GLOBAL COMMODITY INDICES VOLATILITY - A STUDY

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ABSTRACT: Commodities movement is purely based on global economy exports and imports volume are completely associated with commodities consumption across the globe higher volatility of commodity prices leads to the higher risk of the investors investments in this study I had considered 9 different commodities with the combination of 49 sub segment commodities across the globe from 2009 – 2014. Multi regression analysis has been implemented with Baltic Dry Index (BDI) volatility to select global commodity indices volatility and observed that Meat, Cereals, Fruits indices volatility is not influenced by the global economic volatility based on the Stranded Deviation (SD) all the commodities volatility is found to be less that the Baltic Dry Index (BDI) volatility during the analysis period T – Test depicts that global economy not influenced the global commodities returns during the study period. This study is useful to exports and imports investment banker's commodity investors and farmers.

Keyword: Agriculture Index, Baltic Dry Index, Fertilizer Index, Meat Index, Metal Index, Seafood Index and Volatility.

INTRODUCTION: The high agricultural commodity prices in recent years have raised the question of whether or not volatility is increasing and leading to more frequent extreme price swings. This study is intended to contribute to the existing field of work on Global commodity price volatility. It seeks to extend that research by undertaking an extensive statistical analysis of price volatility over the last years (i.e., from Dec 09 to Nov 14) extended range of agricultural commodities. Most commodity markets are volatile, and volatility itself fluctuates over time. This paper examines the short-run dynamics of commodity fluctuations and focusing on the behaviour and role of volatility.

While producers benefit, consumers, especially poor consumers, are severely adversely affected by high prices, Food accounts for a very high share of the total budget of the poorest households. And because poor households often consume foods that are less processed the effect of rises in commodity prices is felt more strongly. These households find their nutrition status (especially of pregnant women, children and those affected by long-term diseases such as HIV), as well as their capacity to purchase education, health care, or other basic needs compromised, when food prices are high.

Volatility first, it directly affects the marginal value of storage (the marginal convenience yield), i.e., the flow of benefits from an extra unit of inventory. When prices—and hence production and demand—are more volatile, there is a greater demand for inventories, which are needed to smooth production and deliveries and reduce marketing costs. Thus an increase in volatility can lead to inventory build-ups and raise prices in the short run. The Commodities which are considered under this topic are: Agricultural Products, beverages, Cereals, Fertilizers, Fruits, Meat, Metals, Sea Foods, Sugar, and Vegetable Oil & Protein Meal.

REVIEW OF LITERATURE:

Barbara Rossi (2012): Researcher examined about the linkage between equity and commodity markets, focusing in particular on its evolution. He also tells that exchange rates are a better predictor of commodity prices than equity markets. This study is limited to explain the link between equity and commodity markets where as my study is concerned to measure the impact on global agri index on selected commodities. Hence, my study is not having any relevance to this study.

Yusuf Soner Başkaya, Timur Hulagu And Hande Kucuk (2012): They examined about business cycle implications of oil prices and it makes the marginal product of capital riskier, creating an incentive to substitute away from capital and also it increases the demand for precautionary savings. The investment decline because of higher oil price volatility under financial integration is almost twice as much as the decline under financial auto cry. This study is limited to oil prices implications on investments but my study is focused on Global commodities including Vegetable index. Hence, my study is not having any relevance to this study.

Stephen J. Turnovsky (2010): Researcher examined about world commodity price aggregates for forecasting the currency and inflation rates in five major commodity their findings also suggest that the information contained in commodity prices can be helpful in predicting both CPI and PPI inflation, this study is only limited for forecasting the currency and inflation rate of world commodity prices which is confined to 5 major commodities were as my study is to measure the volatility of selected global 9 major commodities and compare with BDI volatility. Hence, my study is not having any relevance to this study.

