DOI: 10.52131/pjhss.2025.v13i1.2639

Pakistan Journal of Humanities and Social Sciences

Volume 13, Number 01, 2025, Pages 402-411
Journal Homepage:
https://journals.internationalrasd.org/index.php/pjhss

Spillover Effects of Oil Price Volatility on Pakistan's Agricultural Sector

Mamona Sadaf[1], Abdul Rashid[2], Hafeez ur Rehman[3], Nadia Hassan[4]

[1] Assistant Professor, Knowledge Unit of Business, Economics, Accountancy and Commerce, University of Management and Technology, Sialkot, Pakistan.
[2] Professor, International Institute of Islamic Economics, International Islamic University, Islamabad, Pakistan.
[3] Lecturer, Department of Economics, The Islamia University of Bahawalpur, Pakistan.
[4] Lecturer, Department of Economics, The Islamia University of Bahawalpur, Pakistan.
Email: nadia.hassan.economist@gmail.com

ARTICLE INFO

Article History:
Received: November 09, 2024
Revised: March 23, 2025
Accepted: March 24, 2025
Available Online: March 25, 2025

Keywords:
Food-Energy Nexus
Volatility Spillover
Agricultural Commodity Prices
Oil Price Shocks
Risk Transmission

Funding:
This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

ABSTRACT

Surge in the prices of oil and food has led to the analysis for the volatility spill over between agriculture commodity market and crude oil market. Returns from major agriculture commodities from Pakistan and crude oil have been taken for the post crisis period as 2006M1: 2013M13 for the available data. Different extensions of GARCH model have been employed to see the volatility between the prices in either markets. Causality in variance test is used to examine the volatility spillover between the markets. No spillover effect has been found between both of the markets in case of Pakistan. However, long run relationship for shocks transmission between commodity and oil returns is depicted through VAR analysis.

Corresponding Author's Email: nadia.hassan.economist@gmail.com

1. Introduction

It is believed that food prices are severely affected by prices of energy as agriculture is an energy intensive sector and hence increase in oil prices has a direct effect on food prices and lead to increase the input cost and a higher price of food is resulted (Nazlioglu & Soytas, 2011). The surge in the prices of food and oil in the world from 2000s has led the concern for the relationship between both markets due to the households 'welfare and wealth loss impact of higher food prices (Wright, 2009). Moreover, it is also been argued that Prices for the agricultural commodities are estimated to remain as high as the 2007-08 level prices for the next ten years (Food and Agricultural Organization of the United Nations, 2011). About 83% rise in the global food prices was observed during 2008 (World Bank, 2008). Due to the reason FAO food price index crossed 180 points since 1980s (International Monetary Fund, 2008). Moreover, wheat and other food commodity prices in the big agriculture markets have gone up above the world's average between the period February, 2007 to February 2008 (Liefert et al., 2010). Hence, price transmission between the regions and countries has been observed as a result for allowing perfect integration between the markets makes domestic economy more prone to the world price shocks (Baffes, 2007). It is evident that global food price hike has contributed to a greater extent to the price of the food in Pakistan as global oil and food price hike has stroke Pakistan price badly. As, Pakistan has experienced over 200% increase in the palm oil prices and about 150% increase in the prices of wheat during 2007-08 (Economic Survey of Pakistan, 2008). However, prices of imported wheat were thought as a responsible factor for the prevalent price hike in the country. In the country the price hike was associated with the import of wheat to certain extent (Hanif, 2012). The case of price hike There has been found a significant increase in the prices everywhere. A surge in the prices was found everywhere.

It is of great concerns for investors to seek for the existence of spillovers and its direction between markets in perspective of commodity market as an alternate option for investment. Knowing about the relationship between markets can help investors in management of their risks for alternative investments. The rest of the study is structured as follows. Section 2 presents literature review. Section 3 outlines data sources and methodology. Brief analysis of data is presented in Section 4. Section 5 presents the findings and provides conclusion and discussion for policy implication. References and appendices are provided at the paper.

2. Literature Review

Expansion of global oil market has played a prominent role in stimulation of the growth of physical and cash markets. Moreover the increased volatility in crude oil prices has resulted the growth of largest commodity derivative and prompted the need for hedging for investors (Natanelov et al., 2011). It has been recognized that collapse in the mid 2008 is caused by increased oil prices in start of the year (Zhang et al., 2010). Moreover, the erratic behavior of crude oil prices is supposed as the main reason of financial crisis Current rising food prices have accelerated interest regarding policy actions and portfolio management in perspective of food-stock, and food-energy nexus. Prominently three types of linkages of oil prices impacting food prices have been found in literature, as considering oil prices as contributing factor in the higher input cost, linkage of increased prices of biofuel with food prices and the interaction between food prices and oil price fluctuations is examined from investment fund activity (Ji & Fan, 2012; Nazlioglu, Erdem, & Soytas, 2013). Linkages of biofuel and agriculture commodity prices has been discovered by many studies and found a potential link for explaining the prices of biofuel by agriculture commodities. Spillover effect of volatility of oil as a production cost to agricultural markets has been examined by many researchers most prominently by (Baffes, 2007; Chang & Su, 2010; Harri & Hudson, 2009) and (Alom, Ward, & Hu, 2011).

