ISSN No. 2454 - 1427

CDE
December 2019

ENVIRONMENTAL PERFORMANCE AND CAPITAL MARKETS: EVIDENCE FROM INDIA

Shreekant Gupta
Email: sgupta@econdse.org
Department of Economics
Delhi School of Economics

Bishwanath Goldar
Institute of Economic Growth

Shubham Dang
SCOPT Analytics

Working Paper No. 303

http://econdse.org/wp-content/uploads/2020/02/work303.pdf

CENTRE FOR DEVELOPMENT ECONOMICS
DELHI SCHOOL OF ECONOMICS
DELHI 110007

ENVIRONMENTAL PERFORMANCE AND CAPITAL MARKETS: EVIDENCE FROM INDIA

Shreekant Gupta[*] Bishwanath Goldar[†] Shubham Dang[‡]

Abstract

This paper examines whether capital markets in developing countries respond to news about environmental performance of firms thereby creating incentive for pollution control. In particular we conduct an event study of firms in three polluting industries in India (paper and pulp, cement and iron and steel) that were rated under the Green Rating Project. Along lines of earlier research we find the stock market generally penalizes weak environmental performance among firms. Interestingly, paper and pulp firms that were being rated for a second time and did strictly worse relative to their previous performance experienced significant negative returns. In terms of methodology, the paper controls for event day clustering by using the KP-statistic instead of the commonly used Z or BMP-statistic. We show when KP statistic is used, the negative impact of poor environmental performance on the stock returns is not as pronounced as the standard Z or BMP statistic would lead one to believe.

Keywords: Environmental performance, green rating, capital market, event study

JEL classification: G14, Q53, G32

Acknowledgment: We would like to thank Centre for Science and Environment, especially Priyavrat Bhati and Chandra Bhushan for help in understanding the environmental ratings and answering numerous queries. All remaining errors are our own.

* Corresponding author. Department of Economics, Delhi School of Economics, University of Delhi, Delhi 110007. sgupta@econdse.org

† c/o Institute of Economic Growth, University Enclave, Delhi 110007. b_goldar77@yahoo.com

‡ SCOPT Analytics, 91 Springboard Complex, Koramangla, Bangalore 560095. dangshubham02@gmail.com

ENVIRONMENTAL PERFORMANCE AND CAPITAL MARKETS: EVIDENCE FROM INDIA

1. Introduction

In recent decades Asian economies have shown impressive rates of growth. In addition to China, India is now one of the fastest growing major economies in the world with countries such as Vietnam following suit. At the same time, the environmental and health impact of this growth are of concern. For instance, of 3.7 million deaths due to outdoor air pollution worldwide 2.6 million were in developing Asia (Lim et al. 2012).[1] Inter alia, weak governance, limited institutional capacity and resources hinder effective environmental management by the state. In this context, alternatives to formal regulation have been found useful such as informal regulation through environmental disclosure and community participation (see Blackman and Bannister 1998, Pargal and Wheeler 1999, Afsah et al. 1996, Kathuria 2007).[2] For firms in the formal sector, another channel can be through financial markets. There is now an extensive literature on the relationship between corporate environmental performance (CEP) and corporate financial performance (CFP) which in effect argues that it "pays to be green".[3] An important and growing subset of this literature uses event studies to examine the impact of CEP-related events on stock markets.[4] The intellectual underpinning of event studies goes back to the efficient market hypothesis, according to which at any given time asset prices fully reflect all available information (Fama 1991). Thus, new information (good or bad) about the environmental performance of a firm may cause abnormal changes in its stock price, if this information diverges from the investors' expectations about such performance and is perceived by them to affect the profitability of the firm. As discussed in Endrikat (2016) event studies are well suited to assess the CEP-CFP

[1] The major environmental problems confronting Asia are (i) air pollution (particularly high levels of particulate matter in cities); (ii) reduced availability and quality of freshwater supplies; (iii) desertification, deforestation, and other forms of land degradation; (iv) dust and haze; (v) acid rain; (vi) greenhouse gas (GHG) emissions; (vii) loss of biodiversity; and (viii) the degradation of marine and coastal resources (UNEP 2003).

[2] Blackman REEP provides a review.

[3] We distinguish this from the so-called Porter hypothesis, namely, well-designed environmental regulation can actually enhance competitiveness of firms through exploiting win-win opportunities (see Ambec et al. 2013 for a recent discussion). In our case it is the markets that can in principle provide an incentive to be green by rewarding environmentally friendly behaviour.

[4] Event studies are one of three empirical approaches for examining CEP-CFP relationships, others being (1) comparing the financial performance of firms with high and low CEP, and (2) regression analysis of financial performance with CEP as an explanatory variable (see Albertini 2013, Dixon-Fowler et al. 2013 and Endrikat 2016 for meta analyses of these two approaches).

link especially because they do not suffer from endogeneity and "are quite unambiguous with regard to the causal direction of the relationship" (op. cit. p. 536). There is a large and growing number of environmental event studies.[5] The literature on developing countries, however, is sparse – of 32 such studies included in the previously cited meta-analysis, the majority are for US firms and only 3 are for developing economies (Endrikat 2016, Table 1).[6] We return to this point below.

A general finding of this literature is a positive and causal impact of CEP on CFP. In other words, CEP-related events alter the market's valuation of firms' future profits and cash flow in effect validating the efficient market hypothesis. To elaborate, there is a positive market reaction to positive CEP-related events and vice versa (Endrikat 2016). Further, the response of markets is asymmetric with stronger reactions to negative environmental information than to positive environmental information. It is interesting to note these finding hold across geographies including developing countries.[7] For instance, in the case of India, Gupta and Goldar (2005) examine the impact of environmental rating of large pulp and paper, auto, and chlor alkali firms on their stock prices and found that poor ratings led to negative abnormal returns of up to 30%. A positive correlation was found between abnormal returns to a firm's stock and the level of its environmental performance.

2. Literature Review

Market response to environmental performance of various firms (in isolation) and industries (as a segment) has been a popular area of study in the recent past. The result of these studies has been mixed and show huge variability across geographies and justifiably depends on the degree of free flow of information. These include Powers et al (2011), Blackman (2010), Capelle et al. (2010) and Jacobs et al. (2010).

In particular, Takeda, et al. (2007) measure the stock price reaction to release of environmental management ranking using the standard methodology of measuring cumulative abnormal return (CAR). Evaluated over 1998-2005 the paper concludes that markets took the ratings seriously only after proactive government policies in 2001-2002 manifested the government's desire to clamp down on environmentally irresponsible

[5] The earliest known environmental event study dates back to Shane and Spicer (1983). A recent meta-analysis (Endrikat 2016) compiles 32 of these. But several more have appeared since or were not included in his analysis, e.g., Brouwers et al. (2016), Lyon and Shimshack (2015), and Oberndorfer et al. (2013).

[6] Dasgupta et al. (2001) look at Argentina, Chile, Mexico, Gupta and Goldar (2005) use data on Indian firms and Xu et al. (2012) is for Chinese firms. In addition to these studies included in the meta-analysis there are 4 more recent studies for developing countries, namely, Lyon et al. (2013), Kong et al. (2014) and Lam et al. (2016) all for China and Sarumpaet et al. (2017) for Indonesia.

[7] For instance in the case of India, Gupta and Goldar (2005) examine the impact of environmental rating of large pulp and paper, auto, and chlor alkali firms on their stock prices and found that poor ratings led to negative abnormal returns of up to 30%. A positive correlation was found between abnormal returns to a firm's stock and the level of its environmental performance.

behavior. Similarly, the 2011 paper by Ziegler et al. demonstrates that buying stocks of corporations disclosing responses to climate change and selling stocks of corporations with no disclosures has become more worthwhile over time in Europe. However, another 2011 study by Xu et al. using the same standard methodology of CAR, makes the case that average reduction in market value is lower than the estimated changes in market value given the disclosure of environmental violation events, compared to similar events in other countries.

For the case of India, Kathuria (2006) shows the press can function as an informal regulator provided there is a sustained interest in news about pollution. Powers et al. (2011) refer to the same environmental rating and use a portion of the same data used by Gupta and Goldar (2005) and evaluate the performance of paper and pulp plants based on two successive ratings, in 1999 and 2004, respectively. They find significant improvement for dirty plants but not for the cleaner ones.

Since this paper builds on Gupta and Goldar (2005), albeit with a different methodology, it would be worthwhile to recount their results. Gupta and Goldar 2005, based on the data collected from the Green Rating Project (GRP) of the Centre for Science and Environment (CSE) deduce that stock markets do react to environmentally damaging news and punish the poor performing companies; however there is no reward for performing well and the stock price shows no significant up movement. This study was done for three sectors namely: automobile, paper and pulp, and chlor alkali. Our current study expands the scope and considers fresh data for two industries, namely cement and steel, and applies a modified methodology. Also, we carry out an analysis of paper and pulp firms using data on green rating in two rounds, 1999 which was used in Gupta and Goldar (2005) and 2004 which is brought into use in this study. An interesting issue we examine is the change in green rating of paper and pulp firms between 1999 and 2004 and how this change in green rating has impacted the share prices of the firms as revealed by the CAR following the announcement of the second rating. This analysis is in some ways connected with the study by Powers et al mentioned above.

Most studies measuring market's response to information disclosure, including Gupta and Goldar (2005), tend to ignore the issue of cross sectional correlation which is particularly pertinent in case of event date clustering. Kolari and Pynnonen (KP) (2010) find even relatively low cross-correlation among abnormal returns is serious in terms of over-rejecting the null hypothesis of zero average abnormal returns. They go on to propose a modification over the t-statistic of Boehmer, Musumeci and Poulsen (BMP) (1991) to account and control for cross correlation. The financial literature has been quick to acknowledge and build on the contribution of KP (Petrella et al. 2013, Michaelides et al. 2012 and Amici et al. 2013). These papers have utilized the event study approach as suggested by KP to understand the impact of noteworthy events, regulatory and otherwise, on the stock prices of multiple banks and private organizations.

However, to the best of our knowledge, ours is the first paper to account for event induced variance and cross sectional correlation amongst the abnormal return in an environmental context.

Another novelty of our analysis, as pointed out earlier, is that for firms belonging to one industry, namely paper and pulp, we consider how the change in green rating between two rounds impacted the firms' share prices. This is different from the analysis presented in Gupta and Goldar (2005) and the analysis presented for Cement and Steel industry since it tries to assess the impact of the additional information brought forth by the second green rating after a gap of five years. To our knowledge, this is perhaps the first study in which the impact of change in green rating has been analyzed.

3. Green Rating Project and Environmental Performance Measurement

In a nutshell, this paper is a short horizon event study which measures the impact of environment ratings of various industrial units on the stock prices of the parent firms for the intersection of those firms which are listed on the Bombay Stock Exchange. The environment ratings or "Green Rating Project" is a pet project for the Centre of Science and Environment, a New Delhi based non-profit public interest research and advocacy organization which has emerged as a leading advocacy group and lobbies for a development model that is environment friendly.

The 'Green Rating Project' rates industrial units/plants on their environment friendliness and awards them an environmental score and 'Green Leaves' based on their performance. The environment score is a continuous variable that varies between a minimum of 0 to a maximum of 100. Based on this score the plants are awarded 'Green Leaves' which is a discrete integer having values between 0 and 5, where 5 leaf is the most desirable state to be in (from an environment perspective) and 0 leaf, least desirable.

Given CSE's profile and the media coverage of its activities, the dissemination of information (green ratings) is a given and our ex ante belief is that it should impact the stock prices of the companies rated by altering the investor behavior through the following three channels. Firstly, for many firms in capital intensive sector like 'Iron and Steel' etc. the realization of future projects is tied to investments from banks, international financial institutions and institutional investors many of whom often make sustainable environment footprint a prerequisite for future funding. Secondly, a bad environment score card of a majority of firms in a particular sector may make the entire sector more vulnerable to government scrutiny, harsher regulations, increased taxation and/or fines etc. which directly takes a toll on the company's balance sheet. Thirdly, poor environment performance of a company may also act as a signaling instrument which indicates the management's inability in balancing short-term conflicting objectives.

The third channel suggested above is not a causal link and thus any causal interpretation of our results is likely to be an over-estimate and should be taken with a pinch of salt.

