

How does capital market respond to Certified Emission Reductions (CERs) announcements in India

An event study methodology

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Abstract

Purpose – The purpose of this paper is to analyze the relationship between Certified Emission Reductions (CERs) information and a firm's stock prices.

Design/methodology/approach – The present study is based on 193 CERs announcements by Indian firms over a 13-year period 2005–2017. The event study methodology is used to examine the impact of CERs announcements on a firm's share prices.

Findings – The study suggests that the issuance of CERs did not produce any significant abnormal return. More specifically, the outcomes of event study shows that over a two-day event window from the event day to the day after the event (i.e. days 0 to 1), the mean and median of AARs are –0.25 and –0.34 percent, respectively. The abnormal returns on day 1 are not statistically significant as per the *t*-test. Moreover, the mean and median of abnormal returns after one day (–1) are negative, indicating that investors react negatively to CERs announcements. However, the mean and median of CAARs over both the two-day (i.e. days –1 to 0 and days 0 to +1) and three-day (i.e. days –1 to +1) event windows are positive, but not statistically significant based on the *t*-test.

Research limitations/implications – The findings of the study are quite comprehensive, relatively used only market-based criteria of a firm's financial performance, e.g., share price, at times, inhibits generalizing the results.

Originality/value – To the best of the author's knowledge, the present study is a first of its kind to investigate the relationship between the CERs information and a firm's stock prices.

Keywords India, Event study, CDM, UNFCCC, Stock price

Paper type Research paper

1. Introduction

The impact of the environmental performance of an enterprise on its financial health' has become a matter of growing concern to investors, creditors, government and public at large (Khanna *et al.*, 1998; Al-Tuwaijri *et al.*, 2004; Clarkson *et al.*, 2008; Saka and Oshika, 2014; Matsumura *et al.*, 2014; Kumar and Firoz, 2018a). Instruments like carbon credits give rise to mitigate the corporate carbon footprint through its trading. It can be exchanged among the businesses or can be purchased in the international markets at the prevailing market rate. Carbon trading has drastically transformed the international trade in a creative way by taking care of the sustainable development of developing countries as well as by helping developed countries to comply with their commitment under the Kyoto protocol (Kumar and Firoz, 2016). The carbon trading system gives the financial value to each tone of emissions saved (Carbon Credit). So, the carbon credit announcements can affect a firm's cash inflow in the future and alter the firm's profitability and stock market price. The existing literature exhibits that there is a positive association between emission credit and stock market return of the firms (Oberndorfer, 2009; Jacobs *et al.*, 2010; Hsu and Wang, 2013; Gabbi *et al.*, 2015; Da Silva *et al.*, 2016; Brouwers *et al.*, 2016; Moreno and da Silva, 2016). The financial implications of carbon credit earned by corporate houses need to understand early signs of mitigating climate change. We made an attempt to examine whether issuance of carbon credit affects firms' stock performance in the market.



Conducting an event study of 193 CERs announcements of Indian firms over a 13-year period 2005–2017, this study found that Indian investors react negatively to carbon credit announcements. More specifically, over a two-day event window from the event day to the day after the event (i.e. days 0 to 1), the mean and median of average abnormal returns (AARs) are -0.25 and -0.34 percent, respectively. The abnormal returns on day 1 are not statistically significant for the t -test. This suggests that there is no evidence of information leakage before CERs announcements (-1). Moreover, the mean and median of abnormal returns after one day (-1) are negative, indicating that investors react negatively to CERs announcements of Indian companies. However, the mean and median of cumulative abnormal returns (CARs) over both the two-day (i.e. days -1 to 0 and days 0 to $+1$) and three-day (i.e. days -1 to $+1$) event windows are positive but not statistically significant based on the t -test. Thus, CERs information did not produce any significant AARs and CAARs during the event window.

The current examination contributes to the carbon accounting field in three ways: first, we focus on one of the fastest-emerging economies named India, which is also fourth largest emitter after China, the USA, and the European Union in the world (Kumar and Firoz, 2018b). Second, previous literature typically used multivariate analysis to analyze the impact of carbon credit on firms' stock return (Anger and Oberndorfer, 2008; Oberndorfer, 2009; Guenster *et al.*, 2010), a very few studies have used event study to know the impact of carbon credits on firms' stock performance. This research also fills this gap in the literature. Lastly, prior studies have produced mixed results for the effects of carbon emission credit on corporate stock price performance. Some studies have found a positive correlation between the two variables (Oberndorfer, 2009; Brouwers *et al.*, 2016). On the other hand, some researchers found no/negative relationship between carbon emission credit and firms' stock price (Moreno and da Silva, 2016; Veld-Merkoulova and Viteva, 2016; DaSilva *et al.*, 2016). Therefore, this study provides a shred of further evidence on the relationship between carbon emission credit and corporate stock price performance.

The structure of this paper is as follows: Section 2 reviews the relevant literature; Section 3 describes the data sources. This section also gives a description of the event study methodology in detail that is used for the empirical analysis of this study. Our empirical results are included in Section 4, and Section 5 contains the concluding remarks.

2. Literature review

A literature review is an integral part of conducting any research. It is a critical analysis of the prior studies related to a specific topic or research question. The current study is focused on the impact of CERs information on firms' stock performance. For this purpose, this section will discuss the relevant literature.

