

Modelling Dynamic Conditional Correlations among Stock Price, Oil Price and Wheat Price of Pakistan, Using DCC GARCH Model

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Abstract

The purpose of this study was to examine dynamic conditional correlations among stock, oil and wheat price of Pakistan. The study has used the DCC GARCH model of (Engle,2002) for finding out the correlations. Secondary data was used for this research, and data is transformed into returns by taking logs levels. The findings of the study indicates that the stock, oil and wheat markets of Pakistan are correlated. Pakistan wheat market remained more volatile followed by stock market and oil market respectively. High wheat support prices, impact of world commodity prices and hoarding of wheat due to speculation results in high volatility in wheat price. Wheat market volatility were followed by stock market in Pakistan in our results. Political situation and herding behaviour were cited as the major reason for stock market volatility by investors in Pakistan. In our finding's correlation between stock and oil price remained negative over most of our study period, this is in line with the findings of (Zeeshan and Ferhan,2019). According to them as Pakistan is oil importing country increase in oil prices increases production cost which ultimately affect the level of production at enterprises and returns of the stock markets negatively. Domestic wheat prices are more influenced by international wheat prices than domestic wheat support prices so high reliance on imported commodities should be avoided by increasing domestic production of wheat. Government should maintain law and order situation to boost confidence of investors. Pakistan should use its existing energy resources efficiently and explore new sources of energy to decrease its reliance on imports.

Key words:Returns, Correlations, among Stock, Oil and Wheat Prices of Pakistan Using DCC GARCH Model

1. Introduction

The PSX was established on 11 January 2016 after the merger of the (KSX, LSX and ISX). The stock market is a place where companies list themselves to make their shares available to a broad range of investors to purchase these shares. Pakistan Stock Exchange provides a platform to get the funds to lead their companies for the betterment (Shabbir and Kousar, 2019). It in turn mobilizes savings for investment at domestic and international level and create investment opportunities for small investors. The role of stock exchange is important for the economic development of the country (Sadorsky, 2014). Oil has become the world's most

important source of energy since the mid-1950s. Its products underpin modern society, mainly supplying energy to power industry, heat homes and provide fuel for vehicles and aero-planes to carry goods and people all over the world. Wheat is the major staple food crop in Pakistan and cultivated on the largest acreages. Its importance is evident as it constitutes 60% of the daily diet of common man in Pakistan (GOP, 2019). It occupies a central position in agricultural policies of the government. In this study we look into the dynamic conditional correlations among three home markets of Pakistan i.e., stock market, oil market and wheat market. Toward carry out analysis, we applied DCC GARCH Model that allows the disclosure of the relations of the index to be considered in a dynamic structure and the instances of great and occasional correlations among our three selected markets. We achieve a set of return variances and covariance that permit us to compute the dynamic conditional correlations for the duration spanning from January 2013 till February 2019 on SPI monthly data (GOP, 2019). Correlation in Pakistan stock price, oil price and wheat price are actually a days a not unusual phenomenon. There are lot programs of GARCH and its circle of relatives of models for modelling correlation in crop yield and agricultural commodity costs. However, besides studying co-movement, price discovery and threat transfer are considered to be two crucial contributions of futures market in the direction of the business enterprise of economic activity (Ayub, 2018). Price discovery refers to using future charges for pricing coins market transactions. It method futures rate serves as markets expectancies of next spot charge (Dai and Zhou, 2019). Pakistan stock charge Oil rate and Wheat rate are intensely interrelated: to each relies upon the alternative on behalf of numerous features, across from making sure get admission to offerings to environmental, social, and moral effect issues, in addition to economic relations. These researches have analyzed the technical link that is among markets if you want toward spotlight want for a combined policy meant toward confirming maintainable development. As of a financial factor of observation, nevertheless only a rare examines that make use of observed methods to confirm the latest theoretic literatures. This location of study certainly huge, also a commercial evaluation of the linkage geared toward information the connections plus correlations going on an international scales is quiet wanted. Indeed, the monetary concept describe that extra monetary additives are interconnected, more is opportunity that twitch spread amongst markets. Thus, taking the economical angle takes the critical benefit of underlining the power of those members of the family also their dynamic forces to higher recognize if and the way shocks are spread from one area to an others (Taghizadeh-Hesary *et al.* 2019; Chang *et al.*, 2011)

