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Highest Producer as to the Highest Price Seeker- A study on Price Dependency of Turmeric in India

Arya Kumar, Faculty of MBA, College of IT and Management Education,
B.P.U.T., E-mail: aryantripathy@yahoo.com, 9853422575

Abstract

The price forecasting and dependency of agricultural product is one of the most weak form of prediction as any events or acts affects the prices of agro products in large. The present study incorporates various econometric models to understand the price volatility and interdependencies of the turmeric which is the highest producing agro products of Kalahandi, Odisha. The primary objective of the paper is to highlight the price dependencies of the turmeric throughout the India and confirming which particular state is helpful to explain the prices of turmeric that will support the farmers in forecasting the demand and supply and price fixation to sell within the state or across the border. Taheripour and Tyner (2008) the prices of agro products relies on several factors like demand and supply, substitute products, climatic condition and etc. As per the past studies, the present paper considered the weekly prices of turmeric for last nine years of Odisha and other states of India for explaining the price dependencies and volatility as an issue for price fixation. The paper used GARCH (1, 1) for volatility confirmation which states the turmeric price of Odisha is highly volatile and persistent due to the highest producer of India but weak in price fixation. Furthermore the study implemented the granger causality that confirms the turmeric price of Odisha can be predicted from the prices of Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Tamil Nadu, Telangana and West Bengal. But the opposite is not true for all the cases like Odisha cannot help to predict the prices of turmeric for the states Maharashtra, Tamil Nadu, Telangana and West Bengal. And this confirmation is true in case for short run Tamil Nadu, Karnataka and West Bengal as these states are the neighbouring states and leads in different agro products so they are considered as price leader even though Odisha is the highest producer of turmeric.

Key words**:** Agriculture, Turmeric, volatility clustering, Co-integration, Granger-Causality

Introduction:

In India particularly in Odisha, many are involved in the activities of agriculture. It is also observed that women are also engaging in the farm work and sustaining their families. But it is observed that due to negligence or several different factors like policy formation, political interference and economic issues the farmers are unable to identify the right price of an agricultural product. Farmers are also facing the issues of lack of mobility, credit facilities, and various government schemes and finding the reason behind the change in prices of the product.

Pricing of any agricultural product from its past price and predicting its value is not always true as the price of a product might be dependent on various other factors. The factors may be political, competitor or on its own past price. Taheripour and Tyner (2008) investigated and found a rise of price of corn due to the hike of oil prices. Irwin and Good (2009) examined the prices of agricultural products and found a growth from its previous

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prices. This result became for valuable when this are supported by theoretical and empirical analysis of time series (vector autoregressive and vector error correction models) that gives the evidence of long run relationship between the variables (Crane and Nourzad, 1998; Schmidt, 2000).

Number of research were carried on by Johnson et al. (1977), Schwartz (1986), Bradshaw and Orden (1990), Denbaly and Torgerson (1992), Babula et al. (1995), Kiptui (2007), Aliyu (2008), Oyinlola (2008) and all of them agreed that agricultural prices are dependent on its own prices, supplies, and demands.

Some of the authors tested the causality of prices of agricultural products like Bradshaw and Orden (1990) identified the prices of agricultural products on exchange rates through Granger Causality test and found that agricultural product prices are more keen towards exchange rate i.e. exchange rate defines the prices of agricultural products. Denbaly and Torgerson (1992) measured the long run or short run relationship between wheat prices and its determinants through error correction model (ECM). The result confirmed that the monetary policies affect the wheat prices in short run. Babula et al. (1995) considered exchange rates, price, sales, and shipments with United States corn exports and found no co-integration between them.

Several researchers like Carro (2002), Rapsomanikis (2006), Nellemann (2009), and Anderman et. al. (2014) suggested that the prices of agricultural products are influenced due to various factors. One of the major factors for the change in the prices of products is Oil price Ajanovic (2011), Pokrivčák & Rajčániová (2011) and Avalos (2014). While the result of various on price dependency of agricultural products states that the prices of food crops are influenced from the price of other food crops. Abdulai & Rieder (1995), Baek & Koo (2010), Apergis & Rezitis (2011) and Rapsomanikis & Mugera (2011).

