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Dynamic Inter-Relationship among Commodities Energy Rate and Stock Market Volatility in Saudi Arabia

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Abstract: ***The paper investigated the correlation and volatility relationship among commodity energy rate and the stock exchange in Saud-Arabia for the period April 2007-December 2017 using the monthly time series data. We utilized the dynamic conditional correlation DCC that enable us to measure both the correlation and volatility parameters of the variables of the study. The result from the estimated model provided evidence of a positive, significant and robust relationship among the commodity energy rate and the stock market. The result further showed evidence of time varying correlation. Finally, we found evidence of volatility interdepended between the variables. The study concluded that global and domestic level, commodity energy price affects the financial and macroeconomic variables of Saudi Arabia, especially the stock market. Therefore, we recommended that any economic policy or regulation should include hedging the commodity energy price due to their volatile nature to reduce their influence on the market and the economy at large***

Index Terms: ***Correlation; Volatility; DCC Model; Energy; Price; Saudi Arabia.***

I. INTRODUCTION

Commodity energy price has been a topical issue in economics due to its importance to both developed and emerging markets. Studies such as Manning (1991), Ebohon (1996) and Sachs (1980) had already established how energy commodities affect economic variables for example exchange rate (GDP), stock markets index andgross domestic products . However, commodity energy variables are characterized with price volatility that is challenging to manage especially to oil exporting countries. The consequence of volatility of commodity energy price to these countries an is economic recession, debt crisis, exchange rate and stock volatility.

After a recognizable and extreme calm for two decades period between 1986-2006, fluctuation in the oil rate have been noticed by huge price movement at the oil price market during 2007-2017. Between 2007 and 2009; the rates rose from below \$60 to \$145 and then fell drastically to as low as \$30. During 2014 to 2015, within a a small number of months, oil price reduced almost 75% of its value. Ferderer (1996) argued that the hike in commodity energy price is accompanied by waves of uncontrol volatility, which have shown to be economically detrimental, especially to international stock exchanges. Such price surges that lead to quick decays and volatility have agreed more through similar steps in the stock markets. It has appealed the consideration of policy makers, financiers, practitioners, and scholars to evaluate the interconnectedness among the commodity oil rates and stock markets volatility.

Hamilton (1983) analysed the relationship among commodity energy price and stock markets . His research found that theoil price varies on a regular basis and exercises a substantial influence on the stock market. Heconcluded that most US recessions from the end of WWII up until 1983 were the outcome of the surges in the energy price. It was agreed by later studies (Kaneko et.al 1995; Ferson et. al.1995. They concluded that commodity energy prices have an exact negative consequence on stock market's profit . The divergence in the seminal papers of Jones and Kaul (1996) and Huang et al. (1996) called the attention of many researcher on the nexus between commodity energy rates and stock markets. As stated by Jones and Kaul (1996), commodity energy price employs a significant adverse influence on cumulative profitreturns, whereas the paper of Huang et al. (1996) findings claim that there's not any relationship among the profit of the stock market and commodity energy rates.

Another picture painted in the literature is the scale of the influence of commodity energy rates in oil exporting and importing nations. Prices are a big concern because to leaders in resource-holding countries such as Saudi Arabia, there are anxious about long-term economic models, if prices decline. That's why, the more volatile price in these countries, the more influence on the stock market's investment. Even though other factors threat the commodity price such as climate framework, technology advancements, electricity storage and renewable energy, are all significantly less worrisome to leaders in the export of these commodity than price volatility. Long ago empirical studies of this nature were conducted, for instance, Kling (1985) founded that increase in the prices of crude oil contributed a negative effect in the stock market.Though; Cheng (1996) discovered no relationship between oil rates and the stock market in these countries. Considering the importance and the effects of oil rates , modelling the

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linkages between the commodity energy prices which were dominated by oil related products and the Saudi Arabia stock market is impressive.

Saudi Arabia has traditionally been regarded as the world's most important producer of commodity energy price, especially oil related products. Therefore, price volatility has been a vital issue since massive amounts of capital are tied up in the sector. Price plunge in such countries seriously affect the stock markets were such investments are. Jouini (2013), Abdalla (2013) and most recently Shu-Tong (2018) had employed various methodologies to understand the link among commodity rates and the Saudi Arabian's stock market.