Plenty of the studies have analyzed the dynamics of relationship agriculture and energy market (Creti, Joëts, & Mignon, 2013; Du, Yu, & Hayes, 2011; Mensi et al., 2013; Nazlioglu & Soytas, 2011). Some of the earlier studies quantified the risk transmission between oil and agriculture markets find out the existence of pass through of risk between oil and agriculture commodity market (Chang & Su, 2010; Harri & Hudson, 2009). Studies has also investigated that recent upward trend in the prices of agriculture commodities is mainly associated with increasing oil prices in post crisis period (Creti, Joëts, & Mignon, 2013; Nazlioglu & Soytas, 2011). Al-Maadid (2013) has found variation in risk transmission before and after crisis period between oil and agriculture commodities he has considered. A significant volatility spillover effect has been found between oil and non-oil markets. And after crisis correlation between the markets has increased (Ji & Fan, 2012). Evidence of volatility spillover has been found between crude oil, corn, and wheat markets in post crisis period after 2006 (Du, Yu, & Hayes, 2011). The role of speculation for the transmission of risk between the markets has been also been explored. Gulf and US equity markets are explored for the dynamics of the relationship with oil markets, Gulf equity markets are found more prone to the shocks in global oil markets (Malik & Hammoudeh, 2007). Similarly many other studies as Soytas and Oran (2011), Papapetrou (2001) and Ghosh (2011) have examined the volatility spill over between different markets by employing different techniques and found the link between volatility spill over in markets.

The interaction between the crude oil markets may not always explained by co movement of theirs rather it is argued that crude oil prices are not only factor determining the fluctuations in the prices of agricultural commodities, there are many other macro-economic factors associated with it (Cevik & Saadi Sedik, 2014). Hamilton (2009) has also argued that alternative explanation other than oil prices must be called upon that is responsible for commodity price changes. Similarly, Zhang et al. (2010) has discovered that volatility spillover has not been observed between the markets but cointegration relationship do persist. It deemed important in above perspective as to estimate the relationship between the volatilities of crude oil prices and the prices in agricultural commodity market and their spillover between either markets.

3. Methodology

A Univariate GARCH model has been applied to investigate volatility spillover impact of oil prices to food process. Different linear and non-linear models of GARCH are tested on the basis of information criteria and forecasting abilities as to look for the best fitted model applied to data under consideration. Different extensions of the GARCH models are tested as to check their suitability as per data under consideration. More specifically current study pursued the Exponential GARCH (EGARCH) model as a more practical asymmetry GARCH model as One of them is (EGARCH) model. Propose is to find a suitable model as to encompass other models on the basis of above-mentioned criteria. The EGARCH model, proposed by Nelson in 1991, differs from other models by not requiring non-negativity constraints. It also captures the asymmetric influence of shocks or new information on conditional volatility. Mean equation of ARMA (p,q)-EGARCH in a simplified form can be written as

$$RX_t = \beta_1 + \beta_2 RX_{t-i} + \beta_3 e_{t-i} + \varepsilon_t \tag{1}$$

Where ε_t is iid $(0,\sigma^2{}_t)$

And variance equation for the estimation of the series can be written as

$$\log\sigma^2{}_t = \alpha + \beta\log\sigma^2{}_{t-1} + \theta_1\left|\frac{e_{t-1}}{\sigma^2{}_{t-1}}\right| - \theta_2 E\left[\left|\frac{e_{t-1}}{\sigma^2{}_{t-1}}\right|\right] + \upsilon_t \tag{2}$$

Magnitude of conditional shocks on conditional variance is captured by θ_2 , θ_1 measures the leverage effects and persistency of the shocks to volatility is captured by the GARCH effect β. If $\beta<1$ reflects the stationarity of return series. Volatility takes longer time to die out if β is relatively large following a shock in the market (Carol, 2008). If θ_1 = 0, then the model is symmetric. θ_1 < 0, it shows that negative shocks results in higher volatility and vice versa. This model is advantageous as $\sigma^2{}_t$ would be positive irrelevant of the negativity of parameters due to consideration of logged form of it. Two approaches to test volatility spillover between the series have remained in practice. One is Cheung and Ng (1996)'s proposed method which is based upon cross correlation function (CCF).of squared Univariate GARCH residuals estimates. For the leptokurtic volatility process the problem of over sizing of the test is faced in small and medium size samples (Hafner & Herwartz, 2006). Moreover, CCF based test is sensitive to the order of leads or lags and hence issue of robustness is likely to be faced. Second is approach of multivariate GARCH models which considers parametric restrictions to hold for the null of non-causality in variances. The issue of dimensionality is supposed to multivariate dynamic models. This study employes the causality in variance test, introduced by Hafner and Herwartz (2006), to examine volatility spillovers between crude oil prices and selected agricultural commodities. This test has overcome the issue of Granger and Ng's test as it performs better in small samples and for leptokurtic series. Risk of the selecting wrong order has also been avoided in this test (Hafner & Herwartz, 2006). Consider a stochastic process $\{\varepsilon_t \in \mathbb{R}^N, t \in \mathbb{N}\}$ on a probability space (Ω, f, P). For simplicity we assume stationarity of $\{\varepsilon_t\}$ and $E[\varepsilon_t|f_{t-1}] = 0$. The following null hypothesis will be tested for given $i,j = 1,...,N, i \neq j$;

$$H_0: Var(\varepsilon_{it}|h_{t-1}^{(j)}) = var(\varepsilon_{it}|h_{t-1}), \tag{3}$$

Where $h_t^{(j)} = h_t \backslash \sigma(\varepsilon_{j\tau}, \tau \leq t)$. To test H_0 consider the model

$$\varepsilon_{it} = \xi\sqrt{\sigma_{it}^2 g_t},\ g_t = 1 + z_{jt}'\pi,\ z_{jt}' = (\varepsilon_{jt-1}^2, \sigma_{jt-1}^2)', \tag{4}$$