Sekumade (2009) the study states the price dependency of agricultural product with the change in price of petroleum products. But an adverse result is found for the exported agricultural products with the value of petroleum price. Koirala et. al (2015) the study considered the high frequency data to establish a linear relationship between prices of agricultural products and energy prices. The result states that both the variables are highly related i.e. rise in price of energy leads to rise in agricultural price. Bentivoglio et. al. (2016) the study encompasses the analysis through Vector Error Correction Model (VECM) and Granger Causality tests to identify the relationship between the prices of ethanol prices and sugar prices. The test result reveals agricultural prices affects the value of ethanol prices but there exist no strong evidence on the change in value of food prices with change in ethanol prices. Nazlioglu & Soytas (2012) the analysis is conducted to test the dynamic relation with the prices of twenty four world agricultural commodity and world oil prices. The test uses the co-integration test and granger causality and the result reveals that there exist a strong relationship between world agro commodities prices and oil prices. Ciaian (2011) the paper uses the weekly data consist of 783 observations for prices of food, bioenergy and energy to identify the interdependencies. The result is concluded through time series analysis that the crude oil price and prices of different agricultural commodity like corn; wheat, rice, sugar, soybeans, cotton, banana, sorghum and tea are interdependent to each other i.e. a rise in price of oil leads to rise in price of agricultural commodities. Zhang & Qu (2015) the analysis is carried on oil prices shock on the China’s agricultural commodities. The result shows the existence of volatility clustering adding to it the price change of oil shows different effect on different agricultural products i.e. most of the agricultural products has a asymmetric result.

Except natural rubber other commodities like corn, soybean, bean pulp, strong wheat, cotton has high influence on change in oil price

Few researchers also found different factors that influences the prices of agro products like Awokuse (2005) the study considered the change in price of agricultural products due to macroeconomic variables. The result reveals by incorporating vector autoregression (VAR) type model i.e. the interest rate affects the prices of an agricultural products as it is a monetary policy shock. Sriboonchitta et. al. (2013) the result of their study states that the agricultural production leads to change in the prices of agricultural product. In general sense it is the supply of agricultural products that leads to change in product price. Capelle et. al. (2011) the study identifies the causal relationship between the index prices and the market prices of different grains, livestock and some soft commodity future markets. the result conclude no causal relationship between commodity futures prices and index-based positions.

In respect to agricultural price determination, few analysis were also carried on the price volatility such as Weaver and Natcher (2000), Kumar (2018) opined that price volatility states about the range of price which may vary in near future. Binswanger and Rosenzweig, (1986), Saha and Delgado (1989) found that price volatility of agricultural products can affect the producers' and consumers' forecast on price fixation.

The above stated literature showed various reasons for change in the prices of agricultural products which leads to high volatility in the prices. But less evidence is found on the change of price in agricultural products of a particular state with other states. This motivated the researchers with the following questions: (1) is there any relationship between prices of agricultural product of one state with other state? (2) Does the prices of the agricultural products are volatile in nature? This paper will give emphasis on turmeric as one of the agricultural products of Odisha, India. The turmeric plays a dominant role in the agricultural economy of the country as it is one of the most important cash crops of India. It is observed that India is the highest producer all over the world with total 80% of contribution globally. Andhra Pradesh, Tamil Nadu, Odisha, Karnataka, West Bengal, Gujarat and Kerala are top turmeric producers in India. But it is found that they are not effective in selling those to international markets. However, Myanmar, China, Nigeria and Bangladesh are completely depended on the India regarding the turmeric. Unfortunately, India is not able to satisfy the global market. The reason is many but the major reason is selling it on right time and at right price. This issue is observed in all the state of the nation but it is prominently found in Odisha state perhaps famers are ignorant of market price and price dependency.

