Across Border Integration of Agricultural Food Commodity – An Analysisfrom the ARDL Bound Test and the Toda and Yamamoto approach

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Abstract

This paper tries to identify the connection between emerging commodity markets like India and Developed commodity market of United States. The analysis utilizes various econometric models like ARDL Bound test and Toda Yamamoto approach of Granger causality test which are administered separately on fourteen year monthly data of Indian wheat market and United States wheat market. Findings indicate the absence of co-integration among Indian market and United States wheat market. Toda Yamamoto approach confirms unidirectional causality among these markets.

KeyWords: Agriculture commodity, ARLD Bound, Toda Yamamoto test, causal relationship

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Introduction

Wheat is the 1st biggest produced cereal in the world. More than half of global population considers wheat as a staple food. India as well as United States is largest producer and exporter of wheat. The agricultural industry has undergone major shifts in the scale of trade, market participants, and market structure in the last couple of decades (Irwin & Sanders, 2012). According to Rapsomanikis, Hallam and Conforti (2006), World-wide commodities demands as well as supply assume a noteworthy function for domestic commodity cost set up, as the world turns out to be more integrated. United States is one of the largest producers and exporters of grains. India is also one of the leading producer and exporter of some essential food commodities, is frequently criticized for its defensive measures aimed at curbing the transmission of foreign price shocks.

For the past two to three decades, the increasing incorporation of national economies into the global economy through trade and investment liberalization has been a phenomenon. Closely integrated markets should exist in countries with tight trade and investment links (Cheng and Zhang, 1997). According to kose et al., (2006) Globalization turns the world economy's conventional market systems into timeless, space-less, free and opens. Instead of being an end in itself, incorporation into the global economy should be seen as a means of growth (Sesrtcic, 2005). The nature and speed of integration has been dramatically affected by communication and transportation technology developments, the drift in customer preferences as well as shifts in public policy (Mussa, 2000).

A well integrated market can be known as efficient market. Increasing integration complexity makes it difficult and hard to calculate performance. Among several performance metrics, however, prices are the key technique to determine the efficacy of integration of market at various levels(Kharin, 2015). Country's technical advances strengthen goods and processes, Costs that stimulate trade partner's import demand and reduce market pressure for trade partners. Increasing market convergence can therefore, be evaluated via commodity price lenses (Bolling, 2003). Greatestindicator of the integration of the commodity market is price convergence (Findlay and O'Rourke, 2003).

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In other words, the volatility of integrated commodity prices is the most important source of economic shocks, mainly in emerging as well less developed economies, those are deeply depressed by their long-term economic growth. Consequently, the convergence of the commodity market and the impact of price transmission have received considerable attention recently. Much literature on this topic embraces the traditional wisdom that agriculture is most vulnerable sector to the volatility of worldwide prices. In many declining economies, agriculture is a shining light. Still, it is a dynamic operation in the light of the dynamism and inventions recorded by the worldwide economies (Loto, 2012). Globalization and trade liberalization have exposed several developing nations' agricultural sectors to sudden disruptions triggered through supply demand circumstances and commodities prices fluctuations (Bathla, 2014). In response to changing global market conditions, opening up to global markets and continues adjustment of agriculture policy causes price transmission effects on agricultural product markets (Arnade et al., 2017). Therefore, in the sense of agricultural trade liberalization, the issue of price volatility has assumed crucial significance, leading to volatility transmission of global prices into local market (Sekhar, 2003). However the short price market shift is much smaller than the long-term price shift, driving the effectiveness of stabilization policies to postpone the distribution of price shocks in many commodities (Arnade et al., 2017). Efficient market always describes at whatever point entrance of any news in the market that can straightforwardly influence investor's impression, making them amend their portfolio or ventures and these progressions are promptly estimated in financial market.

In the present study linkage in agricultural commodity wheat which is traded in Indian and United States commodity market is analyzed. Present study is an attempt to know integration and lead lag relationship among these two markets through ARDL model and Toda Yamamoto approach of Granger causality. The remainder of the paper outlines the analysis of literature in section 2. The data and methods used in the section 3 analyses. The outcome and discussion are listed in Section 4. The conclusion is illustrated by Section 5.