Toni Beutler (2012): Researcher examined about prediction of exchange rate of commodity exports currencies and convenience yields which are useful predictors for commodity prices and also commodity currencies have a strong relationship with commodity prices. researcher study is limited to a significant relationship between aggregate measures of convenience yields and commodity currencies exchange rate, both in-sample and out of-sample where as my study is only Confined to predict Global Commodity indices volatility with global economic indicator. Hence, my study is not having any relevance to this study.

J. Groen, Paolo A. Pesentihe (2010): researcher examines about the forecasts of commodity price movements that can improve on naive statistical benchmarks and revisit the forecasting performance of changes in commodity currencies. He considered three different commodity classes across different periods. This study is confined to forecasts of commodity price movements Where as my study is to measure the Global economy impact on Commodities I considered nine different commodities across different time periods from (Dec-09 to Nov-14). Hence, my study is not having any relevance to this study.

Parantap Basu and William T. Gavin (2011): They examines about the massive increase in trading in commodity derivatives over some period of time. The growth was both in organized exchanges and over-the counter (OTC) trading, but the gross market value of OTC trading was an order of magnitude greater. This growth is important to note because a critical factor in the recent crisis was counterparty failure in OTC trading of mortgage derivatives. This study is subjected to explain the growth of commodity derivatives. Whereas, my study is related to measure the selected global commodities benchmarks impact on agriculture commodities over

a period of time about 5 years data i.e., across different time periods from (Dec-09 to Nov-14). Hence, my study is not having any relevance to this study.

L Yin (2014): Researcher explains about the time-varying correlation between macroeconomic uncertainty and commodity prices .he reveals that increased volatility in uncertainty leads to increased price and volatility in commodity markets, while increased volatility in commodity markets enhances policy uncertainty. His result says that the dynamic linkage between uncertainty and commodity prices varies over time. This study is limited to evaluate the time-varying correlation between macroeconomic uncertainty and commodity prices but my study is global commodity indices volatility i considered different types of factor – augmented models that use information from a large data set containing a variety of indicators measure the impact of selected global commodities on global economic indicator. Hence, my study is not having any relevance to this study.

Evgenia Passari (2013): Researcher examined about Commodity Strategy for exchange rate forecasting that conditions on changes in the global prices of commodity indices. This study is limited to commodity currencies for exchange rate forecasting Whereas; My study is to measure the impact of selected global commodities indices volatility on global economic indicator. Hence, my study is not having any relevance to this study.

NEED: In global commodities area numerous articles and research thesis has been submitted by various researchers across the globe most of the researchers have focused such as:

1. Linkage between equity and commodity markets.
2. Higher oil prices volatility impact on commodity prices.
3. Currency and inflation rates impact on world commodity price fluctuation.
4. Global commodities derivative pricing.

Various other research papers analyzed global commodities in different angles by observing these abstracts I found a research gap where no researcher paper focused on global commodity volatility during the 2009-2014 periods. Hence I had considered 49 different commodities along with the global economic indicator Baltic Dry Index (BDI) and observed its impact on returns and influenced on volatility.

OBJECTIVES:

1. To measure the impact of Global Economic Indicator Baltic Dry Index (BDi) Volatility on selected global commodities volatility
2. To measure the impact of Global Agriculture Index on Selected agriculture commodities
3. To measure the volatility of selected global commodities and compare with BDI volatility
4. To measure the Global economy impact on global commodities.

SCOPE: This study has been focused for the period of 5 years i.e., Dec 2009 - Nov 2014 in this study 49 global commodities were considered of 9 different segments Baltic Dry Index (BDI) has been considered as the global economic indicator.

Empirical study:

1. **Agricultural raw material:** Hard logs, Hides, Plywood, Rubber, Soft logs, Soft Sawn wood,Wood pulp, Hard Sawn Wood.
2. **Beverages:** Tea, Coffee, Cocoa Beans, Robusta, mild Arabica.
3. **Cereals:** Barley, Corn, Rice, Wheat, Canadian Wheat, Soft red winter wheat, Sorghum.

