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International Integration of Maize

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Abstract

In the present scenario due to globalization markets are linked with each other not only for domestic commodities but also to compete for international commodities so that economic stand, as well as export, can be increased. The price of commodities is increasing day by day in both the markets Indian as well as international and high volatility is there. Present study analyses co-integration, volatility spillover, and causality among Indian Maize and US Maize by using time series techniques such as Johansen co-integration, Wald Test, GARCH (1, 1), and Granger Causality test to monthly price data from 2005-2019. The result indicates long-run co integration among these two markets is absent but short term relationship is also absent. Granger causality test indicates that US maize market leads Indian maize market but the Indian maize market does not lead US maize market. It means unidirectional causality is there. GARCH result indicates that US maize market influences volatility in Indian maize market but on the other side Indian maize market does not influence volatility in US maize market.

JEL Classification: - C01, C5, Q02, F65, G15

1. INTRODUCTION

Commodities are widely traded in world market. The main purpose of commodity market was price discovery as well as risk management (Garbade and Silber, 1983). Commodities production and utilization in India is of basic significance and in this way an effective Indian commodities market is basic for guaranteeing better financial development possibilities. In India there are six national and sixteen regional commodities exchanges. SEBI regulates Indian commodity exchanges. MCX as well as NCDEX are the major commodities exchanges. Maximum trade is held with them.

Trading in commodity market is as essential for economic development, for the growth and financial safety of hopeful farmers and to stretch other economic parameters like GDP, per capita income. It brings stability in prices across the market. It hedges price risk which is good for agriculturists and all types of manufacturing industries. Commodity market in various ways has impact on the development of nation as it directly impacts the farmers who sell their agriculture produces in the market and may be industries in the need of metals as well as agricultural products for their raw material. It has also role in import and export to earn foreign currency especially for export dependent nations.

However growth of commodity market in globalised and liberalized economy is not up to the expectation of investors and economists because many believe that speculation in commodities and especially in food commodities would cause malfunctioning of spot market and price could be badly manipulated. This may result in inflationary effect on the essential commodities. However, the Indian commodity markets are dependent upon numerous guidelines and numerous multiple times have been scrutinized for theoretical exchanging movement just as for causing an in-wrinkle in spot value unpredictability (Kabra, 2007). Developing commodities markets are commonly reprimanded for theoretical movement and destabilizing job of subsidiaries on spot market through expanded value instability (Mohanty and Langley, 2003; Roy and Kumar, 2007; Yang et al., 2007).

A large portion of the investigation on India's commodity future markets are constrained to strategy related issues. A portion of the significant issues distinguished and examined in India's commodities markets are: the job of spot markets

coordination and rubbing (high exchange cost), appropriate agreement plan, recognizable proof of conveyance area, significance of product lodging offices and strategy issues like limitation on cross-fringe development of wares, distinctive sort of duties and so forth (Saji, 2018; Thomas and Karande, 2002). The literature on value disclosure on Indian markets is restricted to local trades, dated/little example structure the period before setting up of national trades, or to less commodities exchanged on national trades (Roy and Kumar, 2007; Thomas and Karande, 2002). Maximum researchers cover the relationship among future and spot prices. Price discovery function of futures markets has been extensively studied in equity markets (Kawaller, 1987; MacMillan, 2005). With regards to future market price discovery has been analyzed (Fortenbery and Zapata, 1997; Yang et al., 2005). However, these studies are mostly from developed markets in countries like US and UK. Maximum studies are in equity and commodity spot-futures markets. Many studies discuss about integration volatility spillover as well causal relationship in context of commodity market both theoretically and empirically (Sehgal, 2014).

In large numbers of studies, it is found that U.S. market plays dominant role in global market. The greater part of worldwide maize cultivation is in the United States. It has an important place in global food markets and highly traded in countries like United States (Agriculture market information system, 2016). U.S produces 378 million metric ton Maize per year which is the largest contribution worldwide in 2017. Indian economy is a fast growing economy which held third position in world for their purchasing power parity and also overshadowed the Chinese economy (IMF, 2017). According to Krithiga et al. (2018) India's commodity market act as a diffusion of prices for global commodity prices as they are vital consumer as well as producer of commodities. Indian market is not integrated with U.S market in every sector. However to know up to which extent they are integrated and how they influence each other present study has been undertaken.