Smale *et al.* (2006) found that an emissions reduction under EU-ETS has a positive (or at least non-negative) impact on earnings before interest, tax, depreciation and amortization (EBITDA). On the contrary, Anger and Oberndorfer (2008) analyzed a large sample of German companies (419 observations) within the EU-ETS in 2005. This study suggested that the actual allocation within the EU-ETS framework in the first phase did not have a significant impact on revenues and employment. More importantly, Oberndorfer (2009) examined 12 power sector firms' data from August 4, 2005 to June 19, 2007. This investigation reported that the emission allowances price increases (decreases) positively (negatively) affect capital market returns from the selected electricity firms affected under the EU-ETS. However, the effect differs from nation to nation. In a subsequent study, Jacobs *et al.* (2010) also analyzed a sample of 780 announcements (417 Corporate Environmental Initiatives (CEI) and 363 Environmental Awards and Certifications (EAC) announcements) spanning 340 unique firms for the sample period

2004–2006. The outcomes of the event study indicate that the stock market did not react significantly to aggregated CEI and EAC announcements.

Yu (2011) analyzed a sample of 216 Swedish energy companies in 2005 and 2006. Using the treatment/control, before/after the design of the natural experiment method, this study found no significant impact of the introduction of the EU-ETS on the profitability of Swedish energy companies in 2005 and a negative significant impact in 2006. In the same vein, Abrell *et al.* (2011) analyzed the impact of the EU-ETS using emissions and financial data of more than 2,000 European firms. This paper indicates that the shift from the first phase (2005–2007) to the second phase (2008–2012) had an impact on the emission reductions carried out by companies. Finally, this investigation reported that the EU-ETS at most modestly affected profits, employment, and the added value of regulated companies. Furthermore, Mo *et al.* (2012) reported that the carbon allowances price developments have affected the firm value in opposite directions: in phase I, the increase in EUA (European Union Allowances) prices tended to cause corporate value appreciation, whereas in phase II, it was more likely to induce depreciation. Moreover, the company value development has been much more sensitive to changes in emission allowances prices in phase II than in phase I. Finally, this study reported that the EUA price variations have resulted mainly from the adjustment of the EUA allocation policy between phases I and II.

Bushnell *et al.* (2013) studied 552 stocks from the EURO STOXX index. This investigation found that several industries benefited from the EU-ETS rather than being hurt by the imposition of CO₂ regulation. Indeed, when CO₂ prices fell (a relaxation of regulation), the sharpest declines in share prices occurred within industrial sectors that were the most carbon intensive. In addition to raising costs, CO₂ regulation can “pass-through” to affect the prices of the goods sold and companies’ profits. In addition, Ye *et al.* (2013) analyzed a sample of 768 Chinese companies for the year 2011. This paper presented a piece of new evidence that the carbon emission rights trading scheme increases the market value of energy-related companies; moreover, the energy-saving efforts of companies further influence their market value and investor reaction.

Jaraite and Di Maria (2014) studied 5,000 Lithuanian companies between 2003 and 2010. This article showed that EU-ETS did not represent a drag on the profitability of participating companies. Later, Gabbi *et al.* (2015) conducted the interviews with managers and the examination of the sustainability and financial reports of a Brazilian company classified as large according to Brazilian Development Bank (BNDES) 2012 criteria. This study reported that the revenue obtained from the sale of carbon credit positively affected the financial results of the company. Furthermore, at the initial outlay of CDM project, the company was negative in its profitability indicators; however, over the years, the investments began to generate revenue, demonstrating the trend that the values obtained with CO₂ commercialization remunerate the investments over time. In the same vein, Oestreich and Tsiakas (2015) mentioned that, during the initial years of the EU-ETS, companies that received emission credits on average significantly outperformed in the capital market and carbon premium in stock returns can be as high as 17 percent per year. However, Da Silva *et al.* (2016) found that the EUA price change does not have short-run effects on stock market returns of 13 Spanish power industry sector during both EU-ETS phases.

Brouwers *et al.* (2016) reported that verified emissions announcements only resulted in statistically significant market responses when the carbon price was high and allowance scarcity was anticipated. Moreno and da Silva (2016) depicted the impact of EUA prices on the profitability of firms is ambiguous, as the amplitude of the effect of EUA price changes on stock market returns depends mostly on sector-specific characteristics. Similarly, Veld-Merkoulova and Viteva (2016) revealed that the EU carbon trading scheme has not been very effective to achieve its aims of motivating firms to control their emissions.

Most of the verification events in 2006–2011 did not significantly affect stock returns. However, Tian *et al.* (2016) reported that the stock market tends to positively respond to emission allowances price changes for those producers that use predominately green energy in their generation.

3. Research methodology

3.1 Sample selection

The sample of this study comprises all firms listed on the Bombay Stock Exchange (BSE) with CERs announcements over the period 2005–2017, with the necessary financial and share price data available from the Capitaline database. We fetched CERs announcements information from two sources: formal announcements released by Clean Development Mechanism (http://cdm.unfccc.int/Issuance/cers_iss.html) under United Nations Framework Convention on Climate Change (UNFCCC); and announcements published in the financial press, specifically for listed firms. The announcements related to the CERs were sourced from the major Indian and International news databases named Factiva, EMIS, LexisNexis Academic, India Business Insight, Yahoo Finance and Google News by searching for the following keywords: “Carbon credit,” “Carbon trading,” “Certified emission reductions (CERs),” “Clean development mechanism (CDM),” “Emission credit,” “Emission trading,” “Kyoto protocol,” or “United Nations Framework Convention on Climate Change (UNFCCC)” (Table I).

