AN EMPIRICAL STUDY OF ECONOMIC RECESSION IMPACT ON CARBON CREDITS

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ABSTRACT :- Global carbon credits had bold run from 2003 - 2008 period. At that point of time global carbon credits market was expected to give 100% returns in future bur global financial recession affected this market during 2008 and 2009. This paper focused on global economy recession influence on global carbon credits. This paper had considered MSCI, BDI and world GDP as global economic indicators. Weighted least square analysis has proven that these indices influence was not there on global carbon credits. Partial and bivariate correlation has been applied with global carbon credits to alternative energy indices and global economy reflectors. Surprisingly global energy index is having negative relationship with global carbon credits and alternative indices are having positive relation during the analysis period. From the year 2008 onwards global carbon credits had fallen nearly 81%. The present economy is expected to get revive and along with that global carbon credits also expected to come on track in near future. Regression equation has been applied based on the global economic indicator BDI and the analysis predicted global carbon credits will move upside. This paper is useful for the industries who invest on carbon emission technology, non conventional investors in stock market and UNFCC.

Key Words :- Agigl, Agixl, Bdi, Cei, Crude Oil, E&I, Gdp, Global Carbon Credits, Msci, Pmi, Pimco, Solrx

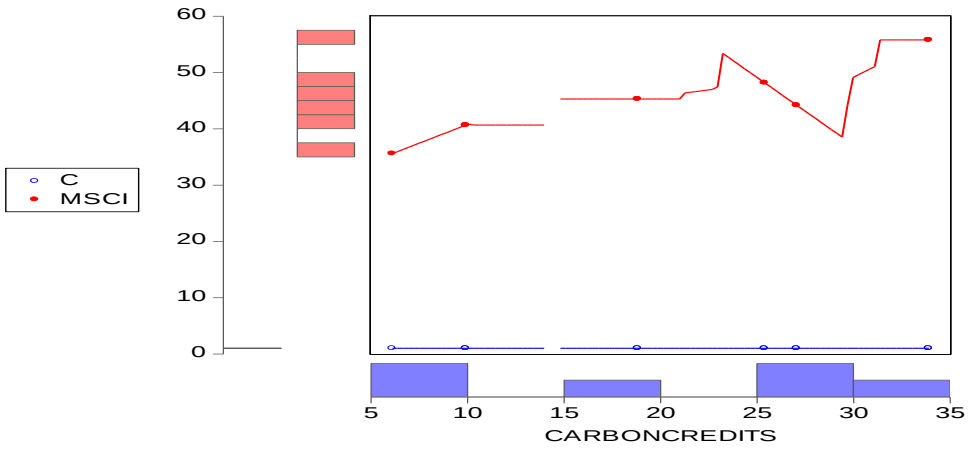
INTRODUCTION :- In the 21st century with the growing concerns among all the countries to reduce the pollution level while maintaining the growth in economy Carbon credits are the immediate solution to reduce the Green house gas(GHSs) emissions in the atmosphere the increase in ratification of Kyoto Protocol by the countries and rising social responsibility of polluting industries in developed nations, the carbon credits trading is expected to become a billion-dollar market in global carbon trading.

Carbon credit helps lower the costs of renewable and low carbon technologies as well as helping in the technology transfer to developing countries. The Sale and generation of carbon credits are increased which are additional to business. During the recession in the year 2008-09 the prices of the carbon credits are high but now there is fall in the prices of carbon credits. The recent study analyzed that people investing in carbon credits has made any money. The FCA Financial Conduct Authority conducted a poll to find out any people profited from carbon credits and no one has made money.

The fuels like crude oil and coal have fallen suddenly to almost 60%. in the developed countries these fuels play crucial role in the factories so they would need more carbon credits to alter for higher pollution. This leads to push up the prices of carbon credits and the suppliers would bank on it. Due to the global recession the carbon credits prices have fallen drastically so factories are compelled to produce less. Earlier in the US the manufacturing was at the fastest pace, signalling weaker fuel demand. when Europe Union in recession its industrial output has come down to 0.7% in 2009 which means the factories need less carbon

credits. many of the investors sold their surplus of European union allowances to raise cash in short-term and this lead to the drop in carbon credit prices and most Indian companies caught unawares.

