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Relationship between Oil Price Fluctuation and Macroeconomic Performance in Saudi Arabia

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Abstract: This paper aimed at investigating the relationship between oil price and some macroeconomic indicators of Saudi Arabia. The co-integration test and VECM were applied to achieve the paper objective. The time series data from (1970-2016) were used. The data was tested for stationarity, and then the co-integration test and VECM were estimated. The results reveal that there is a long run relationship between oil prices and real GDP with weak short run interactions. The result showed that rising of oil prices are negatively correlated with real GDP in the long run. Rising of oil prices may lead to a lower demand for oil in the long run, which will negatively affect government revenue and real GDP growth. The short run results suggest a positive relation between oil prices and real GDP. Rising demand in the short run will increase returns from oil export for the exporting countries. The oil price shocks have significant impact on real GDP in Saudi Arabia. This means the economy of Saudi Arabia will become highly volatile if depends on oil revenue as a major source of income. Diversifying sources of income is highly required in this case.

Keywords: Real GDP, Agricultural GDP, World Oil Prices, Co-integration; Vector Error Correction Model.

INTRODUCTION

Saudi Arabia has the largest economy in the Arab world and the second-largest economy in the region, after Turkey. The economy of Saudi Arabia is largely depends on petroleum resources.

Since 1970s, the country has been the largest oil exporter and possesses the largest proven world conventional crude oil reserves (estimated to be about 20%). The economic growth of Saudi Arabia is extremely depends on oil sector which makes the country vulnerable to oil price fluctuations. Decline in oil prices is considered among the biggest challenges facing the Saudi economy.

There is an oil price boom during 2003-2013 followed by a sharp decrease over the last several years. The sharp increases in oil prices, which rose from about $30 per barrel in 2003 to a sustained peak of about $110 per barrel in 2011 to 2013 before dropping back in 2014 (Figure-1), promoted strong GDP growth during the decade. However the decrease in oil prices in recent years led to a harsh financial strain on Saudi national budgets. This has motivated the government to adopt a number of measures aimed at safeguarding the country's long-term growth capabilities and financial sustainability reflected in Saudi Arabia's Vision 2030.

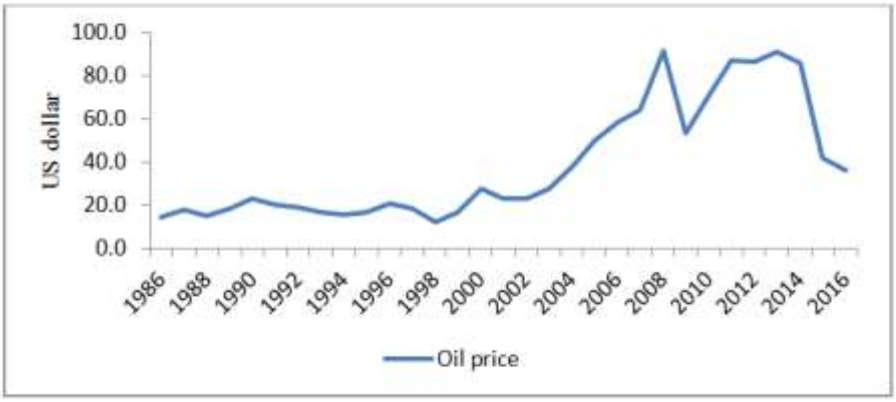

Fig-1: Development of oil prices (1986-2016)
Source: US Energy Information Administration (EIA)

The average of Gross Domestic Product (GDP) was 1600 billion Saudi Riyals (SR) from 1986 until 2016, and rose from 910 billion SR in 1986 to 2589 billion SR in 2016 derived by booming of oil sector (Figure-2).

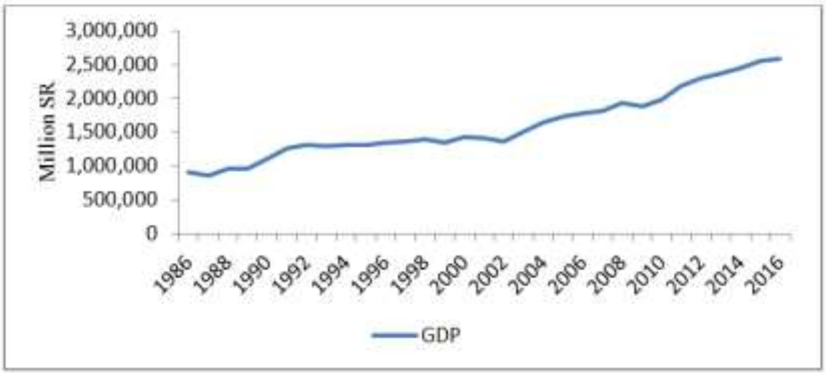

Fig-2: GDP at constant price, 1986-2016
Source: General Authority for Statistics-Saudi Arabia