This process yielded an initial sample of 1,863 carbon credit announcements. These announcements were then read to eliminate irrelevant and duplicate announcements. The present study excluded 1,136 carbon credit announcements related to non-listed firms. In order to remove the association bias, this analysis also excluded 119 projects/announcements in which more than two companies were involved. Furthermore, this study also excluded 406 CERs announcements whose announcements were not published in the financial press. Additionally, announcements for nine companies without the requisite share price or financial data were eliminated. The final sample comprised 193 announcements. Table II summarizes the sample selection process.

3.2 Event study

In order to investigate how the CERs announcements affect firms’ stock prices of CDM participating Indian companies, this study used the market model to predict the abnormal return around the event date under event study methodology framework. The study uses BSE Sensex as a proxy measure of the market portfolio over a 252-day estimation period. The estimation window is the period within which this study estimates how security normally relates to the market by adopting the market model. Using the estimation window also allows us to study the investors’ response to the event. The event window comprises of 21 days (10 days prior to the announcement and 10 days’ post announcement). The announcement date is designated as day “0” in the event period. More specifically ($T_0 - 10$, $T_0 + 10$) is used, which is a commonly used event window because a longer window cannot distinguish investor reaction from other events or market noise (Ye *et al.*, 2013).

For calculating the effect of the announcement of carbon credit on share price, the market model has been used. Under this model, abnormal return is calculated:

$$\text{Abnormal Return} = \text{Actual Return} - \text{Expected Return}. \quad (1)$$

Abnormal return is a term used to explain the returns generated by a given stock or portfolio over a period of time that is different from the expected rate of return. It is important in determining security or portfolio’s risk-adjusted performance when compared to the overall market or a benchmark index. Abnormal returns could assist to determine a

Table I.
Description of
secondary databases

Database	Description	Website
Factiva	Factiva is a business information and research tool owned by Dow Jones & Company. Factiva aggregates content from both licensed and free sources and provides organizations with search, alerting, dissemination and other information management capabilities. Factiva products provide access to more than 32,000 sources (such as newspapers, journals, magazines, television and radio transcripts, photos, etc.) from nearly every country worldwide in 28 languages, including more than 600 continuously updated newswires	https://global.factiva.com/sb/default.aspx?hrep=hp
EMIS	The Emerging Markets Information System (EMIS) brings time-sensitive, hard-to-get, relevant news, research and analytical data, peer comparisons and more for over 125 emerging markets. The EMIS is a new database within the ISI Emerging Markets Group. This provides a unique blend of analysis, data and news on companies, industries and countries. It is formed over 20 years ago and employs nearly 300 people in 13 countries around the world, providing intelligence to nearly 2,000 clients	www.emis.com/
Lexis Nexis Academic	LexisNexis® Academic is a leading global provider of content-enabled workflow solutions designed specifically for professionals in the legal, risk management, corporate, government, law enforcement, accounting and academic markets. Part of Reed Elsevier, LexisNexis Legal & Professional serves customers in more than 175 countries with 10,000 employees worldwide. Across the globe, LexisNexis provides customers with access to billions of searchable documents and records from more than 45,000 legal, news and business sources	www.lexisnexis.com/hottopics/lnacademic/
India Business Insight	India Business Insight is the first and only comprehensive desk-research tool to Indian business and industry information. It captures its knowledge base from more than 325 sources which encompass daily newspapers, magazines and accesses information disseminated through Government sources. It monitors information on listed and unlisted companies, government bodies, topics, industries, and people that matter the most for an organization. The database has 1,574,780 business stories summarized and compiled since 1993 and adds over 80,000 records every year. The database has an index of 96,320 organizations under 44 industry segments and 12,220 products. Besides, articles of the database are indexed under 75 Business Concepts	http://indiabusinessinsight.com
Yahoo Finance	Yahoo! Finance is a media property that is part of Yahoo!'s network. It provides financial news, data and commentary including stock quotes, press releases, financial reports and original content. It also offers some online tools for personal finance management. In addition to posting partner content from a wide range of other websites, it posts original stories by its team of staff journalists	https://in.finance.yahoo.com/
Google News	Google News is a news aggregator and app developed by Google. It presents a continuous, customizable flow of articles organized from thousands of publishers and magazines	https://news.google.com
Capitaline	Capitaline Plus is a state of the art and comprehensive corporate database. Being aesthetic, with powerful aggregation and querying facilities, and strict data validation procedures, covers more than 9500 companies providing financial and non-financial information details pertaining to a company, updated on daily basis ensuring latest financials	www.capitaline.com/SiteFrame.aspx?td=1

portfolio manager's skill on a risk-adjusted basis and whether investors were adequately compensated for the amount of risk assumed.

Expected return is the amount of profit or loss an investor anticipates on an investment that has a various known or expected rates of return. It is calculated by multiplying potential outcomes by the chances of them occurring and summing these results:

$$AR_{it} = R_{it} - \alpha_i - \beta_i R_{mt}, \quad (2)$$

Where, AR_{it} is the abnormal return on security i for day t , and R_{mt} is the return on a stock to day t . Further, α_i and β_i are intercept and slope respectively. They are computed as follows:

$$R_{it} = \alpha_i + \beta_i R_{mt} + e_{it}. \quad (3)$$

For computing the values of R_{mt} and α_i , β_i , the investigation uses the BSE Sensex as a proxy measure of a security.

The daily AARs are cumulated over the window period to calculate the CAR as follows:

$$CAR = \sum_{t=-d}^d AARs_{it}. \quad (4)$$

where $-d$ and d represent the event window period.