Where $\sigma_{it}^2 = \omega_i + \alpha_i\varepsilon_{i,t-1}^2 + \beta_i\sigma_{i,t-1}^2$. In Eq. (2), a sufficient condition for Eq.(1) is $\pi = 0$, so that the null and alternative hypothesis of the LM test are $H_0 = \pi = 0$, $H_1 = \pi \neq 0$. An LM statistic can be constructed by means of estimated univariate GARCH processes. The score of the Gaussian log-likelihood function of ε_{it} is given by $x_{it}(\xi_{it}^2 - 1)/2$, where $x_{it} = \sigma_{it}^{-2}(\partial\sigma_{it}^2/\partial\theta_i)$, $\theta_i = (\omega_i, \alpha_i, \beta_i)'$. We process the following test statistic:

$$\lambda_{LM} = \frac{1}{4T}\left(\int (\xi_{it}^2 - 1)z_{jt}'\right)V(\theta_i)^{-1}\left(\int (\xi_{it}^2 - 1)z_{jt}\right)\vec{d}\chi^2, \tag{5}$$

Where

$$V(\theta_i) = \frac{\kappa}{4T}\left(\int z_{jt}z_{jt}' - \int z_{jt}x_{it}'\left(\int x_{jt}x_{it}'\right)^{-1}\int x_{it}z_{jt}'\right)]$$

$$\kappa = \frac{1}{T}\int (\xi_{it}^2 - 1)^2$$

The distribution of the test statistics in Equation (5) depends on the number of misspecification indicators in Z_{Jt} With two misspecifications λ_{LM}, the test follows an asymptotic chi-square distribution with two degrees of freedom. Along with the causality-in-variance method, this study applies the VAR model to assess the effect of oil market volatility shocks on agricultural commodity markets, as outlined by Pesaran and Shin (1998).

4. Data Description

Current study uses monthly prices of some of major agriculture commodities as of cotton, wheat, rice and R& M seeds' oil (R& M oil) and vegetable oil (VG) data from Pakistani markets and data on world's price of crude oil. Keeping in view the world food and oil price hike of 2007-08; monthly data from 2006M to 2013M09 available till date has been considered to see the volatility spill between both markets. Descriptive statistics is shown in Table1 for the returns series. Excess Kurtosis is found positive and statistically significant for all the series under consideration. It depicts that prices returns series are heavily tailed or leptokurtic. Student-t distribution is proposed to be used for the kind of series by Hsieh (1988) and (Baillie & Bollerslev, 1989). Kurtosis shows that VG and rice are prone to the shocks. Skewness is found negative and positive and statistically significant. Jarque-Bera normality test rejects the null of normality for the returns series. Distribution is accounted accordingly. This table also provides the evidence for the existence of the ARCH effect. As null hypothesis of no ARCH effect in residuals is rejected for the up to the 20 lags as p-value is far less than 5%, providing an evidence of rejection of H0.

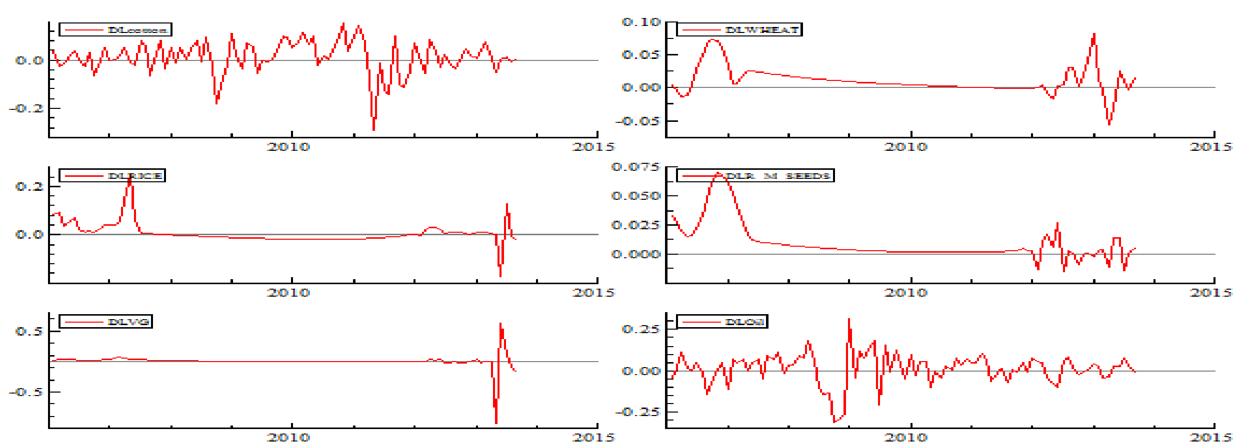
Table 1: Descriptive Statistics of the Returns

	Oil	Wheat	Rice	Cotton	VG	R& M oil
Mean	0.012	0.011	0.006	0.011	0.003	0.009
Maximum	0.316	0.082	0.251	0.154	0.632	0.070
Minimum	-0.315	-0.056	-0.172	-0.291	-1.016	-0.015
Std.Deviation	0.095	0.020	0.043	0.069	0.128	0.016
Skewness	-0.778*	1.102*	1.925*	-1.105*	-4.217*	2.103*
Koutosis	2.565*	4.024*	12.949*	3.109*	47.102*	4.476*
J-B (prob)	0.000	0.000	0.000	0.000	0.000	0.000
LBQ(10)	36.669	68.574	50.991	19.986	25.308	278.885
ARCH(20)Prob	0.000	0.000	0.006	0.021	0.004	0.000
OBS	92	92	92	92	92	92

Note: * shows statistically significant at 5% level

Probability density function are presented in Appendix I. plot indicates the deviation from normality assumption of the series concerned. Graphs of the returns series are presented below which shows the prevalence of extreme flections for the returns series of cotton and crude oil after crisis. However, remaining series shows less intensive fluctuations. Standard deviations are substantially higher for vegetable ghee, cotton and oil returns as compared with the other commodities.