We describe next how CSE arrives at an environment score card for various industrial plants across diverse sectors:

It is interesting to note that CSE rates plants against theoretical best practices. If the theoretical best practice exists for any indicator it gets 100% score while the global best practice gets 80%. Thus, even if a firm is adherent to global best practices, it may not get the highest possible score. At the same time, if regulatory standards exist, they are given a minimum score of 20%. In case the regulatory standards do not exist then the industry average is given a score of 20%. Such stringent requirements might partially explain why none of the plants/firms rated could manage 5 leaf award and across sectors only 1 plant in cement sector could manage a 4 leaf award.

The Rating process relies primarily on voluntary participation and disclosure of data by the firms. There were times when many plants either partially or wholly withheld information. For all such cases CSE would try and get data through secondary sources like the reports submitted to Central/State Pollution Control Board, other publicly available documents and even resort to 'Right To Information' (RTI) queries in case the firm in question was a public sector enterprise. Site inspection/survey of the plant was also done to judge the environment impact. Further, in order to take a holistic approach interaction with local communities, workers, NGOs, PCBs was part of the rating process. Despite these efforts if data for an indicator was unavailable it would get the lowest possible score.

The entire rating process is vetted by industry and academic/technical experts.

The production process for each plant was divided into various phases with each phase being assigned some predetermined weight. For example, the production process in cement and Iron and Steel industries was divided into the following three phases:

1.) Raw material sourcing
2.) Production and conversion
3.) Product use and disposal

These determine the boundary of rating.

It is perhaps very intuitive that the weights assigned to various stages and sub stages differ significantly across industries thus allowing for inherent characteristics and industry structure to take prominence while establishing its impact on the environment.

There were plants that had more than one process route to produce the final good. For example, for iron or steelmaking the final score for the iron making stage is based on weighted average of individual capacities. Thus, if a plant has both coal direct reduced iron (DRI) and blast furnace (BF) routes for iron making, then coal DRI process is assessed for 35 marks and BF route is also assessed for 35 marks. For the BF route, the assessment is again subdivided into coke oven (14 marks), sinter (9 marks) and blast furnace (12 marks). If the installed capacity of BF route is 2 million tons per annum (MTPA) and the coal DRI capacity is 1 MTPA, then the final score for iron making would be calculated as weighted average of individual capacities. Weights for various categories are given in Table 1.

Table 1: Weights assigned to various aspects of iron and steel

Process Stage	Weightage Assigned (%)
Production Phase	82.5
Safety And Environmental management System	7.5
Stakeholders' perception	10

Source: CSE website (https://www.cseindia.org/page/green-rating-project) and documents published by CSE

The production phase itself has been divided into subheadings (Table 2).

Table 2: Weights assigned to the production phase in iron and steel

Process Stage	Weightage Assigned (%)
Ironmaking Combined Stage	35
Steel Making	7.5
Raw Material handling and Storage pollution	6.0
Resource Use(water, energy, land, iron ore and Flux agents)	16.0
Overall Pollution	18.0
Total (Production Phase)	82.5

Source: CSE website (https://www.cseindia.org/page/green-rating-project) and documents published by CSE

Within this sub heading the iron making combined stage has been further divided into the following stages:

a.) Coke Ovens (14%)
b.) Iron Ore Agglomeration (9 %)
c.) Iron Making (12%)

Similarly, a comprehensive view of the activities was taken to rate the other sectors as well. The details/weights can be found in the Appendix-1.

4. Methodology

"Event study" is a well-established tool used to measure the impact of an economic event on the stock price of a firm. Given that stock prices reflect the net present value of the future cash flows and are a good indicator of the value of a firm, any fresh information which impacts the prospects of future cash flows or signals efficiency or the lack of it thereof is likely to affect an investor's expectation and in turn affect the return on investment from that stock. An event study is designed to measure this change in the return. An implicit assumption that we maintain throughout is that of an efficient market and a rational investor. For markets which are less than completely efficient (as might be argued for developing countries) the dissemination of information and investors reaction may take a little longer and we account for this by taking slightly longer event windows.

There are two aspects to any event study. Measuring the change in the stock return which can be attributed to the event and establishing its statistical significance. The event in the context of this paper is defined as the release of Green Rating. The impact of the event is measured by predicting the counterfactual i.e. what the returns might have been had the event not occurred and then taking the difference between the actual stock returns and the counterfactual predicted by the model. This is called the Abnormal Returns.

This paper is different from the earlier study done by Gupta and Goldar (2005) as it controls for three crucial assumptions that were implicitly made in the 2005 paper. We control for:

a.) forecasting error, as the counterfactual is an out-of-sample prediction
b.) event Induced variance
c.) cross correlation among abnormal return (this is of concern because of event date clustering)

Thus, we not only use the Z-statistic to establish significance but also use the BMP statistic (Boehmer et al 1991) and the KP statistic (Kolari-Pynnonen 2010).

4.1 The Market Model

We use the market model to predict the counterfactual returns. As discussed in MacKinlay (1997) and various other studies, assuming negligible changes in the short run in the market portfolio weights, there is a linear relationship between the returns of any stock and the returns of the market portfolio. Thus, for a given stock 'i' we have

$$R_{it} = \alpha_i + \beta_i R_{mt} + e_{it} \qquad \ldots (1)$$

Where

$$E(e_{it}) = 0, Var(e_{it}) = \sigma_{e_i}^2 \qquad \ldots (1.1)$$

We estimate this model for the estimation window period which we have taken to be 90 trading days. Let t=0 be the event day i.e. when the green ratings are made public. We estimate the market model for all the stocks in our sample in the estimation window using ordinary least squares (estimation window is defined from t = - 92 to t = - 3, both dates included]. Based on this estimate we predict the counterfactual that is an out of sample estimate of R_i from t = - 2 onwards. And define the abnormal return as the difference between the actual return and the out of sample prediction.

$$AR_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_i R_{mt} \qquad \ldots (2)$$

The event window could start from the day of the event i.e. t = 0 onwards and carry on for 2 to 10 days post the event. To control for market expectation of the release of information and any pre-emptive actions, as might be argued for the paper and pulp sector since this was the second time this sector was being rated with a majority of firms being rated both the times, we also consider cases where the event window has been taken from t = - 2 onwards.

Conditional on event window market returns, the AR will be jointly normally distributed with zero conditional mean and conditional variance given by $\sigma^2(R_{it})$ which asymptotically tends to $\sigma_{e_i}^2$ as sample size increases.

The AR is aggregated over time and across securities and a Z-statistic arrived at in the same fashion as in Gupta and Goldar (2005) or Campbell et al (1997). This is given by

$$Z = \frac{\text{CAAR } (T_1,T_2)}{(\text{var}(\text{CAAR } (T_1,T_2))^{1/2}} \sim N(0,1) \qquad \text{... (3)}$$

Where,

$$\text{CAAR}(T_1, T_2) = \frac{1}{N} \sum_{i=1}^{N} \text{CAR}_i(T_1, T_2) \qquad \text{... (4)}$$

And,

$$\text{CAR}_i(T_1, T_2) = \sum_{t=T_1}^{T_2} AR_{it} \qquad \text{... (5)}$$

The CAR_i defined above has a normal distribution $\text{CAR}_i(T_1, T_2) \sim N\ (0, \sigma_i^2(T_1, T_2))$ where $\sigma_i^2(T_1, T_2)$ is defined as

$$\sigma_i^2(T_1, T_2) = (T_2 - T_1 + 1)\sigma_{e_i}^2 \qquad \text{... (6)}$$

and T_1, T_2 are the beginning and end of event window respectively.

Thus, $Ts = T_2 - T_1 + 1$ is the length of the event window.

<u>4.2 BMP Statistic</u>

Patell (1977), however, argues that because AR is a function of out-of-sample prediction its variance cannot be taken as $\sigma_{e_i}^2$, and instead it is given by

$$\text{Cov}(AR_{is}, AR_{it}) = \begin{cases} 0\ ; s \neq t \\ \text{C}_{it}\sigma_{e_i}^2 \end{cases} \qquad \text{... (7)}$$

Where C_{it} (increase in variance due to prediction outside the estimation period) is

$$\text{C}_{it} = 1 + \frac{1}{T} + \frac{(R_{mt} - \bar{R}_m)^2}{\sum_{\tau=1}^{T}(R_{m\tau} - \bar{R}_m)^2} \qquad \text{... (8)}$$

T = number of days in estimation period and

$$\bar{R}_m = \frac{1}{T}\sum_{\tau=1}^{T} R_{m\tau} \qquad \text{... (9)}$$

Patell (1977), goes a step further and standardizes the Abnormal Return given by

$$SAR = \frac{AR_{it}}{\sigma_i \sqrt{C_{it}}} \sim N(0,1) \qquad \ldots (10)$$

In this equation, SAR stands for Standardized Abnormal Return.

This standardization is important as it accounts for heteroskedastic residuals and ensures that stocks with huge volatility do not dominate (Boehmer et al 1991).

As Brown Harlow and Tinic (1988, 1989) point out, an event may induce a temporary change in the variance independent of all else. Although the event study literature contains a few proposals to control for this, the Boehmer et al (1991) paper is by far the most authoritative take on this. Boehmer et al (1991) borrow from Patell (1977) and merge it with the ordinary cross-sectional method to build the following t- statistic:

$$BMP\ Statistic = \frac{\frac{1}{N} \sum_{i=1}^{N} SAR_{iE}}{\sqrt{\frac{1}{N(N-1)} \sum_{i=1}^{N} \left[SAR_{iE} - \sum_{i=1}^{N} \frac{SAR_{iE}}{N} \right]^2}} \qquad \ldots (11)$$

where $\mathrm{N} = \text{number of firms in sample}$

E is the event day or t=0

We report this BMP statistic in the analysis presented later in the paper.

4.3 KP Statistic

It should be noted, however, that the BMP statistic described above is still not flawless as their use of ordinary cross-sectional method assumes that Abnormal Return are uncorrelated across firms or simply put the cross-sectional correlation among Abnormal return of firms is zero. This is particularly noteworthy in the context of this paper as event date clustering is vulnerable to the problem of cross correlation and ends up over-rejecting the null hypothesis of zero average abnormal return when in fact it is true. This is so because the cross-sectional correlation causes understatement of the standard deviation and overstatement of the t-statistic. There have been attempts directed at dealing with this issue in the literature. For example, Jaffe (1974) suggest the portfolio method. The multivariate regression method with generalized least squares has also been suggested. But both these methods are either sub-optimal or have heavy data requirements and are susceptible to model misspecification. Kolari and Pynnonen (2010) tackles this and suggest an adjustment to the BMP (1991) Statistic. The innovation brought about by Kolari-Pynnonen is that they reduce the problem of cross-sectional correlation to a single number of mean correlation.

$$t_{KP} = t_{BMP}\sqrt{\frac{1-\bar{r}}{1+(N-1)\bar{r}}} \quad \ldots (12)$$

where $\bar{r}$ is the average of the sample cross correlations of the estimation period residuals.

Equ 11 and 12 above are for a single day. In order to aggregate them over the entire event window we define

$$CAR_i(T_1, T_2) = \sum_{t=T_1}^{T_2} AR_{it} \quad \ldots (13)$$

And then standardize this along the lines of Patell (1977), MacKinlay (1997), Harrington and Shrider (2007), Mentz and Schiereck (2008), and Amici et al (2013).

Thus, SAR over the event window from T_1 to T_2 is given by

$$SAR_i(T_1, T_2) = \frac{CAR_i(T_1, T_2)}{\hat{\sigma}_i\sqrt{T_S + \frac{T_S^2}{T} + \frac{\sum_{t=T_1}^{T_2}\{R_{mt} - T_S\bar{R}_m\}^2}{\sum_{t=1}^{T}\{R_{mt} - \bar{R}_m\}^2}}} \quad \ldots (14)$$

Proceeding along the lines of Boehmer et al (1991), the Z-statistic with a t-distribution with T-2 degrees of freedom and converging to a unit normal is given as

$$BMP\ Statistic = \frac{\frac{1}{N}\sum_{i=1}^{N} SAR_i}{\sqrt{\frac{1}{N(N-1)}\sum_{i=1}^{N}\left\{SAR_i - \sum_{i=1}^{N}\frac{SAR_i}{N}\right\}^2}} \quad \ldots (15)$$

The above is the BMP statistic aggregated over the entire event window.