4. Empirical analysis and discussion

4.1 Analysis of "aggregated full" sample of all 193 CERs announcements

Figure 1 depicted the analysis of AARs for "aggregated full" sample of all 193 CERs announcements. It is clear from Figure 1 that the majority of CERs announcements did not produce any significant abnormal returns during the event window. Thus, the existence of statistically significant abnormal returns is rejected and all sample stocks reflect random fluctuations in the movement of AARs on announcement day. However, Figure 2 shows that the majority of CERs announcements produced significant CARs during the event window. More specifically, analysis of CARs w.r.t. CERs announcements (pre and post) statistically significant at the 5 percent level of significance.

The t -test results of abnormal returns are presented in Table III. Conducting an event study of 193 CERs announcements of Indian firms over a 13-year period 2005–2017, this study found that Indian investors react negatively to carbon credit announcements. More specifically, over a two-day event window from the event day to the day after the event (i.e. days 0 to 1), the mean and median of AARs are -0.25 and -0.34 percent, respectively.

Sample selection procedures	No. of CERs announcements
Initial sample of total Indian projects received Carbon credits under United Nations Framework Convention on Climate Change (UNFCCC) (up to March 31, 2017)	1,863
Exclude Non-Listed Companies issuance projects announcements	–1,136
Exclude projects in which more than two companies were involved (to remove association bias)	–119
Total new announcements	608
Exclude firms missing CERs Announcements news data from Factiva, EMIS, LexisNexis Academic, India Business Insight, Yahoo Finance and Google News	–406
Exclude firms missing share price data in Capitaline (firms which not available in the 252-day estimation period)	–09
Final sample of CERs issuance announcements	193

Table II.
The determining reasons for the inclusion of sample announcements in the analysis

Figure 1.
Event specific
abnormal returns
(ARs) of all stocks
on CERs
announcement day

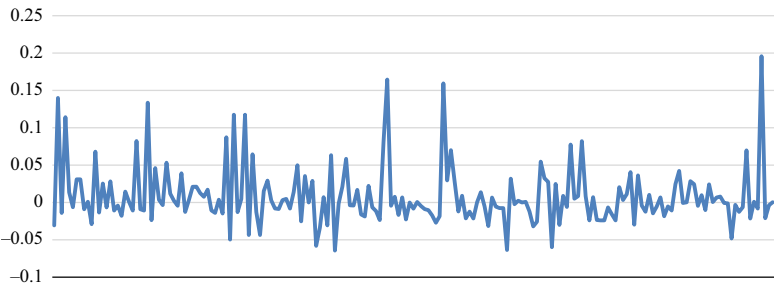


Figure 2.
Event specific
cumulative abnormal
returns (CARs) of all
stocks on CERs
announcement day

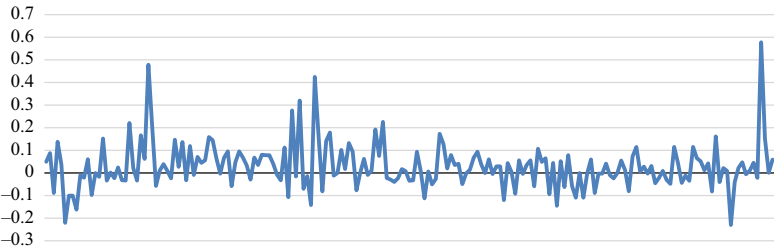


Table III.
t-test results of
abnormal returns
and cumulative
abnormal returns

<i>Panel A</i>				
Average abnormal returns				
Day	<i>N</i>	Mean ARs	Median ARs	<i>t</i> -test
-1	193	0.00354434	0.00131734	0.07231
0	193	0.0082024	-0.00004527	0.21563
1	193	-0.0025665	-0.0034771	-0.1699
<i>Panel B</i>				
Cumulative average abnormal returns				
Day	<i>N</i>	Mean CARs	Median CARs	<i>t</i> -test
-1	193	0.02114558	0.652589173	0.885067748
0	193	0.029311482	0.702344887	1.127092584
1	193	0.026835881	0.658146931	0.985695363
Note: *Significant at the 5 percent level				

Table IV.
Average Abnormal
Returns, Cumulative
Average Abnormal
Returns and *t*-values
of all stocks during
21 days' event window

Days	AARs	<i>t</i> -test	CAARs	<i>t</i> -test
-10	0.001153861	0.067584311	0.001143265	0.067590999
-9	0.002911095	0.136293396	0.003994043	0.200668417
-8	0.003333158	0.144128704	0.007293676	0.33811685
-7	-0.002080673	-0.077617265	0.005537013	0.287439361
-6	0.00361258	0.091756287	0.00920332	0.397333874
-5	0.005242949	0.176305801	0.014366743	0.606418865
-4	0.000264116	-0.004816381	0.01474994	0.640296617
-3	0.001124768	0.011727687	0.01597025	0.688088204
-2	0.001753094	0.081284065	0.017639141	0.791037373
-1	0.003544342	0.072309666	0.02114558	0.885067748
0	0.008202404	0.215631467	0.029311482	1.127092584
1	-0.002566534	-0.169909775	0.026835881	0.985695363
2	2.01486E-05	-0.032099807	0.026951136	0.980491367
3	-0.002142848	-0.150318704	0.025080361	0.869154477
4	0.002936687	0.06337186	0.027898532	0.958370549
5	0.000509232	-0.04301078	0.028292537	0.943102896
6	-3.21374E-05	0.006529965	0.028277313	0.994595517
7	-0.000296645	-0.054962092	0.028227081	1.001959701
8	0.000359009	-0.042012777	0.028286165	0.991905524
9	0.001453575	-0.044675704	0.029913467	0.994364919
10	-0.000264084	-0.04886806	0.029743215	0.984660225

Note: *Significant at the 5 percent level

of significance. Thus, CERs information did not produce any significant AARs and CAARs during the event window (Figure 3).