Literature Review

There are few studies on price transmission and volatility among international to domestic agriculture commodities like Hatzenbuehler et al. (2017), Pishbahar and Alizadeh (2016), Sherafatmand and Baghestani (2016), Layani et al. (2015), Mosavi et al. (2014), Jezghani et al., (2011) and Minot (2011). From review of all these studies it was found that there is connection among different agriculture commodities market and affected by volatility. Most of them applied Error correction model. A vast body of literature examined the relationship between two commodities, gold and crude oil, and the stock market. Gold, according to Baur and McDermott (2010), can be used as a safe haven in emerging and developed economies. Similarly, Souek (2013) discovered that during times of financial crisis, the relationship between stocks and gold futures becomes negative and sluggish, implying that gold serves as a safe haven during these times. Azar (2012) analyzed long term relation among US money supply and commodity prices. Baquedano et al. (2014) investigated integration of market as well as transmission of price among developing countries by applying error correction model. It was found that there is co-integration among developing country market as well as world market. Ganneval (2016) investigated impact of volatility on French food market via Threshold vector error correction model. Arnade et al. (2017) analyzed price transmission in china's market and global agriculture market through ECM model and found integration. Ceballos et al. (2017) examined international grain prices impact on domestic commodities market of developing country. GARCH-M was applied and found volatility transmission in wheat market. Jacques (2018) investigated price transmission in rice market through VECM model. Mosavi and Alipour (2019) examined price transmission in vertical market through VECM, GARCH model as well as granger causality and found prices have positive impact on volatility. Fatima and Shamim (2020) applied ARDL model to know integration among GDP export and consumption and found no co-integration among these countries. Benada (2018) applied GARCH model to know the volatility among Crude oil and Natural gas. Lauenstein (2017) found causal relation via Toda Yamamoto test among crude oil productin and freight rates. Nareswari& Wibowo (2020) analysed global commodity prices can be used to predict local commodities prices via

VECM/VAR model and found two way causality as well as both the prices are cointegrated. The main aim of this research is to fill the gap.

Data and Methodology

Present study consist monthly spot prices of wheat from April 2005-dec 2019. Collection of data is done from the official website of both the exchanges. The reason for selecting this time period is commodity data availability.

Autoregressive Distributive Lag Bound Test

In 2001pearson, sin and smith proposed ARDL model. Due to its appealing characteristics, this technique was used. Compared to other conventional ones, this approach is more versatile and effective. Approaches to the log-run co-integration analysis is it can be used any of the stage of variable integration at level I(0), integrated at leval I(1) or co-integrated fractionally (Bouri et al. 2017; Dutta, 2017; Tursoy and Fasal, 2017). However one aspect that must be taken into consideration before implementing this method is that none of the variables in order 2 or higher should be integrated.

Indian commodity =β1 + ∑i=1 À1i Indian commodityt-1 + ∑ È1i US commodity t-I + ¥1
Indian commodityt-1 + b1US commodityt-1 + µ1t (1)

US commodity = β1 + ∑i=1 À1i Indian commodityt-1 + ∑ È1i US commodity t-I + ¥1
Indian commodityt-1 + b1US commodityt-1 + µ1t (2)

ARDL bound test is applied to check long-run co-integration between variables which is based upon F-Test or Wald Test. F-test value is always compared with upper bound as well as lower bound value. If value is higher than no co-integration null hypothesis is rejected. If value lies between than null hypothesis is inconclusive. To find out co-integration among variables error correction term is used. Here long run co-integration existence implies that error correction term is significant and negative. If the value is lower than it means there is no co-integration exists.

Toda and Yamamoto model

To study causal relation among Indian wheat and United States wheat Toda Yamamoto model is applied which is more efficient in comparison of any other traditional method for studying causal relationship. Main attraction of this method is that it does not require any order of integration as well as no requirement of co-integration relationship. This approach is based upon the concept of implementing the level (p = k + dmax) vector autoregressive (VAR) model with the right VAR order k and d extra lag, where d is the maximum order of time series convergence. The application of Toda and Yamamoto for both related variables under study is as follows:

Xt = b0 + b1xt-1 + b2 xt-2 …….bk xt-k + µt

To find out causal relationship among variables equation is as under:

Xt = b + b1xt-1 + b2 xt-2 …… + bk xt-k + bk+1 xt-k+1_ + bpxt-p + µt

Result and Discussion

For testing unit root presence in both the variables ADF test has been applied. The result of ADF in table one clearly shows that wheat has unit root at level. It means wheat is stationary at level. For unit root presence on 1st difference again tested. Results shows wheat is found stationary on 1st difference also.

