ANWESHAN, Vol. 7, No. 1, March 2021

THE IMPACT OF CARBON PRICE ON STOCK MARKET RETURNS: AN INDIAN EXPERIENCE

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Abstract

The rapid industrialisation is unquestionably considered as a key to achieve higher economic growth and development in modern civilization today. But, this in turn leads to higher carbon emissions and other GHGs. Ever since the Industrial Revolution; human – induced anthropogenic activities have resulted in huge emission of the GHGs due to which global warming has become a serious concern. Undoubtedly, higher industrial outputs add to the country's growth but captivating profits at the cost of nature should not be continued. However, in 1997, with the emergence of the Kyoto Protocol, both developed and developing economies started to treat this matter seriously. Under this protocol the carbon credit system was established that imposed quotas on countries having more carbon emissions. Ever since then, the developing countries with less carbon emission generated carbon credits. This carbon credit can be traded actively in the international market at a certain market price to those developed economies with more carbon emission above the cap limit. This led to a rise in the carbon market to boost both the sustainable and environmental friendly practices among entities. Corporations that can reduce emission generate carbon credit, the right of

which can be sold to entities that are emitting more CO_2 and GHGs. Does this in any way affect corporate valuation and share price? This paper attempts to study the relationship between Carbon emission price and Indian stock market performance for a period covering FY 2008 to FY 2010. The research used simple regression analysis to test the relationship between dependent variables (BSE GREEENEX, BSE INDUSTRIALS, PCBL Ltd., Rain Industries and Reliance Industries) and independent variables (Carbon emission prices). This research is purely based on secondary data collected from websites, journals and other sources. This paper also tries to highlight the trends in the carbon market in India during the period of study.

Keywords: Industrialization, GHGs, CO_2, Carbon price, stock returns, etc.

I. Introduction

Rapid industrialisation and other human induced anthropogenic activities have led to create the biggest challenge for humans in this 21st century. Increased industrial outputs have resulted in more CO_2 and GHGs emission, leading to creating problems of climate change. Civilisations long term sustainability is only possible when we would maintain harmonious balance between environments and economic activities. A report of CEEW (Council on Energy, Environment and Water) revealed that emissions increased from 1802.24 $MtCO_2e$ during 2007 to 2297.32 $MtCO_2e$ in 2012 in India. Therefore, today it is the necessity for profit seekers to realise the true essence of the environment in which they operate. With the advent of Kyoto protocol in 1997, the necessary steps have been taken to resolve issues related to CO2 emission and other GHGs such as methane, sulphur-hexafluoride, hydro-fluorocarbons. These gases have an ill-effect on the environment and have a

massive contribution towards rising global warming. The concept proposed under this protocol made countries to depend on other countries having carbon credits. These credits can be actively traded in the international market at a certain market price from countries emitting less to countries having more carbon emission. This means that a better carbon trading platform would help companies create financial incentives that would boost investments in clean energy technologies and projects. This in turn would lead to enhanced both the development and implementation of cleaner and more sustainable energy solutions.

The Multi Commodity Exchange (MCX) being one of the leading commodity exchanges in India started trading in carbon credits in January 2008. This made MCX to be Asia's first ever commodity exchange to offer trading facilities to corporate houses in carbon credits. Followed by it, on April 11, 2008, the National Commodity Derivative Exchange (NCDEX) also joined upon the similar trajectory, venturing into the world of carbon market by introducing futures contracts in the realm of carbon trading. That diverse initiative undertaken has contributed to transform carbon trading into a promising and lucrative business prospect for India.

India being one of the leading generators of carbon credits has an ample opportunity in future, the benefit of which can be shifted to corporate players in the form of returns. Fortunately, with the active participation of corporations such as Punjab Chemicals and Crop Protection Limited (PCBL), Rain Industries, Reliance, Tata, etc. towards sustainability have added growth to it. Nevertheless, the disconcerting reality is that India still lacks in a comprehensive and standardized policy for carbon credits. Consequently, the prospect to generate foreign exchange in the recent past by the sale of carbon

credits to international buyers has remained unrealized as anticipated. Additionally, for some international buyers such as European market buyers are restricted in certain cases to take part in the Indian carbon trading market. This would obviously hurt the growth of the Indian carbon market. On 2nd October, 2010 a Forward Contract (Regulation) Amendment Bill was passed in the parliament that would further enable the opening of the Indian carbon trading market in near future using platforms such as MCX and NCDEX. Paul (2010) suggests that due to sudden growth in the carbon trading market in developing economies like India, the emission trading seems to be the prime focus in the business domain today. An increase in economic activities accelerates demand for high energy that in turn induces more emission. An increased demand for energy leads to increased carbon emission trading prices.

