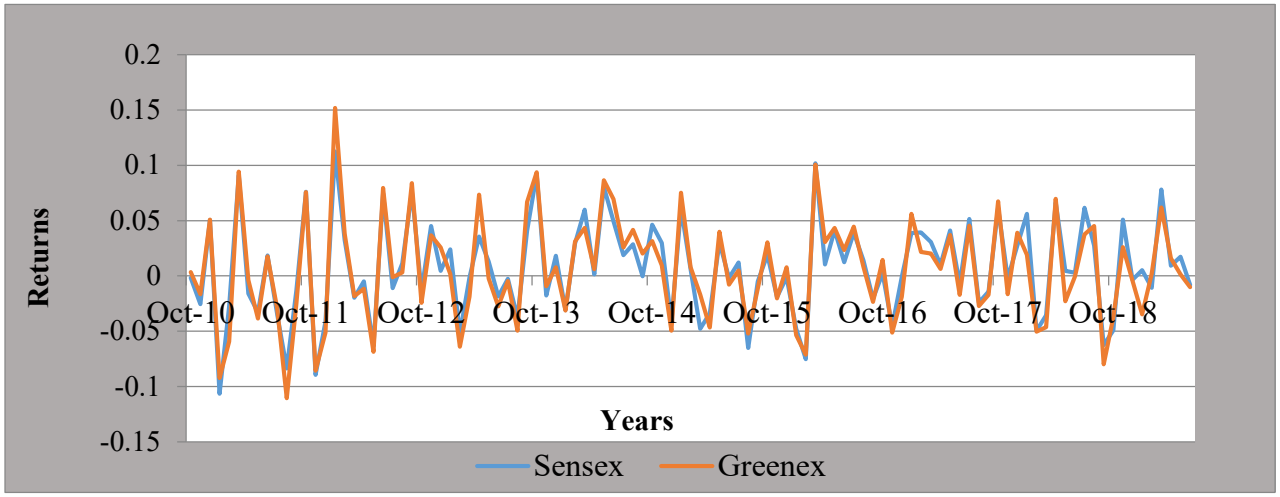

Figure 4. Trend of Sensex and Greenex

Sources: Calculated from the data BSE India Ltd.

When we compare sustainability indices, we can say that the Carbonex index performance is slightly better than the Greenex index. The peak of the Carbonex index slightly matches better with market indices when it is compared with the Greenex index. Moreover, volatility in Greenex returns is higher than in Carbonex returns.

Table 3 indicates that the mean monthly returns of Greenex are lower than Carbonex, BSE 500 and Sensex; also, the standard deviation is higher than the other indices. The means of the returns were tested for difference by using t-test. The Carbonex and Greenex indices were tested for difference with market indices. It was found that the p-value is 0.993 between Carbonex and BSE 500 and 0.986 between Carbonex and Sensex, so we can say that there is strong evidence that the means of Carbonex and the market indices are nearly equal. The P- Value between Greenex and BSE 500 is 0.862 and 0.842 between Greenex and Sensex, which is higher than 0.05 (significance level). It indicates that there is no statistical difference between the means of Greenex and the market indices.

Table 3

Mean Monthly Returns and Standard Deviation of Indices

	Carbonex	**Greenex**	**Sensex**	**BSE 500**
Mean monthly returns	0.7285%	0.6126%	0.7373%	0.7246%
Standard Deviation	4.5000%	4.7011%	4.3422%	4.5894%

Sources: Calculated from the data BSE India Ltd.

There are risk-adjusted measures of Carbonex, Greenex, Sensex, and BSE 500. As per Sharpe's ratio, the Carbonex index slightly outperformed the BSE Sensex and is approximately the same as the BSE 500 (Table 4). The Greenex index performed better than Sensex but not the BSE 500. As per Treynor's ratio, the Carbonex index performed better than Sensex and slightly lower than the BSE 500. Similarly, Greenex performed better than Sensex but was marginally lower than the BSE 500. As per Jensen's alpha, both Greenex and Carbonex outperform the two market indices.

Table 4

Sharpe's Ratio, Treynor's Ratio & Jensen's AlphaoOf Indices

	Carbonex	**Greenex**	**Sensex**	**BSE500**
Sharpe's ratio	-0.38891	-0.39695	-0.40104	-0.38222
Treynor's ratio	-0.01800	-0.01898	-0.01903	-0.01716
Jensen Alpha	-0.00048	-0.00032	-0.00148	-0.00685

Sources: Calculated from the data BSE India Ltd.

So, overall, on a risk adjusted basis, the Carbonex index performance is slightly better than the Greenex index performance. Moreover, Carbonex has better performance than Greenex, as well as Sensex and the broad-based index BSE 500. Hence, there is no improvement in on investing in green stocks. So, the investors should think of investing in green companies' stock rather than dirty companies' stock to obtain better returns at lower risk.

Conclusion

The present study has examined the performance of the sustainability indices Carbonex and Greenex and has analyzed the risk and return of these two sustainability indices in comparison with the market indices BSE 500 and Sensex. Carbonex shows a slightly higher return than Greenex when these are compared to the two market indices. The results of the study show that there is no significant difference between the performance of sustainability indices and market indices. Mean monthly returns of sustainability indices are not found significantly different from market indices. Moreover, by using risk adjusted measures, it has been found that Carbonex outperforms both market indices, and Greenex outperforms Sensex but is slightly lower than the BSE 500.

The results of the study show that the performances of Carbonex and Greenex are very close to the performances of the BSE 500 and Sensex. The insignificant difference in performance of the indices are good incentives to invest in a sustainable index. It means, investors can invest in sustainable stocks for getting good returns at lower risk. Moreover, investors can satisfy their urge to invest in green companies for a better and sustainable future without sacrificing returns. Along with getting good returns by investing in sustainable indices, investors would help the world in building a sustainable future.

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Appendix

List of Companies Included in S&P BSE Carbonex Index

Yes Bank	ONGC	Hindalco	Tata Power	ICICI Bank
Reliance Infra.	Bank of Baroda	Container Corp.	LIC Housing Fin.	Indusland Bank
M & M Financials	Maruti Suzuki	Exide Ind.	Bajaj Finserv	Reliance
SAIL	M & M	Power Finance	Kotak Mahindra	Ashok Leyland
Rel. Capital	Coal India	Bosch	Dabur India	HDFC Bank
Tata Steel	REC	Piramal Enter	Siemens	Divis Labs
Vedanta	JSW Steel	Adani Ports	MRF	Axis Bank
Motherson Sumi	NTPC	GAIL	ABB India	Canara Bank
Indiabulls Hsg	HUL	PNB	Bajaj Finance	Dr. Reddy Labs
NMDC	IOC	United Brewerie	UPL	Larsen
BHEL	IDFC	Godrej Consumers	Hero Motocorp.	Sun Pharma
Tata Motors	Shriram Trans	Grasim	Bharti Airtel	SBI
ACC	Titan Company	Ultratech Cement	ITC	Lupin
Bharat Forge	Cummins	TCS	Petronet LNG	Wipro
Power Grid Corp.	Shree Cements	Britannia	Asian Paints	Ambuja Cements
Zee Entertain				

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Reliance Infra	M & M	ICICI Bank	UPL	SBI
NMDC	GAIL	Lupin	Sun Pharma	Cipla
Tata Motors	Kotak Mahindra	Larsen	Dr. Reddy Labs	Power Grid Corp.
Maruti Suzuki	Hindalco	Bharti Airtel	ITC	TCS