Crude petroleum and natural gas along with manufacturing sector which is mostly petroleum refining contribute more than 50% of the GDP during 2011-2016 (Table-1). Agricultural sector has small contribution to the GDP around 2.4% on average. The government services contributed on average about 14% of the GDP, and wholesale and retail trade about 8.8%.

Table-1: Contribution of economic sectors to Saudi GDP at constant price (percent), 2011-2016

	2011	2012	2013	2014	2015	2016
Crude petroleum and natural gas	42.6	42.6	40.8	39.8	40.0	40.4
Agriculture	2.5	2.4	2.4	2.4	2.3	2.3
Manufacturing	10.9	10.7	10.8	11.4	11.7	11.9
Wholesale and retail trade	8.6	8.6	9.0	9.2	9.1	8.8
Government services	13.9	13.9	14.2	14.1	13.9	13.6
Others	21.5	21.8	22.8	23.1	23.0	23.0

Source: General Authority for Statistics-Saudi Arabia

This paper aimed at investigating the long run and short run relationship between oil price and some macroeconomic indicators of Saudi Arabia, namely real GDP, agricultural GDP, government services and domestic trade, using the co-integration test of Johansen *et al.*, [1] and VECM causality test of Granger [2]. These tests are useful in assessing the influence of oil price fluctuation on Saudi economy.

METHODOLOGY

The study employed the co-integration vector-error-correction model (VECM) to examine the impact of oil price fluctuation on some macroeconomic indicators of Saudi Arabia. Co-integration technique is superior to other techniques because this technique is able to establish the short-run and long-run relationship amongst variables, and estimate the resulting co-integration and error correction models. In econometric literature, the concept of co-integration was introduced by Granger [3] and Eagle and Granger [2]. Granger [4] pointed out that testing for co-integration of the regression residual is an imperative condition to avoid the possibility of producing spurious regression results.

The VECM representation of dynamic system is obtained as a simple rearrangement of the Vector Autoregressive Model (VAR) advocated by Sims [5], when the variables in VAR are co-integrated [6].

The early use of error correction models goes back to Sargan [7], and Davidson, Hendry, Srba and Yeo [8]. In VECM, an equilibrium relationship exists when variables in the model are co-integrated. Two conditions must be satisfied for the variables to be co-integrated. First, the data series for each variable involved should exhibit similar statistical properties, that is, be integrated to the same order; and second, a stationary linear combination must exist [9]. For a time series to be stationary, it means, the variance and covariance at various lags stay the same over time.

Several studies have suggested a number of co-integration methodologies including Hendry [10]; Engle and Granger [2]; Johansen [11]; Johansen and Juselius [12]; and Goodwin and Schroeder [13]. In this paper, Johansen [1] maximum likelihood procedure is used. VECM permits the testing of co-integration as a system of equations in one step and does not require the prior assumption of endogeneity of the variables.

Model specification

If time series is nonstationary of the same order and co-integrated we can run VECM to examine both short run and long run dynamics of the series [16]. The conventional model for co-integrated series takes the following form:

$$\Delta Y_t = B_0 + \sum_{i=1}^{n} B_i \Delta Y_{t-i} + \sum_{i=1}^{n} \partial_i X_{t-i} + \theta Z_{t-1} + \mu_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where ΔY_t is dependent variables, ΔY_{t-i} is the lag order of dependent variables, X_{t-i} is the lag order of independent variables, i is number of lag and B_0, B_i and $\partial_i$are the model coefficients. μ_t is the model error term. Z is the error correction term (ECT) and is the OLS residuals from the following long run co-integrating regression:

$$Y_t = B_0 + B_1 x_t + \epsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

and is define as

$$Z_{t-1} = ECT_{t-1} = Y_{t-1} - B_0 - B_1 x_{t-1} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

The term error-correction relates to the fact that last period deviation from the long run equilibrium (the error) influences short run dynamics of the dependent variable. Thus the coefficient of ECT (θ) is the speed of adjustment, because it measures the speed at which Y returns to equilibrium after a change in X.