The Kolari-Pynnonen 2010 paper suggest a correction factor for this Statistic which is

$$\sqrt{\frac{1-\bar{r}}{1+(N-1)\bar{r}}}$$

Thus, leading to equation 12 above.

5. Data

Over the past several years CSE has released environmental ratings for multiple industries under GRP, of which paper and pulp industry has been rated twice (in 1999 and then again in 2004). The first set of ratings were used by Gupta and Goldar (2005), while the subsequent ratings have been used by us in this paper (except for the green rating released by the CSE for thermal power plants in 2015 which has not been used in this paper for reasons explained later). The date of release of ratings and the number of plants rated is as shown in Table 3.

Table 3: Green rating release date and number of plants rated

	1st set of ratings [used in Gupta and Goldar (2005)]		Subsequent ratings used in this paper	
Industry	Date of Release	No. of Plants Rated	Date of Release	No. of Plants Rated
Automobile	Oct 29, 2001	29	No subsequent rating	No subsequent rating
Chlor Alkali	Sep 2, 2002	25	No subsequent rating	No subsequent rating
Paper and Pulp	July 18,1999	28	Sep 30, 2004	30
Iron And Steel	No previous rating	No previous rating	June 4, 2012	21
Cement	No previous rating	No previous rating	Dec 16, 2005	41

Source: collation of information available on CSE website (https://www.cseindia.org/page/green-rating-project) and from documents published by CSE

As will be seen shortly, not all plants which were rated, were owned by firms that were listed on the Bombay Stock Exchange (BSE). In such cases we had to drop these plants from the study as stock prices were not available. Thus, while it might be a concern that we are dropping a few plants from the sample, it needs to be kept in mind that an event study, by definition, is done for firms which are listed on stock exchanges and whose stock prices are available for the duration of estimation and event window.

The fact that CSE rates plants that may or may not be listed is indicative of the wide coverage of industry under scrutiny.

In subsequent sections and in Table 4, Table 5 and Table 6 we compare the sample data set and the sub-set of the sample aka sub-sample comprising of plants that are listed on the BSE. While the difference between the sample and the sub-sample is small enough in most cases, it was particularly prominent in the case of Thermal Power Sector.

CSE released the ratings for Thermal Power Sector in February 2015. However, out of the 47 plants rated, 25 of them were not listed on the Stock exchange and thus their stock prices were not available. Thus, only 22 plants representing 12 parent firms had stock prices available. Further all the unlisted plants performed very poorly [0 or 1 leaf] compared to the listed plants which were rated better and got 2 or 3 leaves as well. Given such intense selection bias we thought it best to not include this rating in our study.

The date of release of ratings is also our event date often referred to as t=0

There were instances when multiple plants belonging to the same company were rated differently. However, obviously the stock price was only available for the parent firm. For all such cases we followed the rule of majority i.e. assigning the rating of majority of plants to the firm as a whole. The rationale behind such an exercise is that in most scenarios, majority of the plants account for the bulk of capacity and production and their performance should have a direct impact on the share prices of the parent firm. Firms such as J. K. Paper Limited which had two plants and there was a tie; one of the manufacturing plant received 3 leaf award while the other plant 2 leaf award. In all such cases, where there was a tie, the firm was assigned the lower of the ratings. Thus, J. K. Paper Limited as a whole was assigned 2 leaves.

Iron and Steel industry

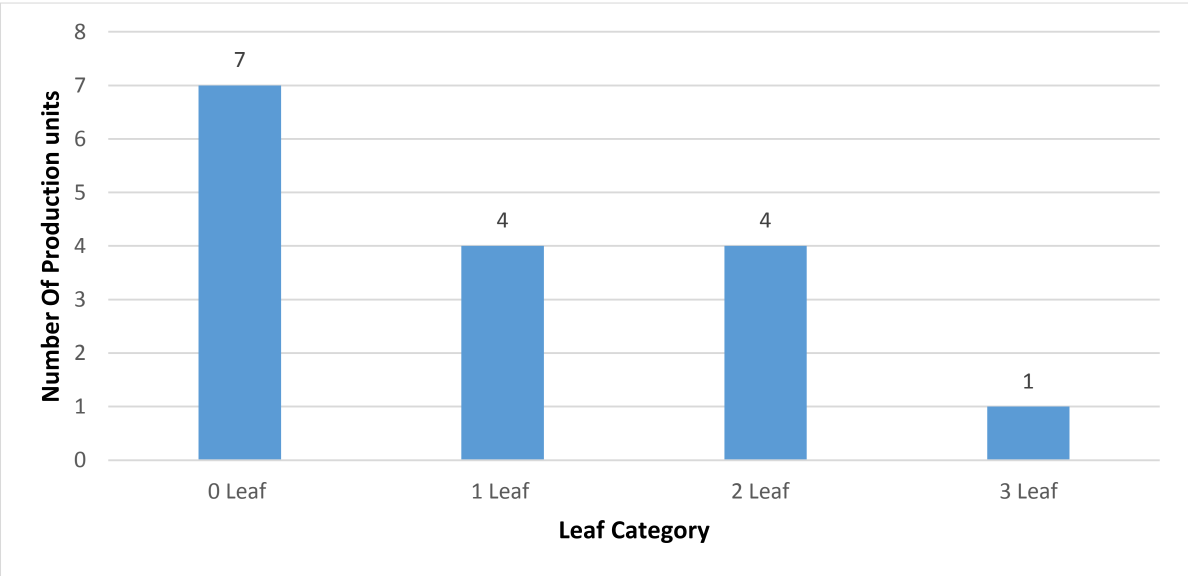
For this rating, CSE selected all the 21 plants in India that had an annual production capacity of at least half a million tones. These plants produce 68 per cent of the total steel in India. Of the 21 plants rated, 16 plants representing 12 parent firms were listed on the BSE (henceforth referred to as sub-sample) and thus their stock prices were available. The average environmental score of the entire sample is 19.3 while the average score for the sub-sample is 16.8. The differences between the complete sample of plants rated and the sub-sample which is listed on the BSE are summarized in Table 4.

Table 4: Sample versus sub-sample attributes of iron and steel industry

	Sample	Sub-sample (parent firm listed on BSE)
Sample size	21	16
Average age (years)	27.8	32.6
Average environmental score (0-100)	19.3	16.8
Total installed capacity (MTPA)	100.9	79.1

The sub-sample accounts for a little less than 80% of the rated capacity and accounts for 54% of the total installed steel capacity in India. The distribution of firms according to green leaf rating is shown in Figure 1 (plant-wise scores and leaf awards are provided in Annexure-2).

Figure 1: Iron and steel sub sample, distribution of plants according to leaf category



Cement:

Cement industry is a major contributor to the country's GDP and one of the largest tax payers. The top 20 cement companies account for almost 70 per cent of the total cement production of the country. What is unique about this industry is that it uses raw materials and energy that are non-renewable; extracts its raw materials by mining, and manufactures a product that cannot be recycled. Limestone mining is in fact one of the more significant reasons for the high environmental impact of this industry.

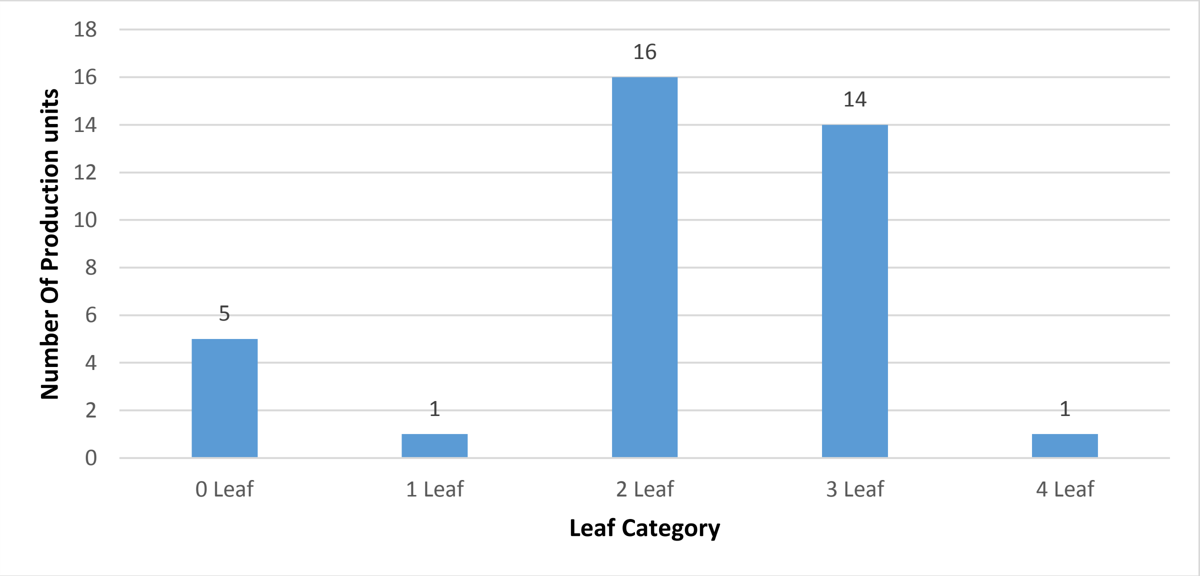
For this sector, CSE rated 41 plants of which 37 plants representing 20 parent firms were listed on BSE and their stock prices were available [There were 3 plants which were not listed and 1 plant belonging to Sanghi Industries was listed but had more than 90% missing value and was hence dropped from the sample]. This sub-sample of 37 plants is not very different from the overall sample and has approximately the same age and Environmental Score. The differences between the complete sample of plants rated and the sub-sample which is listed on the BSE are summarized in Table 5.

Table 5: Sample versus sub-sample attributes of cement industry

	Sample	Sub-sample (Listed on BSE)
Sample Size	41	37
Average Age (Years)	19.7	20.7
Average Environmental Score (Scale of 0-100)	31.6	30.9
Total Production (million tons)	81.9	74.4
Total installed Capacity(million tons)	175.7	158

The frequency distribution for sub-sample of plants is shown in Figure 2 (plant-wise scores and leaf awards are provided in Annexure-2).

Figure 2: Cement sub sample, distribution of plants according to leaf category



Paper and Pulp

The green rating of paper and pulp plants done by the CSE in 2004 was the second time CSE had rated Paper and Pulp industry, the first being in 1999 which was covered in the earlier paper by Gupta and Goldar in 2005. According to CSE's own estimates, the sector's performance improved by 10-15%. However, this might not be immediately visible if one were to compare the overall environmental score from the two ratings (1st in 1999 and 2nd in 2004); that is so because CSE tightened its rating benchmarks.

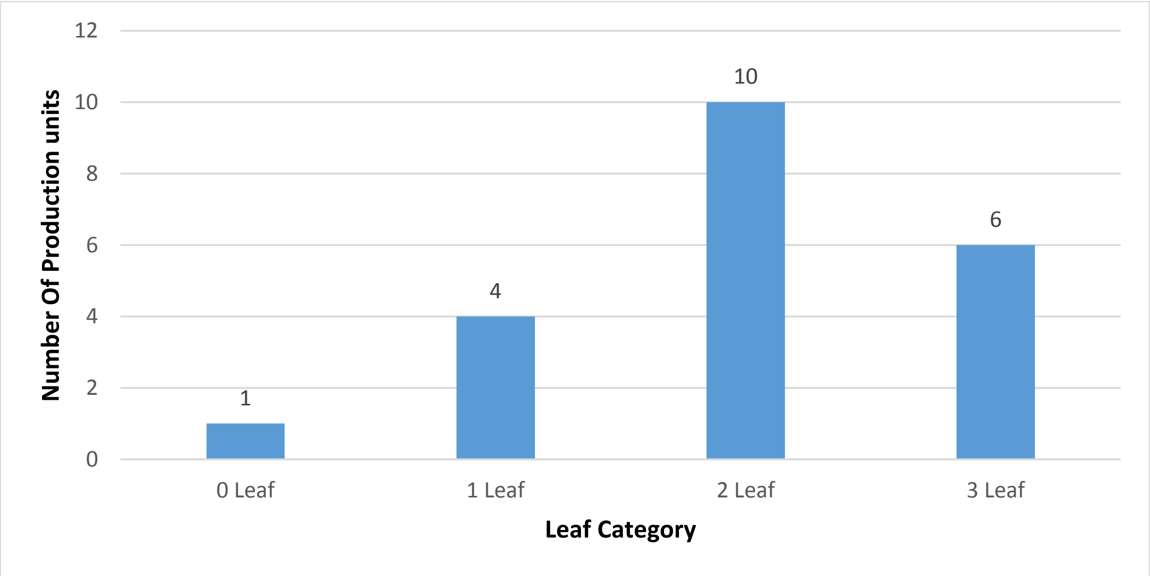
In the rating done in 2004, CSE rated 30 plants of which 7 plants belonged to companies that were not listed on the stock exchange and 2 were such for which more than 1/3rd stock prices were unavailable during the estimation window and hence had to be dropped from the sample. Thus the sub-sample had a total of 21 plants representing 14 different parent firms. The difference between the complete sample of plants rated and the sub-sample which is listed on the BSE are summarized in Table 6.