4.1.1 Analysis of AARs. It is observed that on the day of the announcement and the day following it, AARs is not statistically significant at the 5 percent level of significance. This implies that the carbon credit announcements have no effect on the stock prices for these two particular event days. Furthermore, it is observed that during the pre-announcement period, the majority of AARs are positive but not statistically significant on the event days (from $t = -1$ to $t = -10$) (see Table IV). This means that the market had reacted normally to carbon credit information prior to the actual announcement. This could possibly be attributed to no information leakage prior to the actual announcement. Graphical analysis of AARs (Figure 3) shows that AARs attains the maximum positive value on the day prior to CERs announcement, i.e. $t = -1$. Following the announcement, AARs turns into negative values (but not statistically significant) on $t = 0$ and $t = 1$ (Figure 3). This implies a negative impact of CERs announcement on the “aggregated full” sample. CERs announcements do not lead to a statistically significant

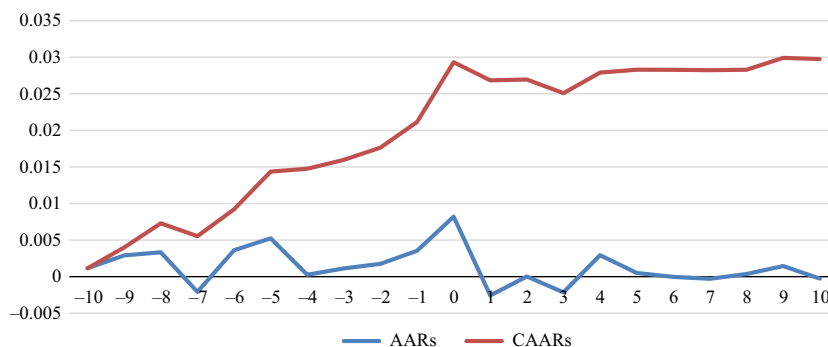


Figure 3.
Average abnormal
returns (AARs) and
cumulative average
abnormal returns
(CAARs) of stocks
during event window

AARs for the majority of the days in the event window in the case of “aggregated full” sample. This observation is true during the booming as well as recessionary market conditions.

4.1.2 Analysis of CAARs. The CAARs, for all event days in the event window, is found to be positive but insignificant at the 5 percent level of significance. This implies that the market participant cannot act on carbon credit information to earn an AARs during the event window (see Table IV). Graphical analysis of cumulative AARs (Figure 3) reflects that CAARs drifts up during the period from $t = -10$ to $t = 0$; thereafter, it gradually drifts down in the period from $t = +1$ to $t = +3$ (Figure 3). It is observed that for all event days, AARs are insignificant. This seems that, for the “aggregated full” sample, the CERs announcements have no impact on security prices.

4.2 Industry-specific analysis of average abnormal returns (AARs) and cumulative average abnormal returns (CAARs) of carbon credit announcements

As discussed earlier this investigation conducted an event study of 193 CERs announcements of Indian firms over a 13-year period 2005–2017. In order to gain new insights into how stock prices of a particular industry react to these CERs announcements, this study runs a separate event study for each participating industry such as chemical industry, energy demand, energy demand and manufacturing Industries, energy industries (renewable/non-renewable sources, Fugitive emissions from production and consumption of halocarbons and sulphur hexafluoride, manufacturing industries, waste handling and disposal agriculture and others (see Table V). Table V portrays the industry-specific abnormal returns (AARs) and CAARs and values and t -values of all stocks during 21 days’ event window.

It can be seen in Table V that the Chemical industry has reacted most negatively to the CERs announcements during 21-day event window followed by waste handling and disposal industries. However, it is shown in Figure 4 that the rest of the industry sector does not produce any statistically significant AARs and CAARs at the 5 percent level of significance. More specifically, these findings provide evidence that the CERs announcements have no effect on the stock prices of all eight industry sectors covered under this study.

4.3 Activity scale specific analysis of average abnormal returns (AARs) and cumulative average abnormal returns (CAARs) of carbon credit announcements

T -values of further analysis of CERs announcements on the basis of activity scale as large activity scale and small activity scale are shown in Table VI. It can be seen in Table VI that neither large nor small activity scale produces any statistically significant AARs and CAARs at the 5 percent level of significance. The activity-scale-specific AARs and CAARs are also shown in Figure 5 over the 21-days event window. The further analysis of the activity scale also revealed that the carbon credit issuance does not significantly influence the stock prices of the listed Indian firms.

4.4 Kyoto protocol phase specific analysis of average abnormal returns (AARs) and cumulative average abnormal returns (CAARs) of carbon credit announcements

Additional analysis is being done to gain more useful insights into how share prices of Indian listed firms react to CERs information during each phase of Kyoto protocol such as trial phase: phase I and phase II. It is shown in Table VII that on the day of the announcement and the day before and days following it, the t -value of AARs and CAARs is not statistically insignificant at the 5 percent level of significance in all phases. The graphical analysis (Figure 6) reflects that AARs and CAARs drift up during the period from $t = -10$ to $t = 0$; thereafter, it gradually drifts down in the period from $t = +1$ to $t = +3$ (Figure 6). It is observed that for all event days AARs are insignificant. This seems that, for the “aggregated full” sample, the CERs announcements have no impact on security prices.