In this paper, the real Gross domestic Product (RGDP), Agricultural Gross domestic Product (GDPA), government services (GS), domestic trade (DT) and oil price (OP) are used in the model formulation as endogenous variables. The main objective is to estimate the impact of oil price fluctuation on growth of the RGDP, GDPA, GS and DT. These four macroeconomic indicators are expected to be affected directly, like RGDP, or indirectly, like GDPA, GS and DT, by changes or fluctuation of oil prices.

To estimate the VECM the following steps are followed: First, a test of stationarity for the variables included in the model is conducted using the Augmented Dickey Fuller test (ADF) in levels and first difference forms. If the variables were found to be non-stationary at level that means the output of regression is spurious. Engle –Granger [2] pointed out that if the regression residuals of an equation are stationary these indicate the existence of long run relationship amongst the variables. Thereafter, a first difference of the variables has been taken in order to obtain stationary variables. If all variables are stationary at the same order i.e. I(1) we can go to the next step. Secondly, a co-integration test for selected variables is conducted using Johansen co-integration procedure. If the variables are co-integrated, we can go to the third step where the VECM is specified and estimated.

Data Sources

Time series data from 1971 - 2016 for the model variables are utilized in the analysis. Data are collected mainly from the General Authority for Statistics, Saudi Arabia. The annual oil prices data is obtained from Energy Information Administration (EIA), USA.

Stationary Test

To check the stationarity of the data, the ADF unit root test is applied. Table-2 shows the results of the ADF unit root test for the model variables both at level and first difference form. For all variables in levels, the null hypothesis that each series has a unit root cannot be rejected as the ADF statistics are below the critical value at 5% level of significance. However, all variables become stationary and have no unit root after taking first differences; therefore, we can go to the next step and conduct co-integration test.

Table-2: Results of the unit root tests

Variables	Augmented Dicky-Fuller Test			
	Variables in Level	P value	Variables in 1st Difference	P value
GDP	0.5	0.98	-5.2	0.0
GDPa	-0.43	-0.89	-4.88	0.0
GS	0.29	0.97	-3.47	0.01
DT	0.52	0.98	-6.5	0.0
OP	-1.64	0.45	-6.8	0.0

Selection of Lag Order

In this paper, a VAR lag order selection process is undertaken. The results of various selection criteria are listed in Table-3. SC selects one lag, HQ selects 2 lags, AIC and LR selects 4 lags. In this paper we adopt HQ criteria and use two lag periods**.**

Table-3: Lag order selection criteria

Lag	SC	HQ	AIC	LR
0	131.1	130.9	130.8	479.8
1	120.2	119.2	118.5	62.6
2	121.2	119.2	118.0	50.5
3	122.3	119.23	117.5	48.6
4	122.5	118.5	116.2	52.9

*AIC: Akaike information criterion, SC: Schwarz information criterion and HQ: Hannan-Quinn information criterion.

The Co-integration Test

After checking the hypothesis of non-stationarity, the time series were examined for their co-integration. Co-integration analyzes the relationship between integrated series and explores a linear combination of integrated time series that is itself stationary. For co-integration, Johansen [1] maximum likelihood procedure was used. The procedure utilizes two statistical tests for deciding the number of co-integrating vectors, Trace test and Maximum Eigenvalue test. In Trace test**,** the null hypothesis (Ho) the number of co-integrating vectors is less than or equal to r, and alternative hypothesis (H1) the number of co-integrating vectors is more than r. In Maximum Eigenvalue test, the null hypothesis (Ho) number of co-integrating vectors is r, and the alternative hypothesis (H1) the number of co-integrating vectors is r+1.

The results of the co-integration test are presented in Table 4 along with the critical values of the trace and max-eigenvalue statistics with lag length of 2 (i=2). The first row in the upper Table tests the hypothesis of no co-integration, the second row tests the hypothesis of one co-integration relation, the third row tests the hypotheses of two co-integrating relations, and so on, all against alternative hypotheses that there are more than r co-integrating vectors (r = 0,1,…,4) .

As shown in Table-4, trace test indicate three co-integrating equations at 5% level of significance, while max-eigenvalue test indicates no co-integration at 5% level of significance. Therefore, taking trace test into accounts, we can say there are non-spurious long run relationships between the model variables and hence the VECM is a valid representation of the relationships between the dependent variable and the independent variables.