The mandates of the research was to determine, the dynamic inter-relationship among theSaudi stock market and commodity energy rate . The contribution of the paper is that we include the short interest rate (SIR) beside the commodity energy rate and stock market variables. In this article, we seek to extend in terms of the methodology. Most of the works do not represent the production of variation in volatility over time as such fails to show a picture of the actual arrangements of our data. In this study, we employed the multivariate GARCH (MGARCH) dynamic conditional correlation (DCC) Model that permit us to determine both the time varying correlation and conditional between the research's variables. The rest the article is organized as follows. Unit 2 analyses throughly a few practical research on the relationship among stock markets and commodity energy rates. Then the methodology that we have used to succeed the objectives of the research. Next section demonstarte the derived data along with statistical properties. Section 5 argues the estimation and empirical results. We find evidence that the correlation between the variables of the study varies across time with significant change during the two regimes (global oil price shock and global financial crisis). The results of the estimated DCC model shows confirmation of a positive, energetic and important conditional correlation between energy rates and the stock market. The result further shows evidence of volatility interdependence among the commodity energy rate and the stock market in Saudi Arabia. The last part determines the concluding findings of the article.

II. LITERATURE REVIEW

The inconsistency in the early studies leads to the wealth of literature trying to evaluate the potential link between commodity the stock market indices andenergy rates . Many researchers have argueded that rise in energy rate lead to negative stock market profits whereas the reverse is not the case (Sadorsky,1999; Hammoudeh and Li 2005; Ciner 2013; Laopodis 2011; Nandha and Faff 2008 and Filis and Chatziantoniou 2014). They further explained that such a scenario is more viable in the period between 1986-1996 when there was a significant reduction in the rates of those commodities, especially oil related products. Focusing on emerging markets, Asteriou and Bashmakova (2013) analysed the relationship in Central and Eastern European Countries (CEEC) and the result is inconsistent with the developed countries as found by Sadorsky (1999).

Studies such as Hamao (1988), Cong et al. (2008) and Jammazi (2010) are against the finding of any major relationship between commodity energy prices and stock markets. Their studies were concerned with both emerging and developed countries for example China, France, Japan and UK . However, these streams of studies focused on the cumulative indices of the stock market. Alternatively, the use of such market indices in analysing the link among oil stock and stock market may mask heterogenous responses from diverse industrialized sectors because of the divergence in characteristics with some energy users, energy substitutes or non-oil related companies.

The issue of heterogeneous response was addressed in studies by Nandha and Faff (2008) who investigated 35 datastream global industry market indices and found that increase in the oil rate have a significant impact on the oil, gas and mining sector. Elyasiani et al. (2011) founded the same result in energy related sectors and found that the relationship with non-oil and financial industries is negative and indirect whereas El-Sharif et al. (2005) showed that the relationship is weak in the UK commodity energy industries. In contrast to these findings, Narayan and Sharma (2011) provided some evidences that positive changes in commodity energy prices primarily oil related commodities did not only have an impact on energy associated industries indices but also non-oil related industries such as finance sector. Scholtens and Yurtsever (2012) and Hammoudeh and Li (2005) suggested that changes in commodity energy prices are heterogenous for different areas while European markets react negatively to positive energy rate changes separately from the energy related indices which react definitely to the fluctuations of oil rates.

Miller and Ratti (2009) acknowledged time varying correlation among commodity energy rates and the stock markets. Their study employed a quasi-time varying framework and founded that the link among energy products and stock market for the period between 1971-2018. They found evidence of time varying relationship where the relationship is negative between 1970s to 1990s and become positive after 1999. This supported by studies of Bharn and Nikolova (2010) and Awartani (2013).They determined that the time varying relationship among commodity energy rate and the stock market and is driven mainly by economic and geopolitical developments. Filis et al. (2011) argued that the time-varying link among commodity energy rate and the stock market responded differently to various types of shock. That demand shock leads to lower correlation, but the magnitude of these correlations is not always the same, whereas supply-side shock does not trigger changes in the relationship. The study justified that the result is qualitative the same for energy exporting and importing countries.