Table1: Result of ADF test

Variables	Level		First difference	
	Statistic	P-Value	Statistic	P-Value
Wheat	14.5414	0.0058	150.743	0.0000

Source: Author 'calculation

For robustness checking Phillips Perron Test has been applied. Phillips Perron test also shows the same result. The result of PP test in table two clearly shows that wheat has unit root at level. It means wheat is stationary at level. For unit root presence on 1st difference again tested. Results shows wheat is also stationary on 1st difference also.

Table2: Result of PP test

Variables	Level		First difference	
	Statistic	P-Value	Statistic	P-Value
Wheat	12.4355	0.0144	147.227	0.0000

Source: Author 'calculation

One of the conditions for the implementation of the ARDL model is that series should be either I (0) or I

(1) but no one should be I (2).

Before applying ARDL as well as Granger test leg length selection is necessary. For optimal lag length selection VAR has been applied. Optimal lag has been selected as per Akaike information criteria that are shown in table three. Result of ARDL model is presented in table four. Result shows that F-statistic is lower than upper bound as well as lower bound. It exhibits the absence of co-integrated relationship among Indian wheat and United States wheat.

Table 3: Optimal Lag length for Indian wheat and United States wheat

Variables	Optimal Lag Length
Wheat	2

Source: Author's calculation

Table 4: ARDL model results for Indian wheat and United States wheat

Variables	F- Statistic	Lower Bound	Upper Bound
Wheat	3.710029	4.303	4.16

Source: Author's calculation

The results of the current study suggest that the U.S. wheat market does not contain adequate information to forecast long-term Indian wheat prices. In the long run, both markets do not shift together linearly when a typical stochastic distress arises in any one of the markets. From these finding it can also be recommended that Indian wheat markets are not directly connected with United States wheat markets thus has no returns predictive power. Therefore the variables shift indiscriminately away from each other in the absence of long-run relationships between both markets. In order to diversify the portfolio, In the long run, whether the two markets are independent or not co-integrated investors should invest in both markets. Shocks are not transferred from one market to another in the event of instability in any of the markets.

It needs to be explained here that the similar news impacts Indian and United States commodity market in a different way. As per normal terms, similar shocks occurrence drives both markets to shift in opposite directions. In the economy, they would be kept together by the linear combination of the two markets, or it can be assumed that the two markets move in the same linear direction. Toda Yamamoto approach was applied to study causal relationship among Indian wheat market and United States wheat market. Before applying this model we need to check stationary of data or it can be said order of integration of data. Table one and table two describes the order of integration. Lag length criteria are also required which is described in table three. Results of Toda Yamamoto test which is shown in table five describes the presence of unidirectional causality among Indian wheat market and United States wheat market.

Table5: Result of Toda Yamamoto approach

Independent variable	Dependent variable	Chi-square	Df	P value
U S wheat	Indian wheat	11.26909	2	0.0036
Indian wheat	U S wheat	1.126679	2	0.5693

Source: Author's calculation

Main reason behind it Indian wheat market may be influenced by domestic as well as worldwide demand. Prices may be high duo to inappropriate supply in comparison of demand. On the other side due to negative shock investors may reduce investment to minimize risk and the result may be in terms of reduction in prices.

Conclusion

Present study is an attempt to know connection among Indian wheat market and United States wheat market using daily data from the period April 2005 to December 2019. Results of ARLD bound test revealed that there is no co-integration among Indian wheat market as well as United States wheat market. Results of Toda Yamamoto test confirm unidirectional causality among Indian wheat market as well as United States wheat market. On the whole it can be said that United States wheat market does not have enough details to predict Indian wheat price. From the investor's viewpoint, the finding recommends that both markets could not shift in the same direction when there is shock or innovation in the markets. Policymakers ought to make legislative decisions as well as accounting adjustments from a policy point of view to promote greater integration of these markets. In order to facilitate integration, SEBI has recently made some legislative amendments.

Policy Implications

From the financial backer's viewpoint, the above

outcomes suggest that when there is stun or advancements in the business sectors, both the business sectors don't move a similar way. Accordingly, if there should be an occurrence of nonappearance of co-integration and causality between agricultural Commodities of India and United States, financial backers can support their danger by enhancing their portfolio in both the markets. In any case, this equivalent can't be said about the wares that are having unidirectional causal relationship. According to Gormus (2013), in contrast to the regular discernment, the financial backers ought to be cautious while utilizing these wares as broadening apparatus. From the approach perspective, policymakers need to make controllers and bookkeeping changes to empower further reconciliation among these business sectors. SEBI has as of late made certain alterations in law to advance combination in both the markets to develop certainty among market members.