2. Methodology

2.1 Data source

Secondary data was used for analysis purpose from different sources such as Pakistan bureau of Statistics and Yahoo.finance.com. While, data transformation was performed as suggested in literature. Our data spans from January 2013 to February 2019. To estimate the degree of correlation time-varying conditional co-movement GARCH model was used, by using DCC GARCH version of Engle (Engle, 2002; Tse and Tsui, 2002) struggled to model both variances and conditional co-movements of numerous series applying the DCC GARCH procedure

2.2 Data examination procedure

Mainly the data were prepared and ordered in Microsoft Excel. By applying the Microsoft Excel sheet, all the data were tabularized, summarize and examined through Microsoft Excel. Data is converted to returns by taking log of the data. Rats 8.3 and EViews 5 has been used for analyses purpose.

2.3 Model

The multivariate model was defined as follows: In the first stage, a multivariate GARCH model was used to examine the price volatility of these three markets. At this point of the analysis, it is thinkable to select a nonlinear model to account for the contrivance of asymmetric shocks on volatility. In the second stage, the standardized residuals of the regressions, made in the first step, are used to model the correlations in an autoregressive manner. This allows, to get the conditional correlation matrix fluctuating over time. The conditional variance-covariance matrix is the product of the diagonal matrix of conditional standard deviations by the conditional correlation matrix and the diagonal matrix of conditional standard deviations. It is important to stress that the DCC procedure relies on the decomposition of the conditional covariance as the product of conditional standard deviations as well as conditional correlations between two markets. The parameters are appraised using quasi-maximum likelihood method (QMLE) presented by (Bollerslev and Wooldridge, 1992). This technique permits to obtain, for each variable, the conditional variance also the conditional covariance. Under the Gaussian assumption. The estimation of the vector of unidentified parameters is carried out by QMLE method which is strong to departures from normalcy of return series under some regular conditions (Bollerslev and Wooldridge, 1992).

➤ Equation of model

$$X_t = \mu_t + H_t^{1/2} \epsilon_t$$

$$H_t = D_t R_t D_t$$

With:

$X_t = (X_{1t}, X_{2t}, \dots, X_{Nt})$ is the vector of the past observations.

$\epsilon_t = (\epsilon_{1t}, \epsilon_{2t}, \dots, \epsilon_{Nt})$ is the vector of the conditional returns.

$\epsilon_t = (\epsilon_{1t}, \epsilon_{2t}, \dots, \epsilon_{Nt})$ is the vector of the standardized residuals.

R_t is a $(N \times N)$ symmetric dynamic correlations matrix.

D_t is a diagonal matrix of conditional standard deviations for each of the returns series.

3. Results and Discussion

Non-stationarity is the fundamental problem within the time series data and for resolving that trouble more than one tools have been used inside the empirical part of the research. Augmented Dickey–Fuller test (ADF) (Mushtaq and Rizwan, 2011) tests nonstationarity inside the data series of all variables at log-degree 1 and on 1st difference data series of variables become stationary. Long term relation between variables is checked through co-integration model and volatility of stock market with respect to macro-economic variables is tested by using DCC GARCH model.