Another research done by Mohanty et al. (2011) discussed that the influence of commodity energy rate in economies that are oil exporters is different compared to oil importers that the negative relationship explained by previous literature does not hold in stock exchange working in oil exporting nations. It was confirmed by Al-Janabi et al. (2010) in a research of gulf corporation council countries (GCC) that oil is not an element that predicts for GCC stock markets. Another same research was conducted by Apergis and Miller (2009) in 8 developed countries such as Canada, Italy, Australia, JapanFrance, Germany, , the UK and the USA They founded findings similar with Kilian (2009) and Kilian and Park (2009) that the magnitude of the effect is minimal As far as volatility is concerned, as the following researchers Ross (1989), Huang et al. (1996) and Malik and Ewing (2009) argued that volatility of a different asset could transmit to each other such that volatility between commodity energy price and stock market can transmit and potentially be realized. Mainly, Arouri et al. (2011) and Malik and Ewing (2009) argued that the relationship between the two volatilities is only to some segment of the stock market industries such as industrials, financials technology,,automobile and parts, , telecommunications, utilities, andbasic materials . The study of Vo (2011), Mensi et al. (2013), Ewing and Malik (2016) concentrated on *West Texas Intermediate (WTI*) and found evidence of cross volatility effect between commodity energy price and stock market. Additionally, the oil price fluctuations takes strongely effects from the stock market unpredictability.

Angelidis et al. (2015) findings showed that bent crude oil instability on the probability of the Dow Jones during high risk regime but could not provide evidence that significant effects on stock market volatility. Phan et al. (2016) used unpredictability from the futures contracts of the WTI, S&P500, andNASDAQ . He showed that, there are substantial cross market volatility effects even in the futures markets. Jouini (2013) employed the VAR-GARCH model and found that instability changes between oil price and stock sectors. Conversely, the spillover effects are unidirectional from oil to some sectors for profit but bidirectional for volatility patterns with obvious relations from these sectors to oil.

Having reviewed several literature, it is pertinent to note that a huge number of studies were determined in the developed economies and oil as the principal commodity energy variable. Other variables, such as natural gas was not given priority, which left a massive gap in the literature work. Furthermore, in the literature, the issue of time varying correlation was not adequately treated in oil exporting states.

III. METHODOLOGY

This paper targets to determine the correlation and correlation dynamics between commodity energy price and stock market volatility in Saudi Arabia. Correlation is vital inputs for many tasks in economics and financial management. Regulators and investors require hedges estimates of the correlation between relevant variables. The change in correlation and volatilities happen; then the hedge ratio must be attuned to explain the maximum latest information. Therefore, this study employed the MGARCH-DCC model designed by Engle (2002) and Sheppard (2001) which allowed us to determine both the correlation and correlation dynamics between our variables of the study. The model parametrizes the conditional correlations have a two stages process to guess the parameters and makes the model reasonably easy for the interpreter. The first stage estimates the conditional variance via the univariate GARCH model for each variable to obtain GARCH-estimates of the respective series' conditional variances to standardize the residuals. At next level, the parameters in the first step (the standardized residuals) are utilized to estimate both the conditional correlation and time varying conditional covariances. In the DCC model, the covariance matrix is positively certain at each point in time domain and the procedure covariance stationary. The following equations are used tfor DCC model:

The conditional variance co-variance matrix H_t for the DCC Model is giving by Equation (1) below

$$H_t = D_t R_t D_t \qquad (1)$$

Where $D_{t=}\{\sqrt{h_{i,t}}\}$ diagonal matrix taking the functional form of univariate GARCH model. The model estimates the D_t as a univariate GARCH (1,1) model of the Equation (2)

$$h_{it} = w_i + \sum_{p=1}^{pi} \alpha_{ip} r_{it-p}^{2} + \sum_{q-1}^{Qi} \beta_{iq} h_{it-p,} U_t = \varepsilon_{it} / \sqrt{h_{it}} \qquad (2)$$

And i = 1,2,3 with the normal GARCH restriction for non-negativity and imposed stationarity, for example non-negativity of the variance. Moreover, $\sum_{p=1}^{pi} \alpha_{ip}$ + $\sum_{q=1}^{Qi} \beta_{iq}$<1 ($\alpha$ *and* β are non negative adjusted parameters that satisfy $\alpha + \beta$< 1).