Reference

Arnade, C., Cooke, B. and Gale, F. (2017). Agricultural Price Transmission: China Relationship
with World Commodity Markets. Journal of Commodity Markets, 7, 28-40.

Azar, S. A. (2012). Commodity prices and the US money supply in the long run. International Journal of Trade and Global Markets Vol.5 No.3/4. pp. 316 - 335. DOI: 10.1504/IJTGM.2012.049983

Baquedano, F. G. and Liefert, W. L. (2014). Market Integration and Price Transmission in Consumer Markets of Developing Countries. Food Policy, 44: 103-114

Bathla, S. (2014). Public and Private Capital Formation and Agricultural Growth in India: State Level Analysis of Inter-linkages during Pre- and Post-reform Periods. Agricultural Economics Research Review, 27(1), 19-36.

Baur, D. G., & McDermott, T. K. (2010). Is gold a safe haven? International Evidence. Journal of Banking & Finance, 34(8), 1886–1898.

Benada, L. (2018). Linear Hedging of Crude oil and Natural Gas. International Journal of Trade and Global Markets Vol.11 No.4, 323 - 333. DOI: 10.1504/IJTGM.2018.097279

Bolling, C. (2003). Measuring market integration in the global economy. Paper presented at American agricultural economics association Annual Meet Montreal Canada July 27-30.

Bouri, E., Jain, A., Biswal, P. C., &Roubaud, D. (2017). Co-integration and nonlinear causality amongst gold, oil, and the Indian stock market: Evidence from implied volatility indices. Resources Policy, 52, 201–206.

Ceballos, F., Hernandez, M. A., Minot, N. and Robles, M. (2017). Grain Price and Volatility Transmission from International to Domestic Markets in Developing Countries. World Dev., 94: 305-320.

Cheng, N. and F. Zhang, (1997). Correlations, Trades and Stock Returns of the Pacific-Basin Markets. Pacific-Basin Finance Journal 5(5), 559-577.

Dutta, A. (2017). Oil and energy sector stock markets: An analysis of implied volatility indexes. Journal of Multinational Financial Management, 44, 61–68.

Esfahani, F.Z., (2006). Testing the Law of One Price in the Chinese Wholesale Agriculture Markets. Journal of Agribusiness, 22(4), 569-589.

Fatima, Z., & Shamim, M. (2019). The Dynamic Nexus between GDP, Consumption and Export of BRICS countries: an ARDL cointegration analysis. internation Journal of Trade and Global Markets . Vol.13 No.3, 267 - 287 DOI: 10.1504/IJTGM.2020.108776

Findlay, R. and O'rourke, K.H., (2003). Commodity Market Integration 1500-2000. In Globalisation in Historical Perspective Bordo, D.M., Taylor, A.M. and Williamson, J.G. (Eds.) http//www.nber.org/chapter/c9585

Ganneval,S.(2016). Spatial Price Transmission on Agricultural Commodity Markets under Different Volatility Regimes. Econ. Model., 52: 173-185

Gormus, N. A. (2013). Causality and volatility spillover effects on sub-sector energy portfolios (Published Doctoral Dissertation). The University of Texas, Arlington, Texas. Retrieved from https://rc.library.uta.edu/uta-ir/bitstream/handle/10106/11531/Gormus_uta_2502D_11853.pdf ?Sequence=1&isAllowed=y .

Hatzenbuehler PL, Abbott PC, Abdoulaye T (2017). Price Transmission in Nigerian Food Security Crop Markets. Journal of Agric Econ 68(1):143–163

Irwin, S.H., & Sanders, D.R. (2012) "Financialization and Structural Change in Commodity Futures Markets." Journal of Agricultural and Applied Economics 44, 3: 371–96.

Jacques, H. D. (2018). A Methodological and Applied Analysis on Asymmetric Price Transmission Models: Brazilian Rice Market Issues. Thesis Submitted to the Graduate Program in Economic Sciences, as Part of the Requirements for Obtaining the Doctor of Economics, State University of Maringá.

Jezghani, F. Moghaddasi, R. Yazdani, S. and Mohamadinejad, A. (2011). Price Transmission Mechanism in the Iranian Rice Market. Int. J. Agric. Sci. Res., 2(4): 31-38.

Kaabia, M.B., Gil, J.M. and Boshnjaku, L. (2002). Price Transmission Asymmetries in the Spanish Lamb Sector. International Congress, August 28-31, 2002, Zaragoza, No. 24908. Spain Press

Kharin, S., (2015). Vertical Price Transmission along the Dairy Supply Chain in Russia. Studies in Agricultural Economics 117(2), 80-85.