Figure 1: Volatility in Returns series of commodities under consideration



Correlation matrix between the series is given below in table 2. Correlation matrix gives very interesting figures as correlation between oil and wheat and R& M seeds oil returns is negative. This can lead to explore for the background reason for the negativity of the correlation coefficients between the variables.

Table 2: Correlation Matrix

	Cotton	Wheat	Rice	R & M oil	VG	oil
Cotton	1	-	-	-	-	-
Wheat	-0.01792	1	-	-	-	-
Rice	-0.02188	0.14861	1	-	-	-
R & M oil	-0.04825	0.58786	0.26738	1	-	-
VG	0.067949	0.2756	-0.12346	0.064376	1	-
DLOil	0.32503	-0.0304	0.010078	-0.11014	0.002572	1

Evidence for serial correlation is not found as depicted by ACF and PACF plots in appendices. So conditional mean can be modeled as a stochastic process also confirmed by LQB statistics above in table 1.

5. Empirical Results

Different extensions of GARCH especially EGARCH as mentioned earlier are applied as to see the accommodation foe leverage effect, volatility persistence, leptokurtic and skewness. Findings are depicted in table 3.

Table 3: Parameters Estimates for Selected commodities Returns

	GARCH	EGARCH	EGARCH	EGARCH	EGARCH	GARCH
	Cotton	Rice	Wheat	R & M seed oil	VG	Crude Oil
C(M)	0.012*	-0.1519*	0.0029*	0.0057*	-0.371	0.0165
AR(1)	0.379	-	0.7497*	0.8700*	0.967	0.1174
AR(2)	-	-	-	-	-	-
MA(1)	0.7086*	0.636*	0.4636*	-	-	-0.392
MA(2)	-0.228*	0.091	-	-	-	-
C(V)	0.004	0.044	0.0522	0.505	6.2995*	0.001*
α	0.450*	0.597*	1.0007*	0.7202*	1.799*	0.357*
β	0.497*	0.548*	1.0239*	1.0355*	0.998*	0.415
ϑ1	-	0.2935*	0.2393*	-0.30775*	-0.246*	-
ϑ2	-	0.999*	0.999*	0.999*	0.999*	-
Q(5)	1.828	13.10**	3.77	24.62**	6.3305	6.011
Q(10)	10.88	17.24*	10.11	31.356**	16.898	15.99*
$Q^2(5)$	0.681	0.190	9.33	25.617	22.07	3.641
$Q^2(10)$	0.723	0.204	17.52	35.18	22.64	5.652
ARCH(1-2)	0.487	0.063	2.59	3.124	16.898	0.0692
ARCH(1-5)	0.307	0.265	1.09	3.904	7.5015	0.6361
Goodness of Fit	30.00	138.0*	86.26*	179.0*	112.0*	39.00*