Days	1	2	3	4	5	6	7	8
-10	0.360048869	0.01065421	0.116806599	0.067584311	0.080061504	0.119485248	-0.05953	0.143066841
-9	0.226127453	0.11975072	0.144455124	0.136293396	0.118046439	0.138472019	1.119419	0.089601448
-8	-0.006492929	0.285232322	0.149892495	0.144128704	0.11788293	0.134016779	-0.14773	0.1288604
-7	-0.267573817	0.272735444	-0.073636553	-0.077617265	-0.096075862	-0.074889952	0.565779	-0.017151041
-6	-0.280352562	0.432589737	0.149037024	0.091756287	0.100941535	0.179668937	0.190821	0.246024822
-5	0.120405787	0.261344105	0.191342795	0.176305801	0.176517891	0.194047661	-0.2405	0.281169392
-4	0.1042804	-0.225898903	0.018752108	-0.004816381	-0.053797518	-0.013738788	-1.40705	-0.077320044
-3	-0.118943367	0.199512531	0.073448785	0.011727687	0.042731672	0.097281529	-1.11552	0.084123659
-2	-0.119787277	0.220882632	0.091064493	0.081284065	0.032981131	0.056891726	2.049404*	0.090911504
-1	-0.110928816	0.23040055	0.086665259	0.072309666	0.085203585	0.093784584	-0.0082	0.043175456
0	0.031654878	0.247256166	0.209206825	0.215631467	0.2322326023	0.188330209	0.569142	0.170282383
1	-0.143765098	0.12490287	-0.131629247	-0.169909775	-0.151808517	-0.128463468	0.170708	-0.1388306
2	0.138467356	0.056131018	0.02210375	-0.032099807	-0.044855314	0.008133551	-0.48401	-0.007285638
3	-0.363267138	-0.077581272	-0.190579362	-0.150318704	-0.168527042	-0.171428266	-0.82752	-0.064360291
4	-0.011201112	0.344975453	0.068775929	0.06337186	0.082633376	0.115373931	0.304957	0.163977232
5	0.058527036	0.066902805	0.023015436	-0.04301078	-0.013337329	0.010647516	-1.27626	0.02616299
6	-0.190064627	-0.040872143	0.002927877	0.006529965	-0.007465678	-0.011026006	2.013236*	-0.02677351
7	-0.060717462	-0.057432042	-0.026365192	-0.054962092	-0.042240364	-0.050564057	-0.13026	0.019146731
8	-0.097812466	0.021964183	-0.022018184	-0.042012777	-0.061161812	-0.048508563	-1.69758	0.003300793
9	0.170847326	-0.0776893	-0.07439606	-0.044675704	-0.065627533	-0.05910989	1.067759	-0.014271214
10	-0.295934283	0.055005207	-0.054375763	-0.04486806	-0.081736249	-0.056177211	1.563764	-0.051192268

Note: *Significant at the 5 percent level

Table V.
Industry specific
t-values (AARs) of all
stocks during 21 days'
event window