4. **Fertilizers:** Urea, Rock Phosphate, Potassium Chloride, Diammonium Phoshate, Triple Superphosphate.
5. **Fruits:** Banana, Oranges.
6. **Meat:** Beef, Poultry (Chicken), Lamb, Swine (Pork).
7. **Metals:** Gold, Hot Rolled Steel, Iron ore, Lead, Nickel, Sliver, Uranium, Steel wire rod, Tin, Zinc.
8. **Seafood's:** Fish, Shrimp.
9. **Sugar.**
10. **Vegetable Oil & Protein Meal:** Sunflower Oil, Soybeans, Soybean Oil, Soybean Meal, Ground nut, Peanut oil, Rapeseed oil.

RESEARCH METHODOLOGY:

Volatility: In finance, volatility is a measure for variation of price of a financial instrument over time. The symbol σ is used for volatility, and corresponds to standard deviation, which should not be confused with the similarly named variance, which is instead the square, σ^2.

$$\sigma = \frac{\sigma_{SD}}{\sqrt{P}}.$$

Standard Deviation (SD): The Standard Deviation is a measure that is used to quantify the amount of variation or dispersion of a set of data values. A standard deviation close to 0 indicates that the data points tend to be very close to the mean of the set, while a high standard deviation indicates that the data points are spread out over a wider range of values.

$\sigma = \sqrt{[\sum (x\text{-}mean)2 / N]}$

T Test: T test is used to compare two different set of values. It is generally performed on a small set of data. T test is generally applied to normal distribution which has a small set of values. This test compares the mean of two samples.

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

Average: an average is the sum of a list of numbers divided by the number of numbers in the list. It may also refer to the median, mode, or other central or typical value. In statistics, these are all known as measures of central tendency.

$$AM = \frac{1}{n}\sum_{i=1}^{n} a_i = \frac{1}{n}(a_1 + a_2 + \cdots + a_n)$$

Arch: An ARCH (q) model can be estimated using ordinary least squares. A methodology to test for the lag length of ARCH.

$$\sigma_t^2 = \alpha_0 + \alpha_1 \epsilon_{t-1}^2 + \cdots + \alpha_q \epsilon_{t-q}^2 = \alpha_0 + \sum_{i=1}^{q} \alpha_i \epsilon_{t-i}^2$$

Garch: when testing for heteroskedasticity in econometric models, the best test is the White test. However, when dealing with time series data, this means to test for ARCH and GARCH.

$$\sigma_t^2 = \alpha_0 + \alpha_1 \epsilon_{t-1}^2 + \cdots + \alpha_q \epsilon_{t-q}^2 + \beta_1 \sigma_{t-1}^2 + \cdots + \beta_p \sigma_{t-p}^2 = \alpha_0 + \sum_{i=1}^{q} \alpha_i \epsilon_{t-i}^2 + \sum_{i=1}^{p} \beta_i \sigma_{t-i}^2$$

Egarch: The formulation for $g(z_t)$ the sign and the magnitude of Z_t to have separate effects on the volatility. This is particularly useful in an asset pricing context.

$$g(Z_t) = \theta Z_t + \lambda(|Z_t| - E(|Z_t|))$$

Tarch: Using the heteroskedasticity in regression model based on the affects of egarch white test tarch model deals with time series data and measures separate affects on volatility.

$$\epsilon_{t-1}^{+} = \epsilon_{t-1} \text{ if } \epsilon_{t-1} > 0, \text{ and } \epsilon_{t-1}^{+} = 0 \text{ if } \epsilon_{t-1} \leq 0.$$

PARCH: Using the heteroskedasticity in regression model based on the affects of tarch white test parch model deals with time series data and measures separate affects on volatility.