*, ** shows significance at 5% and 10% level of Significance

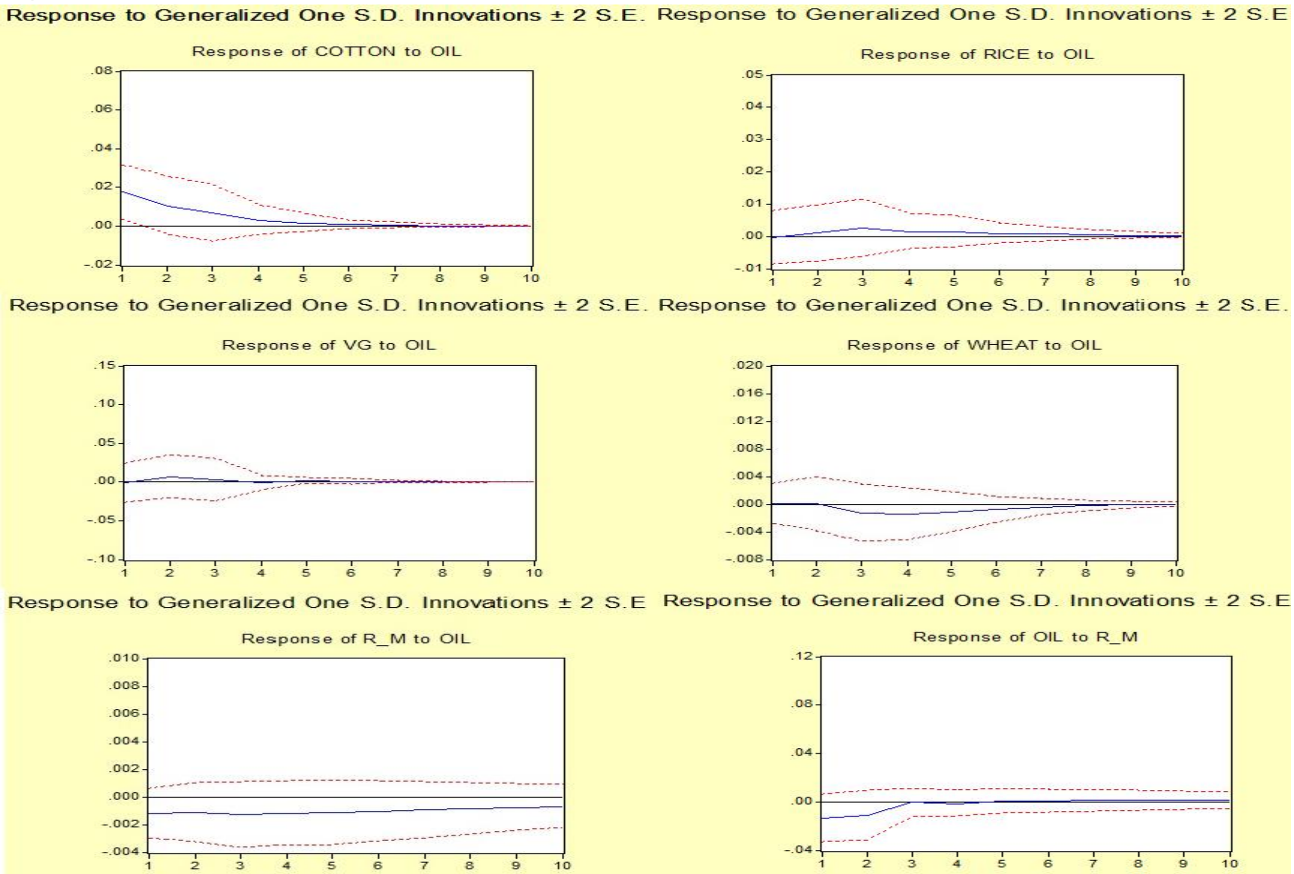
For the GARCH (1, 1) model as it has been applied for two series as cotton and oil; stability condition requires that $\omega > 0$, $\alpha \geq 0$, $\beta \geq 0$ and $\alpha + \beta < 1$. Parameters for both of the series fulfill the stability conditions; it means that there exists volatility persistence in both cotton and oil returns. ARCH parameter α indicates that effects of shocks would be more visible in future , however A high GARCH parameter as β shows that impact of shocks is more persistent. In other words, a high short run and long run volatility is implied from a high ARCH and GARCH parameter (Enders, 1995; Nazlioglu, Erdem, & Soytas, 2013). As it is shown in above table that for both of the series cotton and oil $\alpha_i < \beta_i$; implies that short run volatility is dominated by long run volatility in data series under consideration. Leverage effect θ_1 is significantly positive for rice and wheat the series and negative for R & M seed's oil and VG. It can be posited that the both oil's prices are Positive coefficient for the rice and wheat meant that they don't follow any track the movement with shocks. And for remaining negative coefficient mean that prices have reacted to the shocks. Value of θ2 is substantially larger than zero for all the indices for the period under consideration, which means that volatility is very much susceptible to market events for the study period. Moreover, it may have proved more sensitive if we compare with pre-crisis period. Parameter β as measures persistency in the conditionality volatility; remained significantly positive for all the returns that indicate that volatility takes longer time to die out. Comparing coefficients' scale θ2 is greater than all other parameters that mean that volatility is remained very sensitive for the period under study.

Table 4: Estimation Results for Causality In variance

	LM-Stats	P-value		LM-Stats	P-value
Oil ≠> wheat	3.4037	0.1823	*Wheat ≠> oil*	2.745	0.253
Oil ≠> Rice	0.5237	0.765	*Rice ≠> oil*	2.097	0.350
Oil ≠> cotton	0.0959	0.953	*Cotton ≠> oil*	2.0873	0.352
Oil ≠> Vg	3.188	0.203	*Vg ≠>≠> oil*	1.997	0.368
Oil ≠> R&Mseed	1.71	0.425	*R&Mseed ≠> oil*	2.575	0.251

Volatility process has been explained in detail. Next step is to investigate the volatility spillover between agriculture and oil markets' returns. To execute the analysis, causality in variances test developed by Hafner and Herwartz (2006) is employed as it is mentioned in section of methodology. Estimation from the analysis depicted the following information in table 4. Results depicts that there exist no volatility spill over between agriculture and oil returns. As p-values for all the commodities' LM statistics are greater than 5% which shows the rejection of volatility spillover between either markets. Moreover, analysis shows the prevalence of neutrality of the impact of oil returns to the commodity returns and vice versa. It is cleared from above table that no risk has been transformed from oil market to Pakistani agriculture commodity market and vice versa. It means that measures by government to curb the agriculture from surge of oil prices has remain beneficial in Pakistan. Finally, current study considers the use of impulse response analysis for the reruns for the impact of shocks in oil market to change in volatility in agriculture commodity market. Generalized impulse response analysis is being used from the VAR model for the period concerned. Considering the conditions for the stability of VAR system impulse response function for one ± 2SD has been generated to view to see the impact of shock in oil market to the agriculture commodity market. It is shown that effect is completely transmitted after some periods. Graphs of impulse responses can be viewed as

Figure 2



Impact to the R & M seeds oil takes more time to reflect full transmission between the prices. But for cotton series an immediate reflection can be find out in the retunes of cotton to oil and vice versa. It's shown that wheat took almost seven months within the shock to be significantly impacted by it. Moreover, positive impact on Vg of oil is depicted to b died out after 5 months. Positive impact for R & M seed oil and wheat lasts 7-10 months and then dies out to reflect the significant impact of oil prices 'shock on these commodities.