R_t in Equation (1) now being time-varying and is given by Equation (3) below

$$R_t = diag\left(q_{iit}^{-1/2}\right) Q_t \; diag\left(q_{ii,t}^{-1/2}\right) \qquad (3)$$

$$Q_t = (1-\alpha-\beta)\overline{Q} + \alpha\, u'_{t-1} + \beta\, Q_{t-1} \qquad (4)$$

R_t have the identical parameterizations requirements as H_t . H_t excepted that the conditional variances have to unity. The correlation matrix is represented through matrix Rt and $\bar{Q}$ is the diagonal matrix of the square roots of the diagonal elements of Q_t. Q_t can further be seen as an Autoregressive Moving Average (ARMA) process encapsulating the short-term deviation of the correlation within its long-run level.

The conditional covariance follows the below DCC (1,1) specification

$$h_{i\,j,t} + \rho_{i\,j,t} \sqrt{h_{ii,t}}\, \sqrt{h_{i\,j,t}} \qquad (5)$$

$$\rho_{i\,j,\,t} + \frac{q_{i\,j,t}}{\sqrt{q_{ii,\,t}}\,\sqrt{q_{i\,j,t}}} \qquad (6)$$

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$$Therefore, q_{i\,j,t} = \bar{\rho}_{ij}\left(1-\alpha-\beta\right)+\alpha\, q_{ij,t\text{-}1} + \beta\pi_{i,t-1n\ \ j,t-1} \tag{7}$$

where $q_{ij,t}$ in Equation 6 is the conditional covariance between the standardized residuals and $\bar{\rho}$ ij is the unconditional residuals of the model. The mean of $q_{ij,t}$ will be equal to $\bar{\rho}$ij and the mean-variance will also be equal to unity. When $\alpha + \beta < 1$, the conditional covariance of the standardized residuals will be mean reverting. The above specifications of the DCC model, like many of the MGARCH models, reduce the parameters of estimation and makes it easy to estimate and interpret the time varying correlation and covariance.

IV. DATA ANALYSIS

The purpose of this study was to determine the time varying and conditional correlation among commodity energy rate and stock market volatility in between sector pairs that reflect the co-movement between the variables of the study. The data set consists of the monthly time series of the 5 variables of the study which consist of Saudi stock market return (TASI), Saudi petroleum price (SPP), global oil price (GOP), Saudi gas price (SGP) and Saudi interest rate (SIR) for the period April 2007 to December 2017. The variables accurately reflect the commodity energy variables and stock market volatility. Datastream international was used to retrieve the data and were log-transformed except the TASI, which was converted from the market index.

Table 1 below displays the statistics description of the study variables. The variables typically economic time series behavior. It is characterized by the excess kurtosis and skewness which result in rejecting the Jacque-Bera normality statistics (unless for SPP and GOP) and the approximate leptokurtic distributions (with a flatter tail and a high peak) common to economic and financial time-series data. From the table, the GOP variable displays the highest unconditional mean and the most significant standard deviation, which makes it the most volatile variable among the data series.

Table 1. Descriptive Statistics

Variables	Min	Mean	Max	Std. Dev.	Skewness	Kurtosis	Jarque - Bera
TASI	-0.251	0.000	0.182	0.068	-0.561	4.521	19.240*
SPP	-0.415	0.000	0.222	0.092	-1.100	6.936	109.356*
GOP	122.78	288.509	524.85	89.139	-0.010	2.031	5.038
SGP	15.650	25.011	36.86	5.331	0.310	1.867	8.959*
SIR	-0.510	0.233	1.627	0.612	0.946	2.690	19.793*

(*) indicates significance at 1 percent

Before embarking in any econometric analysis, it's recommended to recognize the stationarity properties of the series. The study employed the PP, KPSS , and ADF unit root test to perform the task. Table 2 displays the outcome of test; the result indicates that the TASI variable is static at both sides and first difference, this is not surprising given the fact that the variable is a stock market profit. Besides this, according to the ADF and PP all the variables are non-stationary but after the first variance becomes stationary. The result of the ADF and PP are not inconsistent with the KPSS in some variables. This may be because the test statistics and method of hypothesis testing are quite different.