The price discovery and the highest price at minimum risk in India are the two important issues, trading of carbon credits and European Association on commodity exchanges expected to help correct local price. The foreign companies and investors are barred from exchanges. In effect , the Indian sellers are trading with each other. Since no party requires carbon credits, there are no takers for physical delivery. This created disconnection between future prices and physical market. Carbon credits suppliers remain caught between desire to get maximum value and fear of risk. Companies new to the Carbon credits business usually take the route of least risk. Most suppliers, tend to fix a firm price with their buyer even before the Carbon credits is issued. That makes them immune to market volatility.



The above graphs shows the trend of carbon credits along with global equity indicator MSCI returns from the year 2003-09. Global carbon credits performed well than the other conventional asset classes. During this period India's market share in global carbon credits nearly 38% and this business was expected to grow 100% year on year but the above graph shows that MSCI started moving upside from 2009 to till date. In the same period global carbon credits performance deteriorating year on year and behaving exactly opposite what the experts thought 5years back. The financial recession affected manufacturing industries which influence negatively on carbon credits.

OBJECTIVES OF THE STUDY:

1) To find the global economy impact on carbon credits.
2) To know the alternative energy indices relation with global carbon credits.
3) To know the global carbon credits relation with selective global economic indicators.
4) To find the performance measure of global equity, commodity and carbon credits returns in post recession period.
5) To measure the selective factors impact on global carbon credits.
6) To know the future movement of global carbon credits based on economy.

SCOPE OF THE STUDY:- The analysis has been emphasized on carbon credits movement after financial recession in the world. For this paper data has been collected from the year 2008-2014. This analysis focused on macro economic factors which were influencing global carbon credits during the analysis period.

EMPIRICAL STUDY: - AGIGL, AGIXL (ardour global index extra liquid), BDI (baltic dry index), CEI(commodity equity index), CRUDE OIL, E&I, GDP, GLOBAL CARBON CREDITS, MSCI, PIMCO, SOLARX

NEED OF THE STUDY:- During the period of recession the prices of carbon credits are high and from the post recession period the prices had become very low. So to find out the future movement of carbon credits and investors preference as a non conventional investment choice. There is a need to reinforce interest from the UNFCC and Kyoto protocol among the countries on carbon emission reduction technologies development. Along with the normal investment options Global carbon credits also help the investor to create the wealth.

REVIEW OF LITERATURE :-

Kenneth M. Chomitz & Franck Lecocq :- Temporary crediting of carbon storage is an instrument that allows entities with emissions reductions obligations to defer some obligations for a fixed period of time. This instrument provides a means of guaranteeing the environmental integrity of a carbon sequestration project. But because the user of the temporary credit takes on the liability of renewing it, or replacing it with a permanent credit, the temporary credit must sell at a discount compared to a permanent credit. We show that this discount depends on the expected change in price of a permanent credit. Temporary credits have value only if restrictions on carbon emissions are not expected to tighten substantially. The intuition is illustrated by assessing the value of a hypothetical temporary sulfur dioxide sequestration credit, using historical data on actual SO2 allowance prices.

Eva Lovbrand & Johannes Stripple :- This article explores how climate governance is accomplished in practical terms. To that end we develop an 'analytics of carbon accounting' that draws attention to the calculative practices that turn stocks and flows of carbon into objects of governance. Carbon accounting as a rationality of government is primarily concerned with the ways in which carbon can be measured, quantified, demarcated and statistically aggregated; but the concept also alludes to questions about (political) accountability in relation to emissions of greenhouse gases. The paper outlines three different regimes of carbon accounting – 'the national carbon sink', 'the carbon credit' and 'the personal carbon budget' – to illustrate how stocks and flows of carbon are constructed as administrative domains amenable to certain forms of political and economic rationality, such as government regulation, market exchanges and self-governance by responsible individual subjects.

Shiv Kumar & Khaled T. Kurmaji:- This paper presents the theoretical analysis of CO_2 emission/mitigation and carbon credit earned by different designs of solar still in India. Numerical computation is performed on the basis of experimental performance of the solar stills, reported by various researchers. Estimation of carbon credits, which will accrue to the nation, is carried out for an expected system life span of 20 years and accounting 250, 275, and 300 clear days during a year. Return on the

investment on the basis of life cycle cost analysis has also been carried out accounting carbon trading in the European market. It is found that the annual cash flow due to the carbon trading decrease the cost of production of distillate by Rs. 0.15 per liter with current carbon trading rate €2.10 per ton.