Table 6: Sample versus sub-sample attributes of paper and pulp industry

	Sample	Sub-sample (Listed on BSE and stock prices available)
Sample Size	30	21
Average Age (Years)	29.1	32.1
Average Environmental Score (Scale of 0-100)	26.2	29.8
Total Installed Capacity (Million tons per annum)	2.73	2.05

The frequency distribution for sub-sample of plants of the paper and pulp industry is shown in Figure 3 (plant-wise scores and leaf awards are provided in Annexure-2).

Figure 3: Paper and Pulp sub sample, distribution of plants according to leaf category



6. Results

As explained in Section 4 above, the event study methodology is applied in this paper to evaluate the financial impact of green rating of industrial plants in India. The impact is captured by measuring the Cumulative Average Abnormal Return (CAAR) on the shares of companies whose plant were rated by the CSE under the green rating scheme. The CAAR associated with the announcement of green rating of the plants is estimated and its statistical significance is ascertained. As explained earlier, the analysis is undertaken for three industries, namely (a) Paper and pulp, (b) Cement and (c) Iron and Steel. The empirical results i.e. the estimates of CAAR and their level of statistical significance assessed on the basis of Z-statistic and BMP statistic for these three industries are discussed below in that order. Following that, some estimates of CAAR that have been made by pooling paper, cement, and iron and steel plants are presented and discussed. The section ends with a discussion on the results obtained by using the KP statistic which as pointed out earlier has an advantage over Z-statistic and BMP statistic methodologically.

6.1 Paper and Pulp

It has been mentioned above that for paper and pulp plants, green rating was done by the CSE twice with a short period of time, first in 1999 and then in 2004. For the paper and pulp firms, we have therefore carried out a comparative analysis. Using the data for 2004, CAAR has been computed for 14 firms. This is shown in Table 7. The Table shows the CAAR and the corresponding normal Z-statistic. The estimation window is 90 trading days. Seven event windows are considered for the analysis: (-2 to +2), (-2 to +5), (-2 to 10), (0 to 1), (0 to +2), (0 to 5) and (0 to 10), where zero denotes the date of announcement of green rating.

Table 7: CAAR, Paper and pulp firms

Event Window →	**-2,2**	**-2,5**	**-2,10**	**0,1**	**0,2**	**0,5**	**0,10**
CAAR	-0.0415	-0.0214	-0.0238	-0.0082	-0.0218	-0.0018	-0.0042
Z Statistic	-2.5885	-1.0568	-0.9213	-0.8047	-1.7593	-0.1014	-0.1752
Std Error	0.0160	0.0203	0.0259	0.0101	0.0124	0.0176	0.0238

CAAR is negative in all the event windows considered. This is in agreement with the estimates presented in Gupta and Goldar (2005) which were based on similar data for 1999. In the study undertaken by Gupta and Goldar (2005), the CAAR was computed for three event windows: (0 to 1), (0 to 5) and (0 to 10). CAAR was negative for all three event windows, and statistically significant for the event windows (0,5) and (0,10). In the estimates for 2004 made for this study, by contrast, CAAR is not found to be statistically significant for the event windows (0,5) and (0,10). Instead, it is found to be statistically significant for the event windows (-2,2) and

(0,2). Thus, the results for 2004 presented in Table 7 and those for 1999 reported in Gupta and Goldar (2005) are not exactly similar, but do point by and large in the same direction in that taking all paper and pulp firms together the CAAR was negative, and is found to be statistically significant for some event windows.

The analysis in Gupta and Goldar (2005) indicated that the negative sign of CAAR at the aggregate level is essentially driven by adverse impact of green rating on share prices of firms which were rated relatively low. It is important therefore to find out if this holds true also for the second round of green rating of paper and pulp industry in 2004. The results of such an analysis are presented in Table 8. CAAR is shown separately for the firms that were awarded 0 or 1 leaf and the firms that were awarded 2 or 3 leaves (as done in Gupta and Goldar 2005). The table shows the CAAR, the normal Z-statistic, and the probabilities for the corresponding BNP statistic. Where the probability is over 0.1, it has not been shown. Instead it is pointed out that the CAAR is not significantly different from zero. The estimation window is 90 trading days. Four event windows are considered for the analysis: (-2 to +2), (0 to +2), (-2 to +5) and (0 to 5) where zero denotes the date of announcement of green rating.

The estimated CAAR for plants getting zero or one leaf is negative for all four event windows, but it is not statistically significant. As regards the plants getting two or three leaves, the CAAR is negative for three out of four event windows. In one case (-2 to +2), the estimated CAAR is negative and statistically significant. Prima facie, this appears to be a wrong result[8], because one would expect a negative impact for plants that have a relatively lower green rating, rather than plants which have been given relatively higher rating. The expected pattern is observed for the event windows (-2 to +5) and (0 to +5), though the estimated CAAR is statistically insignificant for both group of plants. The plot of CAAR for different event windows shown in Figure 4 makes it clear that till t=5 the CAAR for plant with zero or one leaf is generally lower than the CAAR for plants with two or three leaves. This seems to be a more appropriate inference to draw from the estimates made.

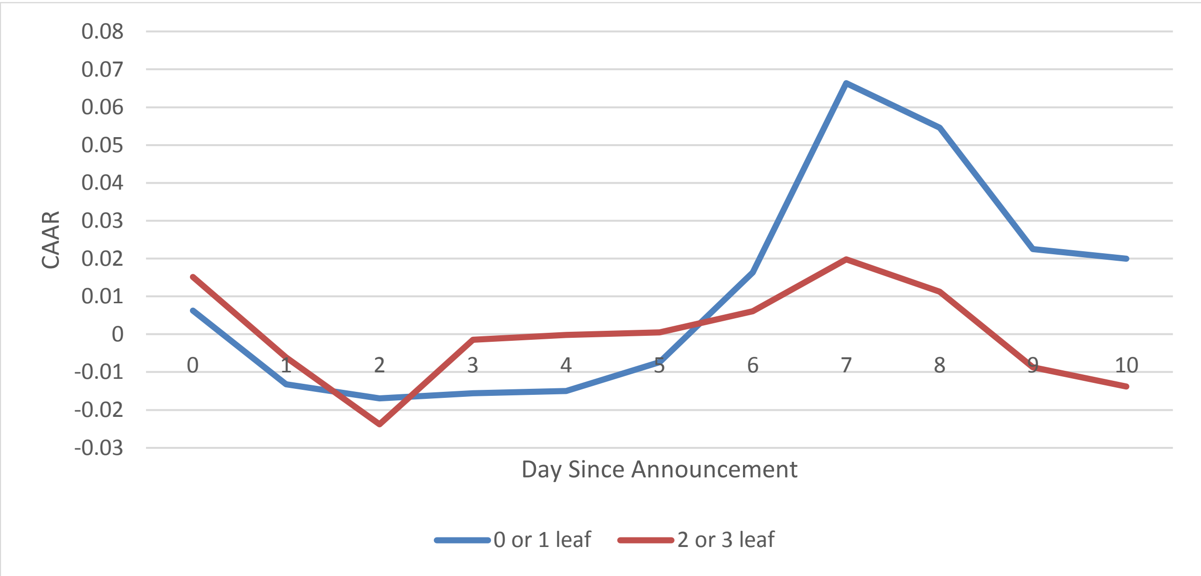
[8] One possible explanation for the results could be that if we break down 2 and 3 leaves further this result is being driven entirely because of 2 leaves firms. These are the same firms which were rated rather poorly in the previous rating done in 1999. So perhaps the market is preemptively reacting. This would also explain why the result is being captured in (-2 to +2) and not in (0 to +2).

Table 8: CAAR, Paper and pulp firms

Event Window→	-2,2	-2,5	0,2	0,5	Indicator and statistic
0 or 1 leaf (4 firms)	-0.0396	-0.0301	-0.0169	-0.0074	CAAR
	-1.2056	-0.7240	-0.6653	-0.2059	Normal Z statistic
	-1.3936	-0.8902	-0.6772	-0.1684	BMP Statistic
	0.1669	0.3758	0.5001	0.8667	P value corresponding to BMP statistic
2 or 3 leaves (10 firms)	-0.0423	-0.0180	-0.0238	0.0005	CAAR
	-2.0496	-0.6890	-1.4913	0.0210	Normal Z statistic
	-2.4372	-0.6404	-1.3482	0.2540	BMP Statistic
	0.0168	0.5236	0.1811	0.8001	P value corresponding to BMP statistic

Note: If p-value more than 10% has not been shown. Instead, it is pointed out the estimated CAAR is statistically insignificant.

Figure 4: Paper and pulp firms, CAAR



To continue further with the analysis of paper and pulp firms, an interesting line of investigation is to consider the change in green rating that has taken place among the firm between the two rounds, 1999 and 2004, and assess how this change in rating has impact the share prices of firms. For this purpose, the plant and firms which were rated both in 1999 and

2004 have been identified. It is found that rating are available for both 1999 and 2004 for a total of 22 common plants, of which stock prices are available for 17 plants, and these 17 plants belong to 12 parent firms. The list of these plants and firms are given in Annexure-2 along with matrices showing distribution of plants and firms according to the number of leafs awarded in 1999 and 2004.

To study how the change in green rating has impacted share prices, firms have been divided into three groups: 1) those firms that have done strictly worse than the previous rating, 2) those firms that have done strictly better than the previous rating, and 3) those firms whose rating has not changed. Estimated CAAR for the three groups is shown in Table 9 and a graphic presentation is made in Figure 5.

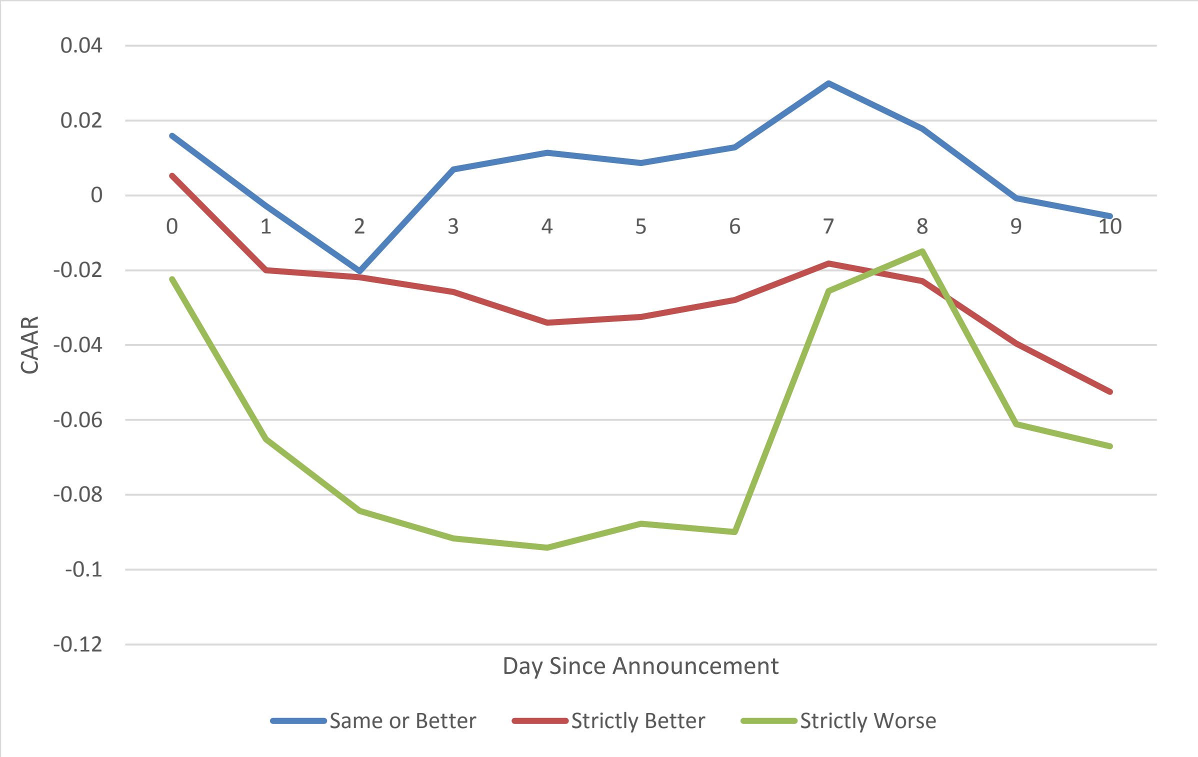
Table 9: CAAR, Paper and Pulp Firms, Impact of changed rating