As per the issues involved the objective of the papers will firstly try to identify the existence of volatility clustering in turmeric prices of Odisha. Secondly the study will give study the long run or short run relationship between the turmeric prices of Odisha and other states of India. Lastly the paper shows the causal relationship with the turmeric prices of Odisha and other states. This type of empirical analysis can help producers, suppliers, consumers and other stake holders in fixation of price, risk free investment and marketing of agricultural product.

Methodology:

The research paper is longitudinal in nature. The data is collected from secondary sources i.e. AGMARKNET website. The analysis uses the weekly prices of turmeric of top producer in India like Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Odisha, Tamil

Nadu, Telengana and West Bengal. The test includes the data of nine years from 1st January 2010 to 31st December 2018. As per the research objective a test of normality and stationary will be conducted. The study will use ARCH family model for the measurement of volatility, followed with test of Co-integration, VAR or VECM to identify the relationship between the variable. To measure the causality between the variable Granger causality will be carried on.

Results and Discussion:

A weekly price data of turmeric are considered to test the normality of the data series. The data includes the turmeric producers of India for nine years. JB statistics is considered for the test of normality. Table-1 shows the result of normality.

Table-1 Test of Normality of the states producing Turmeric in India

	ODISHA	WESTBENGAL	TELANGANA	TAMILNADU	MAHARASHTRA	KARNATAKA	GUJARAT	ANDHRA PRADESH
Mean	6009.258	7997.853	6732.069	7625.090	8269.890	7387.122	9757.09	6572.048
Median	5900.000	7950.335	6346.560	7106.230	7770.700	6976.260	9000.00	6242.660
Maximum	11166.67	19500.00	16016.06	16862.76	18201.27	17571.43	22000.0	15300.75
Minimum	3125.660	3500.000	2827.560	3310.030	3508.010	1902.300	4383.40	102.7200
Std. Dev.	1601.367	3583.621	2546.947	2726.962	2777.742	2696.871	3063.17	2583.776
Skewness	1.309451	1.611814	1.525992	1.430311	1.086136	1.558163	1.39939	1.497050
Kurtosis	4.962716	5.527509	5.299223	4.858567	3.805850	5.931097	5.23150	5.198994
Jarque-Bera	192.7962	302.0414	262.8187	209.4736	96.62695	329.4507	230.631	248.4038
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.00000	0.000000
Sum	2596000.	3455072.	2908254.	3294039.	3572593.	3191237.	4215065.	2839125.
Sum Sq. Dev.	1.11E+09	5.54E+09	2.80E+09	3.21E+09	3.33E+09	3.13E+09	4.04E+09	2.88E+09
Observations	432	432	432	432	432	432	432	432
Result	Non-Normal	Non-Normal	Non-Normal	Non-Normal	Non-Normal	Non-Normal	Non-Normal	Non-Normal

From the table-1, the result of JB test shows the value of skewness and kurtosis which is expected to be 0 and 3 respectively. But the result of all the data series has the higher value from the normality. The probability value for all the series are 0.000 which is less than 5% level of significance which rejects the hypothesis and confirms that the data series are not normally distributed.

After the confirmation of non-normality of data series the next step is to identify the stationarity of data through Augmented-Dickey Fuller test and Philips Perron Test. Table-2, below shows the result of stationarity.