In this paper researcher measures co-integration by using Johansen co integration, volatility spillover by using GARCH (1, 1) as well as causal relationship by using Granger causality test. Rest of the paper describes as follows: literature review in section 2. Data and methodology used in study in section 3. Section 4 describes about result and discussion. Section 5 highlights the conclusion.

2. LITERATURE REVIEW

The linkage among India and world market was examined and result demonstrated high level of integration between markets until recession. It was additionally recommended that emerging market like India ought to empower their residential agriculture creation and farthest point reliance on global markets to build up atmosphere of economic growth, (Saji 2018). Luo and Ji (2018) studied volatility connectedness of agricultural commodity in US as well as Chinese market with a different angle. Although the study confirms the notion of direction of spillover from US to China but further adds that the magnitude of spillover is weak and volatility effects has leverage across markets. For the US agricultural commodity market, it was found that in long run there is a co movement in the price of crude oil and agricultural commodities of US. It was suggested that various political, economical and seasonal factors have effect on the intensity of volatility in the price of both crude oil and agricultural commodities. Fung et al. (2013) studied the linkage of China future market with the market of US, UK, Japan and Malaysia using the lead leg relationship among two commodity markets and found short run causality by using causality test. Li and Zhang, (2014) examined causal relation among India, Chicago, UK and china market by using Vector Auto regression (VAR) model. Khalifa et al. (2011), Immanuval and Lazar, (2020) and many others like Kang and Yoon (2016) used spillover index to study volatility spillover effects by using generalized autoregressive conditional heteroskedasticity (GARCH) model. Mohantly and Langley (2003) investigated linkage of grain market among Canada and the U.S. via Johansen Co integration as well as Vector Error correction model (VECM). Four different sub periods (January 1986 to December 1993), (January 1994 to July 1999), (January 1986 to July 1995) and (August 1995 to July 1999) were used to investigate connection among prices and trades agreement among these trades flows affected countries. The result indicates that co-integration was found in the four sub periods, and trade agreement improved connection among Canada and the U.S., speed of adjustment to price changes was higher in the fourth sub period. Araujo (2009) examined the connection among U.S. and Mexico maize prices. It was found that prices in Mexico share a common long-term relationship with prices in the U.S. Dutoit et al. (2009) analyzed price transmission in international markets to domestic markets of American countries for the period 1985-2008; main objective of the study was to find out how international price affects local prices, and how fast this phenomenon takes place. It was found that in the case of rice, the American market is connected to the international markets; there was also a situation where it was found that the producers and wholesale rice markets are integrated with the markets of Argentina and Uruguay. The results obtained by Yin and Han (2013) showed that after the global turmoil, intensity of spillover of UK exchange has increased. However the direction of spillover is time-variant. It is noteworthy here that the model used by Yin and Han (2013) was BI-vitiate E GARCH (GARCH family model). Chakrabarty, De, and Bandyopadhyay (2015) examine volatility spillover using dynamic conditional correlation (DCC-GARCH) and found spill over changes with the change in investment decision. Sharma and Dhiman (2019) examined performance of Indian

commodity market. From above review it was found most of the studies on international linkage are done among developed countries. Only limited studies are done with India as well as maximum studies are on metal, oil. So this study is an attempt to examine short term as well as long relation, volatility spill over and causality among United States Maize market and Indian Maize market.

3. DATA AND METHODOLOGY

Data used in the present study consists of monthly observation of maize that is an agricultural commodity for the time period 2005-19. This time period is chosen due to availability of data. Data is obtained from official websites of both commodities markets (Bloomberg and RBI) and per quintal monthly data is converted in USD. Integration of markets, volatility spillover and causal relations are examined using the time series techniques co integration test, VECM, GARCH and causality test. Details of all these areas under:

1st of all we need to check stationary of data. There are many models for non-stationary checking but unit root in time series is most popular among all. These are Dickey-Fuller, Augmented Dickey-Fuller as well as Phillips Perron test to check unit root in time series.