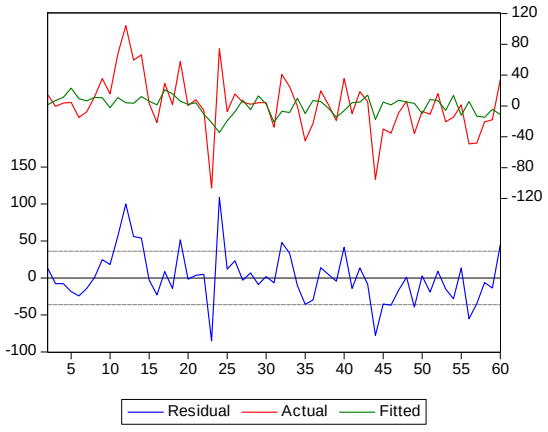
LIMITATIONS:

1. Candian wheat data has been considered till 2012.
2. In fruits index Oranges and banana data not been considered for 2 months i.e., November and December of 2014.
3. In metal index steel wire rod and hot rolled steel data has been considered till 2012.

DATA ANALYSIS:

1. To measure the impact of Global Economic Indicator Baltic Dry Index (BDi) Volatility on selected global commodities volatility.

Vegetables

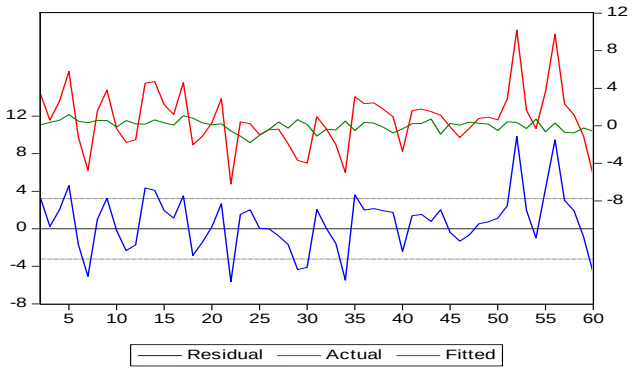


The above residual graph shows that volatility of vegetable is observed because the actual line is moving in non-fitted region. This indicates that volatility is existing in vegetable commodity.

	Coefficient	Std.Error	Z-Statistics	Prob	AIC	SIC
ARCH	1.730919	0.692467	2.499641	0.0124	9.928269	10.03391
GARCH	1.752707	0.675555	2.594469	0.0095	9.956431	10.09728
TARCH	1.756681	0.740529	2.372197	0.0177	9.990314	10.16638
EGARCH	1.572669	0.42266	3.720881	0.0002	9.916548	10.09261
PARCH	1.649178	0.787697	2.093671	0.0363	10.0143	10.22558

Interpretation: The above table of multi regression model as been applied between global economic indicator Baltic Dry Index (BDI) volatility and global vegetable index. The probability value of all the regression models are found to be significant this indicates that global vegetable index volatility got influenced with the Baltic Dry Index (BDI) volatility.

Meat:

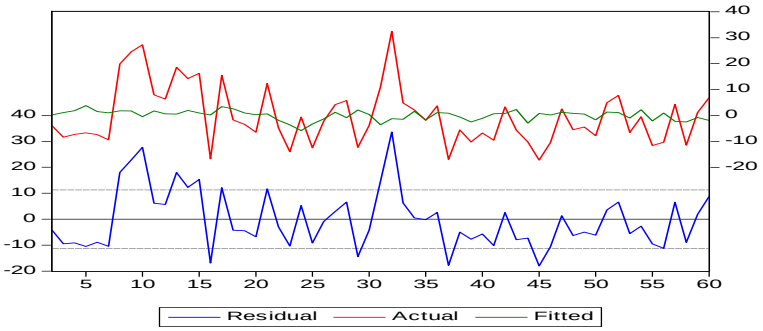


The above residual graph shows that volatility of meat is observed because the actual line is moving in non-fitted region. This indicates that volatility is existing in meat commodity.