Event Window→	-2,2	-2,5	0,2	0,5	Indicator and statistic
Strictly Worse (2 firms)	-0.1232	-0.1266	-0.0843	-0.0878	CAAR
	-2.3507	-1.9110	-2.0766	-1.5291	Z statistic
	-3.4959	-5.6871	-3.5408	-2.3110	BMP Statistic
	0.0007	0 .00001	0.0006	0.0232	P value corresponding to BMP statistic

Event Window →	-2,2	-2,5	0,2	0,5	Indicator and statistic
Strictly Better (3 firms)	-0.0479	-0.0586	-0.0218	-0.0325	CAAR
	-1.0525	-1.0168	-0.6191	-0.6510	Z statistic
	-3.4677	-2.5063	-1.3480	-1.3315	BMP Statistic
	0.0008	0.0141	0.1811	0.1866	P value corresponding to BMP statistic

Event Window →	-2,2	-2,5	0,2	0,5	Indicator and statistic
Same or Better (10 firms)	-0.0371	-0.0082	-0.0203	0.0087	CAAR
	-1.7640	-0.3085	-1.2429	0.3752	Z statistic
	-2.7659	-0.5134	-1.4983	0.5179	BMP Statistic
	0.0069	0.6092	0.1377	0.6058	P value corresponding to BMP statistic

Figure 5: Paper and pulp firms, CAAR (1st rating vs 2nd rating: comparison of plants)



It is seen from Table 9 that the estimated CAAR is negative for all four event windows considered for the group of firms which did strictly worse in the second rating, and the value of CAAR is statistically significant in three out of four event windows. For the event window (0.5), the estimated CAAR is not statistically significant as per Z-statistic, but it is statistically significant as per BMP statistics. The estimate of CAAR is negative also for the firms that did strictly better in the second round of rating, but the value of CAAR is not statistically significant for two event windows, (0,2) and (0,5). For the other two event window, (-2.0) and (-2,5) the estimated CAAR is statistically significant as per BMP statistics, but it is statistically insignificant as per Z-statistic. When firms that did strictly better or those that performed the same in the second round of rating are taken together, the estimate of CAAR is found to be negative in all but one event window, and mostly statistically insignificant. For this group of firms, estimated CAAR is found to be negative and statistically significant for the event window (-2,+2). It should be noted, however, that in terms of the numerical value, the estimated CAAR for this event window is much bigger negative for the firms that did strictly worse than the firms that did strictly better or the same. It will be noticed further from Figure 5 that the estimated CAAR for different periods since the day of announcement of green rating is always less for firms that did strictly worse than the firms that did strictly better or the same. Also, the estimated CAAR for the former group of firms (which did strictly worse in terms of environmental rating) is negative in all cases, whereas that for the latter group of firms is positive in a majority of cases. It may accordingly be inferred that a worsening of rating of paper and pulp firms between the successive rounds of environmental rating did have the expected negative effect on their share prices.

6.2 Cement

The estimates of CAAR for cement plants are shown in Table 10. The estimation window is 90 trading days, and CAAR has been computed for four event windows as in the case of paper and pulp firms. The CAAR has been computed for plants divided into two groups: those awarded zero or one leaf and those awarded two or three leaves.

For plants with zero or one leaf, the estimated CAAR is found to be consistently negative for all four event windows considered. It is statistically significant in one estimation window according to both Z-statistic and BMP statistics, and in the remaining three windows, although going by the Z-statistic the estimated CAAR is not statistically significant, but going by the BMP statistic which is methodologically superior, the estimated CAAR is statistically significant. As regards the plants that were awarded two or three leaves, the estimated CAAR is negative for three out of four event windows. It is found to be statistically significant only in two cases out of four on the basis of BMP statistic and in none of the four cases on the basis of Z-statistic. Thus, going by the results obtained, there is indication of a significant negative CAAR for firms awarded zero or one leaf, but for firms awarded two or three leaves representing better environmental performance, there is no such indication – at least no clear indication of a negative CAAR.

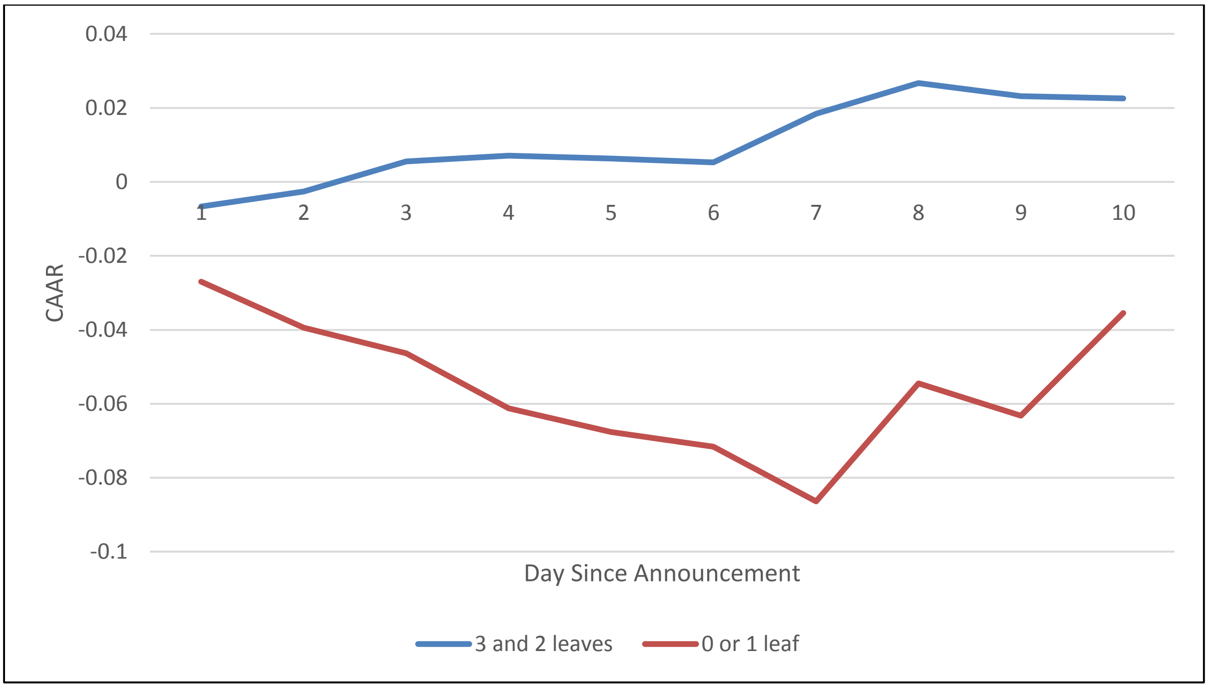
Making a comparison of the numerical values of estimated CAAR for various event windows, it is found that the estimated CAAR is relatively lower for firms awarded zero or one leaf than that for the firms awarded two or three leaves in three cases, and the difference is marginal in one case. Hence, it appears that the plants given low green rating have had suffered a negative impact on stock returns vis-à-vis the plants that were given a higher green rating. This is brought out more clearly by Figure 6 which shows the CAAR for various time periods (days) from the time of announcement of green rating. It will be noticed that the estimated CAAR in respect of firms rated zero or one leaf is negative all cases, whereas that for firms rated two or three leaves is positive in most cases.

Table 10: CAAR, Cement firms

Event Window→	-2,2	-2,5	0,2	0,5	Indicator and statistic
0 or 1 leaf (5 firms)	-0.0231	-0.0513	-0.0394	-0.0677	CAAR
	-0.6340	-1.1124	-1.3955	-1.6925	Normal Z statistic
	-2.2552	-3.8279	-2.3252	-2.9653	BMP Statistic
	0.0266	0.0002	0.0224	0.0039	P value corresponding to BMP statistic
2 or 3 leaf (15 firms)	-0.0234	-0.01453	-0.0026	0.0063	CAAR
	-1.4804	-0.7254	-0.2104	0.3650	Normal Z statistic
	-3.3684	-1.6830	-0.3069	-0.0973	BMP Statistic
	0.0011	0.0959	0.7596	0.9227	P value corresponding to BMP statistic

Note: p-value more than 10% is not reported. Instead, it is pointed out the estimated CAAR is statistically insignificant.

Figure 6: Cement firms, CAAR



6.3 Iron and steel firms

The results for iron and steel plant are presented in Table 11. The estimation window is 90 trading days, and CAAR has been computed for four event windows as in the case of cement and paper and pulp firms. The results are in certain ways similar to the of cement plants. The estimated CAAR is negative for plants that have been awarded no leaf or one leaf. This is found to be statistically significant for all four event windows using Z-statistic and for two of the four windows using BMP statistics. As regards the plants which were awarded two or three leaves, the estimated CAAR is negative and statistically significant in only two event windows out of four when BMP statistic is considered. On the other hand, going by the Z statistic, the estimated CAAR for firms awarded two or three leaves is found to be statistically insignificant for all four event windows.

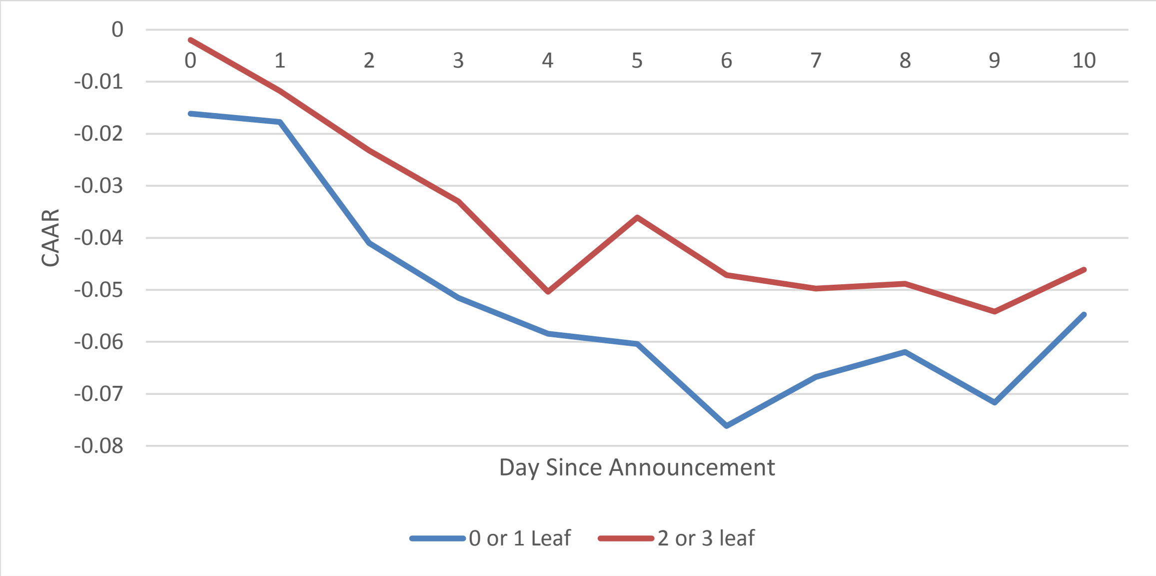
For those two event widows (0 to 2 and 0 to 5) for which the estimated CAAR for firms awarded 2 or 3 leaves is found to be negative and statistically significant according to BMP statistic, the estimated CAAR for plants with zero or one leaf is a bigger negative number than that for plant which were awarded two or three leaves. This points to poor green rating being associated with a negative impact on stock returns. This is brought out also by Figure 7 which shows the CAAR for different periods (days) since the day of announcement of green rating. The estimated CAAR is negative for both firms awarded zero or one leaf and firms awarded two or three leaves, but is consistently lower for the former group of firms.

