OIL AND AGRICULTURAL COMMODITY MARKETS OF PAKISTAN: LOOKING FOR A PREFERABLE TRADING AVENUE.

Abstract

The primary objective of this study is to find out the impact of oil price on futures and spot markets of agricultural products in Pakistan. Secondly, the study compares the research findings to suggest less oil price sensitive market for trading agricultural products in Pakistan. Futures (1 and 2 months futures) and spot prices of rice and sugar are taken as proxies for prices of agricultural products representing respective markets. Oil price sensitivity analysis is conducted via Vector Error Correction model. Further, Granger Causality approach is used for the causality analysis. Futures (1 and 2 months futures) and spot prices of rice and sugar are taken as proxies for prices of agricultural products representing derivatives and spot markets respectively. Time series data constituting 7 variables of 60 observations is analyzed from October 2012 to October 2017. The results are then subject to comparison and discussed.

Keywords: agricultural futures; futures market; vector error correction model; Granger causality, rice futures, Pakistan Mercantile Exchange

1. INTRODUCTION

Oil is an important economic indicator affecting the world's economy. Numerous researches are reported in the field of economics and business explaining and analysing the impact of oil price movements over different economies and sectors of a single economy(Park & Shin, 2018; Victoriia & Naoyuki, 2018; Dolores et al., 2016). Emerging economies also undergo the influence of movements in oil price. The price of oil also impacts the economic growth of

Pakistan (Kiani, 2011). Pakistan is an oil importing country and fulfils a considerable portion of its industrial and domestic need of oil by purchasing crude oil from foreign countries. Pakistan imports Dubai Oman or Fateh crude oil majorly from Saudi Arabia, Kuwait and the United Arab Emirates. Pakistan's economy heavily relies for its operations on crude oil which makes oil price a triggering variable to investigate.

As far as financial markets are concerned, a vast amount of literature is available on oil price movements and its relationship with the stock markets. It has been found during this study that oil price movements are addressed with futures prices of assets but considerably lesser than spot prices of assets (both financial and physical). Derivatives usage in Pakistan is reported to be less recognized in case of financial derivatives (Mahmood & Kashif-ur-Rehman, 2010; Afza & Alam, 2011) and yet needed to be recognized in case of commodity derivatives in the literature. Literature also emphasized the existence of exchanges for the trading of agricultural products in developing economies (Rejnus, 2002). The study tries to highlight this gap and selects a commodity futures market (PMEX) along with spot market of an emerging economy for research purpose.

1.1 Pakistan – an agrarian economy

The agriculture sector is the largest contributing sector to the GDP of Pakistan's emerging economy. The agriculture sector in Pakistan contributes 26% to the GDP whereas 68% of the rural and 69% of the total population is directly or indirectly linked with the agriculture sector (Rehman et al., 2016). Literature repeatedly investigated and confirmed the influence of oil price movements on different agricultural products prices in different economies (Zafeiriou et al., 2018; Kapusuzoglu & Merve, 2015; Guellil et al., 2016). Agricultural products are traded in the spot as well as the futures market in Pakistan. Pakistan Mercantile Exchange (PMEX) started

offering trade and investment opportunities over commodities in 2007. Initially named as National Commodity Exchange Limited (NCEL), Pakistan Mercantile Exchange is now offering commodity futures over oil, precious metals and agricultural products at national as well as international level. The first two agricultural futures launched by PMEX were on Sugar and Wheat in April 2012 followed by Rice futures in October 2012. As PMEX is in its intial stage of development , the study faced data constraints in collecting futures price data for statistical analysis and could only include two agricultural commodities (Sugar and Rice) representing the agricultural sector of Pakistan. Rice and sugar are also two major agricultural products of domestic consumption as well as exports. Rice is a world-famous staple food. It is stated that rice has been consumed by half of the population of the world or more (Gnanamanickam, 2009). Pakistan is the biggest producer of rice in the world, and it comes at number second in the list of staple foods in Pakistan adding 0.6% to the country's GDP (Memon, 2013). Like rice, sugar is also an salient agricultural variable contributing to the economy (Khushk et al., 2010).The study first investigates about the impact of oil price on the futures and spot prices of agricultural commodities in Pakistan and then compare the results for the both agricultural trading markets (futures and spot).