6. Conclusion and Policy Implications

Asymmetric model has been used to analyze the fuel Vs food nexus by newly developed test for causality in variances by Hafner and Herwartz (2006). More specifically, EGARCH model and GARCH model has been employed for the analysis. Results of the current study depicts that crude oil may not have a central position in commodity market. Bo risk has been found transmitted to agriculture markets from oil markets in Pkaistan. However, its role as an important input cannot be ignored. This is may be the reason that subsidies in agriculture commodities has been provided by the government. About 4.9 % of the value of production subsidy has been provided to the farmers in 2010-11 in Pakistan (Ahmad et al., 2005) and policies made as cushion from global prices has been remain successful. Results are analogues to the studies as Mutuc, Pan and Hudson (2011); Zhang and Reed (2008) and (Nazlioglu & Soytas, 2011) that local prices are not sensitive to the world's oil prices. However, causal link can be discovered from the world price to domestic prices, that for how many times this phenomenon persists or it dies out. Impulse response analysis has included exploring this link. It has lead to examine the prevalence of the impact. Many causal linear or non linear relationships has been discovered by researchers between commodity and oil market and these relationship may not reflected by volatility spill over in case of Pakistan. Bi-variate model may not capture the impact of all dynamics. Multivariate model may be used to capture the strength of relationship. As there are many factor impacting this relationship as exchange rate, speculation, future markets, interest rate and many factors are recommended to include in the model (Nazlioglu, Erdem, & Soytas, 2013). Multivariate volatility spill over can be explored as to depict the true picture of the relationship.

References

Ahmad, M., Croraton, C., Qayyum, A., Iqbal, M., & Dorosh, P. (2005). Impact of domestic policies towards agricultural trade liberalization and market reform on food security in Pakistan.

Al-Maadid, A. (2013, 2013). Volatility Spillover Between Oil And Agricultural Commodity Markets. Qatar Foundation Annual Research Forum,

Alom, F., Ward, B. D., & Hu, B. (2011). Spillover effects of World oil prices on food prices: evidence for Asia and Pacific countries.

Baffes, J. (2007). Oil spills on other commodities. *Resources Policy*, *32*(3), 126-134. https://doi.org/10.1016/j.resourpol.2007.08.004

Baillie, R. T., & Bollerslev, T. (1989). Common Stochastic Trends in a System of Exchange Rates. *The Journal of Finance*, *44*(1), 167-181. https://doi.org/10.1111/j.1540-6261.1989.tb02410.x

Carol, A. (2008). Market risk analysis Volume II Practical financial econometrics. *England: John Wiley & Sons Ltd The Atrium, Southern Gate, Chichester*.

Cevik, S., & Saadi Sedik, T. (2014). A Barrel of Oil or a Bottle of Wine: How Do Global Growth Dynamics Affect Commodity Prices? *Journal of Wine Economics*, *9*(1), 34-50. https://doi.org/10.1017/jwe.2014.2

Chang, T.-H., & Su, H.-M. (2010). The substitutive effect of biofuels on fossil fuels in the lower and higher crude oil price periods. *Energy*, *35*(7), 2807-2813. https://doi.org/10.1016/j.energy.2010.03.006

Cheung, Y.-W., & Ng, L. K. (1996). A causality-in-variance test and its application to financial market prices. *Journal of Econometrics*, *72*(1-2), 33-48. https://doi.org/10.1016/0304-4076(94)01714-X

Creti, A., Joëts, M., & Mignon, V. (2013). On the links between stock and commodity markets' volatility. *Energy Economics*, *37*, 16-28. https://doi.org/10.1016/j.eneco.2013.01.005

Du, X., Yu, C. L., & Hayes, D. J. (2011). Speculation and volatility spillover in the crude oil and agricultural commodity markets: A Bayesian analysis. *Energy Economics*, *33*(3), 497-503. https://doi.org/10.1016/j.eneco.2010.12.015