Sally M. Benson:- Large scale implementation of CO_2 Capture and Storage is under serious consideration by governments and industry around the world. The pressing need to find solutions to the CO_2 problem has spurred significant research and development in both CO_2 capture and storage technologies. Early technical success with the three existing CO_2 storage projects and over 30 years experience with CO_2-EOR have provided confidence that long term storage is possible in appropriately selected geological storage reservoirs. Monitoring is one of the key enabling technologies for CO_2 storage. It is expected to serve a number of purposes - from providing information about safety and environmental concerns, to inventory verification for national accounting of greenhouse gas emissions and carbon credit trading. This paper addresses a number of issues related specifically to monitoring for the purpose of inventory accounting and trading carbon credits. First, what information would be needed for the purpose of inventory verification and carbon trading credits? With what precision and detection levels should this information be provided? Second, what monitoring methods and approaches are available? Third, do the instruments and monitoring approaches available today have sufficient resolution and detection levels to meet these needs? Theoretical calculations and field measurements of CO_2 in both the subsurface and atmosphere are used to support the discussions presented here. Finally, outstanding issues and opportunities for improvement are identified.

X Lim, W H Lam and A H Shamsuddin :- The introduction of Clean Development Mechanism (CDM) to Malaysia improves the environment of the country. Besides achieving sustainable development, the carbon credit earned through CDM enhances the financial state of the nation. Both CDM and renewable energy contribute to the society by striving to reduce carbon emission. Most of the CDM projects are related to renewable energy, which recorded 69% out of total CDM projects. This paper presents the energy overview and status of renewable energies in the country. Then, the renewable energy will be related to the CDM.

Roger A. Sedjo & Gregg Marland :- Permit trading among polluting parties is now firmly established as a policy tool in a range of environmental policy areas. The Kyoto Protocol accepts the principle that sequestration of carbon in the terrestrial biosphere can be used to offset emissions of carbon from fossil fuel combustion and outlines mechanisms. Although the lack of guaranteed permanence of biological offsets is often viewed as a defect, this paper argues that the absence of guaranteed permanence need not be a fundamental problem. We view carbon emissions as a liability issue. One purpose of an emissions credit system is to provide the emitter with a means to satisfy the carbon liability associated with her firm's (or country's) release of carbon into the atmosphere. We have developed and here expand on a rental approach, in which sequestered carbon is explicitly treated as temporary: the emitter temporarily satisfies his liability by temporarily "parking" his liability, for a fee, in a terrestrial carbon reservoir, or "sink," such as a forest or agricultural soil. Finally, the paper relates the value of permanent and temporary sequestration and argues that both instruments are tradable and have a high degree of substitutability that allows them to interact in markets.

Richard Benwell :- Seven years after the United States rejected binding emissions limitations and George Bush declared the Kyoto Protocol dead, there are signs of change. There is growing interest in

emissions trading at the regional, national and sub-state level, and in the prospect of linking schemes together. This article suggests that the rapid growth of emissions trading markets themselves may be helping to swing the cost-benefit analysis of participation in emissions reduction commitments for American actors and others. Most simply, the practical viability of international emissions trading has now been confirmed, largely by the European market, but there are two further elements to this development for which this article presents the early evidence. Firstly, unanticipated benefits appear to be accruing in the established compliance markets. Secondly, ownership of the emerging markets can bring new bargaining power to encourage others to adopt meaningful climate targets.

Hege Westskog :- The possibility of using flexibility mechanisms as a way to achieve national commitments under an international agreement to reduce climate gases has been a hot issue throughout the negotiating process of the Kyoto Protocol. A variety of arguments either in favor of or against emissions trading have been put forward by different Parties and by different groups. The purpose of this viewpoint is to look further into the various arguments opposing emissions trading or favoring their restriction (which are really arguments that could be used against all the different flexibility mechanisms) and comment on their validity.