Research studies over agricultural commodities in Pakistan are rare. This study is the first quantitative research study of its type to be done over agricultural futures prices available at Pakistan Mercantile Exchange (PMEX). The market traders of rice and sugar in Pakistan are the direct beneficiaries of the study as the comparison indicates towards a market which less oil price sensitive. Moreover, existing literature does not provide any such research comparing two simultaneously operating agricultural commodity markets (futures and spot) in emerging economies in the context of oil price impact.

2. LITERATURE REVIEW

It is suggested by the economic theory that rise in crude oil price affects numerous sectors of economies and transportation/fuel cost (Gardebroek & Hernandez, 2013). Existing literature about the oil impact on prices of agricultural commodities presents a mixed review. Under different economies relationship between oil and agricultural products is found different. Available literature provides numerous studies explaining the relationship between oil prices and spot prices of agricultural products. Research studies countering the impact of crude oil spot prices over futures prices of agricultural commodities are rare. (Gozgor & Memis, 2015) investigated relationship among prices of agricultural futures and crude oil price. (Rezitis, 2015) examined the relationship between crude oil and 30 agricultural commodities prices using VAR and Granger Causality test on a panel data set and found bi-directional causality effects running from crude oil prices to the prices of rice and sugar. (Wang et al., 2014) concluded that before the commodity crisis of 2006-2008 oil prices did not significantly impact the spot prices of rice but the results reversed materially after the period of commodity crisis. Sample data from January 1980 to December 2012 is divided into two sub-samples to counter the period of commodity crisis. Data is analysed using a Vector Autoregressive Model (VAR) with post-estimation tests of Variance Decomposition and Impulse Response. Between prices of crude oil and prices of rice, there has been found long-run relationship by (Abdul-Rahim & Zariyawati, 2011). Data were analysed using Autoregressive Distribution lag (ARDL) model. (Pasrun et al., 2018) run Granger Causality Test by fitting the VAR model to examine data from January 2000 to 2017 September and concluded that there was no long-run association between crude oil prices and spot prices of rice. But in the short run, causality is evidenced from crude oil prices to the rice spot prices. (Bakhat & Würzburg, 2013) concluded the asymmetric relationship between

crude oil prices and sugar spot prices while symmetric relationship between crude oil price and rice spot prices. Data were analysed in five sets under momentum equilibrium adjustment path (MEAP), Granger causality test and tests of co-integration. (Nwoko et al., 2016) used GARCH (1,1) and Granger causality test for analysis of data and found no long run or short run association between oil prices and spot prices of rice. (Huchet-Bourdon, 2011) gave evidence of causality relationship from crude oil prices of the sugar price. (McFarlane, 2016) used Johansson test of co-integration and VAR model for concluding about the strong co-integration between crude oil prices and sugar prices. (Chen & Saghaian, 2015) used Vector Error Correction Model to find that oil prices weakly affect the prices of sugar commodity. (Saghaian, 2010) concluded that oil and commodity prices are strongly correlated, but there is no material evidence found about the causality between the oil market and agricultural market. (Ji & Fan, 2012) checked volatility spill-over between the oil market and commodities market using bivariate EGARCH model. The results of the study related that volatility spill-over is significant from the crude oil market to commodity markets and volatility in crude oil prices always affect the futures prices of agricultural commodities. (Kurniasih et al., 2018) used VEC model followed by Granger Causality test and Impulse response funtion to investiagte the impact of oil price on rice spot prices in Indonesia. The study found long term unidirectional causality running from oil price to the rice spot prices. In the light of available thoeretical and empirical litearture, the study has formulated the following two hypotheses.

H1: There is no significant impact of oil price on the prices of agricultural commodities in Pakistan.

H2: Oil price does not granger causes the prices of agricultural commodities in Pakistan.

3. MATERIAL AND METHODS

3.1 Data

Monthly futures prices are gathered from the official website of Pakistan Mercantile Exchange. Monthly spot price data is collected from the official website of Index Mundi. Time series data set constitutes 60 observations of seven 7 agricultural variables traded in futures and spot markets of Pakistan from October 2012- October 2017.