Table 11: CAAR, Iron and steel firms

Event Window →	-2,2	-2,5	0,2	0,5	
0 or 1 leaf (7 firms)	-0.0469	-0.0662	-0.0410	-0.0604	CAAR
	-2.2193	-2.4794	-2.5083	-2.6107	Normal Z statistic
	-1.5560	-1.7474	-1.6196	-1.8177	BMP Statistic
	0.1233	0.0841	0.1089	0.0726	P value corresponding to BMP statistic
2 or 3 leaf (5 firms)	0.0004	-0.0125	-0.0232	-0.0361	CAAR
	0.0190	-0.4669	-1.4185	-1.5595	Normal Z statistic
	0.4551	-1.0246	-1.9613	-5.1047	BMP Statistic
	0.6502	0.3084	0.0530	0.00001	P value corresponding to BMP statistic

Note: p-value more than 10% is not reported. Instead, it is pointed out the estimated CAAR is statistically insignificant.

Figure 7: CAAR, Iron and Steel Firms



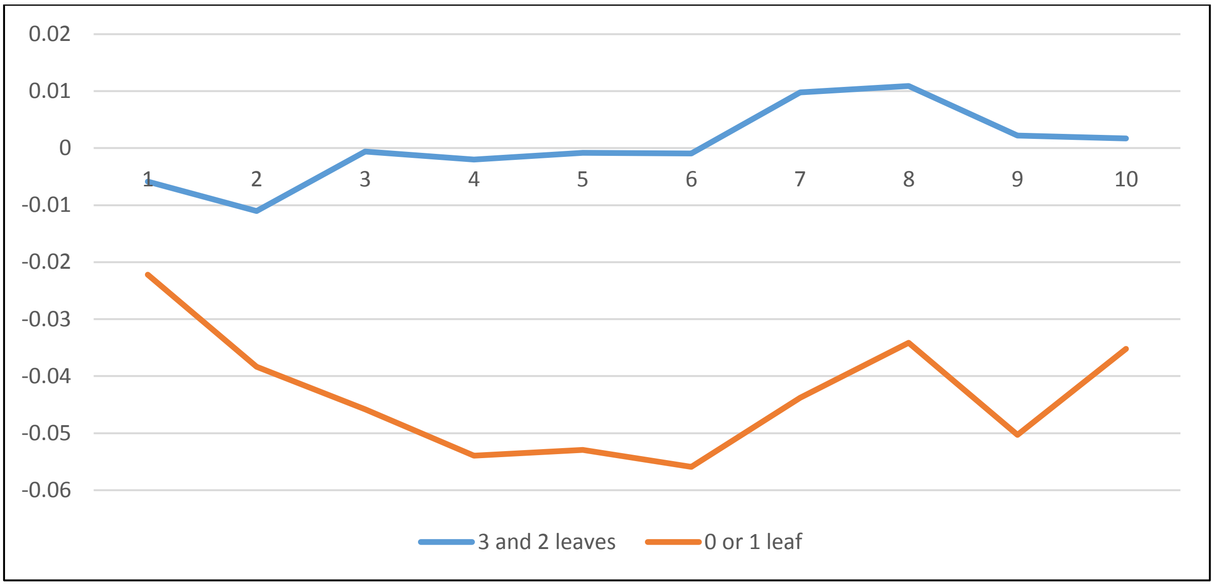
6.5 Analysis of pooled data: cement, paper and pulp, and iron and steel

The data for three industries, cement, paper and pulp, and iron and steel have been pooled and an analysis similar to that presented above has been carried out. Attention is focused on the firms that were rated low, i.e. zero or one leaf, since it is this category of firms for which the analysis presented above indicated a negative impact of low rating on their share prices. The estimated CAAR for plants of the three industries which were given zero or one leaf is shown in Table 12. A comparison of CAAR for plants with zero or one leaf and those with two or three leaves is in Figure 8.

Table 12: CAAR, pooled data on all firms in all industries

Event Window →	-2,2	-2,5	-2,10	0,2	0,5	
0and1 leaf only. 16 firms	-0.04355	-0.05811	-0.0404	-0.0384	-0.0529	CAAR
	-2.5812	-2.7227	-1.4840	-2.9360	-2.8637	Normal Z statistic
	-2.3799	-2.4745	-2.0527	-2.2520	-2.2943	BMP statistic
	0.0195	0.0153	0.0431	0.0269	0.0242	P value corresponding to BMP statistic

Figure 8: CAAR, pooled data all firms in all industries



It is seen from Figure 8 estimated CAAR for firms with two or three leaves rating was mildly negative in the event windows (0,1) and (0,2) which hovered close to zero from day 3 to day 6 and turned positive only from sixth day onwards. By contrast, the estimated CAAR for firms with zero or one leaf rating, i.e. poorer green rating, was negative in the event windows (0,1) and (0,2) and became larger negative from the third day onwards. The estimated CAAR for this group of firms is negative and statistically significant for all the event windows considered in Table 12. The estimates of CAAR based on pooled data clearly point to a negative effect of announcement of green rating on the stock prices of companies that were given low green rating reflecting their relatively lower environmental performance. This finding is consistent with the findings of Gupta and Goldar (2005). This shows that the pattern that was seen in the initial rounds of green rating done by the CSE held true also for the subsequent rounds.

6.5 KP Statistics

To the best of our knowledge previous studies on the impact of environmental news on stock prices of companies using the event study method have only computed the Z-statistic (or t-statistic) to assess the statistical significance of the estimated CAAR. The null hypothesis is that the environmental news had no impact on stock returns and this was tested by the Z-statistic/ t-statistic. This method for instance was used by Gupta and Goldar (2005), Dasgupta et al. (2006), Jacobs et al. (2010) and Capelle-Blancard and Laguna (2010), among others. One methodological improvement made in this paper is to use the BMP statistics (which corrects for Forecasting Error and Event Induced Variance) instead of Z-statistic or t-statistic. As explained in Section 4 of the paper, for assessing the statistical significant of CAAR, BMP statistic has an advantage over the conventional Z-statistic or t-statistic. A second improvement done in the paper is to use the KP statistic. The KP statistic corrects for the cross correlation amongst stock returns to various firms in the sample. The presence of such correlation is a matter of concern for the analysis presented in the paper because all firms of an industry have a common event date. In none of the studies undertaken so far on the impact of environmental news on stock returns based on the event study methodology, the KP statistic has been used. Thus, in the earlier studies, the issue of cross-correlation among stock returns to different firms has been ignored which might have affected the inferences drawn on the basis of the estimates of CAAR obtained.

For the pooled sample, the KP statistic is presented in Table 13. This analysis is done for the firms whose plants were given zero or one leaf in the green rating done by the CSE. The BMP statistic indicates that the estimated CAAR is negative and statistically significant. The KP statistic is found to statistically insignificant in one event window out of five considered. In other cases, the P-value is found to be more than 0.05. Thus, hypothesis of no impact of announce of green rating on stock prices of the concerned companies cannot be rejected at five percent level of significance. It can be rejected only at 10%. The implication is that the negative impact of low environmental rating on stock prices is perhaps not as strong as the Z-statistic and BMP statistic would make us believe. Yet, it needs to be noted that the estimated CAAR is consistently negative and is statistically significant at 10 percent level in four out of five event windows considered. This results along with the pattern observed in Figure 8 gives clear indication the announcement of green rating by CSE has a negative effect on the stock returns for companies which were rated low.

Table 13: CAAR, pooled data all firms in all industries

Event Window →	-2,2	-2,5	-2,10	0,2	0,5	
0and1 leaf only. 16 firms	-0.0435	-0.0581	-0.0404	-0.0384	-0.0529	CAAR
	-1.8006	-1.8722	-1.5531	-1.7038	-1.7359	KP Statistic
	0.0753	0.0645	0.1240	0.0921	0.0862	P value corresponding to KP statistic
	-2.3799	-2.4745	-2.0527	-2.2520	-2.2943	BMP statistic
	0.0195	0.0153	0.0431	0.0269	0.0242	P value corresponding to BMP statistic

Note: p-value more than 10%, is not shown. Instead, it is pointed out the estimated CAAR is statistically insignificant.

7. Concluding remarks

There has been growing interest in the academic literature in enquiring into the efficacy of the capital markets in creating strong incentives for firms to improve their environmental performance. A number of environmental event studies have been undertaken which relate firms' environmental performance to stock returns aimed at ascertaining whether capital market response to news regarding environmental performance of firms creates incentive for pollution control. These studies, undertaken mostly for developed countries, and in a few cases, for developing countries, have come up with empirical evidence indicating the presence of such an impact on capital market.

In this paper, an environmental event study has been carried out in the context of polluting industries in India, building on a very similar earlier research carried out by Gupta and Goldar (2005). Gupta and Goldar had investigated the impact of environmental rating of industrial plants on the stock returns for three Indian industries, namely paper and pulp, automobiles and chlor-alkali, utilizing the environmental rating done by the CSE. In this paper, making use of the ratings done by the CSE subsequent to the Gupta-Goldar study, two more industries were considered for the analysis. These industries are cement and iron and steel. For paper and pulp industry, the CSE has done environmental rating twice, first in 1999 which was covered in the Gupta-Goldar study, and then in 2004. Accordingly, in the paper, we investigated the market's reaction to release of environmental scores for those firms whose environmental performance has been reported a second time.

The broad conclusion that emerges from the analysis presented in the paper is that capital market penalizes the Indian industrial firms that score relatively low in terms of environmental performance. The negative impact is reflected in the stock returns, or to be more specific in terms of average cumulative abnormal returns (CAAR) following the announcement of ratings. For cement firms and iron and steel firms, our results show that the CAAR is negative and statistically significant for the firms that were rated low (awarded zero or one leaf in terms of environmental performance). But, this cannot be said of the firms that were rated relatively higher, i.e. awarded two or three leaves. For firms in paper and pulp industry, we find that CAAR is negative and statistically significant for firms that have done worse, i.e. their green leaf award has gone down, between the first and second rating of the CSE, but for firms that have done strictly better or remained the same have been meted out insignificant capital market reaction.

The findings of this study are in agreement with the finding of Gupta and Goldar (2005) who carried out a similar analysis for Indian industries. Also, the findings are in line with the findings of several other environmental event studies including those undertaken for developing countries. The policy implications of the findings are obvious: need for creating systems of disclosure of environmental information of industrial firms in order to create pressure of firms to control pollution.

For judging the statistical significance of CAAR, environmental event studies have commonly used the Z-statistic or t-statistic. Some recent studies have used the BMP statistic, which has an advantage over Z-statistic or t-statistic in that it corrects for forecasting error and event induced variance. In this study, both Z-statistic and BMP statistic have been presented and used for drawing statistical inference. A methodological novelty introduced in the paper is the use of the KP statistic, thus going beyond the standard Z-Statistic or BMP statistic. The KP statistic has an advantage that it controls for event day clustering. As mentioned earlier in the paper, event date clustering is vulnerable to the problem of cross- correlation and Kolari and Pynnonen (2010) has found from their analysis that even relatively low cross-correlation among abnormal returns is serious in terms of over-rejecting the null hypothesis of zero average abnormal returns. For the dataset used for our analysis, with environmental rating of different firms of an industry being announced on the same date, event day clustering could be a serious estimation issue. Our results show that when KP statistics is used the previously manifested negative impact of poor environmental performance on the stock returns is not as pronounced as the standard Z-statistic or BMP statistic would lead one to believe. Clearly, the problem of estimation arising from cross-correlation caused by event day clustering is a real issue for the dataset used and analysis undertaken by us. At the same time, it is reassuring to observe that our finding of a significant negative CAAR for plants that are rated low in terms of environmental performance remains intact even when we use the KP statistics in place of the Z-statistic or BMP statistic.