Christoph Böhringer & Heinz Welsch:- The allocation of emission entitlements across countries is the single most controversial issue in international climate policy. Extreme positions within the policy debate range from entitlements based on current emission patterns (sovereignty) to entitlements based on equal-per-capita allocations (egalitarianism). This paper shows that gradual convergence from sovereignty towards egalitarianism could provide a pragmatic solution to the equity debate: When combined with international emissions trading, the convergence approach stands out for offering the developing countries substantial incentives for participation in the international greenhouse gas abatement effort without imposing excessive burdens on the industrialized countries.

Michael Dutschke, Bernhard Schlamadinger, Jenny L.P. Wong & Michael Rumberg:- The Milan conference of the UN Framework Convention on Climate Change has established two types of emission offsets under the Clean Development Mechanism (CDM), valid for a forestation and reforestation activities. In order to account for the non-permanent nature of carbon storage in forests, these credits expire after predefined periods, after which the buyer needs to replace them. The present article assesses their market value in relation to ‘permanent’ credits, identifies their specific risks, and proposes how to mitigate and manage them. It analyzes strengths and weaknesses of expiring credits for sellers and buyers. Taking the example of the EU emissions trading system, the authors discuss how expiring credits could reach fungibility with permanent emission allowances on domestic markets.

RESEARCH METHODOLOGY:-

T-Test:- T-tests are kind of like little F-tests, and similar to Z-tests. It's appropriate for smaller samples, and relatively easy to interpret since any calculated t over 2.0 is, by rule of thumb, significant. T-tests can be used for one sample, two samples, one tail, or two-tailed. You use a two-tailed test if there's any

possibility of bi-directionality in the relationship between your variables. The formula for the t-test is as follows:

$$t = \frac{\overline{X}_T - \overline{X}_C}{\sqrt{\frac{var_T}{n_T} + \frac{var_C}{n_C}}}$$

Correlation:- The correlation is one of the most common and most useful statistics. A correlation is a single number that describes the degree of relationship between two variables. The most frequently used correlation coefficient in data analysis is the Pearson product moment correlation. It is symbolized by the small letter r, and is fairly easy to compute from raw scores using the following formula

$$r = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{\sqrt{[\, n\Sigma x^2 - (\Sigma x)^2 \,][\, n\Sigma y^2 - (\Sigma y)^2 \,]}}$$

Weighted Least Squares: Weighted least squares (WLS) regression is useful for estimating the values of model parameters when the response values have differing degrees of variability over the combinations of the predictor values. in the regression function are estimated by finding the numerical values for the parameter estimates that minimize the sum of the squared deviations between the observed responses and the functional portion of the model. Unlike least squares, however, each term in the weighted least squares criterion includes an additional weight that determines how much each observation in the data set influences the final parameter estimates. The weighted least squares criterion that is minimized to obtain the parameter estimates is

$$Q=\sum_{i=1}^{n} w_i[y_i - f(\vec{x}_i;\vec{\beta}\,\hat{})]^2$$

Regression:- Regression is the closest thing to estimating causality in data analysis, and that's because it predicts how much the numbers "fit" a projected straight line. There are also advanced regression techniques for curvilinear estimation. The most common form of regression, however, is linear regression, and the least squares method to find an equation that best fits a line representing what is called the regression of y on x.

$$Y = A+Bx$$

Sortino Ratio :- The Sortino Ratio for an investment, a measure of risk-adjusted return. Investments that emphasize their Sortino Ratio often try to minimize their losses as a part of the trading strategy. The Sortino Ratio, however, only penalizes downside risk, and is defined as

$$\text{Sortino Ratio} = \frac{\text{Portfolio Return} - \text{Target Return}}{\text{Downside Risk}}$$

LIMITATIONS FOR THE STUDY:-

- Baltic dry index was considered from 2009 due to non availability of data.
- Commodity index CEI i.e., commodity equity index has been considered instead of CRB index.
- Alternative energy indices data collected from the Dow Jons index which was considered as base index for US market.
- PIMCO global bond index has been considered as a risk free rate of return.

DATA ANALYSIS :-

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.999[a]	.998	.993	93.56276

a. Predictors: (Constant), MSCI, GDP, BDI

ANOVA[b,c]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	5249339.743	3	1749779.914	199.884	.052[a]
	Residual	8753.990	1	8753.990		
	Total	5258093.733	4			

Coefficients[a,b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-50.153	3.835		-13.077	.049

BDI	.007	.001	.593	9.706	.065
GDP	1.895	.233	.387	8.122	.078
MSCI	1.160	.103	.627	11.239	.056

a. Dependent Variable: Global Carbon Credits

Interpretation: The above analysis reflect the global economic indicators impact on global carbon credits. The R2 with all the predicted values found to be very strong during the analysis period. Weighted least square analysis has rejected the hypothesis because only calculated variables of respective predictors fallen in non significant region and the t values were above the significant value. Hence selected global factors influence not observed on carbon credits.