Empirical Results of VECM

The VECM provides the long term relationship and short term dynamics of the endogenous variables. The model shows the achievement of long run equilibrium and the rate of change in the short run to achieve equilibrium. Depending on the results of Johansen co-integration analysis (Table-4), we assumed three co-integrating equations in the VECM. To capture both the short run dynamics between time series and their long run equilibrium relationship, the VECM with 2 lags is estimated and the results are presented in Table-5.

To accept co-integration equation, its coefficient should have a negative sign and statistically significant [17]. As indicated from the results in Table-4, this condition is only satisfied for two variables RGDP and GDPA. Therefore, the models for these two variables were tested for goodness of fit and discussed separately in the next sections.

Table-4: Johansen co-integration test

Trace Test				
Number of co-integration	Eigenvalue	Trace statistics	Critical Value (5%)	Prob.
None *	0.49	81.8	69.8	0.004
At most 1	0.39	52.3	47.8	0.017
At most 2	0.31	31.1	29.7	0.035
At most 3	0.27	14.7	15.4	0.065
At most 4	0.02	1.1	3.8	0.295
Maximum Eigenvalue				
Number of co-integration	Eigenvalue	Max-Eigen statistics	Critical Value (5%)	Prob.
None *	0.49	29.5	33.8	0.152
At most 1	0.39	21.3	27.5	0.259
At most 2	0.31	16.3	21.1	0.204
At most 3	0.27	13.6	14.3	0.062
At most 4	0.02	1.1	3.8	0.291

Source: Calculated in EViews 6

*denotes rejection of hypothesis at 5% level of significance

Table-5: Results of VECM

Cointegrating Eq:	CointEq1	CointEq2	CointEq3		
$RGDP_{-1}$	1	0	0		
DT_{-1}	0	1	0		
$GDPA_{-1}$	0	0	1		
GS_{-1}	-2.182 [-3.63]	1.788 [1.27]	-0.353 [-13.37]		
OP_{-1}	-3183.39 [-6.55]	-8466.2 [-7.47]	130.10 [6.088]		
C	-570031	217804.3	15094.68		
Error Correction:	D(RGDP)	D(DT)	D(GDPA)	D(GS)	D(OP)
CointEq1	-0.43 [-2.84]	-0.26 [-0.58]	-0.01 [-3.34]	-0.01 [-1.00]	0.00 [0.47]
CointEq2	0.21 [2.80]	-0.15 [-0.67]	0.00 [-0.96]	0.00 [-0.11]	0.00 [0.31]
CointEq3	-5.78 [-1.42]	-14.11 [-1.18]	-0.01 [-0.30]	0.51 [2.78]	0.00 [0.27]
$D(RGDP_{-1})$	0.24 [1.19]	0.51 [0.87]	0.01 [2.70]	0.02 [2.11]	0.00 [-0.32]
$D(RGDP_{-2})$	0.33 [1.63]	0.87 [1.48]	0.00 [-0.54]	0.00 [-0.54]	0.00 [-0.13]
$D(DT_{-1})$	-0.17 [-2.08]	0.03 [0.14]	0.00 [0.77]	0.00 [-0.22]	0.00 [0.19]
$D(DT_{-2})$	-0.10 [-1.28]	0.00 [-0.01]	0.00 [-0.021]	0.00 [-0.59]	0.00 [0.22]
$D(GDPa_{-1})$	-27.62 [-1.69]	18.61 [0.39]	0.08 [0.40]	-1.21 [-1.66]	0.00 [0.13]
$D(GDPa_{-2})$	-3.06 [-0.22]	-38.39 [-0.96]	-0.38 [-2.33]	-1.17 [-1.92]	0.00 [-0.22]
$D(GS_{-1})$	1.14 [0.27]	-7.63 [-0.63]	-0.06 [-1.21]	0.46 [2.49]	0.00 [-0.25]
$D(GS_{-2})$	-1.93 [-0.51]	8.62 [0.78]	0.08 [1.68]	0.19 [1.11]	0.00 [-0.43]
$D(OP_{-1})$	1445.77 [2.00]	607.33 [0.28]	-25.75 [-2.99]	-58.69 [-1.82]	0.00 [-0.00]
$D(OP_{-2})$	-242.35 [-0.36]	278.99 [0.14]	-3.22 [-0.40]	-45.52 [-1.53]	-0.02 [-0.06]
C	70186.78 [2.30]	11448.25 [0.12]	1348.17 [3.71]	5387.02 [3.96]	16.29 [0.89]
R-squared	0.45	0.16	0.62	0.66	0.08