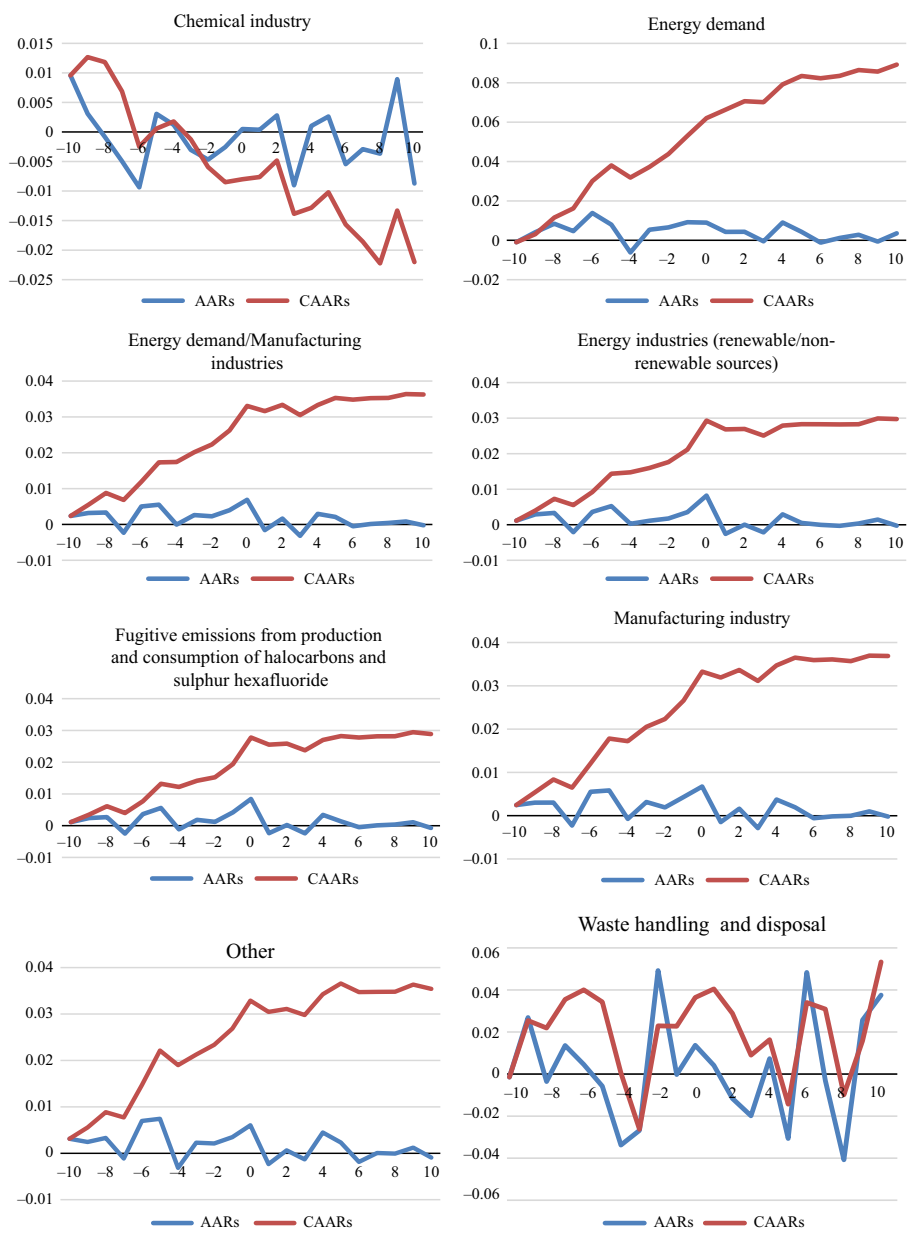


Figure 4. Average abnormal returns (AARs) and cumulative average abnormal returns (CAARs) of industry specific sector stocks during 21 days' event window

5. Conclusion

The empirical analysis of sample firms listed on the BSE suggests that firms' issuance of CERs did not produce a significant abnormal return on stock price. More specifically, conducting an event study of 193 CERs announcements of Indian firms over a 13-year period 2005–2017, this research found that Indian investors react negatively to carbon

Days	AARs	Large <i>t</i> -test	CAARs	<i>t</i> -test	AARs	Small <i>t</i> -test	CAARs	<i>t</i> -test
-10	0.001024543	0.063880859	0.001013892	0.071781747	0.001216815	0.071775024	0.003952138	0.197486367
-9	0.002884173	0.135742153	0.003837434	0.197486367	0.002806605	0.128937348	0.007320633	0.339134243
-8	0.003361195	0.145199218	0.007164925	0.339134243	0.003402194	0.14836294	0.005423814	0.279361414
-7	-0.001976822	-0.074584334	0.00551381	0.279361414	-0.002222517	-0.086852916	0.009137683	0.391747345
-6	0.003473172	0.087492684	0.009040988	0.391747345	0.003659863	0.094153236	0.014345395	0.603093956
-5	0.005162011	0.173980305	0.014123065	0.603093956	0.005287651	0.178396695	0.01463327	0.630587813
-4	0.000246112	-0.005422169	0.014488877	0.630587813	0.000168174	-0.011401808	0.015854882	0.678287655
-3	0.001084866	0.010417399	0.015669782	0.678287655	0.001125573	0.011448109	0.017514568	0.780566506
-2	0.001723068	0.080534003	0.017308209	0.780566506	0.001744327	0.080500909	0.020951158	0.869146877
-1	0.003567281	0.072820549	0.02083739	0.869146877	0.003474691	0.066746533	0.029157659	1.112302037
0	0.008404708	0.221537308	0.029205422	1.112302037	0.008243193	0.216624325	0.026778296	0.977525136
1	-0.002839985	-0.178588675	0.026456844	0.977525136	-0.00247077	-0.163437958	0.026824791	0.967618326
2	0.000237337	-0.025761473	0.026789788	0.967618326	-4.91069E-05	-0.036942704	0.024976289	0.857859888
3	-0.002144842	-0.150827239	0.024918425	0.857859888	-0.002121992	-0.148943282	0.027831527	0.949049884
4	0.002769024	0.058219234	0.027568321	0.949049884	0.002974371	0.065211178	0.028267045	0.936362857
5	0.000659332	-0.038816461	0.028111816	0.936362857	0.000551346	-0.04057465	0.028322503	0.992893742
6	0.000142904	0.011813767	0.028271695	0.992893742	3.84555E-05	0.011334049	0.028260022	0.999488227
7	-0.000366914	-0.057307843	0.028152477	0.999488227	-0.000310177	-0.056056407	0.028404489	0.995116766
8	0.000508744	-0.037800864	0.028359723	0.995116766	0.000445954	-0.036496513	0.0300104	0.995541556
9	0.001428997	-0.045874252	0.029963742	0.995541556	0.001430655	-0.046967741	0.029803329	0.983377037
10	-0.000182692	-0.046642814	0.029875389	0.983377037	-0.000301394	-0.051545808	0.029803329	0.983377037

Note: *Significant at the 5 percent level

Table VI.
Activity scale
specific-values (ARs)
of all stocks during
21 days' event window

Figure 5.
Average abnormal
returns (AARs),
Cumulative Average
Abnormal Returns
(CAARs) of the
activity scale covered
under study

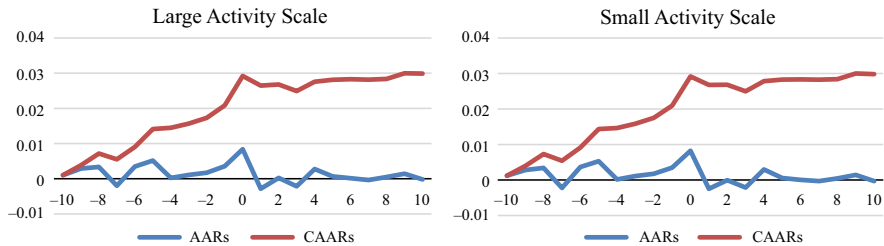


Table VII.
Kyoto protocol
phase's specific
t-values (ARs) of all
stocks during 21 days
'event window