Partial correlation with alternative energy indices

		GlobalCarbonCredits	AGIGL	AGIXL	SOLRX	GlobalEnergyIndex
GlobalCarbonCredits	Pearson Correlation	1	.851*	.818*	.901*	-0.733
	Sig. (2-tailed)		0.031	0.046	0.014	0.097
	N	6	6	6	6	6
AGIGL	Pearson Correlation	.851*	1	.996**	.985**	-0.335
	Sig. (2-tailed)	0.031		0	0	0.516
	N	6	6	6	6	6
AGIXL	Pearson Correlation	.818*	.996**	1	.983**	-0.304
	Sig. (2-tailed)	0.046	0		0	0.559
	N	6	6	6	6	6
SOLRX	Pearson Correlation	.901*	.985**	.983**	1	-0.468
	Sig. (2-tailed)	0.014	0	0		0.35
	N	6	6	6	6	6
GlobalEnergyIndex	Pearson Correlation	-0.733	-0.335	-0.304	-0.468	1
	Sig. (2-tailed)	0.097	0.516	0.559	0.35	
	N	6	6	6	6	6

Interpretation: Partial correlation has been applied on global carbon credits with alternative energy indices. Except global energy index the global carbon credits all indices are found to be very strongly correlated during the analysis period. Global energy index is having negative correlation with global carbon credits.

Bivariate correlation with global economic indicators

Control Variables			MSCI	GDP	BDI	CEI	PIMCO	GlobalEnergyIndex
Global Carbon Credits	MSCI	Correlation	1	-0.555	-0.133	-0.052	-0.168	-0.709
		Significance (2-tailed)	.	0.445	0.867	0.948	0.832	0.291
		Df	0	2	2	2	2	2
	GDP	Correlation	-0.555	1	-0.745	0.837	0.911	0.031
		Significance (2-tailed)	0.445	.	0.255	0.163	0.089	0.969
		Df	2	0	2	2	2	2
	BDI	Correlation	-0.133	-0.745	1	-0.921	-0.936	0.589
		Significance (2-tailed)	0.867	0.255	.	0.079	0.064	0.411
		Df	2	2	0	2	2	2
	CEI	Correlation	-0.052	0.837	-0.921	1	0.981	-0.259
		Significance (2-tailed)	0.948	0.163	0.079	.	0.019	0.741
		Df	2	2	2	0	2	2
	PIMCO	Correlation	-0.168	0.911	-0.936	0.981	1	-0.269
		Significance (2-tailed)	0.832	0.089	0.064	0.019	.	0.731
		Df	2	2	2	2	0	2
	GlobalEnergyIndex	Correlation	-0.709	0.031	0.589	-0.259	-0.269	1
		Significance (2-tailed)	0.291	0.969	0.411	0.741	0.731	.
		Df	2	2	2	2	2	0

Interpretation: The above table depicts the relationship between global carbon credits with global economic indicators along with the commodity and bond indicators. Bivariate correlated has been applied keeping global carbon credits as a control variable. Most of the variables who are found to be moderately correlated except energy index which is negatively slightly correlated with commodity and bond indices. With MSCI global energy index having negative strong relation but with GDP and BDI having positive moderate correlation

Performance Measure

Performance measure

	Carbon credits		MSCI		CEI	
pimco	average returns	actual returns	avg rtns	act rtns	avg rtns	act rtns
9.008159	-25.09144543	34.09960439	-13.6546	-22.6628	-8.71171	-17.7199
7.465207	6.560604867	0.904602193	-8.31483	-15.78	14.11972	6.654514
7.698382	-30.45084996	38.14923195	2.499264	-5.19912	6.629779	-1.0686
3.905826	-47.25823592	51.16406203	-10.1994	-14.1053	-6.19996	-10.1058
0.226514	-38.38404191	38.61055606	-12.4327	-12.6592	-3.12749	-3.354
		32.58561133		-14.0813		-5.11875
Std dev	10.65406707		6.849476		202.0662	
Sortino Ratio = average normal returns/ standard deviation						
	3.058513816		-2.05582		-0.02533	