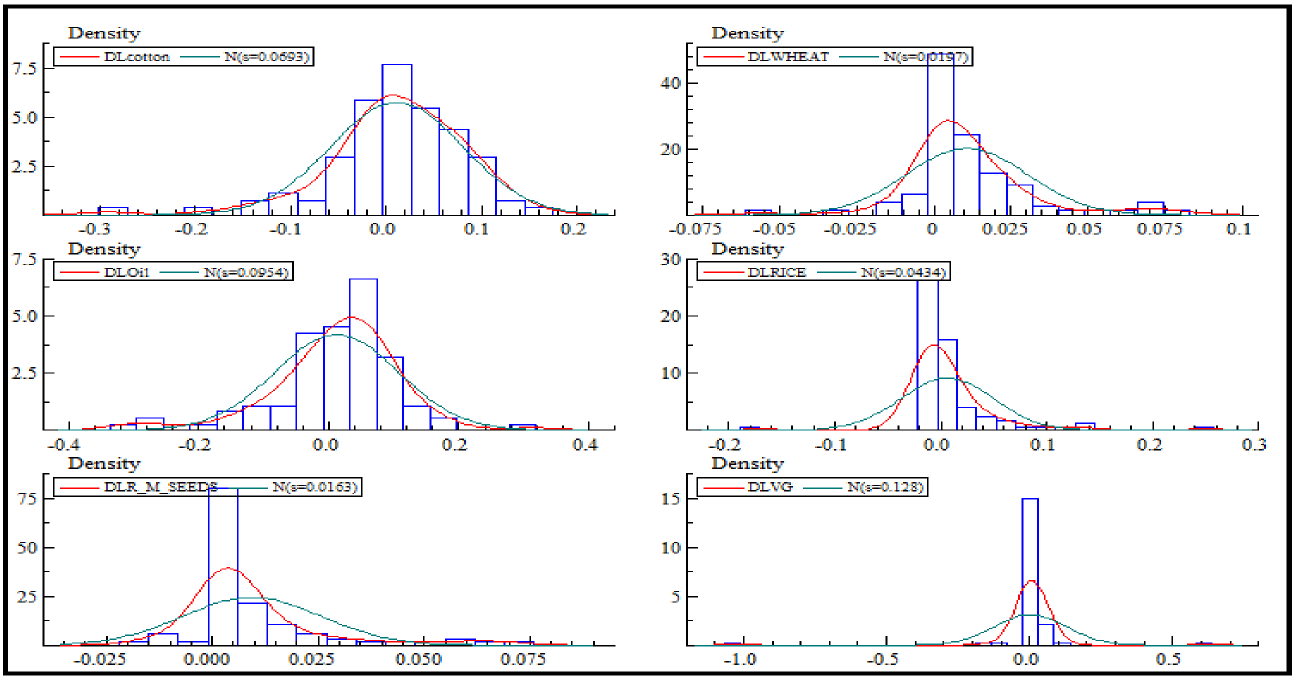
Economic Survey of Pakistan, E. (2008). *Government of Pakistan, Finance Division Economic Adviser's Wing*. https://www.finance.gov.pk/survey_0708.html
Enders, W. (1995). Applied Econometric Time Series, John Wiley&Sons. *Inc., New York*, *365*.
Food and Agricultural Organization of the United Nations, F. (2011). *FAO Food Outlook: Global Market Analysis. Rome: Food and Agricultural Organization of the United Nations*.
Ghosh, S. (2011). Examining crude oil price – Exchange rate nexus for India during the period of extreme oil price volatility. *Applied Energy*, *88*(5), 1886-1889. https://doi.org/10.1016/j.apenergy.2010.10.043
Hafner, C. M., & Herwartz, H. (2006). A Lagrange multiplier test for causality in variance. *Economics Letters*, *93*(1), 137-141. https://doi.org/10.1016/j.econlet.2006.04.008
Hamilton, J. D. (2009). Understanding Crude Oil Prices. *The Energy Journal*, *30*(2), 179-206. https://doi.org/10.5547/ISSN0195-6574-EJ-Vol30-No2-9
Hanif, M. N. (2012). A note on food inflation in Pakistan. *Pakistan Economic and Social Review*, 183-206.
Harri, A., & Hudson, D. (2009). Mean and variance dynamics between agricultural commodity prices and crude oil prices. presentation at the economics of alternative energy sources and globalization: the road ahead meeting, Orlando, FL,
Hsieh, D. A. (1988). The statistical properties of daily foreign exchange rates: 1974–1983. *Journal of International Economics*, *24*(1-2), 129-145. https://doi.org/10.1016/0022-1996(88)90025-6
International Monetary Fund, I. (2008). *World Economic Outlook, October 2008: Financial Stress, Downturns, and Recoveries*. https://www.imf.org/en/Publications/WEO/Issues/2016/12/31/World-Economic-Outlook-October-2008-Financial-Stress-Downturns-and-Recoveries-22028
Ji, Q., & Fan, Y. (2012). How does oil price volatility affect non-energy commodity markets? *Applied Energy*, *89*(1), 273-280. https://doi.org/10.1016/j.apenergy.2011.07.038
Liefert, W. M., Liefert, O., Vocke, G., & Allen, E. W. (2010). Former Soviet Union region to play larger role in meeting world wheat needs. *Amber Waves: The Economics of Food, Farming, Natural Resources, and Rural America*, 12-19. https://doi.org/10.22004/ag.econ.121958
Malik, F., & Hammoudeh, S. (2007). Shock and volatility transmission in the oil, US and Gulf equity markets. *International Review of Economics & Finance*, *16*(3), 357-368. https://doi.org/10.1016/j.iref.2005.05.005
Mensi, W., Beljid, M., Boubaker, A., & Managi, S. (2013). Correlations and volatility spillovers across commodity and stock markets: Linking energies, food, and gold. *Economic Modelling*, *32*, 15-22. https://doi.org/10.1016/j.econmod.2013.01.023
Mutuc, M., Pan, S., & Hudson, D. (2011). Response of cotton to oil price shocks. *Agricultural Economics Review*, *12*(2).
Natanelov, V., Alam, M. J., McKenzie, A. M., & Van Huylenbroeck, G. (2011). Is there co-movement of agricultural commodities futures prices and crude oil? *Energy Policy*, *39*(9), 4971-4984. https://doi.org/10.1016/j.enpol.2011.06.016
Nazlioglu, S., Erdem, C., & Soytas, U. (2013). Volatility spillover between oil and agricultural commodity markets. *Energy Economics*, *36*, 658-665. https://doi.org/10.1016/j.eneco.2012.11.009
Nazlioglu, S., & Soytas, U. (2011). World oil prices and agricultural commodity prices: Evidence from an emerging market. *Energy Economics*, *33*(3), 488-496. https://doi.org/10.1016/j.eneco.2010.11.012
Papapetrou, E. (2001). Oil price shocks, stock market, economic activity and employment in Greece. *Energy Economics*, *23*(5), 511-532. https://doi.org/10.1016/S0140-9883(01)00078-0
Pesaran, H. H., & Shin, Y. (1998). Generalized impulse response analysis in linear multivariate models. *Economics Letters*, *58*(1), 17-29. https://doi.org/10.1016/S0165-1765(97)00214-0
Soytas, U., & Oran, A. (2011). Volatility spillover from world oil spot markets to aggregate and electricity stock index returns in Turkey. *Applied Energy*, *88*(1), 354-360. https://doi.org/10.1016/j.apenergy.2010.07.018
World Bank, W. (2008). *World Development Report 2008*. https://openknowledge.worldbank.org/entities/publication/ba969388-b5eb-5155-b8f2-6d323a6e5a52
Wright, B. D. (2009). International grain reserves and other instruments to address volatility in grain markets. *World Bank Policy Research Working Paper*(5028).