Days	Trial Phase I <i>t</i> -test		Phase I <i>t</i> -test		Phase II <i>t</i> -test	
	AARs	CAARs	AARs	CAARs	AARs	CAARs
-9	0.032814643	0.02849	0.07758	0.07925	0.08238	0.08238
-8	-0.067413139	-0.0484	0.15752	0.23524	0.38901	0.47139
-7	0.046972743	0.00552	0.0962	0.31802	0.52268	0.99407
-6	0.131061102	0.179	-0.1766	0.1685	0.00676	1.00083
-5	0.164580656	0.41175	0.11732	0.28885	-0.1459	0.85492
-4	0.086809191	0.62816	0.20676	0.49865	0.19342	1.04834
-3	-0.272241794	0.51427	0.05474	0.55492	0.18612	1.23446
-2	0.004398038	0.6528	0.06408	0.62558	-0.2084	1.02602
-1	0.079564382	0.85658	0.0268	0.63962	0.32635	1.35237
0	0.155342275	1.1066	0.06256	0.70081	-0.0258	1.32656
1	0.34391825	1.56021	0.13932	0.84053	0.33624	1.66279
2	-0.086661838	1.56395	-0.1701	0.68163	-0.3109	1.35193
3	-0.292386826	1.38437	0.0212	0.70284	0.17445	1.52639
4	-0.263404081	1.23898	-0.1131	0.60723	-0.1232	1.4032
5	0.281362519	1.65983	0.03437	0.62969	-0.1791	1.2241
6	-0.294951629	1.50978	0.04971	0.66847	-0.0259	1.19823
7	-0.246152886	1.44821	0.01165	0.68168	0.41427	1.61249
8	-0.125467644	1.53244	-0.0371	0.66444	-0.0142	1.59825
9	-0.043216637	1.6818	-0.0378	0.60419	-0.0585	1.53972
10	-0.127540887	1.71452	-0.0207	0.59767	-0.0092	1.53051
	-0.248811716	1.60411	0.00513	0.61228	0.0538	1.58431

Note: *Significant at the 5 percent level

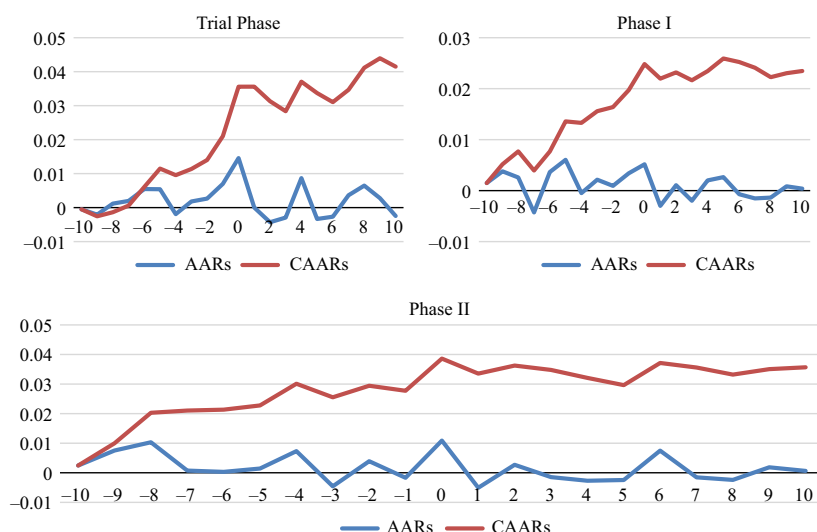


Figure 6.
Average abnormal
returns (AARs) and
cumulative average
abnormal returns
(CAARs) of carbon
credit announcements
during Kyoto protocol
trial phase and
Phase I and II

reporting standards are almost silent in this regard. Consequently, stakeholders need to rely on voluntary disclosure to better assess the environmental implications of the firms' operations (Bauer and Hann, 2010; Orens *et al.*, 2010; Chaklader and Gulati, 2015; Kumar and Firoz, 2019). It is challenging to measure the financial implications of emission credits. Therefore, the carbon accounting framework should be developed for recognition, measurement and disclosure of CERs within the financial statements. The CERs disclosure practices should be encouraged by the Indian firms. This will help the companies to increase their stock prices in the stock market and create a good image, credibility, and promote corporate ethical practices. Therefore, further research is desired to gain more insight into the issues raised in the study. Though findings of the study are quite comprehensive, relatively used only market-based criteria of a firm's financial performance e.g. share price, at times, inhibits generalizing the results. Therefore, another study can be conducted using accounting-based criteria measures of firms' financial performance such as return on investment, return on assets, value-added, etc. The present work is limited to companies situated in India only. Another research covering foreign countries can be undertaken. The scope of the study can further be extended by comparing the emission credit disclosure practices of Indian and overseas companies. Last but not least, a cross-sectional analysis of the abnormal returns can also be done in future research.

Glossary

AARs	Average Abnormal Returns
ARs	Abnormal Returns
CAARs	Cumulative Average Abnormal Returns
CARs	Cumulative Abnormal Returns
CDM	Clean Development Mechanism
CERs	Certified Emission Reductions
EU ETS	European Union Emission Trading Scheme
EUA	European Union Allowances
UNFCCC	United Nations Framework Convention on Climate Change.

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