Table 2. Unit root Test

	LEVEL			FIRST DIFFERENCE		
Variables	**ADF**	**PP**	**KPSS**	**ADF**	**PP**	**KPSS**
TASI	-9.286*	-9.281*	0.047	-11.871*	-45.884*	0.056
SPP	-8.163*	-8.152*	0.032*	-10.718*	-34.545*	0.065
GOP	-2.953	-2.784	0.193*	-8.356*	-8.444	0.039*
SGP	-2.472	-2.536	0.201**	-12.019*	-11.999*	0.201*
SIR	-2.412	-1.964	0.276	-5.425*	-5.884	0.049

* and ** designates statistical significance at 1% and 5% respectively.

DCC model is modified form of the MGARCH models which is of the ARCH family models. One of the necessary and pre-condition for any ARCH family model is that the variables to be engaged shall have an ARCH effect. The ARCH effect is when the error variance in a time series tracks an autoregressive (AR) model. we have employed the lagrange multiplier (LM) ARCH test developed by Engle (1982). Table 3 presents the result. From the result, we discarded the null hypothesis of no ARCH effect for all the variables. Therefore, the result implied that all the variables are appropriate for any ARCH family model parametrization.

Table 3. ARCH Test

Variables	ARCH Effect
TASI	17.060*
SPP	39.561
GOP	7.951*
SGP	2.945**
SIR	15.280*

* and ** designates statistical significance at 1% and 5% respectively

V. ESTIMATION AND EMPIRICAL RESULT

Table 4 indicates the result of the estimated DCC model. The result is presented in two panels representing the two steps of the DCC model. In the first panel, the result starts with the constants of the five variables of the study. All the constant from C1 to C5 are not statistically significant. It indicates that there is spillover effect in the mean of the estimated variables. Similarly, α_1 and β_1, α_2 and β_2, α_3 and β_3, α_4 and β_4, α_5 and β_5 are the ARCH and GARCH parameters of TASI, SPP, GOP, SGP and SIR respectively. The result of the parameters indicates that the ARCH parameter of the Saudi stock market return is not statistically important. In the same vein, the GARCH parameter of the Saudi interest rate, which is used as control is also not statistically significant. The magnitude of the coefficients the result indicates that there is more volatility persistence in some of the energy commodities than in the stock returns. It indicates that variance will continue higher as an rise in the conditional variance because of shocks will decline gradually.

Table 4. Estimates from GARCH (1,1) DCC MODEL

Coefficient		Probability	Coefficient		Probability
Panel A			**Panel B**		
C1	0.007	0.150	ρ_{21}	0.841	0.000
C2	57.14	0.103	ρ_{31}	0.379	0.000
C3	0.940	0.584	ρ_{41}	0.726	0.000
C4	0.025	0.853	ρ_{51}	-0.176	0.033
C5	0.003	0.612	ρ_{32}	0.465	0.000
α_1	0.292	0.108	ρ_{42}	0.603	0.000
β_1	0.707	0.000	ρ_{43}	0.242	0.005
α_2	0.544	0.033	ρ_{52}	-0.186	0.022
β_2	0.471	0.000	ρ_{53}	0.105	0.242
α_3	0.242	0.005	ρ_{54}	-0.127	0.153
β_3	0.748	0.000	$\mathbf{q_a}$	0.008	0.576
α_4	0.195	0.003	$\mathbf{q_b}$	0.916	0.000
β_4	0.758	0.000			
α_5	2.239	0.053			
β_5	0.101	0.282			