3.2 Variables

As the study will have to do comparison among its research findings, it requires a consitent and atleast 5 years data set for both the futures and spot prices. From PMEX, the study has taken the two of the three earliest agricultural futures contracts to complete desirable data set. Therefore, the study was bound to include rice and sugar as proxies for the agricultural commodities in the study. Monthly futures selected for rice and sugar commodities are PMEX-IRRI-6 and PMEX Sugar Futures respectively. 1 and 2 months futures prices of rice and sugar added 4-time series variables to the data set. Spot prices of rice and sugar added 2-time series to the data set. Price of Fateh crude oil is taken as a proxy for oil spot price in the study. Thus, the study has a time series data set of 7 variables defined as below:

RF1= prices of 1 month Rice Futures

RF2= prices of 2 months Rice Futures

SF1= prices of 1 month Sugar Futures

SF2= prices of 2 months Sugar Futures

Rspot= Spot prices of Rice

Sspot= Spot prices of Sugar

COP= spot prices of crude oil

The study has taken the prices of 1-month rice futures (RF1), 2 months rice futures (RF2), 1-

month sugar futures (SF1), 2 months sugar futures (SF2), rice spot (Rspot) and sugar spot (Sspot) as endogenous variables in the model. Crude oil spot price (COP) is taken an exogenous variable.

3.3 Methodology

Augmented Dickey-Fuller test of unit roots and Johanson test of cointegration suggested to run Vector Error Correction Method for data analysis. Granger causality test is used as post-estimation test for short-run causality analysis. For the acceptance or non-acceptance of developed hypotheses, probability values (p-values) are to be compared with the level of significance. This study set 5% level of significance throughout the statistical analysis. Decision rule is that for a hypothesis to get accepted, reported p-value should be less than 5% or 0.05. In other words, p-value should be statistically signficant.

3.3.1 Unit Root Test

Stationarity or no unit roots means that data have time-invariant mean and variance. For running vector error correction model and post-estimation Granger causality test, there is an assumption to be fulfilled that the variables have unit roots at the level I (0). But when these variables are converted to the first difference I (1), they became stationary. Running vector error correction model, also requires variables to be cointegrated. Augmented Dickey-Fuller (ADF) test has been used for checking stationarity among variables. ADF test has non-stationarity (unit root) among variables in the null hypothesis (H_o) and stationarity (no unit root) among variables in the alternative hypothesis (H_1). ADF test was conducted with three basic model equations. Taking U as any of the time series variable, π as an trend element and μ as error term, included univariate equations are model equation with intercept only ($\Delta U_t = \alpha + \beta U_{t-1} + \mu_t$), model equation with trend and

intercept ($\Delta U_t = \alpha + \pi_t + \beta Ut_{-1} + \mu_t$) and model equation with neither intercept nor trend ($\Delta U_t = \beta U_{t-1} + \mu_t$). ADF test requires all the three model equations should produce the same results at I (0) and I (1). ADF test concluded that the variables on the level I(0) had unit roots for all three model equations, but when converted into the first difference I(1), variables become stationary. Comprised results to the ADF unit roots test are given in the Table 1 below:

Table 1. Results to ADF test

Variables	Model Equation 1				Model Equation 2				Model Equation 3			
	I(0)		I(1)		I(0)		I(1)		I(0)		I(1)	
	T-stat	C-value	T-stat	C-value	T-stat	C-value	T-stat	C-value	T-stat	C-value	T-stat	C-value
RF1	2.041	2.922	5.058	2.923	2.108	3.490	5.011	3.491	0.257	1.950	5.104	1.950
RF2	2.024	2.922	5.055	2.923	2.100	3.490	5.008	3.491	0.270	1.950	5.101	1.950
SF1	1.849	2.922	6.881	2.923	1.626	3.490	6.880	3.491	0.169	1.950	6.943	1.950
SF2	1.797	2.922	6.150	2.923	1.647	3.490	6.142	3.491	0.162	1.950	6.204	1.950
Rspot	1.891	2.922	5.306	2.923	1.775	3.490	5.320	3.491	1.034	1.950	5.299	1.950
Sspot	1.788	2.922	6.868	2.923	1.770	3.490	6.806	3.491	0.726	1.950	6.915	1.950
COS	1.040	2.922	5.052	2.923	0.834	3.490	5.044	3.491	1.412	1.950	5.028	1.950

Source: by author

3.3.2 Test of Cointegration

Cointegration among variables can be interpreted as variables will have an association in the long run. Results to the respective test are shown in Table 2. Johanson test of cointegration has the null hypothesis (H_o) with no cointegration among variables. Lag 2 was selected for running

Johanson test of cointegration as per Akiake selection criterion. Results of Johanson test of cointegration concluded that the variables are cointegrated and suggested about running Vector Error Correction Model (VECM) for the purpose of data analysis. The statistical theory stated that if the trace statistics at rank 0 is above than the critical value, do not accept H_o. The results also indicated the presence of one error term among variables or cointegration rank of 1.