Table 2: Test of stationary after 1st order difference through ADF and PP test

Data Set	ADF-At level (Trend and Intercept) at 5% level		PP-At level (Trend and Intercept) at 5% level		Result
	t-statistics	Prob.	t-statistics	Prob.	
Andhra Pradesh	-3.420308	0.0000	-3.420308	0.0000	Stationary
Gujarat	-3.420357	0.0000	-3.420308	0.0000	Stationary
Karnataka	-3.420332	0.0000	-3.420308	0.0000	Stationary
Maharashtra	-3.420357	0.0000	-3.420308	0.0000	Stationary
Odisha	-3.420382	0.0000	-3.420308	0.0000	Stationary
Tamil Nadu	-3.420332	0.0000	-3.420308	0.0000	Stationary

Telangana	-3.420332	0.0000	-3.420308	0.0000	Stationary
West Bengal	-3.420308	0.0000	-3.420308	0.0000	Stationary

The test of stationary is carried on from 1st order difference as the series is not found stationary at level. From table-2 it is clear that the data series are stationary in nature as the p-value for both ADF and PP test shows 0.0000. It rejects the hypothesis of non-stationarity of data series i.e the value of mean and variance remain constant for specific period of time.

From the above results it is clear that the data series are not following any random walk and it is stationary in nature, which result to further analysis on volatility clustering. As per the objective the existence of volatility in turmeric prices of Odisha is calculated from GARCH (1, 1) model as this model is considered after the confirmation of ARCH and GARCH effect. For volatility measurement a selection of model is done from ARMA test which shows that ARMA(1, 1) model as best fit. From table-3 we can see the output of GARCH (1, 1) model.

Table-3- Test of Volatility in turmeric prices of Odisha through GARCH (1, 1)

Dependent Variable: ODISHA
Included observations: 431 after adjustments
Convergence achieved after 95 iterations
MA Backcast: 1
Presample variance: backcast (parameter = 0.7)
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	7475.272	287.9572	25.95967	0.0000
AR(1)	0.966910	0.004342	222.7076	0.0000
MA(1)	-0.405405	0.052472	-7.726173	0.0000
	Variance Equation			
C	25799.08	2705.358	9.536291	0.0000
RESID(-1)^2	0.795154	0.076622	10.37768	0.0000
GARCH(-1)	0.502375	0.022975	21.86528	0.0000
R-squared	0.648228	Mean dependent var		6011.862
Adjusted R-squared	0.646585	S.D. dependent var		1602.312
S.E. of regression	952.5547	Akaike info criterion		15.67656
Sum squared resid	3.88E+08	Schwarz criterion		15.73316
Log likelihood	-3372.298	Hannan-Quinn criter.		15.69891
Durbin-Watson stat	2.170803			
Inverted AR Roots	.97			
Inverted MA Roots	.41			

From table 3, the result of GARCH (1, 1) for test of volatility reveals that there is volatility clustering in the turmeric prices of Odisha as the value is found positive at 1% level of significance with p-value as 0.0000.

After the confirmation of volatility of data series, the next objective is to identify the existence of long run or short run relationship between the Odisha turmeric prices with other states. Before testing the relationship the primary activity was to identify the existence of co-integration between the variable. Table 4, below shows the outcome of co-integration.

Table-4- Test of co-integration between the variable

		Unrestricted Co-integration Rank Test (Trace)			Unrestricted Co-integration Rank Test (Maximum Eigenvalue)		
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical	Prob.**	Max-Eigen	0.05 Critical	Prob.**

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			Value		Statistic	Value	
None *	0.181013	337.7793	159.5297	0.0000	85.26641	52.36261	0.0000
At most 1 *	0.173916	252.5129	125.6154	0.0000	81.58218	46.23142	0.0000
At most 2 *	0.134288	170.9307	95.75366	0.0000	61.57475	40.07757	0.0001

*Trace Max-Eigen Statistics indicates 1 cointegrating eqn(s) at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

From table-4, the result of co-integration shows the value of p as 0.000 which rejects the hypothesis, adding to it the result of Trace Statistic and Max-Eigen Value are more than the critical value which confirms that the variables are co-integrated.

When the varibales are co-integrated then to test the short or long run relationship we need to run Vector Error Correction Model (VECM). Table- 5 shows the result of VECM to measure the long run relationship for the prices of Odisha and other states.