II. Literature Review

Jiménez-Rodríguez (2019) argues that the enterprise's economic incentives might impact the carbon emission trading prices and this change would further get priced in equity. Through this, he established a theoretical connection between stock market returns and carbon emission trading prices.

Wen et al. (2020) suggest a significant effect passing from the carbon market to the overall stock market in China. They also argue that information related to carbon emission trading prices would help investors to predict future returns from the stock market both in the long-run and short-run. This would benefit not only the domestic and global investors but also the policy makers in China.

Scholars over time have also reviewed the critical relationship between Carbon Emission Trading (CET) policy and corporate market value. Their study posits that Carbon price, innovative studies and carbon disclosure are influenced by the CET Policy, which in turn impact corporate market value of companies listed in stock market. Some scholars even argue that companies involved in lowering carbon footprint and helping the environment would attract more investment in future. Corporations committed towards sustainability practices are poised to benefit from global efforts to mark problems associated with climate change.

Modi and Bhojak (2013**)** have studied the growth and trend of the carbon market in India. Further researchers highlight that carbon finances will help companies make green investments.

Ekka et al. (2016) state some mechanisms such as clean development mechanism (CDM), joint implementation(JI), emission trading(ET). These mechanisms by being traded would help assist companies particularly in developing economies in earning carbon emission reduction credits from green investments.

Garg and Arya (2015) have attempted to study the future of the carbon market and its impact on business, particularly in India. To conduct the study, researchers collected data from 20 organisations, both primary and secondary sources, based on random sampling techniques to know the need for growth and the degree of awareness in the carbon credit market. Researchers conclude that carbon trading will become popular and help organisations earn revenue by trading in the carbon market. Some researchers, assuming that, stock market affects the carbon market through trading volume, report that

an improvement in stock market liquidity might significantly improve the liquidity in the carbon market.

In our quest to examine the relationship, especially in changed regime, the variable namely carbon emission trading prices were selected based on existing literatures in this area as suggested by Rodríguez, R. (2019); Fenghua Wen; L.Z. (2020) and by applying our own economic intuition. Aiming to expand to the existing literatures, this research made the following contribution. Firstly, in contrast to the existing literatures, this issue further deserves special attention and we hypothesize that the daily carbon emission trading prices significantly impact the stock indices behaviour namely S&P BSE GREENEX and S&P BSE INDUSTRIALS. Secondly, we also hypothesize that, select stocks namely PCBL, Rain Industries and Reliance share price is significantly impacted by carbon price over a period ranging FY 2008 to FY 2010. This study used the outputs obtained using regression analysis to test the relationship between variables. Thirdly, India being one of the leading generators of carbon credit and well developed stock market, it becomes imperative to extend our research on this area, as no or very few research assess the association between carbon emission trading price and stock market returns.

III. Research Methodology

This research used data collected from secondary sources such as Bombay Stock Exchange (BSE), Multi Commodity Exchange (MCX), National Commodity Derivative Exchange (NCDEX), etc. The daily closing price is retrieved for a period ranging from 1st October 2008 to 10thMarch 2010 and monthly data is extracted for a period covering FY 2008 to FY 2010.Indices

such as NCDEX (National Commodity and Derivative Exchange Limited) is used to fetch the daily closing data for CER (Carbon Emission Reduction) prices and MCX (Multi Commodity Exchange of India Ltd.) is used to collect monthly average data related to MCX CER spot prices (Rs./tonne). However, this research also made use of closing price of carbon trading and related companies listed in BSE such as PCBL Ltd, Rain Industries and Reliance Industries. Additionally, we also used daily closing prices of select stock indices such as S&P BSE GREENEX, S&P BSE INDUSTRIALS. The entire study is designed as a causal predictive model to examine the impact of carbon price (i.e. independent variable) on select stocks and stock indices (i.e. dependent variables) in India. This research made use of simple regression analysis to compute the relationship among variables. The regression output is obtained using a popular statistical software. Since the data is of time series in nature, we used Augmented Dickey Fuller test (ADF-test) to check the stationarity in the data set keeping in mind the recommendations of the eminent scholars (Maddala and Kim, 1998). In order to test that the residuals (prediction errors) have relative independence and presence of no serial autocorrelation between them, the Durbin-Watson test statistic was used.