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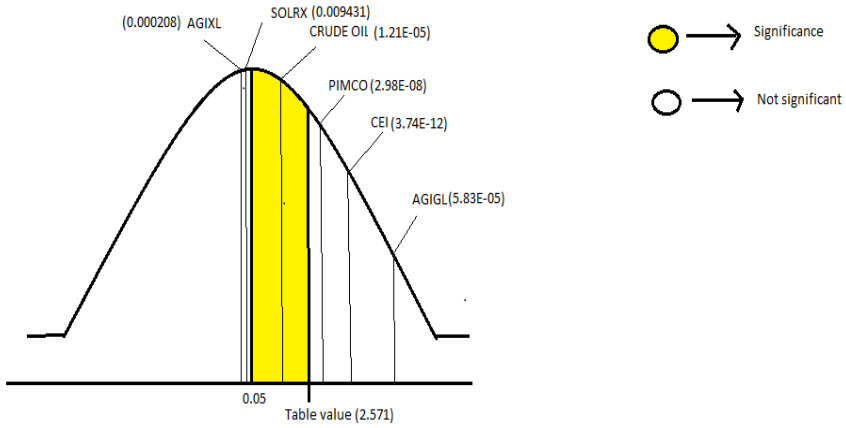
*** Note: pimco bond index has been considered as a RFR**

Interpretation: The above table depicts the performance measure of global carbon credits, MSCI and CEI. Performance measure tool Sortino has been applied by considering PIMCO global bond index as risk free rate of return. The analysis has reflected commodity equity index as a superior performer in comparison to other two indices. Global carbon credits performance found to be lower during the analysis period i.e., -3.058. **Factors effect on Carbon Credits:**

	T-TEST	
	crude oil	1.21E-05
	pimco	2.98E-08
	cei	3.74E-12
	agigl	5.83E-05
	agixl	0.000208
	solrx	0.009431
table value		2.571
significance	Crude oil	



Interpretation: T-test 2 tail has been applied to find the impact of select economic factors on global carbon credits. With the above analysis it has been observed that the crude oil is the only commodity found to be significant and where as SOLRX, AGIXL, PIMCO, CEI and AGIGL are found to be not significant because these indices values are fallen above the table value. Hence we reject null hypothesis and accept alternative hypothesis. Only crude oil accept the null hypothesis and reject the alternate hypothesis during the analysis period.

Future movement of Carbon Credits

carbon credits	BDI
25.394	2987.678
27.06	2349.245
18.82	1422.612
9.926	901.646
6.116	1349.37

Correlation= 0.832155568, Standard deviation= 10.654 Risk(B) = 0.078106845, Intercept(x) = 472.87493

A = 6.116(current value). Equation of Regression: Y = A+Bx = 43.05077

To find the future movement of global carbon credits has been predicted using regression equation. Risk has been measured between BDI and global carbon credits. Hence the calculated value is found to be more than the present value of global carbon credits which indicates that global carbon credits is expected to move upside in the near future.

FINDINGS:-

1) The global economic factors does not have any influence on carbon credits.

2) There is a negative correlation for global energy index with global carbon credits.

3) Energy index having negatively slightly correlated with commodity and bond indices. With MSCI global energy index having negative strong relation but with GDP and BDI having positive moderate correlation.

4) Global carbon credits performance was lower compared to MSCI and CEI.

5) Only crude oil is found to be significant where as other economic factors are not significant.

6) In the near future global carbon credits are expected to move upside.

CONCLUSION :-

We conclude the analysis of global recession impact on global carbon credits. This paper has been emphasized to find the global economy reflectors influence on carbon credits. In the year 2009 global economy started towards boom zone but global carbon credits performance getting deteriorated year on tear. During the analysis period global energy index moving opposite direction with global carbon credits but in the same period alternative indices were found to be positively correlated. The present economic situation is having adverse reaction on carbon credits movement. Future movement of global carbon credits are expected to perform well and it is expected to regain its lost glory once again. Hence there is a further scope to do research in this area to find global carbon credits movement and the factors which were influencing it in the future.

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