3.1 The descriptive statistics returns of stock, oil and wheat markets of Pakistan are given in the table below

It is clear from **Table 1** the descriptive statistics interconnected to returns of variables used, which are in turn subcategorized under their respective market headings. Second column of **Table 1** indicates statistics related to return series of Pakistan stock market (PSX). Average returns for these rates are positive for almost all the markets. The average returns range 0.008277 in Pakistan stock market, 0.000861 in petrol whereas the wheat remains 0.000446, Pakistan wheat market remained more volatile followed by stock market and oil market respectively. Third column of **Table 1** indicates statistics related to return series of petrol under study. Average returns for these rates range 0.000861. Fourth column of **Table 1** indicates statistics related to return series of wheat under study. The average returns are positive ranges 0.000446. Median of Pakistan stock market 0.009986 while petrol and wheat markets remain 0.000000. Highest and least level of unconditional volatility was experienced by wheat with a standard deviation of 0.034969 respectively. Pakistan stock and wheat market returns are negatively skewed while petrol skewed positively. The JarqueBera test (Carlos, 2011) test for normalcy based upon the skewness and kurtosis for the returns of three markets. Data do not come from normal distribution reject null hypothesis, which mean the returns do not follow normal distribution. This fact forms strong basis through using DCC GARCH model.

Table 1 Descriptive statistics

Particulars	Returns of Pakistan		
	Stock Market	Oil Market	Wheat Market
Mean	0.008277	0.000861	0.000446
Median	0.009986	0.000000	0.000000
Maximum	0.052251	0.042917	0.109484
Minimum	-0.079058	-0.046891	-0.133131
Std. Dev.	0.024970	0.010766	0.034969
Skewness	-0.805558	0.320856	-0.879927
Kurtosis	4.359772	11.89471	7.774188

Jarque-Bera	13.51921	241.8968	78.74860
Probability	0.001160	0.000000	0.000000
Sum	0.604216	0.062878	0.032523
Sum Sq. Dev.	0.044892	0.008345	0.088045
Observations	73	73	73

3.2 Estimation results for the set of variables: stock market, oil and wheat markets using rats 8.3 and EViews 5

Table 2 Three markets DCC GARCH results

Variable	Coeff	Std Error	T-Stat	Signif
1. Mean(1)	7.2627e-03	3.0932e-03	2.34797	0.01887607
2. Mean(2)	9.7230e-04	1.6931e-03	0.57427	0.56578668
3. Mean(3)	-5.7585e-04	6.6589e-03	-0.08648	0.93108621
4. C(1)	3.6668e-05	1.2045e-05	3.04415	0.00233338
5. C(2)	5.8797e-05	7.0239e-06	8.37104	0.00000000
6. C(3)	1.4658e-03	2.7760e-04	5.28039	0.00000013
7. A(1)	0.0457	0.0176	2.59613	0.00942808
8. A(2)	-8.2528e-03	0.0534	-0.15457	0.87715940
9. A(3)	0.1695	0.1107	1.53101	0.12576754
10. B(1)	0.9157	0.0163	56.20171	0.00000000
11. B(2)	0.6970	0.0363	19.17522	0.00000000
12. B(3)	0.1019	0.1367	0.74570	0.45584993
13. DCC(1)	0.2738	0.2754	0.99425	0.32010272
14. DCC(2)	1.6576e-15	0.7045	2.35281e-15	1.00000000