One interesting question that arises from the findings of our analysis is: why capital market does not appear to be rewarding good environmental performance of Indian industrial firms when there is clear indication from the data that it penalizes poor environmental performance. A good insight into this issue is provided by a recent paper by Wang et al. (2019). They observe that there is nearly unanimous empirical evidence that public news of negative environmental performance of a firm leads to significantly negative financial outcome; on the other hand, the evidence on the financial impact of positive environmental news is mixed -- several studies have found a negative impact or absence of a significant impact. They have investigated this issue using 308 media releases during 2005-2014 and find that whether or not a significant positive impact will occur depends on the nature of the positive news. In particular, they find that the largest positive abnormal stock returns arise from announcement of future environmental activities. The announcement of green rating considered in this study does not belong to this type of news, and this fact possibly explains, at least partly, why a significant positive impact of relatively high environmental rating of Indian firm on stock returns is not found.

References

Afsah, Shakeb, Benoit Laplante, and David Wheeler. "Controlling Industrial Pollution: a new paradigm." No. 1672. *World Bank, Policy Research Department, Environment, Infrastructure, and Agriculture Division* (1996)

Albertini, Elisabeth. "Does environmental management improve financial performance? A meta-analytical review." *Organization & Environment* 26, no. 4 (2013): 431-457.

Aguzzoni, Luca, Gregor Langus, and Massimo Motta. "The effect of EU antitrust investigations and fines on a firm's valuation." *The Journal of Industrial Economics* 61, no. 2 (2013): 290-338.

Ambec, Stefan, and Philippe Barla. "Can environmental regulations be good for business? An assessment of the Porter hypothesis." *Energy Studies Review* 14, no. 2 (2006): 42.

Ambec, Stefan, Mark A. Cohen, Stewart Elgie, and Paul Lanoie. "The Porter hypothesis at 20: can environmental regulation enhance innovation and competitiveness?" *Review of Environmental Economics and Policy* 7, no. 1 (2013): 2-22.

Amici, Alessandra, Franco Fiordelisi, Francesco Masala, Ornella Ricci, and Federica Sist. "Value creation in banking through strategic alliances and joint ventures." *Journal of Banking & Finance 37*, no. 5 (2013): 1386-1396.

Becchetti, Leonardo, and Rocco Ciciretti. "Stock market reaction to the global financial crisis: testing for the Lehman Brothers' event." *Giornale degli Economisti e Annali di Economia* (2011): 3-58.

Blackman, Allen, and Geoffrey J. Bannister. "Community pressure and clean technology in the informal sector: An econometric analysis of the adoption of propane by traditional Mexican brickmakers." *Journal of Environmental Economics and Management* 35, no. 1 (1998): 1-21.

Blackman, Allen. "Alternative pollution control policies in developing countries." *Review of Environmental Economics and Policy*, Volume 4, Issue 2, (2010): 234–253

Boehmer, Ekkehart, Jim Masumeci, and Annette B. Poulsen. "Event-study methodology under conditions of event-induced variance*." Journal Of Financial Economics* 30, no. 2 (1991): 253-272.

Brännlund, Runar, and Tommy Lundgren. "Environmental policy without costs? A review of the Porter hypothesis." *International Review of Environmental and Resource Economics* 3, no. 2 (2009): 75-117.

Brouwers, Roel, Frederiek Schoubben, Cynthia Van Hulle, and Steve Van Uytbergen. "The initial impact of EU ETS verification events on stock prices." *Energy Policy* 94 (2016): 138-149.

Brown, Keith C., W. Van Harlow, and Seha M. Tinic. "Risk aversion, uncertain information, and market efficiency." *Journal of Financial Economics* 22, no. 2 (1988): 355-385.

Brown, Keith, W. V. Harlow, and Seha M. Tinic. "The effect of unanticipated events on the risk and return of common stock." *Working Paper*, University of Texas, Austin, United States (1989).

Campbell, John Y., Andrew W. Lo, and Archie Craig MacKinlay. *The Econometrics Of Financial Markets*. Vol. 2. Princeton, NJ: Princeton University press, 1997.

Capelle-Blancard, Gunther, and Marie-Aude Laguna. "How does the stock market respond to chemical disasters*?." Journal of Environmental Economics and Management* 59, no. 2 (2010): 192-205.

Charest, Guy. "Split information, stock returns and market efficiency-I." *Journal of Financial Economics* 6, no. 2-3 (1978): 265-296.

Charest, Guy. "Dividend information, stock returns and market efficiency-II." *Journal of Financial Economics* 6, no. 2-3 (1978): 297-330.

Corbett, Charles J., and Robert D. Klassen. "Extending the horizons: environmental excellence as key to improving operations." *Manufacturing & Service Operations Management* 8, no. 1 (2006): 5-22.

Dasgupta, Susmita, Benoit Laplante, and Nlandu Mamingi. "Pollution and capital markets in developing countries." *Journal Of Environmental Economics And Management* 42, no. 3 (2001): 310-335.

Dasgupta, Susmita, Jong Ho Hong, Benoit Laplante, and Nlandu Mamingi. "Disclosure of environmental violations and stock market in the Republic of Korea." *Ecological Economics* 58, no. 4 (2006): 759-777.

Dinda, Soumyananda. "Environmental Kuznets curve hypothesis: a survey." *Ecological Economics* 49, no. 4 (2004): 431-455.

Dixon-Fowler, Heather R., Daniel J. Slater, Jonathan L. Johnson, Alan E. Ellstrand, and Andrea M. Romi. "Beyond "does it pay to be green?" A meta-analysis of moderators of the CEP–CFP relationship." *Journal of Business Ethics* 112, no. 2 (2013): 353-366.

Elsayed, Khaled, and David Paton. "The impact of environmental performance on firm performance: static and dynamic panel data evidence." *Structural Change And Economic Dynamics* 16, no. 3 (2005): 395-412.

Endrikat, Jan, Edeltraud Guenther, and Holger Hoppe. "Making sense of conflicting empirical findings: A meta-analytic review of the relationship between corporate environmental and financial performance." *European Management Journal* 32, no. 5 (2014): 735-751.

Endrikat, Jan. "Market reactions to corporate environmental performance related events: A meta-analytic consolidation of the empirical evidence." *Journal of Business Ethics* 138, no. 3 (2016): 535-548.

Fama, Eugene F. "Efficient capital markets: II." *The Journal Of Finance* 46, no. 5 (1991): 1575-1617.

Farruggio, Christian, Tobias C. Michalak, and Andre Uhde. "The light and dark side of TARP." *Journal of Banking & Finance* 37, no. 7 (2013): 2586-2604.

Filbeck, Greg, and Raymond F. Gorman. "The relationship between the environmental and financial performance of public utilities." *Environmental and Resource Economics* 29, no. 2 (2004): 137-157.

Fratianni, Michele, and Francesco Marchionne. "The fading stock market response to announcements of bank bailouts." *Journal of Financial Sability* 9, no. 1 (2013): 69-89.

García, Jorge H., Thomas Sterner, and Shakeb Afsah. "Public disclosure of industrial pollution: the PROPER approach for Indonesia?." *Environment and Development Economics* 12, no. 6 (2007): 739-756.

Guenster, Nadja, Rob Bauer, Jeroen Derwall, and Kees Koedijk. "The economic value of corporate eco- efficiency." *European Financial Management* 17, no. 4 (2011): 679-704.

Gupta, Shreekant, and Bishwanath Goldar. "Do stock markets penalize environment-unfriendly behaviour? Evidence from India." *Ecological Economics* 52, no. 1 (2005): 81-95.

Halkos, George, and Anastasios Sepetis. "Can capital markets respond to environmental policy of firms? Evidence from Greece." *Ecological Economics* 63, no. 2-3 (2007): 578-587.

Hassel, Lars, Henrik Nilsson, and Siv Nyquist. "The value relevance of environmental performance." *European Accounting Review* 14, no. 1 (2005): 41-61.

Hettige, Hemamala, Mainul Huq, Sheoli Pargal, and David Wheeler. "Determinants of pollution abatement in developing countries: evidence from South and Southeast Asia." *World Development* 24, no. 12 (1996): 1891-1904.

Jacobs, Brian W., Vinod R. Singhal, and Ravi Subramanian. "An empirical investigation of environmental performance and the market value of the firm." *Journal of Operations Management* 28, no. 5 (2010): 430-441.

Karpoff, Jonathan M., John R. Lott, Jr, and Eric W. Wehrly. "The reputational penalties for environmental violations: Empirical evidence." *The Journal of Law and Economics* 48, no. 2 (2005): 653-675.

Kathuria, Vinish. "Informal regulation of pollution in a developing country: evidence from India." *Ecological Economics* 63, no. 2-3 (2007): 403-417.

Kawahara, Ryo, and Fumiko Takeda. "Mergers and Acquisitions and Corporate Performance in Japan." *ICFAI Journal of Mergers & Acquisitions* 4, no. 3 (2007).

Kolari, James W., and Seppo Pynnönen. "Event study testing with cross-sectional correlation of abnormal returns." *The Review Of Financial Studies* 23, no. 11 (2010): 3996-4025.

Konar, Shameek, and Mark A. Cohen. "Does the market value environmental performance?" *Review Of Economics And Statistics* 83, no. 2 (2001): 281-289.

Kong, Dongmin, Shasha Liu, and Yunhao Dai. "Environmental policy, company environment protection, and stock market performance: Evidence from China." *Corporate Social Responsibility and Environmental Management* 21, no. 2 (2014): 100-112.

Lam, Hugo KS, Andy CL Yeung, T. C. E. Cheng, and Paul K. Humphreys. "Corporate environmental initiatives in the Chinese context: Performance implications and contextual factors." *International Journal of Production Economics* 180 (2016): 48-56.Lanoie, Paul, Jérémy Laurent- Lucchetti, Nick Johnstone, and Stefan Ambec. "Environmental policy, innovation and performance: new insights on the Porter hypothesis." *Journal of Economics & Management Strategy* 20, no. 3 (2011): 803-842.

Lee, Eungkyoon. "Information disclosure and environmental regulation: green lights and gray areas." *Regulation & Governance* 4, no. 3 (2010): 303-328.

Lim, Stephen S., et al. "A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010." *The Lancet* 380, no. 9859 (2012): 2224-2260.

Luechinger, Simon, and Christoph Moser. "The value of the revolving door: Political appointees and the stock market." *Journal of Public Economics* 119 (2014): 93-107.

Lyon, Thomas P., and Jay P. Shimshack. "Environmental disclosure: Evidence from Newsweek's green companies rankings." *Business & Society* 54, no. 5 (2015): 632-675.

Lyon, Thomas, Yao Lu, Xinzheng Shi, and Qie Yin. "How do investors respond to Green Company Awards in China?." *Ecological Economics* 94 (2013): 1-8.

Michaelides, Alexander, Andreas Milidonis, George Nishiotis, and Panayiotis Papakyriacou. "Sovereign debt rating changes and the stock market." *CEPR Discussion Paper* No. DP8743 (2012).

Molina-Azorín, José F., Enrique Claver-Cortés, Maria D. López-Gamero, and Juan J. Tarí. "Green management and financial performance: a literature review." *Management Decision* 47, no. 7 (2009): 1080-1100.

Oberndorfer, Ulrich, Peter Schmidt, Marcus Wagner, and Andreas Ziegler. "Does the stock market value the inclusion in a sustainability stock index? An event study analysis for German firms." *Journal of Environmental Economics and Management* 66, no. 3 (2013): 497-509.

Patell, James M. "Corporate forecasts of earnings per share and stock price behavior: Empirical test." *Journal Of Accounting Research* (1976): 246-276.

Petrella, Giovanni, and Andrea Resti. "Supervisors as information producers: do stress tests reduce bank opaqueness?." *Journal of Banking & Finance* 37, no. 12 (2013): 5406-5420.

Powers, Nicholas, Allen Blackman, Thomas P. Lyon, and Urvashi Narain. "Does disclosure reduce pollution? Evidence from India's green rating project." *Environmental And Resource Economics* 50, no. 1 (2011): 131-155.

Sarumpaet, Susi, Melinda Lydia Nelwan, and Dian Nirmala Dewi. "The value relevance of environmental performance: evidence from Indonesia." *Social Responsibility Journal* 13, no. 4 (2017): 817-827.

Shane, Philip B., and Barry H. Spicer. "Market response to environmental information produced outside the firm." *The Accounting Review* 58, no. 3 (1983): 521-538.

Takeda, Fumiko, and Takanori Tomozawa. "A change in market responses to the environmental management ranking in Japan." *Ecological Economics* 67, no. 3 (2008): 465-472.