Panel B is the second step of the expected DCC model, which reports the pairwise correlation between the variables of the study. The parameter of the pairwise correlation is denoted as ρ_{21} for conditional correlation between ρ_{21}TASI and SPP, ρ_{31} TASI and GOP, ρ_{41} TASI and SGP, ρ_{51} TASI and SIR, ρ_{32} GOP and SPP, ρ_{42} SGP and SPP, ρ_{52} SPP and SIR, ρ_{43} SGP and GOP, ρ_{53} SIR and GOP and finally ρ_{54} SIR and SGP. The result indicates a positive, significant and robust correlation between ρ_{21} TASI and SPP and ρ_{41} TASI and SGP and a relatively weak conditional correlation between ρ_{31} TASI and GOP. The result satisfied the outcomes of Hamilton (1983), Nandha and Faff (2008) and Narayan and Sharma (2011) which indicated changes in commodity energy price, especially in oil related commodities, have an impact on the stock markets. The parameter q_a and q_a are the ARCH and GARCH parameters of the step 2 of the estimated DCC model which determine the volatility interdependence between the variables of the study. The ARCH parameter is unfortunately insignificant while the GARCH parameter is statistically important and show a high degree of volatility persistence, which provides evidence of volatility interdependence between commodity energy rate and the Saudi stock market. The result supports the finding of Mensi et al. (2013), Ewing, and Malik (2016) about volatility independence between commodity energy price and stock markets.

Following Figure 1 describe the time varying correlation between commodity energy rate and the stock market in Saudi Arabia. It shows the correlation among the variables is not static but varies across time. The correlation between TASI and SPP is at lowest during 2014 because of the decrease of the global oil rate. The correlation between TASI and GOP is at its lowest between 2014-2015 because of global oil price drop. The correlation between TASI and SGP is at the lowest during the year 2011. Correlation between TASI and SIR exhibit it highest in 2012 while that of SPP and GOP are lowest at the year 2014 due to falling in global oil price. The correlation between SGP and SPP is stable in 2008 during the worldwide financial disaster and weak during 2014-2015 because of the drop in oil price. The correlation between SPP and SIR fluctuate over time with no extreme strong or low at a particular time while that of GOP and SGP is high at 2008 during the global financial crisis and low during fall of oil rate. The correlation between GOP and SIR and that of SOP and SIR are similar to two extreme situations during 2008 and 2015. The graph shows evidence of significant change in correlation during extreme regimes such as 2008 because of the worldwide global financial disaster and 2015 because of shock in the global oil rate. This result is in accordance to Awartani and Maghyereh (2013) and Filis et al. (2011) who argued that the time-varying relationship among commodity energy price and the stock market respond differently to various types of shocks. However, the study does not support the finding of Miller and Ratti (2009), which provided confirmation that the time-varying correlation changes from positive to negative across time and events.

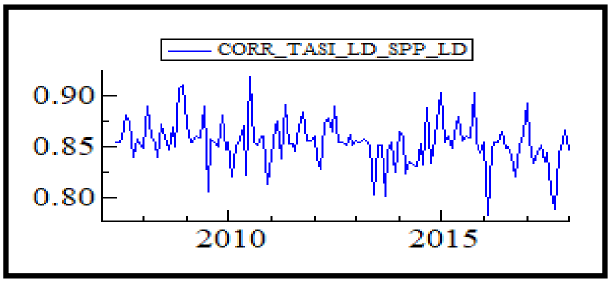

Fig 1. Time varying correlation between Saudi Stock market index TASI

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Saudi Petrochemicals price index SPP.

From the figure, it is clear that correlation relationship changes with time among the two variables . The strongest correlation between the variables is during the regime before the latest oil rate shock of 2014, during the time, there's a very strong relationship between the variables. During the time, the correlation between the variables was positive and 90% . Furthermore, the picture shows that the lowest correlation between the variables is during the regime of oil rate shock, specifically in mid-2014. The correlation between the variables in that period was 82%.