Fig 1: Returns of stock, oil and wheat markets of Pakistan

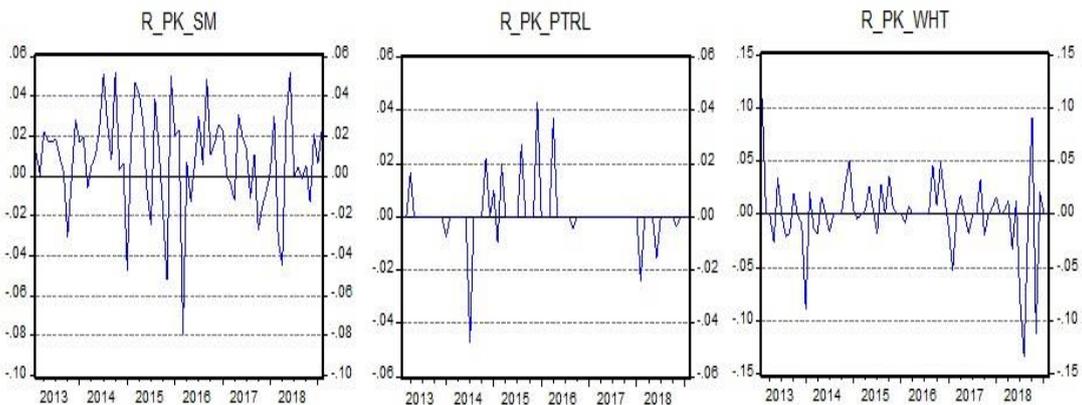


Fig 1 shows the return of three selected markets in Pakistan i.e. stock market, oil market and wheat market. Their reasons are provided below.

3.2.1 Stock Market Return

Positive returns during 2014 in stock market were due to the strong foreign interest, healthy earning's growth and improvement in business sentiments were the major reasons behind this. Accordingly, the post-election stock market improved by more than 45% till April 2014 (GOP, 2013-14). Negative returns during 2016 in stock market were due to less dividend on per share to stockholders.

3.2.2 Oil Market Return

Several factors contributed to the 2014 decline in oil prices. Economies such as China, whose fast growth and opening out created an unquenchable thirst for petrol in the first period of the new millennium, started to slow after 2010. China is the world's biggest country by populace, so its decrease petrol demand had significant price consequences. Other big emerging economies such as of Brazil, Russia and India practiced alike economic trajectories in the initial 21st century – quick growth during the first span, followed by much slower progress after 2010. The same republics that pushed up the value of oil in 2008 with their ravenous demand help out bring oil prices down in 2014 by demanding much less of it.

Spurred by the adverse impact of great oil prices on their economies, nations such as the Canada and U.S accelerated their performance to supply oil, in order to reduce their oil imports sharply, which put further downward pressure on world prices. Saudi Arabia's actions also contributed to falling 2014 oil prices. Because Saudi Arabia produces oil so cheaply and holds the biggest oil reserves in the world (Tahir *et al.* 2019). Positive returns in oil market during 2015 as china and the developing world increase oil consumption while supply of shale oil from North America and other regions grows more slowly.

3.2.3 Wheat Market Return

According to experts, one of the major reasons for food-inflation remains the government's judgment to rise the wheat support amount by more than 300% in last 10 years that really benefited big landlords, but proved a setback for the majority of people, specifically belonging to the poor and fixed income groups. They said that big increase in wheat support value has raised flour amount by increasing speculative pressure on price that has previously gotten close to alarming ratio for a majority of people. They stated that increase in price has worked as encouragement for hoarding, making flour marketplace even more volatile (Salman and Abduhu, 2016). Pakistan major import comprises of energy and food (Pakistan Gulf Economist, 2019). Following world commodity prices, Pakistan wheat market returns broke the upward trend in December 2018. In third quarter of 2018 high positive return in wheat price is due to the economic instability at the national level has made the government to withdraw all the subsidies that the authorities provided on agricultural products.