* Values between brackets are t- values

Real GDP Model

Results of VECM in Table-5 provide strong evidence of existence of long run and short run relationship between RGDP and oil prices. System equation for RGDP model is estimated to test its significance and goodness of fit. To test the significance of the coefficients, Wald test has been conducted and the results are presented in Table-6. The Wald test result showed that CointEq1 is significant and has a negative sign, while other co-integration coefficients do not satisfy this condition. Therefore, CointEq1 can only be used as an indication of the presence of long run equilibrium relationship between the model variables. On the other hand, the other coefficients are not significant except for $D(DT_{-1})$ and $D(OP_{-1})$ this indicate a weak short run equilibrium relationship between the model variables.

Table-6: Results of RGDP model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CointEq1	-0.432	0.152	-2.846	0.008
CointEq2	0.213	0.076	2.806	0.009
CointEq3	-5.780	4.054	-1.426	0.165
$D(RGDP_{-1})$	0.238	0.199	1.195	0.242
$D(RGDP_{-2})$	0.326	0.199	1.636	0.113
$D(DT_{-1})$	-0.173	0.083	-2.088	0.046
$D(DT_{-2})$	-0.102	0.079	-1.290	0.207
$D(GDPa_{-1})$	-27.615	16.267	-1.698	0.100
$D(GDPa_{-2})$	-3.062	13.531	-0.226	0.823
$D(GS_{-1})$	1.142	4.083	0.280	0.782
$D(GS_{-2})$	-1.928	3.749	-0.514	0.611
$D(OP_{-1})$	1445.773	721.172	2.005	0.054
$D(OP_{-2})$	-242.350	663.988	-0.365	0.718
C	70186.780	30429.860	2.307	0.028

For statistical accuracy of estimated RGDP model, a number of diagnostic tests are performed on the residuals. As indicated by the results in Table-7, the residuals of the estimated RGDP model have no trace of autocorrelation or heteroskedasticity (ARCH effect) and are normally distributed. Therefore, we can consider the residual of VAR components of VECM model as a white noise (stationary and unrelated). Also, the model is tested for dynamic stability using CUSUM test, the result shows that the model coefficients are stable over time (Figure-3).

Table-7: Residual diagnostic tests of the estimated RGDP model

Autocorrelation Test LM(5)	0.15
p-value	0.85
Normality Test	
Jarque-Bera $\chi 2$ (2)	2.91
p-value	0.23
ARCH Test	
F value	0.01
p-value	0.94

Source: Calculated in EViews 6

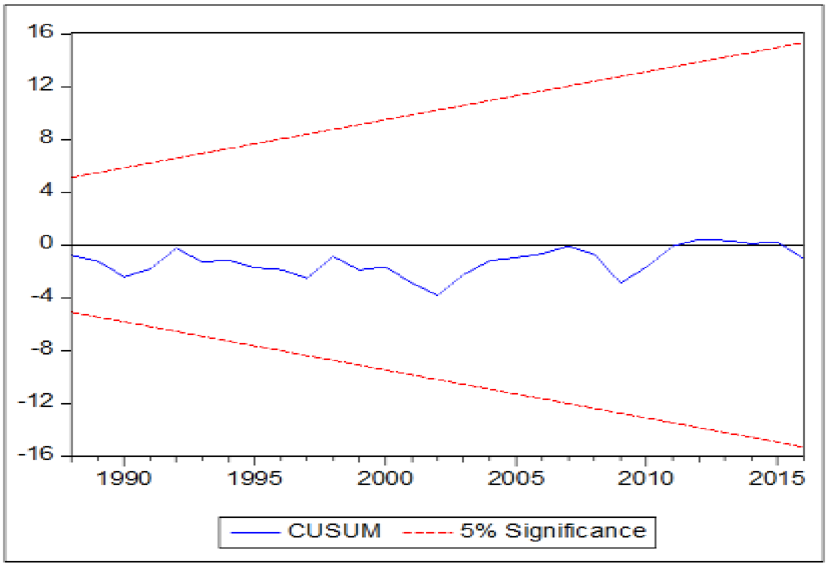

Fig-3: Dynamic stability of RGDP model, CUSUM test

Long Run and Short Run Effect of Oil Price Fluctuation on RGDP

Having confirmed the existence of three co-integrating relationship, the results in Table 5 showed that the co-integration equation one is the only equation that satisfy the condition of negative sign and significance. Therefore, the co-integration equation relating RGDP and oil prices in the long run is estimated as follows:

$$ECT_{-1} = 1.00RGDP_{-1} - 3183.3OP_{-1} - 2.18GS_{-1} - 570030.9 \qquad \ldots\ldots\ldots\ldots\ldots\ldots(4)$$
(-6.55) (-3.63)

A positive relationship between oil price and RGD growth in Saudi Arabia is assumed, but equation (4) suggests that rising oil prices are negatively correlated with RGDP in the long run. This may be justified by the fact that rising oil prices may lead to a lower demand for oil in the long run, which in turn negatively affect government revenue and RGDP growth. The same result is documented in study conducted by Ftiti *et al.*, [14]. They justified the negative impact of oil prices on RGDP in the long run by fact that the oil price increase reduces aggregate supply because higher energy prices mean that firms purchase less energy. Consequently, the productivity of any given amount of capital and labor declines, and potential output falls. The decline in factor productivity implies that real wages will be lower. If some labor supply is withdrawn voluntarily as a result, potential output will be lower than it would otherwise be, thus compounding the direct impact of lower productivity.

In contrast to the long run, the short run model results suggest a positive relation between oil price and RGDP as shown by equation (5). This could be explained by that higher oil prices in short run is a result of rising demand and this will increase returns from oil export for the exporting countries which in turn will positively affect the RGDP.

$$D(RGDP) = -0.43ECT_{-1} - 0.173D(DT_{-1}) + 1445.7D(OP_{-1}) + 70186.8 \qquad \ldots\ldots\ldots\ldots(5)$$
(-2.86) (-2.10) (2.00)

The coefficient of the $ECTt_{-1}$ is a short-term adjustment coefficient and represents the proportion by which the long-run disequilibrium (or imbalance) in the dependent variable is being corrected in each short period. The estimated coefficient (ECTt-1) is negative and significant at 5% level. This suggests the validity of a long run equilibrium relationship among the variables. In other words, if there is a change in oil prices, the RGDP system is corrected its previous period's disequilibrium for the long term by 43% of speed adjustment.

Impulse Response of RGDP to A Shock in Oil Prices

After VECM has been estimated, the short run dynamics can be examined by impulse response function (IRF). The IRF shows the response of each variable in the system to a shock in any of other variables [15]. Impulse response functions, or IRFs, measure the effects of a shock to an endogenous variable on itself or on another endogenous variable.

Cholesky decomposition method is applied in this study to estimate the response of a RGDP to a shock of one standard deviation in oil price over time. Figure-4 shows the effects of oil price shock on RGDP. The findings depict a substantial and persistent decreasing of RGDP due to oil price shocked. The RGDP keep decreasing for six years, after that it starts to rebuild again. The oil price shocks during fluctuations in the global business cycle (downturn or expansion) or financial turmoil exhibit a significant impact on real economic activity in Saudi Arabia. This means the economy of Saudi Arabia will become highly volatile if it depends on oil revenue as a major source of income. Diversifying sources of income is inevitable in this case.