Kose, M.A., E. Prasad, K. Rogoff, and S.J. Wei. (2006). Financial Globalization: A Reappraisal. Working Paper No. WP/06/189, International Monetary Fund. Available at https://scholar
.harvard.edu/files/rogoff/files/imf_wp_06_189.pdf

Lauenstein, P. (2017). The Dynamic relationship between Tanker Freight rates and crude oil production: Evidence fron Causality Analysis. International Journal of Trade and Global Markets Vol.10 No.4, pp 267 - 289. DOI: 10.1504/IJTGM.2017.090250

Layani, GH. Ghorbanian, A. Bakhshoudeh, M. (2015). World price transmission of cereals to domestic markets of these products. Journal of Agricultural Economics and Development. 29(4): 334-344.

Loto, M.A., (2012). Global Economic Downturn and the Manufacturing Sector: Performance in the Nigerian Economy (A Quarterly Empirical Analysis). Journal of Economics and Management Sciences 3(1), 38-45.

Minot, N. (2011). Transmission of World Food Price Changes to Markets in Sub- Saharan Africa, IFPRI discussion paper

no. 1059, International Food Policy Research Institute: Washington, DC

Mosavi, S. H., &Alipour, A. (2019). Price Transmission and its Volatility in Rice Marketing Chain in Iran: A Case Study of Kamfirozian Variety. J. Agr. Sci. Tech, vol. 21, 1767-1782.

Mosavi, S. H., Esmaeili, A. K., Azhdari, S. (2014). Evaluating Economic effects of Exchange Rate Depreciation on the Rice Market in Iran. J. Agr. Sci. Tech. 16:705-717.

Mosavi, S. H. Alipour, A. and Shahvari, N. (2017). Liberalizing Energy Price and Abatement Cost of Emissions: Evidence from Iranian Agro-Environment. Journal of Agr. Sci. Tech., 19(3): 511-523.

Mussa, M., (2000). Factors Driving Global Economic Integration. Paper presented at Federal Reserve Bank of Kansas City Symposium Global Opportunities and Challenges. 25 August Jackson, Hole Wyo.

Nareswari, P., & Wibowo, S. (2020). Global and Local Commodity Prices: A Further Look at the Indonesian Agricultural Commodities. Capital Markets Review Vol. 28, 1 , 65-76.

Pishbahar, E. and Alizadeh, P. (2016). Vertical Price Transmission in the Market of Potato and Onion (Case Study: Kurdistan Province. Iranian Journal of Agricultural Economics and Development Research, 47(3): 533-543.

Rapsomanikis, G., Hallam, D. and Conforti, P. (2006). "Market Integration and Price Transmission in Selected Food and Cash Crop Markets of Developing Countries: Review and Applications." Agricultural Commodity Markets and Trade: New Approaches to Analyzing Market Structure and Instability. A. Sarris and D. Hallam, eds. Rome, Italy: Food and Agriculture Organization of the United Nations; Cheltenham, UK: Edward Elgar, 187–217.

Sekhar, C.S.C., (2003). Volatility of Agricultural Prices-an Analysis of Major International and Domestic Markets. Working Paper No 103. Indian Council for Research on International Economic Relations, New Delhi.

Sesrtcic, S., (2005). Integration into the World Economy: Experience of the OIC Countries. Journal of Economic Cooperation 26(1), 1-62.

Sharma, S., and Dhiman, B. (2019). Commodity Market Fluctuation- A Bane or A Boon. International Journal of Research and Analytical Reviews Vol. 6(1), 77-86

Sharma, S., and Dhiman, B. (2019). Volatility Transmission between Indian Commodity Market and United States Commodity Market -Evidence from Literature. International Journal of Advance Science and Technology, Vol.28, Issue 19, ISSN: 2005-4238, 277-285

Sherafatmand, H. and Baghestani, A. (2016). Identification of Price Transmission Mechanism in Iran's Date Market (Application of Bivariate GARCH Model). J. Agric. Econ. Develop. 30(1): 70-79.

Souček, M. (2013). Crude oil, Equity and Gold Futures open interest co-movements. Energy Economics, 40(C), 306–315.

Tursoy, T., & Faisal, F. (2017). The Impact of Gold and Crude oil Prices on Stock Market in Turkey: Empirical evidences from ARDL bounds test and combined co integration. Resources Policy, 55, 49–54.