AUGMENTED DICKEY-FULLER TEST

This test examines the weather that first order difference equation has unit root.

PHILLIPS PERRON TEST

One of the significant suppositions of Dickey Fuller (DF) test is that the blunder terms are uncorrelated, homoscedastic just as indistinguishably and autonomously conveyed. Phillips and Perron (1988) have altered the DF test, known as PP test, which can be applied when the above properties are not legitimate. The PP test appears to follow the equivalent basic values as that of DF test; yet has more prominent capacity to dismiss the invalid theory of unit root.

JOHANSEN CO-INTEGRATION TEST

For understanding connection among Indian maize and US maize Johansen co-integration is applied. Co-integration theory proposes that two non-stationary arrangements having same stochastic pattern, will in general move together as time goes on (Engle and Granger, 1987). In any case, deviation from since a long time ago run equilibrium can happen in the short run. The Johansen full information multivariate co-integrating system (Johansen, 1999; Johansen, 1991) is broadly used to play out the co-integration. It must be performed between the arrangements having same level of combination.

CAUSALITY TEST

It is an econometric tool which is based on Chi-Square test to decide if one time series is helpful to foresee what's to come of another series.

4. RESULT AND DISCUSSION

Beginning of analysis of data is always done via examining stationary of data. Here for analysis purpose ADF and PP test are used for both the series. Table-1 represents the combined results of these tests. Result shows that at level, data is non stationary. Then it is again tested in 1st difference and data is stationary at 1st difference.

Table-1 Result of Stationary Test

	India Level		India 1st Difference		US Level		US 1st Difference	
	t-Statistic	p-value	t-Statistic	p-value	t-Statistic	p-value	t-Statistic	p-value
ADF Test	-.33004	0.0534	-131.581	0.000	-10.35054	0.0645	-151.781	0.000
PP Test	-6.43687	0.1688	-147.272	0.000	-8.65981	0.1874	-171.574	0.000

PP test also shows the same result. p value comes very low in both the cases. For both the series null hypothesis is rejected at 95% level of significance. It is very important before applying any model that data should be stationary. Before moving towards Johansen and Granger causality test Leg selection is also required. Here for lag selection Akaike information criterion has been applied. For both the series lag 3 is selected.

Table-2 lag Length

Variables	Optimal Lag Length
Maize	3

If the variables are stationary at first difference than Johansen co-integration test can be conducted. Lag can be selected by running VAR model. Equation can be as under:

$$£_t = \alpha_1 £_{t-1} + \dots \dots + \alpha_r £_{t-r} + \mu\beta_t + \varepsilon_t$$

Here $£_t$ is non-stationary at first difference and deterministic variable is β_t

1988 based on the maximum Eigen value criteria Johansen co-integration test that was introduced by Johansen. Summary of result is given in table 3. Acceptance of the null hypothesis at significance level of 5% means no co integration at significance level of 5%. Test concludes that there is no long-run co integration among these two markets. Even it can be said that no linear relationship among these two.

Table-3 Result of Johansen Co-integration Test

Variable	Hypothesis	Lag Length	Trace Statistics	Maximum Eigen Statistics	Maximum Trace Statistics	Critical value (Trace) 95%	Critical value (Eigen) 95%
Maize	**0**	**3**	11.05331	5.966333	0.040042	15.49471	14.26460
	1	**3**	5.086973	5.086973	0.034242	3.841466	0.034242

Trace test indicates no co-integration at the 0.05 level and Max-eigen value test indicates no co-integration at the 0.05 level. Because both Trace Statistic and Max-Eigen Statistic are lesser than their corresponding critical value at 5 per cent level of significance. Trace statistics (11.05331) < critical value (15.49471) at 5% level of significance and maximum eigen statistics (5.966333) < critical value (14.26460). Test concludes that there is no long-run co-integration among these two markets. Even it can be said that no linear relationship among these two.