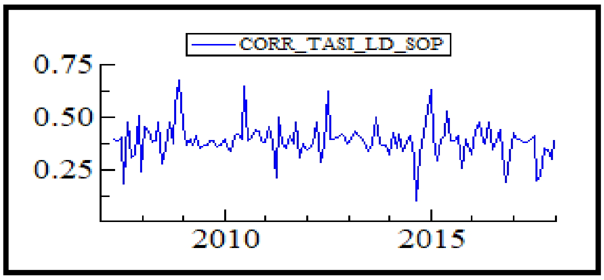

Fig 2. Time varying correlation between the Saudi stock market index TASI and the Saudi oil price SOP

Fig. 2 illustrates the correlation among the stock market index TASI and Saudi oil price(SOP).It indicates the strongest correlation between the variables to be above 60% during the pre-oil price shock regime. In the same vein, the least correlation between the variables in the period of the study is in mid 2014, which coincident the period when there is a severe decrease in the global oil price. Like the relationship between TASI and SPP, the relationship between TASI and GOP also signifies a strong relationship among the variables in the pre-oil price shock regime and a low correlation during the oil price shock regime.

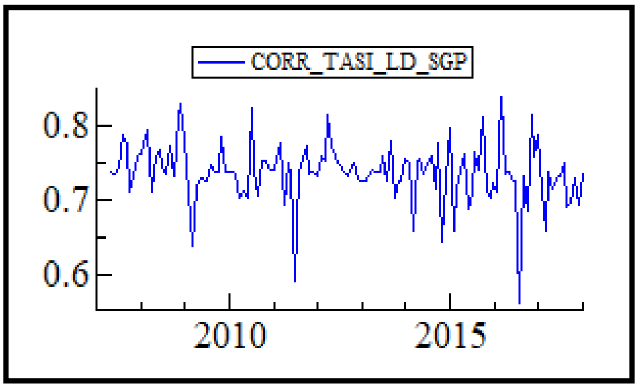

Fig.3. Correlation between the Saudi stock index TASI and the Saudi gas prices SGP

Figure 3 presents the correlation relationship among stock market index TASI and Saudi Gas Price (SGP) overtime, from the figure show the strongest between the variables to be 80% in the pre-global oil rate shock while the lowest is 24% around 2015.

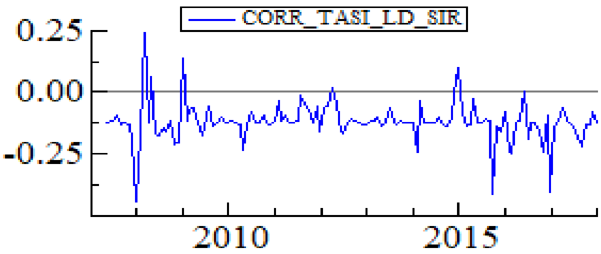

Fig 4. Correlation relationship between the Saudi stock market index TASI and short interest rate SIR.

Figure 4 shows the correlation relationship between the stock market index TASI and low interest rate SIR. The graph shows a negative correlation between the variables as expected by the theory. The figure further shows two extreme negative correlation between the variables in both the pre oil price shock regime and the oil price shock regime. Both the economist and the investors have great interest to find the relationship between these two variables.

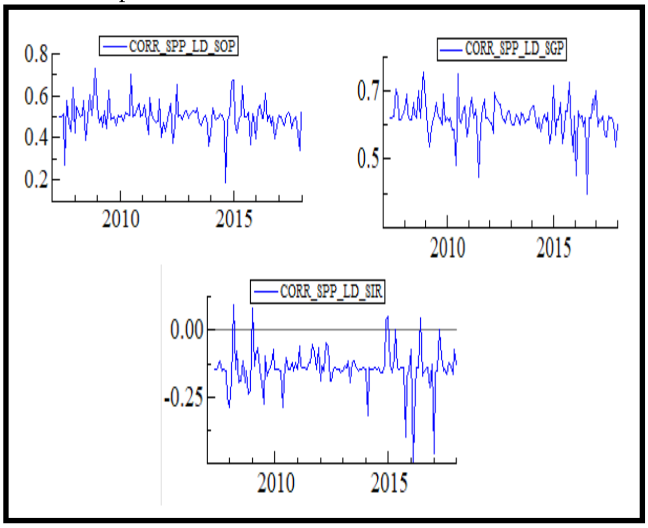

Fig 5. Correlation relationship between the Saudi petrochemicals prices SPP and SOP, SGP, SIR

Figure 5 shows evident of a positive link among the petrochemicals rates and oil. Additionally, It shows a positive relationship among petrochemicals rates and gas prices but the correlation between these variable weak and it is under 5% percent. Conversely, the correlation among petrochemicals prices and interest rate is negative as it is shown in the figure.