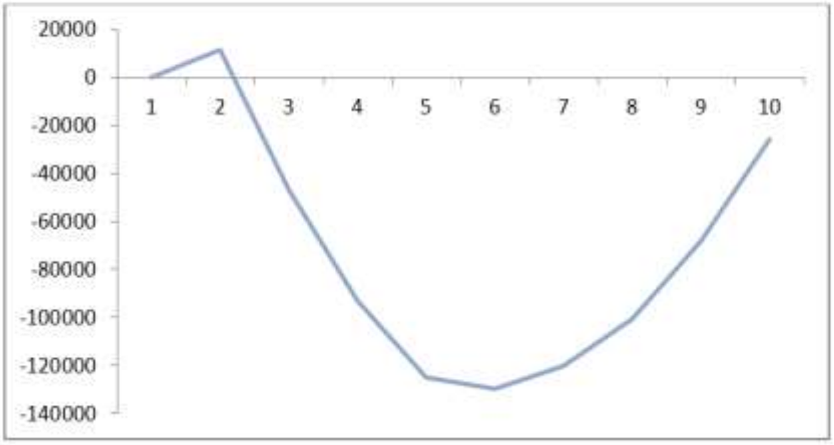

Fig-4: Impulse response of RGDP to oil price shock

Agricultural GDP Model

From the results of VECM in Table-5, an evidence of existence of long run and short run relationship between GDPA and oil prices is confirmed. System equation for GDPA model is estimated to test its significance and goodness of fit. To test the significance of the coefficients, Wald test has been conducted and the results are presented in Table-8. The Wald test result showed that CointEq1is significant and has a negative sign, while other co-integration coefficients and do not satisfy this condition. Therefore, CointEq1 can only be used as an indication of the presence of long run equilibrium relationship between the model variables. On the other hand, the other coefficients are not significant except for D($RGDP_{-2}$) and D(OP_{-1}) this implies a weak short run equilibrium relationship between the model variables.

Table-8: Results of GDPA model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CointEq1	-0.006	0.002	-3.343	0.002
CointEq2	-0.001	0.001	-0.968	0.341
CointEq3	-0.015	0.048	-0.305	0.763
D($RGDP_{-1}$)	0.006	0.002	2.705	0.011
D($RGDP_{-2}$)	-0.001	0.002	-0.549	0.587
D(DT_{-1})	0.001	0.001	0.778	0.443
D(DT_{-2})	0.000	0.001	-0.024	0.981
D($GDPa_{-1}$)	0.079	0.194	0.406	0.688
D($GDPa_{-2}$)	-0.376	0.162	-2.330	0.027
D(GS_{-1})	-0.059	0.049	-1.217	0.233
D(GS_{-2})	0.075	0.045	1.685	0.103
D(OP_{-1})	-25.748	8.609	-2.991	0.006
D(OP_{-2})	-3.224	7.927	-0.407	0.687
C	1348.168	363.265	3.711	0.001

For statistical accuracy of estimated GDPA model, a number of diagnostic tests are performed on the residuals. As indicated by the results in Table-9, the residuals of the estimated GDPA model have no trace of autocorrelation or heteroskedasticity (ARCH effect) and are normally distributed. Therefore, we can consider the residual of VAR components of VECM model as a white noise (stationary and unrelated). Also, the model is tested for dynamic stability using CUSUM test, the result shows that the model coefficients are stable over time (Figure-5).

Table-9: Residual diagnostic tests of the estimated GDPA model

Autocorrelation Test LM(5)	0.27
p-value	0.75
Normality Test	
Jarque-Bera $\chi 2$ (2)	5.40
p-value	0.07
ARCH Test	
F value	0.42
p-value	0.52

Source: Calculated in EViews 6

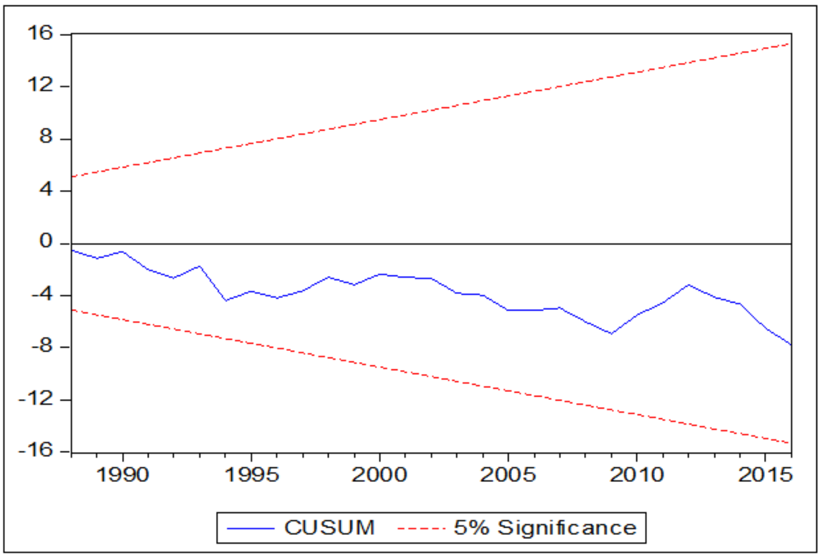

Fig-5: Dynamic stability of GDPA model, CUSUM test

Long Run and Short Run Effect of Oil Price Fluctuation on Agricultural GDP

The co-integration equation relating agricultural GDP and oil prices in the long run is estimated as follows:

$$ECT_{-1} = 1.00GDPA_{-1} + 130.1OP_{-1} - 0.35GS_{-1} + 15094.6 \qquad \ldots\ldots\ldots\ldots.(6)$$