Table- 4 Results of Granger Causality Test

	F-Statistic	P value
U S maize does not Granger cause Indian maize	3.97339	0.0209
Indian maize does not Granger cause US maize	0.81634	0.4441

To know which one is cause and which one is the effect, Granger causality test is done. This test is also applied stationary data that is on 1st difference for both the series. Result of ADF and PP test indicates data was found stationary on 1st difference. Table-4 indicates the result of Granger causality test. Granger causality test indicates that US maize market leads Indian maize market but the Indian maize market does not lead US maize market. It means unidirectional causality is there. It shows US maize market influenced the Indian Maize market. Gormus (2013), Reddy and Sebastin (2009), Yamori (2010), said that on the off chance that there is no causality input in any of the headings, at that point it implies both the business sectors are free of one another and speculators may support their hazard by expanding their portfolio over the business sector's.

Table-5 Volatility Spillover Result

Variables Maize		Coefficient	Z-Statistic	P value
Mean equation	India	0.887494	20.91932	0.0000
	US	0.472250	22.06659	0.0000
Variance equation	RESID(-1)^2 India	0.874192	2.322661	0.0202
	GARCH(-1) India	0.114751	0.548593	0.5833
	RESID(-1)^2 US	0.928487	2.944479	0.0032
	GARCH(-1) US	0.007824	0.080854	0.9356

GARCH (1, 1) model is applied for volatility estimation among Indian as well as US maize market. It is also known as ARCH and GARCH model. This model has two part mean equation and variance equation. Mean equation indicated high volatility is there in both the market. it means price fluctuation is there in both the markets. Here RESID means residuals. It is current day volatility. It can be represented as ARCH term. Previous day volatility is known as GARCH term. Here error term is conditionally hetroscedastic that can be represented by GARCH (1, 1) model. Here once Indian maize is taken as dependent variable and once US maize is taken as dependent variable. Results indicate ARCH is significant but GARCH is not significant for both the markets. It means both the markets are affected by previous day's information but influenced by previous day's volatility. Result shows that US maize market transmits volatility in Indian market but Indian does not. US market gives shock to Indian market. US market influences volatility but Indian market does not influence any volatility to US market.

Table-6 Result of wald test

Indian			**US**		
	F-Statistics	**P-Value**		**F-Statistics**	**P-Value**
Maize	1.364901	0.2555	**Maize**	0.506948	0.6780

To know short term relation among Indian and U.S market wald test is applied. Table-6 indicates the result of wald test. Here null hypothesis is India t-1= India t, when US is dependent variable and US t-1 = US t, when India is a dependent variable are equal to zero. The result of wald test rejected the null hypothesis. It means there is no short run connection from India

to U.S as well as U.S to India. Both the markets do not reflect any short term relationship among them.

5. CONCLUSION

Present study analyses co-integration, volatility spillover, and causality among Indian Maize and US Maize by using time series techniques such as Johansen co-integration, Wald Test, GARCH (1, 1), and Granger Causality test to monthly price data from 2005-2019. Indian commodity market is an emerging commodity market but US commodity market is developed commodity market. Result of Johansen co-integration test and wald test indicates long-run co integration among these two markets is absent and short term relationship is also absent there. It means no information is flowed from US commodity market to Indian commodity market. Granger causality test indicates that US maize market leads Indian maize market but the Indian maize market does not lead us maize market. It means unidirectional causality is there. GARCH (1, 1) result indicates that US maize market influence volatility in Indian maize market but on the other side Indian maize market does not influence volatility in US maize market. US market gives shock to Indian market.

6. Applications of the Study

Findings suggest that when markets experience shocks or innovations, both markets do not move in the same way. As a result, in the absence of co-integration between the two markets, investors can mitigate risk by diversifying their portfolio across both markets. but due to unidirectional causality investor should be careful. To encourage tighter integration across these markets and build confidence among market players, governments must undertake regulatory measures.

7. Scope for further work

The findings are derived from a sample of spot maize prices. It is possible to expand the analysis to a broader sample of future maize costs, as well as to some other countries because it is limited to India and US.

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