	Coefficient	Std. Error	Z-Statistics	Prob	AIC	SIC
ARCH	0.101999	0.065865	1.548605	0.1215	5.196175	5.301812
GARCH	0.09062	0.071676	1.264296	0.2061	5.237691	5.378541
TARCH	0.09062	0.071676	1.264296	0.2061	5.237691	5.378541
EGARCH	0.000788	0.056504	0.013952	0.9889	5.147701	5.323763
PARCH	-0.002437	0.072296	-0.033706	0.9731	5.216907	5.428182

Interpretation: The above table of multi regression model as been applied between global economic indicator Baltic Dry Index (BDI) volatility and global meat index. The probability value of all the regression models are found to be non significant this indicates that global Meat index volatility didn't get influenced with the Baltic Dry Index (BDI) volatility.

Cereals

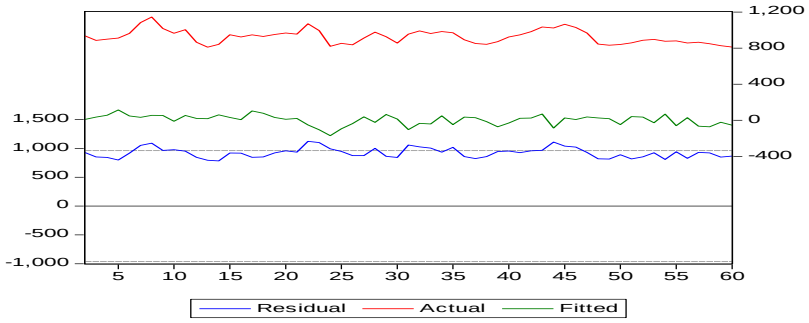


The above residual graph shows that volatility of cereals is observed because the actual line is moving in non-fitted region. This indicates that volatility is existing in cereals commodity.

	Coefficier	Std.Error	Z-Statistic	Prob	AIC	SIC
ARCH	0.292367	0.199563	1.465039	0.1429	7.633911	7.739548
GARCH	0.258853	0.192929	1.341699	0.1797	7.594206	7.735056
TARCH	0.222041	0.174275	1.274079	0.2026	7.59857	7.774632
EGARCH	0.30913	0.193242	1.5997	0.1097	7.622953	7.799015
PARCH	-0.12656	0.220478	-0.57402	0.566	7.73672	7.947995

Interpretation: The above table of multi regression model as been applied between global economic indicator Baltic Dry Index (BDI) volatility and global cereals index. The probability value of all the regression models are found to be non significant this indicates that global cereal index volatility didn't get influenced with the Baltic Dry Index (BDI) volatility.

Fruits:

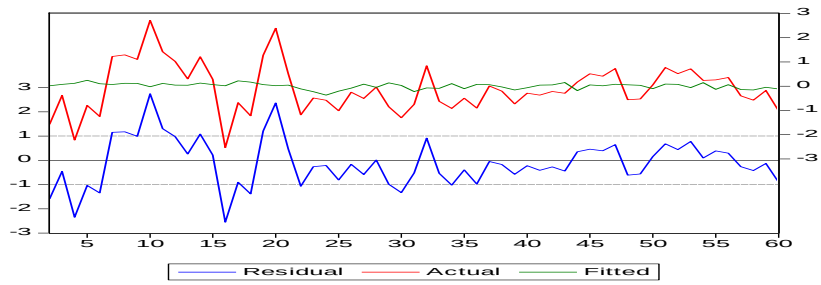


The above residual graph shows that volatility of Fruits is observed because the actual line is moving in non-fitted region. This indicates that volatility is existing in Fruits commodity.

	Coefficier	Std.Error	Z-Statistic	Prob	AIC	SIC
ARCH	11.11108	23.72204	0.468386	0.6395	16.59797	16.70361
GARCH	8.655985	22.07015	0.392203	0.6949	16.63153	16.77238
TARCH	9.268979	NA	NA	NA	16.66543	16.84149
EGARCH	9.77682	22.87432	0.427415	0.6691	16.666	16.84206
PARCH	11.29957	24.07757	0.469299	0.6389	16.70336	16.91463

Interpretation: The above table of multi regression model as been applied between global economic indicator Baltic Dry Index (BDI) volatility and global Fruits index. The probability value of all the regression models are found to be non significant this indicates that global Fruits index volatility didn't get influenced with the Baltic Dry Index (BDI) volatility.