Zhang, Q., & Reed, M. R. (2008). Examining the impact of the world crude oil price on China's agricultural commodity prices: the case of corn, soybean, and pork.

Zhang, Z., Lohr, L., Escalante, C., & Wetzstein, M. (2010). Food versus fuel: What do prices tell us? *Energy Policy*, *38*(1), 445-451. https://doi.org/10.1016/j.enpol.2009.09.034

Appendices

Appendix I: probability Density Function of Returns



Appendix II: PAcf and ACF od Squared DLOIL and Squared CL cotton

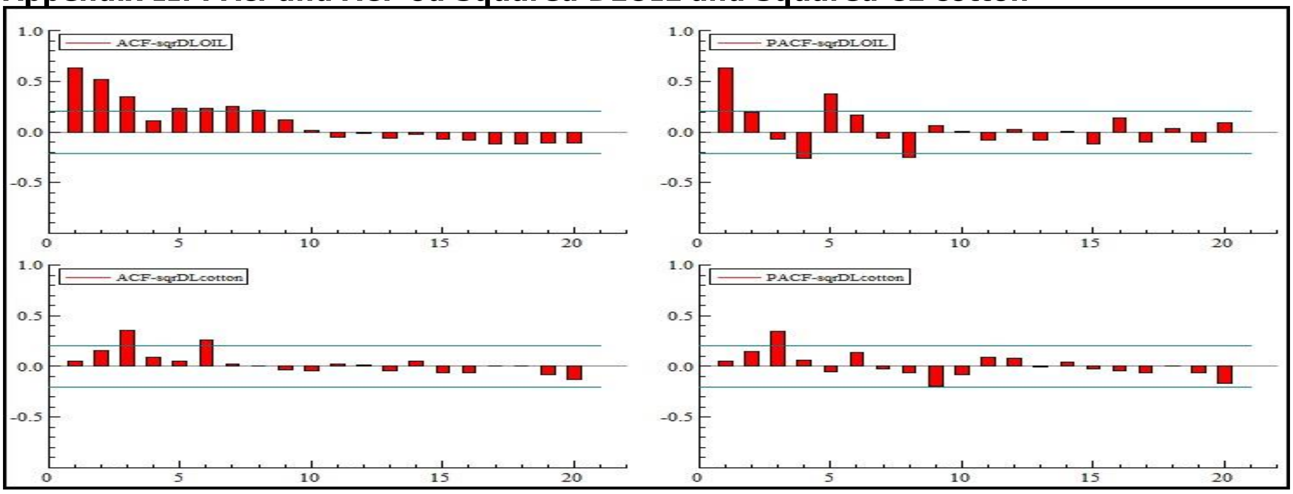


Figure 2: PACF and ACF od Squared DLWheat and Squared DLRice

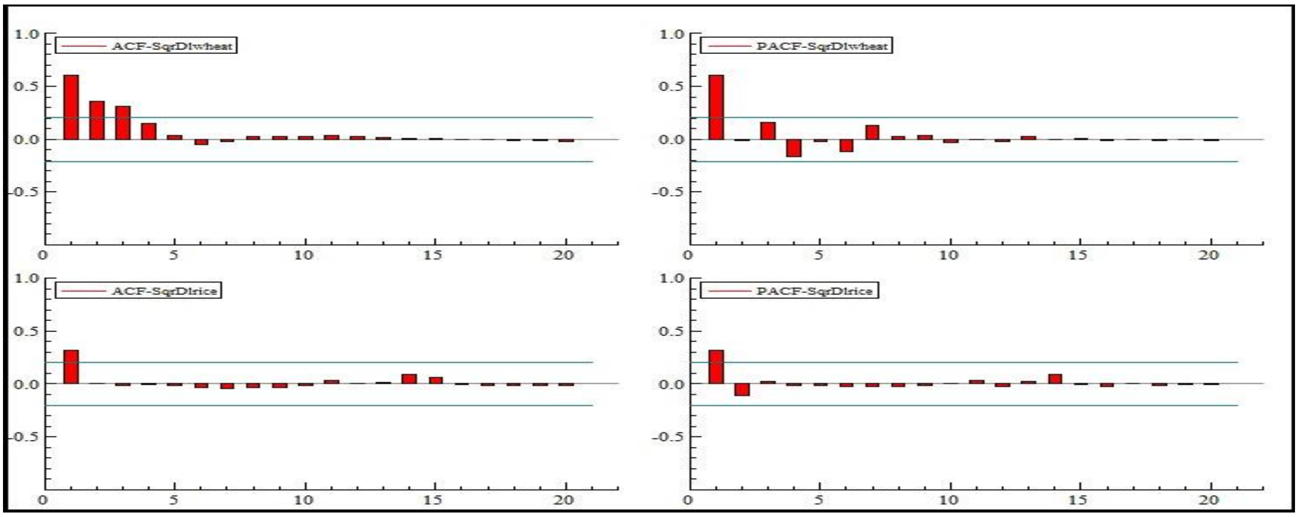


Figure 3: PACF and ACF od Squared DLR & M Oil and Squared DLVG