Table-5 Test of long run relationship of Turmeric price for all the states with Odisha

Dependent Variable: D(ODISHA)

Method: Least Squares

Sample (adjusted): 4 432

Included observations: 429 after adjustments

D(ODISHA) = C(1)*(ODISHA(-1) - 0.47121979709*ANDHRAPRADESH(-1) - 0.38805205965*GUJARAT(-1) - 0.864065607659*KARNATAKA(-1) +0.935582521851*MAHARASHTRA(-1) - 0.179512258167*TAMILNADU(-1) + 0.538902607395*TELANGANA(-1) - 0.0508564914028*WESTBENGAL(-1) - 2346.13055534) + C(2)*D(ODISHA(-1)) + C(3) *D(ODISHA(-2)) + C(4)*D(ANDHRAPRADESH(-1)) + C(5) *D(ANDHRAPRADESH(-2)) + C(6)*D(GUJARAT(-1)) + C(7) *D(GUJARAT(-2)) + C(8)*D(KARNATAKA(-1)) + C(9)*D(KARNATAKA(-2)) + C(10)*D(MAHARASHTRA(-1)) + C(11)*D(MAHARASHTRA(-2)) + C(12)*D(TAMILNADU(-1)) + C(13)*D(TAMILNADU(-2)) + C(14) *D(TELANGANA(-1)) + C(15)*D(TELANGANA(-2)) + C(16) *D(WESTBENGAL(-1)) + C(17)*D(WESTBENGAL(-2)) + C(18)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.119276	0.033954	-3.512902	0.0005
C(2)	-0.398151	0.054419	-7.316403	0.0000
C(3)	-0.070182	0.050698	-1.384304	0.1670
C(4)	-0.027328	0.106178	-0.257382	0.7970
C(5)	-0.083807	0.106868	-0.784205	0.4334
C(6)	0.042635	0.055270	0.771398	0.4409
C(7)	0.039227	0.056832	0.690221	0.4904
C(8)	-0.150988	0.049005	-3.081053	0.0022
C(9)	-0.068597	0.047738	-1.436929	0.1515
C(10)	0.060853	0.070242	0.866328	0.3868
C(11)	-0.074509	0.070916	-1.050659	0.2940
C(12)	0.107968	0.120084	0.899108	0.3691
C(13)	0.296871	0.115185	2.577339	0.0103
C(14)	0.074460	0.088779	0.838706	0.4021
C(15)	0.118717	0.088183	1.346267	0.1790
C(16)	0.194368	0.089716	2.166488	0.0308
C(17)	0.176492	0.089495	1.972089	0.0493
C(18)	13.05429	45.95702	0.284054	0.7765

R-squared	0.248034	Mean dependent var	1.522914
Adjusted R-squared	0.216931	S.D. dependent var	1073.510

S.E. of regression	949.9622	Akaike info criterion	16.59177
Sum squared resid	3.71E+08	Schwarz criterion	16.76218
Log likelihood	-3540.935	Hannan-Quinn criter.	16.65907
F-statistic	7.974537	Durbin-Watson stat	2.081014
Prob(F-statistic)	0.000000		

From table-5 the result confirms the existence of long run relationship of turmeric prices of Odisha with other states as the coefficient of C (1) is negative and significant as the p value is 0.000 which less than 1% level of significance.

After the confirmation of long run the next objective was to test the short run relationship between the dependent and independent variable which is tested through Wald Test. Table- 6 below shows the outcome for short run relationship.

Table-6- Wald test for short run relationship considering Odisha turmeric prices as dependent Variable

	Andhra Pradesh	Gujarat	Karnataka	Maharashtra	Tamil Nadu	Telengana	West Bengal
P-Value	0.7335	0.6338	0.0086	0.3111	0.0348	0.3354	0.0247
Existence of Short run relation	Non-Existence	Non-Existence	Existence	Non-Existence	Existence	Non-Existence	Existence

From table-6, the result of short run relationship between dependent and independent variable shows the existence of short run relationship of prices of turmeric between Karnataka, Tamil Nadu and West Bengal, it means the price of turmeric of Odisha has short run relationship between them. While Andhra Pradesh, Gujarat, Maharashtra and Telangana does not influence Odisha price in short run.