IV. Scope of the Study

We have found very scanty research in this area after an in-depth analysis, particularly in Indian perspective, to test the causality between the carbon prices with select stock market indices and select carbon trading companies. This has compelled us to extend our study that whether the corporate valuation and stock prices in any way gets influenced by Carbon prices in India during FY 2008 – FY 2010.

Objectives of the Study:

1. To understand the carbon market in India during the period 2008-2010.

2. To investigate the impact of CERNCDEX Futures on S&P BSE GREENEX.

3. To examine the impact of CERNCDEX Futures on S&P BSE INDUSTRIALS.

4. To explore the impact of MCX CER spot prices on PCBL Ltd.

5. To explore the impact of MCX CER spot prices on Rain Industries.

6. To explore the impact of MCX CER spot prices on Reliance Industries.

The Analytical Model:

1. BSE GREENEX = $\alpha_1 + \beta_1$CERNCDEX_Futures + μ_i.

2. BSE INDUSTRIALS = $\alpha_2 + \beta_2$CERNCDEX_Futures+ μ_i.

3. PCBL Ltd _Share price = $\alpha_3 + \beta_3$MCX CER _ spot prices + μ_i.

4. Rain Industries _Share price = $\alpha_4 + \beta_4$MCX CER _ spot prices + μ_i.

5. Reliance Industries _Share price = $\alpha_5 + \beta_5$MCX CER _ spot prices + μ_i.

Table 1: Data Sources

Sl. No.	Data	Source
1	MCX CER spot prices (Rs/tonne) Monthly average.	Multi Commodity Exchange of India Ltd.
2	CERNCDEX Futures Daily Closing prices.	National Commodity and Derivative Exchange Limited.
3	S&P BSE GREENEX Daily Closing prices.	Bombay Stock Exchange (BSE)
4	S&P BSE INDUSTRIALS Daily Closing prices.	Bombay Stock Exchange (BSE)
5	PCBL Ltd. Monthly Closing	Bombay Stock Exchange (BSE)
6	Rain Industries Monthly Closing	Bombay Stock Exchange (BSE)
7	Reliance Industries Monthly Closing	Bombay Stock Exchange (BSE)

Hypotheses:

H01: There is no significant impact of CERNCDEX Futures on S&P BSE INDUSTRIALS.

H02: There is no significant impact of CERNCDEX Futures on S&P BSE GREENEX.

H03: There is no significant impact of MCX CER spot prices on PCBL Ltd.

H04: There is no significant impact of MCX CER spot prices on Rain Industries.

H05: There is no significant impact of MCX CER spot prices on Reliance Industries.

V. Data Analysis and Interpretation

Table 2.1: Results of regression between select stock indices and carbon prices

Variables	Independent Variable	Coefficients	Standard error	F-statistic	p-value
S&P BSE INDUSTRIALS	CERNCDEX Futures prices	0.041681	0.048195	0.747937	0.3879
S&P BSE GREENEX	CERNCDEX Futures prices	1.329866	0.069351	367.7152	0.0000*

Note: * indicates significant at 1% level of significance.

Table 2.2: Results of regression between select companies and carbon prices

Variables	Independent Variable	Coefficients	Standard error	F-statistic	p-value
PCBL Ltd.	MCX CER spot prices	0.117874	0.049987	5.560573	0.0256*
Rain Industries	MCX CER spot prices	0.138505	0.061890	5.008239	0.0334*
Reliance Industries	MCX CER spot prices	1.049622	0.503766	4.341185	0.0464*

Note: * indicates significant at 1% level of significance.

In this study, an attempt has been made to establish a causal relationship between the dependent and independent variables. In order to develop the

relationship two different approaches have been used to identify the dependent variable. The first set of dependent variables consists of select stock indices namely S&P BSE GREENEX and S&P BSE INDUSTRIALS. In contrast, another set of dependent variables comprises select stocks namely PCBL Ltd., Rain Industries and Reliance Industries.

From the above table 2.1, it is found that the regression coefficient of S&P BSE INDUSTRIALS is 0.041681, which is insignificant at 1%, 5% and 10% level of significance. Therefore, the result concludes that a percentage increase in CERNCDEX Futures daily closing price might not have an impact on S&P BSE Industrials. However, the result of S&P BSE GREENEX in conjunction with CERNCDEX Futures daily closing price is found to be significant at 1%, 5% and 10%, with F(1,226) = 367.7152, indicating that S&P BSE GREENEX got impacted by CERNCDEX Futures daily closing. Notably, a slope coefficient of 1.329866 indicates that a unit increase in CRENCDEX Futures daily closing will increase S&P BSE GREENEX by 1.329866.