Sugar

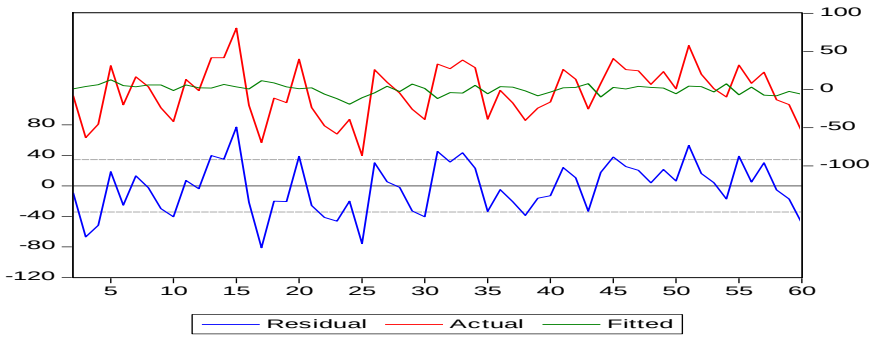


The above residual graph shows that volatility of Sugar is observed because the actual line is moving in non-fitted region. This indicates that volatility is existing in Sugar commodity.

	Coefficient	Std.Error	Z-Statistics	Prob	AIC	SIC
ARCH	0.018531	0.027909	0.663993	0.5067	2.882069	2.987706
GARCH	0.028932	0.00128	22.60037	0	2.458155	2.599005
TARCH	0.028803	0.017812	1.617068	0.1059	2.54649	2.722552
EGARCH	0.030937	0.018746	1.650359	0.0989	2.56737	2.743438
PARCH	0.029365	0.000132	221.833	0	2.616515	2.82779

Interpretation: The above table of multi regression model as been applied between global economic indicator Baltic Dry Index (BDI) volatility and global Sugar index. The probability value of all the regression models are found to be significant this indicates that global Sugar index volatility got influenced with the Baltic Dry Index (BDI) volatility.

Beverages:

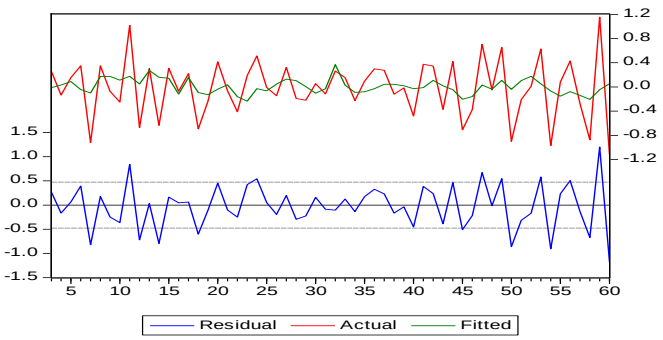


The above residual graph shows that volatility of Beverages is observed because the actual line is moving in non-fitted region. This indicates that volatility is existing in Beverages commodity.

	Coefficient	Std.Error	Z-Statistics	Prob	AIC	SIC
ARCH	0.971679	0.574166	1.692332	0.0906	9.954003	10.05964
GARCH	0.861693	0.0112	76.93877	0	9.831687	9.972537
TARCH	0.712426	0.570654	1.248439	0.2119	9.919288	10.09535
EGARCH	0.942935	0.100288	9.402255	0	9.861837	10.0379
PARCH	1.021729	0.722392	1.414369	0.1573	10.04941	10.0379

Interpretation: The above table of multi regression model as been applied between global economic indicator Baltic Dry Index (BDI) volatility and global Beverages index. The probability value of all the regression models are found to be significant this indicates that global Beverages index volatility got influenced with the Baltic Dry Index (BDI) volatility.