As there exist both long run and short run relationship between the variables the next step is to identify the granger causality between the variables to measure which states influences the price of turmeric in Odisha or vice versa. Table- 7 shows the outcome of Granger Causality between the variables.

Table-7 the result of Granger Causality for the price of turmeric between Odisha and other states.

Null Hypothesis:	F-Statistic	Prob.	Hypothesis
ANDHRAPRADESH does not Granger Cause ODISHA	11.5081	0.00001	Rejected
ODISHA does not Granger Cause ANDHRAPRADESH	3.31360	0.0373	Rejected
GUJARAT does not Granger Cause ODISHA	11.0023	0.00002	Rejected
ODISHA does not Granger Cause GUJARAT	8.21208	0.0003	Rejected
KARNATAKA does not Granger Cause ODISHA	10.1812	0.00005	Rejected
ODISHA does not Granger Cause KARNATAKA	12.1319	0.000008	Rejected
MAHARASHTRA does not Granger Cause ODISHA	8.68321	0.0002	Rejected
ODISHA does not Granger Cause MAHARASHTRA	2.59362	0.0759	Accepted
TAMILNADU does not Granger Cause ODISHA	12.7808	0.000004	Rejected
ODISHA does not Granger Cause TAMILNADU	1.14198	0.3202	Accepted
TELANGANA does not Granger Cause ODISHA	15.4975	0.0000007	Rejected
ODISHA does not Granger Cause TELANGANA	2.87557	0.0575	Accepted
WESTBENGAL does not Granger Cause ODISHA	17.3785	0.00000006	Rejected
ODISHA does not Granger Cause WESTBENGAL	0.42282	0.6555	Accepted

From table 7, the result of granger causality states that the turmeric price of Odisha can be predicted from the prices of Andhra Pradesh, Gujarat, Karnataka, Maharashtra, Tamil Nadu, Telangana and West Bengal. But the opposite is not true for all the cases like Odisha cannot help to predict the prices of turmeric for the states Maharashtra, Tamil Nadu, Telangana and West Bengal.

Conclusion and Policy Implications:

There is a general tendency among the farmers and policy makers that the price of an agricultural product is depended on its own price or as per the demand and supply of the particular product. Even after such ideology with minimum market survey the farmers value the agricultural products. But this does not help them to sell at right price. This phenomenon makes the price of a product highly volatile. This issue lies with them due to unawareness of market trend and pricing of the products. Sometimes the prices quote by the farmers are of higher rate or low rate. There are several factors involved in fixation of prices. This paper reduces the gap by identifying one of the factors which is least considered that is how a price of an agricultural product of a particular state affects the price of same product of other state. The study encompasses the weekly turmeric prices of Odisha and other states in India and found that the prices of turmeric of Odisha are highly volatile. The paper uses co-integration test and found the variables are co-integrated with each other. A further analysis on long run and short run relationship between the prices of turmeric of different states shows that prices of turmeric of Odisha has a long run relationship with the price of other states and their exist a short run relationship with Karnataka, Tamil Nadu and West Bengal only. The paper also uses the granger causality to identify the causal relationship between the variable and it states that almost every state defines the turmeric price of Odisha but the opposite is not in case of Maharashtra, Tamil Nadu, Telangana and West Bengal. Lastly it can be said that this paper can support various intermediaries mainly the farmers in fixing a price of the product alongside they can also identify how a value of product of its own state tends to change due to the change in price of its native states.

Limitation

The paper uses the secondary data of a single product which is a cash crop. So, the pricing decision for such may be different for other products especially for non-perishable agricultural commodities. Along with that the paper focused on particular region of a nation i.e. various states of India which might show a different result for other nation. Hence, this is an area where several research can be conducted to make a generalise statement.

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