In the another approach, we run the causality between select carbon trading and related companies listed in BSE such as PCBL Ltd., Rain Industries and Reliance Industries with MCX CER spot prices i.e. independent variable. Table 2.2 reports the regression output between PCBL Ltd. and MCX CER spot prices monthly average which is deemed to be significant at 5% level of significance with F (1,29) = 5.560573; $p<0.05$. The regression coefficient of 0.117874indicates that a unit increase in MCX CER spot price would result in 0.117874-unit increase in Rain Industries share prices over the study period.

Similarly, the study again reveals a positive and significant association between the share price of Rain Industries and MCX CER spot prices. The study is found significant with F (1, 29) = 5.008239; $p<0.05$. Additionally, the regression coefficient of 0.138505indicates that a unit increase in MCX CER spot price would result in 0.138505-unit increase in share price of Rain Industries.

In terms of Reliance Industries, we tested the significance of share price of Reliance Industries with monthly MCX CER spot price (i.e. independent variable). We again observed the study to be positively and significantly associated with F (1, 29) = 13.37858. The p-value is less than 5%. Therefore, we have sufficient evidence to reject the null hypothesis indicating that the share price of Reliance Industries got impacted by MCX CER spot price. Noteworthy is the coefficient of 1.049622, signifying a unit increase in MCX CER spot price would result in substantial increase in share price of Reliance Industries by 1.049622.

Table 3: Results of ADF Test for Unit Root

Variables	With Constant		
	Order of Integration	t-statistic	p-value
ΔS&P BSE GREENEX	I(1)	-13.65301	0.0000*
ΔS&P BSE INDUSTRIALS	I(1)	-14.47797	0.0000*
ΔPCBL Ltd.	I(1)	-3.993066	0.0047*
ΔRain Industries	I(1)	-5.194507	0.0002*
ΔReliance Industries	I(1)	-4.117778	0.0034*
ΔCERNCDEX Futures prices	I(1)	-9.823255	0.0000*
ΔMCX CER spot prices	I(1)	-4.875883	0.0005*

Note:1) Δ is the first difference operator, 2) * indicates rejection of null hypothesis at 1% level of significance.

On the basis of the widely used methodologies suggested by Said and Dicky (1984) to augment the basic autoregressive unit root test with constant the Augmented Dicky-Fuller (ADF) Test was used to examine the stationarity of each variable incorporated in this study. The results of test shown in Table 3 suggests that the S&P BSE GREENEX, S&P BSE INDUSTRIALS, PCBL Ltd., Rain Industries, Reliance Industries, CERNCDEX Future prices, MCX CER Spot prices are all found to be stationary at first difference, that is, I(1) at 1% level of significance.

Table 4: Results of Autocorrelation using Durbin-Watson Test

Dependent variables	Independent variables	Durbin-Watson Statistic
S&P BSE GREENEX	CERNCDEX Futures prices	1.745471
S&P BSE INDUSTRIALS	CERNCDEX Futures prices	1.690426
PCBL Ltd.	MCX CER spot prices	1.869573
Rain Industries	MCX CER spot prices	2.085988
Reliance Industries	MCX CER spot prices	1.593270

Table 4 reveals the Durbin-Watson statistic on the residuals (prediction errors) used to test the presence of serial autocorrelation up to lag 1. Azami et al. suggest the acceptable range of 1.5 to 2.5 for Durbin-Watson statistic value. The Durbin-Watson statistic for all the above variables lies within the acceptable range indicating the presence of no serial autocorrelation among variables.

V. Conclusions

The increased global awareness to curb the industrial emissions of GHGs with accelerated industrial growth and derived interrelations have necessitated the carbon trading should be a focal point of any business. In line of commitment towards Kyoto Protocol, it further bolster ups the notion that emission trading poised to evolve as the most lucrative area in a contemporary business landscape. Findings of this research revealed that one out of two stock indices got significantly impacted by the daily closing prices of CERNCDEX Futures. It is S & P BSE GREENEX which is significantly

impacted by the closing prices of CERNCDEX Futures but S&P BSE Industrials is not impacted through it. Moreover, the study of the relationship between select carbon trading companies (PCBL Ltd. and Rain Industries) and related stocks namely Reliance Industries with MCX CER monthly average spot prices (i.e. independent variable), in which all are found to be positively and significantly associated with each other. It is the PCBL Ltd., Rain Industries and Reliance Industries share prices are positively and significantly impacted by MCX CER spot price (Rs/tonne) monthly average. Finally, the study also suggests the need to promote the global carbon market by proper policy formulation and implementation that would help to boost carbon trading in India.

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