Seafood

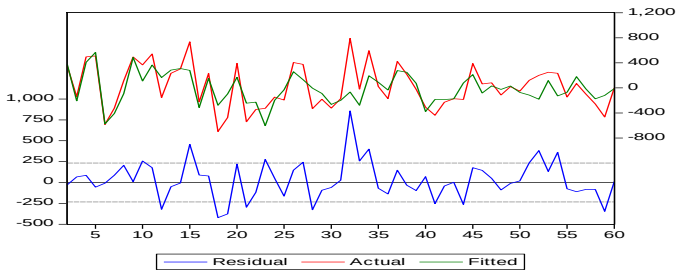


The above residual graph shows that volatility of Seafood is observed because the actual line is moving in non-fitted region. This indicates that volatility is existing in Seafood commodity.

	Coefficier	Std.Error	Z-Statistic	Prob	AIC	SIC
ARCH	0.02503	0.010393	2.408408	0.016	1.292285	1.39886
GARCH	0.023631	0.011942	1.978856	0.0478	1.249602	1.391701
TARCH	0.023733	0.011855	2.001914	0.0453	1.276292	1.453916
EGARCH	0.023067	0.010119	2.279553	0.0226	1.280125	1.453916
PARCH	0.023725	0.011865	1.999649	0.0455	1.310495	1.523645

Interpretation: The above table of multi regression model as been applied between global economic indicator Baltic Dry Index (BDI) volatility and global Seafood index. The probability value of all the regression models are found to be significant this indicates that global Seafood index volatility got influenced with the Baltic Dry Index (BDI) volatility.

Metal



The above residual graph shows that volatility of Metal is observed because the actual line is moving in non-fitted region. This indicates that volatility is existing in Metal commodity.

	Coefficier	Std.Error	Z-Statistic	Prob	AIC	SIC
ARCH	27.40299	3.805953	7.200035	0	13.87289	13.87289
GARCH	25.98771	3.020057	8.605041	0	13.4448	13.58565
TARCH	25.81097	2.194481	11.76177	0	13.66621	13.84228
EGARCH	26.51046	3.445407	7.694434	0	13.71724	13.71724
PARCH	26.59514	3.733422	7.12353	0	13.78423	13.99551

Interpretation: The above table of multi regression model as been applied between global economic indicator Baltic Dry Index (BDI) volatility and global Metal index. The probability values of all the regression models are found to be significant this indicates that global Metal index volatility got influenced with the Baltic Dry Index (BDI) volatility.

Fertilizer

The above residual graph shows that volatility of Fertilizer is observed because the actual line is moving in non-fitted region. This indicates that volatility is existing in Fertilizer commodity.

	Coefficier	Std.Error	Z-Statistic	Prob	AIC	SIC
ARCH	0.618364	0.4877	1.267921	0.2048	8.0503	8.155943
GARCH	0.556079	0.408499	1.361275	0.1734	8.0532	8.194037
TARCH	0.431813	0.481536	0.896741	0.3699	8.0212	8.19724
EGARCH	0.330254	0.161354	2.04676	0.0407	7.9979	8.173917
PARCH	0.32888	0.161354	1.381676	0.1671	8.0231	8.173917

Interpretation: The above table of multi regression model as been applied between global economic indicator Baltic Dry Index (BDI) volatility and global Fertilizer index. The probability value of all the regression models are found to be significant this indicates that global fertilizer index volatility got influenced with the Baltic Dry Index (BDI) volatility.