3.3 Correlations among stock, oil and wheat markets of Pakistan

Fig 2 Correlations among stock oil and wheat markets of Pakistan

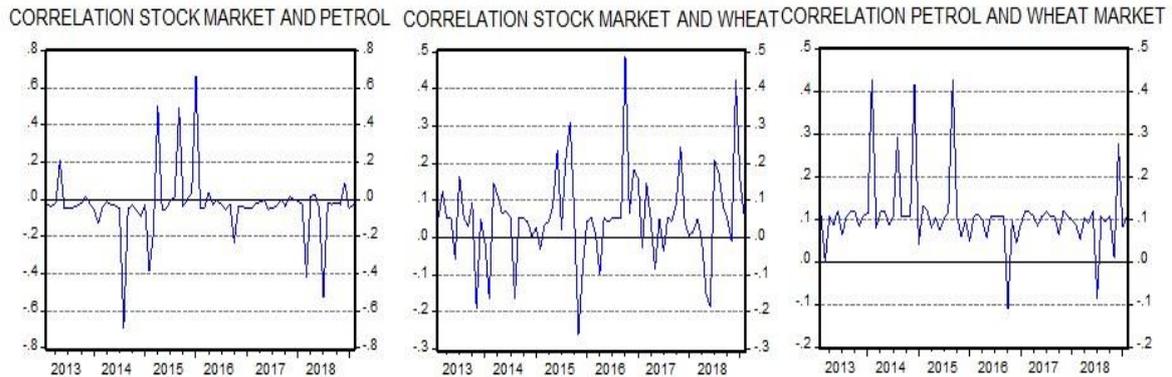


Fig 2 shows the correlations among three selected markets in Pakistan i.e stock market, oil market and wheat market.

3.3.1 Correlation between Stock and Oil Market of Pakistan

The purpose of this study is to show the changing correlations between stock and oil market of Pakistan. The data is taken from January 2013 till February 2019. We have used the DCC GARCH model. Najaf, *et al.* (2016) stated that many researchers found out that there is negative correlation between oil and stock market. It is observed that every stock market has the crucial position in development of economy. Increasing in the prices of oil can become cause of inflation in the state hence due to rising inflation investment in stock market declines. We found slightly positive co-movement of prices in the month of February 2013, but in the middle of 2014, there is strong negative correlation between them as the price of stocks were increasing and oil prices were decreasing, while in early 2016 there is strong positive correlation in prices of both markets.

3.3.2 Correlation between Stock and Wheat Market of Pakistan

The most negative correlation between stock market and wheat market is observed at the end of 2015. We found highest positive correlation at the end of 2016 in both markets. The major reasons were discussed above.

3.3.3 Correlation between Oil and Wheat Market of Pakistan

If oil price increases inflation will be also increase because oil is a major component of (CPI). Agriculture is nearly depending on steadfast supplies of oil for farming in addition for pumping water, plus on fuel for its fertilizers; in totalling, for each calorie of energy used by cultivation itself, five more are used for dispensation, supply and storage or transportation. Here's why oil prices are increasing: The increase in fuel prices is mainly due to hike in the cost of crude oil and high excise duty levied on transportation fuel in the nation. Petroleum prices are determined by the charge of crude oil in global markets.

We found most positive correlation between oil and wheat market in mid of 2015. In the other side there is also negative correlation occurs between them in the august 2016 oil price were slightly decreasing and wheat price were increasing.

4. Conclusion and suggestions

It is concluded that Pakistan wheat market remained more volatile followed by stock market and oil market respectively. High wheat support prices, impact of world commodity prices and hoarding of wheat due to speculation results in high volatility in wheat price. According to (Ghufran *et al.* 2016) political situation were cited as the major reason for stock market volatility by investors followed by herding behaviour among investors. The correlation between stock and oil price remained negative over most of our study period, this is in line with the findings of (Zeeshan and Ferhan, 2019). According to them as Pakistan is oil importing country increase in oil prices increases production cost which ultimately affect the level of production at enterprises and returns of the stock markets negatively. Equity marketplace of Pakistan is likewise prompted by way of global crude oil prices because businesses profits and coins float streams are without delay tormented by exchange in world Oil prices as above mentioned that excessive oil expenses makes high input prices, production costs which produce much less profits for the organization, share costs cross down. Further decline in stock prices may also cause reduction in company's income and dividends. Domestic and overseas buyers will not attract for investments. Whereas, decrease in oil price show low input price and makes increment in income and greater investments. Moreover, will increase in global oil prices also causes inflation in an economy that cause of growth in interest price and makes difficulties for traders to continue to exist in the market. So, this examine concludes that mean and instability spillover from crude oil marketplace to stock and wheat market will be located. This study also suggests the vital information so that it will assist to coverage makers and investor to make higher choice and earn more profit. Suggest it is therefore, imperative that the business community and the policy makers keep a close eye on movement of prices of energy and food products.

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