Wagner, Marcus, and Stefan Schaltegger. "The effect of corporate environmental strategy choice and environmental performance on competitiveness and economic performance:: an empirical study of EU manufacturing." *European Management Journal* 22, no. 5 (2004): 557-572.

Wahba, Hayam. "Does the market value corporate environmental responsibility? An empirical examination." *Corporate Social Responsibility and Environmental Management* 15, no. 2 (2008): 89-99.

Wang, Yanbing, Michael S. Delgado, Neha Khanna, and Vicki L. Bogan. "Good news for environmental self-regulation? Finding the right link." *Journal of Environmental Economics and Management* 94 (2019): 217-235.

Wheeler, David, and Sheoli Pargal. Informal regulation of industrial pollution in developing countries: evidence from Indonesia. *The World Bank*, 1999.

Xu, X. D., S. X. Zeng, and Chi Ming Tam. "Stock market's reaction to disclosure of environmental violations: evidence from China." *Journal of Business Ethics* 107, no. 2 (2012): 227-237.

Ziegler, Andreas, and Michael Schröder. "What determines the inclusion in a sustainability stock index?: A panel data analysis for european firms." *Ecological Economics* 69, no. 4 (2010): 848-856.

Ziegler, Andreas, Timo Busch, and Volker H. Hoffmann. "Disclosed corporate responses to climate change and stock performance: An international empirical analysis." *Energy Economics* 33, no. 6 (2011): 1283-1294.

Annexure-1

The methodology utilized by the CSE to rate cement and paper and pulp sectors is described below. This is only a summary whose purpose is to provide an overview and more importantly provide to the reader the exact weights that were assigned to various process and sub-process constituting the life cycle. Refer to CSE website for more details.

Cement

Boundary of rating:

The following aspects have been included for rating the environmental performance of cement companies:

1. Raw material sourcing phase: This includes all issues related to the sustainable sourcing of major inputs. All aspects related to mining of limestone, its management and its environmental and socio-ecological impacts have been considered. Due consideration has also been given to assessing the efforts made by plants to restore the mining lease area to its original state. The sourcing of two other inputs — water and energy — has also been assessed.
2. Production and conversion phase: All operations from raw material processing to production of clinker and cement have been covered in this phase and include the packaging section. Utilities are included as essential ancillary plants under the rating exercise. Technology, eco-efficiency, environmental management practices, storage and handling of major raw materials and pollution generation, prevention and control during the production process are the rating criteria.
3. Product use and disposal phase: This phase mainly assesses the products promoted and their environmental implications.

The indicators have been divided into the following broad categories:

Indicator	Weightage Assigned (%)	
a.) Life Cycle Assessment		77.5
-Mining	25	
-Production Plant and Pollution	52.5	
b.) Environmental and Occupational health policy and management system		10
c.) Compliance and Stakeholder Perception		12.5

Paper and pulp

Rating criteria and weights: maximum weightage has been assigned to the production phase because major pollution is generated at that stage

Segments	Weightage Assigned (%)	
a.) Life Cycle Analysis		77.5
- Raw Material Sourcing Phase	11.5	
- Production and Conversion Phase	66.0	
b.) Corporate Environment Policy and Management System		10.0
c.) Local community and GRN surveyor perception		12.5

Source: CSE, New Delhi

Annexure-2

This section gives a list of all plants rated, their score and the green award they earned. The one with the star mark are those whose parent firms are not listed on the stock exchange or those whose stock prices are not available for the relevant event window.

A. Iron and Steel

Plant Name	Score (%)	Leaves
Ispat Industries Raigad, Maharashtra	40	3
Essar Steel, Hazira, Gujarat *	39	3
Rashtriya Ispat Nigam, Vishakhapatnam, Andhra Pradesh *	36	3
Neelachal Ispat Nigam, Kalinganagar, Odhisa *	33	2
Tata Steel, Jamshedpur, Jharkand	32	2
JSW Steel, Vijayanagar, Bellary, Karnataka	27	2
Visa Steel, Kalinganagar, Odhisa	26	2
Godavari Power and Ispat, Raipur, Chattisgarh	26	2
Jindal Steel and Power, Raigarh, Chattisgarh	24	1
Jai Balaji Industries, Durgapur, West Bengal	23	1
SAIL, Rourkela, Odisha	21	1
Bhushan Power and Steel, Sambalpur, Odisha *	20	1
Usha Martin, Jamshedpur, Chattisgarh	15	1
Welspun Maxsteel, Raigad, Maharashtra *	9	0
SAIL, Bhilai, Chhattisgarh	9	0
SAIL, Durgapur, West Bengal	7	0
SAIL, Bokaro, Jharkhand	7	0
Jayaswal Neco Industries, Raipur, Chhattisgarh	4	0
SAIL Iisco Burnpur, West Bengal	3	0
Monnet Ispat and Energy, Raigarh, Chhattisgarh	3	0
Bhushan Steel, Dhenkanal, Odisha	2	0

B. Cement

Plant name	**Score (%)**	**Leaves**
Lakshmi Cement	46	3
ACC-Gagal Cement Works	46	3
ACC-Wadi Cement Works	33	2
ACC-Jamul Cement Works	31	2
ACC-Kymore Cement Works	29	2
GACL-Gujarat Unit	48	3
GACL-Darlaghat Unit	45	3
GACL-Maratha Cement Works	39	3
GACL- Rajasthan Unit	34	2
Andhra Cements-Durga Cement Works	20	1
Binani Cement *	40	3
Birla Corporation: Chittor Cement Works	31	2
Birla Corporation: Satna Cement Works and Birla Vikas Cement	29	2
CTIL-Manikgarh Cement	30	2
CTIL-Maihar Cement	0	0
Chettinad Cement Corporation	40	3
GIL -Grasim Cement	40	3
GIL-Aditya Cement	38	3
GIL-Rajashree Cement	35	3
GIL-Vikram Cement	33	2
Gujarat Siddhee Cement	29	2
India Cement – Shankarnagar Unit	0	0
India Cement – Vishnupuram Unit	0	0
Jaypee Cement- Bela Unit	35	3
Jaypee Cement- Rewa Unit	27	2
JK Synthetic – Cement Division	0	0
Vasavadatta Cement	37	3
Lafarge India *	42	3
Diamond Cement	0	0
OPIL-Orient Cement	30	2
Prism Cement	46	3
MCL-Alathiyur Factory	51	4
MCL-Jayanthipuram Factory	32	2
Sanghi Industries (Cement Division) *	40	3
Saurashtra Cement	34	2
Shree Cement	29	2
UCL- Andhra Pradesh Cement Works	43	3
UCL-Gujarat Cement Works	39	3
UCL-Hirmi Cement Works	34	2
UCL-Awarpur Cement Works	29	2
Zuari Cements *	30	2

C. Paper and Pulp

C1. Paper and Pulp Plant ratings: [22 plants rated both times]

	Plant	1st Scorecard (1999)			2nd Scorecard(2004)		
		Score(%)	Rank	Leaves	Score(%)	Rank	Leaves
1	JK Paper Mills	42.75	1	3	45.3	2	3
2	Andhra Pradesh Paper Mills	38.5	2	3	30.6	11	2
3	BILT-Ballarpur Unit	33.44	3	2	28.6	13	2
4	Hindustan Newsprint *	33.3	4	2	33.6	8	2
5	Pudumjee Pulp and Paper	31.44	6	2	19.2	24	1
6	Tamil Nadu Newsprint	31.4	7	3	41.3	4	3
7	ITC .-Bhadrachalam Unit	31.15	8	2	47	1	3
8	Century Pulp and Paper	31.07	9	2	32.3	10	2
9	HPCL: Nagaon Paper Mill *	28.7	10	2	24	20	1
10	Seshasayee Paper and Boards	28.2	11	2	28.8	12	2
11	West Coast Paper Mills	27.67	12	2	25.8	16	2
12	BILT-Shree Gopal Unit	25.7	14	2	25.6	17	2
13	Central Pulp Mills	25.35	15	2	25.4	18	2
14	Star Paper Mills	24.76	16	1	24.2	19	1
15	BILT-Sewa Unit	23.75	18	1	20.9	22	1
16	Orient Paper Mills	22.1	19	1	27.2	15	2
17	Mysore Paper Mills *	21.6	20	1	18.7	25	1
18	HPCL: Cachar Paper Mill *	21.43	21	1	20.7	23	1
19	Rama Newsprint	21.1	22	1	33.8	7	2
20	ABC Paper *	19.01	27	-	20.9	21	1
21	BILT-Asthi Unit, Maharashtra	27.1	13	2	33.1	9	2
22	Sinar Mas Pulp & Paper (India) , Maharashtra (rank and leaves not reported by CSE for 1st scorecard)	37.4	#	#	45.2	3	3

* either not listed on the stock market or stock prices are not available

C2.Paper and Pulp plants rated only in 1999

1	South India Viscose Industries , Tamil Nadu	31.73	5	2			
2	Shree Vindhya Paper Mills , Maharashtra	24.7	17	2			
3	BILT-Chaudwar Unit, Orissa	21.06	23	1			
4	Nath Pulp & Paper Mills , Maharashtra	20.8	24	1			
5	Grasim Industries (Mavoor), Kerala	20.65	25	1			
6	Mukerian Papers, Punjab	20.01	26	1			

C3.Paper and Pulp plants rated only in 2004

1	Harihar Polyfibres				40.3	5	3
2	BILT-AP Rayons				36.2	6	3
3	Daman Ganga Papers *				27.4	14	2
4	Coastal Papers				15.3	26	1
5	Emami Paper Mills *				14.1	27	No leaves
6	Chadha Papers *				0	28	No leaves
7	Sirpur Paper Mills				0	28	No leaves
8	Satia Paper Mills *				0	28	No leaves

C4. 22 common plants of which stock prices available for 17 (belong to 12 parent firms)
Plant to parent firm mapping

	Plant Name	**Parent Company Name**
1	JK Paper Mills	JK Paper
2	Andhra Pradesh Paper Mills	International Paper
3	Sinar Mas Pulp & Paper (India) , Maharashtra	Ballarpur Industries .
4	BILT-Ballarpur Unit	Ballarpur Industries .
5	Hindustan Newsprint *	NA
6	Pudumjee Pulp and Paper	Pudumjee Pulp & Paper Mills .
7	Tamil Nadu Newsprint	Tamil Nadu Newsprint & Papers .
8	ITC .-Bhadrachalam Unit	ITC
9	Century Pulp and Paper	Century Textiles & Inds. .
10	HPCL: Nagaon Paper Mill *	NA
11	Seshasayee Paper and Boards	Seshasayee Paper & Boards .
12	West Coast Paper Mills	West Coast Paper Mills .
13	BILT-Asthi Unit, Maharashtra	Ballarpur Industries .
14	BILT-Shree Gopal Unit	Ballarpur Industries .
15	Central Pulp Mills	JK Paper
16	Star Paper Mills	Star Paper Mills .
17	BILT-Sewa Unit	Ballarpur Industries .
18	Orient Paper Mills	Orient Paper & Inds. .
19	Mysore Paper Mills *	NA
20	HPCL: Cachar Paper Mill *	NA
21	Rama Newsprint	Shree Rama Newsprint .
22	ABC Paper *	NA

C5. Common plants and their parent firm rating

	Firm Name	Leaf 1999	Leaf 2005
1	JK Paper	3,2 = 2	3,2 = 2
2	International Paper	3	2
3	Ballarpur Industries .	3,2,2,2,1 = 2	3,2,2,2,1 = 2
4	Pudumjee Pulp & Paper Mills .	2	1
5	Tamil Nadu Newsprint & Papers .	3	3
6	ITC	2	3
7	Century Textiles & Inds. .	2	2
8	Seshasayee Paper & Boards .	2	2
9	West Coast Paper Mills .	2	2
10	Star Paper Mills .	1	1
11	Orient Paper & Inds. .	1	2
12	Shree Rama Newsprint .	1	2
	TOTAL PLANTS	17	17

C6. Firm level cross tabulation

	1999	Leaves					
2004		All	0	1	2	3	4
Leaves	All	12		3	6	3	
	0						
	1	2		1	1		
	2	7		2	4	1	
	3	3			1	2	
	4						

C7. Plant level cross tabulation

	1999	Leaves					
2004		All	0	1	2	3	4
Leaves	All	22		7	12	3	
	0						
	1	7		5	2		
	2	11		2	8	1	
	3	*4*			*2*	*2*	
	4						