2. To measure the impact of Global Agriculture Index on Selected agriculture commodities

Multiple R	0.869
R Square	0.754
Adjusted R Square	0.727
Std. Error of the Estimate	4.66E+03
Log-likelihood Function Value	-227.037

	Sum of Squares	df	Mean Square	F	Sig.
Regressio	3.54E+00	6	5.90E+08	27.147	0
Residual	1.15E+09	53	2.17E+07		
Total	4.69E+00	59			

			Unstandardized Coefficients	Standardized Coefficients	t	Sig.
	B	Std. Error	Beta	Std. Error		
(Constant)	66.304	36.295			1.827	0.073
Veg	0.102	0.032	0.716	0.224	3.202	0.002
Meat	0.523	0.177	0.27	0.091	2.963	0.005
Cereals	-0.085	0.109	-0.167	0.215	-0.777	0.441
Fruits	0.068	0.021	0.238	0.073	3.238	0.002
Sugar	2.788	0.676	0.451	0.11	4.121	0
Bevarages	0.069	0.027	0.335	0.128	2.609	0.012

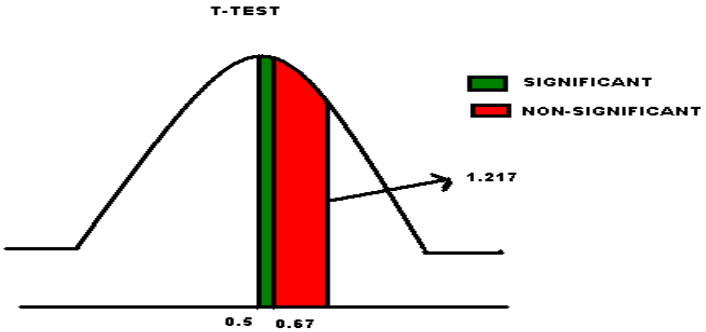
Interpretation: The above analysis of regression weight estimation has been applied to measure the global Agri Index impact on global Agri commodities. The r^2 (Correlation) is 75.4 % > 60 % . The probability value is found to be significant which indicates that Agri index influenced the Agri commodities except Cereals because the probability value is observed non-Significant.

3. To measure the volatility of selected global commodities and compare with BDI volatility.

	Global Indices Avg	BDI Index	Difference in between Index
Agriculture raw material	0.585164077	3.594902	-3.009737623
Beverages	1.309081824	3.594902	-2.285819876
Cereals	0.838046509	3.594902	-2.756855191
Fertilizers	0.97498861	3.594902	-2.61991309
Fruits	1.111625289	3.594902	-2.483276411
Meat	0.431707293	3.594902	-3.163194407
Metals	3.277134142	3.594902	-0.317767558
Seafood	0.172925194	3.594902	-3.421976506
Sugar	0.236153379	3.594902	-3.358748321
Vegerable oil	1.594836518	3.594902	-2.000065182

Interpretation: The above analysis of volatility depicts that BDI Volatility is observed higher when it is compared with the other selected commodities volatility the Metal volatility is observed near to the global economic indicator volatility i.e., 3.27.

4. To measure the Global economy impact on global commodities.



Interpretation: The above picture indicates that BDI had fail to impact the over all global commodities during the analysis period. The t-test as been applied between BDI and selected commodities the calculated value have fallen in Non-Significant region.

FINDINGS:

1. Meat, Cereals and Fruits volatility is not influenced by the global economic indicator during the study period.
2. Agriculture commodity are impacted by the global agriculture index during the analysis period except cereals.
3. Selected agriculture commodities metals and beverages indices volatility is observed less than global economic indicator Baltic Dry index BDI volatility during the analysis period.
4. The study result indicates that global commodities were not impacted by the global economic indicator.

CONCLUSION: I conclude the analysis of global commodity indices volatility during the period of Dec 2009 - Nov 2014. In this study I have considered 9 different types of global commodity indices along with the global economic indicator Baltic Dry Index (BDI). Commodities across the globe move according to the global economy in this analysis I had measured the global economy volatility influence on selected global commodity volatility and also studied impact of global agriculture index on agriculture commodities over all study proves that Baltic Dry Index (BDI) had fail to influence the commodities returns during the study period hence future study is recommended in this area to measure the commodity

movement of global commodities along with the global economy and considered the macro level economic factors impact on global commodities price volume and quantity so that how commodities will behave in the global economy in near future.

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