Table 2. Results to Johanson test of cointegration

Rank	Trace Statistics	5% Critical Value
0	130.9631	124.24
1	86.3163*	94.15

Source: by author

3.3.3 Vector Error Correction Model

The model equation for VECM with RF1, RF2, SF1, SF2, Rspot, Sspot and COP has taken the form of

$$\Delta COP_t = \beta_1 \Delta RF1_t + \beta_2 \Delta RF2_t + \beta_3 \Delta SF1_t + \beta_4 \Delta SF2_t + \beta_5 \Delta Rspot_t + \beta_6 \Delta Sspot_t + \beta_7 (COP_{t-1} - \gamma_1 RF1_{t-1} - \gamma_2 RF2_{t-1} - \gamma_3 SF1_{t-1} - \gamma_4 SF2_{t-1} - \gamma_5 Rspot_{t-1} - \gamma_6 Sspot_{t-1}) + u_t$$

Where,

β = partial regression coefficients

γ = cointegration coefficients

The term in the equation with cointegration coefficients represents the error term.

3.3.4 *Granger Causality Test*

Causality among variables can be defined as the historical values of one variable got repetition in the values of other variables after some lag. Thus, the previous values of one variable can be

used for predicting the values of the other variables. Causality among variables could exist in long-run and short-run as well as it could be uni-directional (one-way) and bi- directional (two-way). The long-run causality analysis can be found from the significance of the cointegration equation provided by the results of VECM because VECM model captures the effects of cointegration among the variables. However, short-run causality evidence among variables can be found by running post-estimation granger causality test for short run causality.

4. RESULTS AND INTERPRETATIONS

4..1 Results and interpretation of VECM

Impact of the independent variable and long-run causality among variables can be evidenced from the VEC model. The magnitude of the impact over the dependent variable can be realised by the values of regression co-efficients while the p-values are used for the making decision about the acceptance or non-acceptance of reseach hypotheses.

Results from vector error correction model do not accept hypothesis 1 of the study in case rice futures prices and spot prices of sugar. Hence, VECM indicated that crude oil prices produce significant positive impact on the prices of 1-month rice futures, 2 months rice futures and spot prices of sugar in Pakistan. However, the impact of crude oil prices on the prices of 1-month sugar futures, 2 months sugar futures and rice spot prices is not found to be statistically significant which means the acceptance of hypothesis 1 for the prices of earlier said commodities. Moreover, coefficients of lagged values of sugar futures prices evidenced an inverse relationship with the crude oil prices.

Results for long-run causality analysis do not accept hypothesis 2 only for spot prices of sugar. Long-run uni-directional causal relationship has been evidenced only between the prices of crude oil and the spot prices of sugar. However, no indication of long-run causality from crude

oil prices to the prices of 1-month rice futures, 2 months rice futures, 1-month sugar futures, 2 months sugar futures and spot prices of rice has been found. Concise results from vector error correction model are demonstrarted in the Table 3.

Table 3. Results to vector error correction model

Variables	Regression Coefficient	P-value
RF1 (ce1)(L1.)	-14.43672	0.137
RF2 (ce1)(L1.)	-14.08589	0.151
SF1 (ce1)(L1.)	0.1038907	0.550
SF2 (ce1)(L1.)	0.1723691	0.307
Rspot (ce1)(L1.)	1.901336	0.904
Sspot (ce1)(L1.)	-0.4342574	0.031
RF1 to COP (LD.)	0.1429406	0.002
RF2 to COP (LD.)	0.1429896	0.002
SF1 to COP (LD.)	-0.0005377	0.513
SF2 to COP (LD.)	-0.0007552	0.344
Rspot to COP (LD.)	0.003458	0.963
Sspot to COP (LD.)	0.0028133	0.003