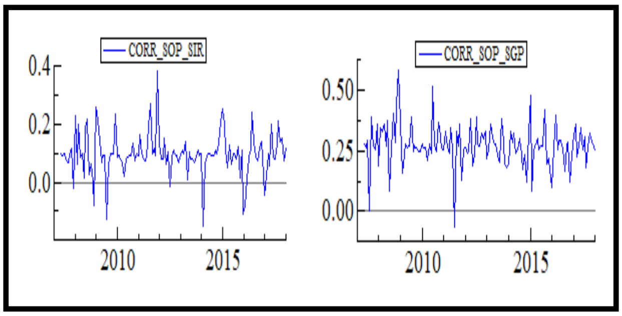

Fig 6. Correlation relationship between the Saudi oil prices SOP and SGP, SIR

The figure 7 displays a negative correlation between oil rate, gas rate and interest rate.

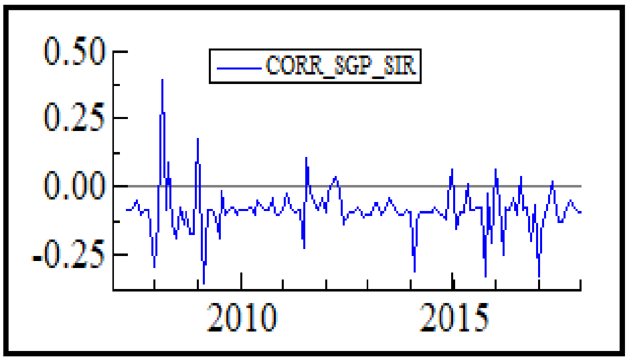

Fig 7. Correlation relationship between the Saudi gas prices SGP and SIR

Figure 7 displays the dynamic correlation among gas prices and interest rate. From the figure there is evident of negative correlation between the two variables.

The reliability of any inferences made from any econometric model estimated depends upon passing its diagnostic checks. We employed Hosking's Multivariate Portmanteau Statistics on standardized residuals and found out no serial correlation in the model. The same result is found with Li and McLeod's Multivariate Portmanteau Statistics. This indicated the reliability of the estimated model.

Table 5. Vector Normality Test

Vector Normality test:	Chi^2(10) =
51.937 [0.0000]**	

Table 6. Hosking's multivariate portmanteau Test

Lag Standardized	**Standardized Residuals**	**Squared Residuals**
Hosking (5)	**121.443**	**120.679**
Hosking (10)	**233.586**	**267.201**
Hosking (20)	**473.188**	**484.586**
Hosking (50)	**1198.42**	**1087.17**

**indicates significant at 5%

Table 7. Li-McLeod multivariate portmanteau Test

Lag Standardized	**Standardized Residuals**	**Squared Residuals**
Li-McLeod (5)	**121.769**	**120.689**
Li-McLeod (10)	**234.658**	**265.503**
Li-McLeod (20)	**476.220**	**487.869**
Li-McLeod (50)	**1207.02**	**1132.47**

**indicates significant at 5%

VI. CONCLUSION

The paper provides the dynamic correlation dynamic and volatility relationship among commodity energy rate and the Saudi stock market index. As the leading oil producer, Saudi Arabia has observed a significant shock in the global oil rate that affects its macroeconomic variables, which includes the stock market. From the empirical analysis, we find evidence that the correlation between the variables of the study varies across time with significant change during the two regimes (global financial crisis and global oil price shock). The finding from the estimated DCC model shows evidence of a positive, strong and important conditional correlation among energy rate and the stock market. It indicates that the rise in commodity energy rate increase the stock market activities and vice versa. Furthermore The result shows evidence of volatility interdependence between the commodity energy rate and the stock market in Saudi Arabia. The paper concluded that at the global and domestic level, commodity energy price affects the financial and macroeconomic variables of Saudi Arabia, especially the stock market. Therefore, we recommend that any economic policy or regulation shall include hedging the commodity energy price due to their volatile nature to reduce their influence on the economy and the stock market at large.

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