Source: by author

4.2 Results and interpretation from Granger Causality test

Results from the short-run Granger causality test do not accept the hypothesis 2 for rice futures prices and sugar spot prices. It is evidenced from the short-run causality analysis that there is short-run causality running from the lagged values of crude oil prices to the prices of 1-month rice futures, 2 months rice futures and spot prices of sugar. In other words, crude oil prices

granger causes the prices of 1-month rice futures, 2 months rice futures and spot prices of sugar in short-term in Pakistan. While no evidence of short-run causality has been found between lagged values of crude oil prices and prices of 1-month sugar futures, 2 months sugar futures and spot prices of rice. Thus, the study accepts the hypothesis 2 for sugar futures prices and rice spot prices in short-run. P-values concluding about Granger Causality test for short-run causality are given in the Table 4.

Table 4. Results to Granger Causality test (short-run)

Target Model	P- value
RF1: COP (LD L2D L3D)	0.0087
RF2: COP (LD L2D L3D)	0.0098
SF1: COP (LD L2D L3D)	0.1210
SF2: COP (LD L2D L3D)	0.0739
Rspot: COP (LD L2D L3D)	0.7324
Sspot: COP (LD L2D L3D)	0.0295

Source: by author

The results to the Granger Causality test for short-run causality imply that crude oil prices can only be helpful in predicting about the futures prices of rice and spot prices of sugar in short-run.

4.3 Result summary

The results from the study are summarized in the Table 5 given above for making quick and easy conclusion.

Table 5. Summary to the research study

Target Model	Statistical Significance	Long run causality	Short run causality
COP to RF1	Yes	No	Yes
COP to RF2	Yes	No	Yes
COP to SF1	No	No	No
COP to SF1	No	No	No
COP to Rspot	No	No	No
COP to Sspot	Yes	Yes	Yes

Source: by author

5. CONCLUSION

For the rice commodity markets, the research concluded that oil prices significantly affect the rice futures prices and in short-run crude oil prices can predict about the prices of rice futures. In contrast to this, the crude oil prices did not influence the spot prices of rice in any way. Hence, the spot market of rice has been found less oil price sensitive than the futures market of rice in Pakistan. The research findings suggested to trade rice in the spot market rather than commodity future market (PMEX) in Pakistan.

About the sugar commodity markets, research concluded that oil did not influence the sugar futures prices, but the sugar spot prices were highly affected by the prices of oil. The results to the study summarized that the crude oil prices can predict about the spot prices of sugar both in short-run and long-run which makes sugar spot prices highly related to the crude oil prices. Hence, the futures market of sugar is found less oil price sensitive than spot market of sugar in Pakistan. Trading sugar commodity in commodity futures market (PMEX) is suggested

on the basis of obtained results.The study suggested the preferable trading avenues in terms of oil price sensitivity for tarding rice and sugar in Pakistan.

6. PRACTICAL IMPLICATIONS AND SUGGESTIONS

Research has importance on the both micro and macro-economic level. It is valuable for both individual as well as institutional traders (buyer, seller, brokerage houses, mutual and hedge funds) of rice and sugar in Pakistan because it indicates the less risky agricultural market for their trading purposes. As provided with quantified information about the riskiness of agricultural markets in comparison, results are also helpful for portfolio managers where the clients are interested in trading of rice and sugar. At the macro level, the commodity futures market of Pakistan (PMEX) can offer more variety of futures for trading sugar commodity because it has been found in inverse relationship with oil prices. For the interest of policy makers in agricultural sector , the study found that the crude oil prices can be used as a justified proxy to predict about the future prices of sugar spot prices in Pakistan. The research opens up the investigating areas in the number of fields of academia. For research scholars, this research cast light towards a less highlighted area of research and methodology in Pakistan. The study can be extended towards commodity futures market as it has sampling limitation because Pakistan Mercantile Exchange is in developing phase and its portfolio of offered commodities is increasing day by day. The study motivates future researchers to extend the topic of this research by making qualitative investigation about the buying and selling behaviours of commodity traders. In the field of agricultural economics, further research studies can be developed by coutering the cost factors of cultivating crops. The two chosen commodities can be analyzed further for inquiring about their inconsitent response to the oil price fluctuations. Investigating

the relationship of energy, commodity and financial markets with different cryptocurrencies can also be an interesting topic to explore in future.

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