(6.00) (-13. 3)

Equation (6) shows a significant positive relationship between GDPA and oil prices in the long run. This implies that rising oil prices lead to an increase in domestic agricultural production in the long run because higher oil prices mean more government spending and support for agricultural producers. Also, there a connection between oil prices and food prices as they are moving in same direction. When crude oil price rise the cost of food supply increase and hence food prices increase. High food prices provide incentive for increasing domestic food production.

In the short run, equation (7) shows a negative relationship between oil price and agricultural GDP with slow speed of adjustment of 0.6%. The negative relationship between oil prices and growth of agricultural GDP in the short run can be justified by the fact that increasing of government revenue from oil export in short run may increase dependence on outsources (imports) rather than domestic one. Also, higher cost of production due to rise of crude oil prices reduces domestic agricultural production in the short run.

$$D(RGDP) = -0.006ECT_{-1} - 0.38D(GDP_{-2}) - 25.7D(OP_{-1}) + 1348.6 \qquad \ldots\ldots\ldots. (7)$$

(-3.3) (-2.33) (-2.99)

Impulse Response of Agricultural GDP to A Shock in Oil Prices

Figure-6 shows the effects of oil price shock on agricultural GDP. The response of agricultural GDP to a shock in oil prices is positive and significant. This could be attributed to fact that the government will adopt economic diversification policy to overcome the effect of oil price fluctuation, and therefore, more spending on agriculture is expected which makes the sector boost.

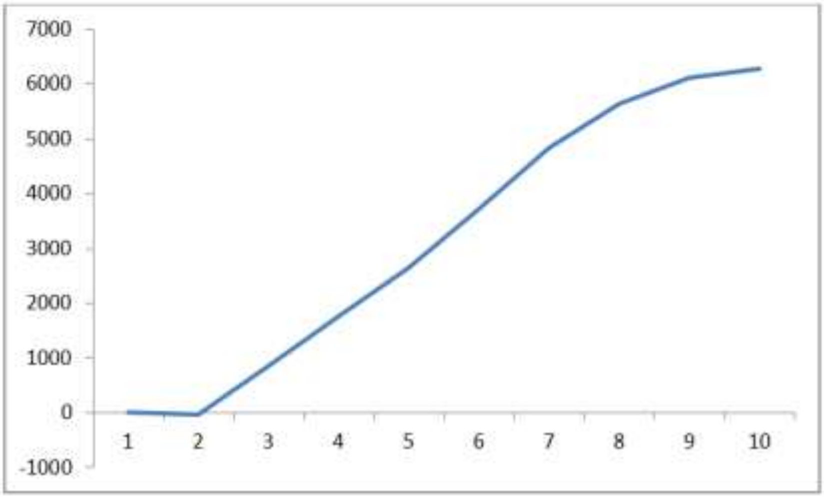

Fig-6: Impulse responses of agricultural GDP to oil price shock

CONCLUSION

This paper investigates the relationship between oil price fluctuation and some macroeconomic performance in Saudi Arabia. The results reveal that there is an evidence for a long-run relationship between the oil price, real GDP and Agricultural GDP, and weak short run interactions among them. The result showed that rising oil prices are negatively correlated with real GDP in the long run. This may be justified by the fact that rising oil prices may lead to a lower demand for oil in the long run, which in turn negatively affect government revenue and real GDP growth. The short run results suggest a positive relation between oil price and real GDP. This could be explained by fact that higher oil prices in short run is a result of rising demand which will increase returns from oil export for the exporting countries which in turn positively affect the real GDP growth. The oil price shocks during fluctuations in the global business cycle (downturn or expansion) or financial turmoil exhibit a significant impact on real GDP in Saudi Arabia. This means the economy of Saudi Arabia is volatile if depends on oil revenue as a major source of income. Diversifying sources of income is required. The results for agricultural GDP showed a significant positive relationship between agricultural GDP and oil prices in the long run. This implies that rising oil prices lead to an increase in domestic agricultural production in the long run because higher oil prices mean more government spending and support for agricultural producers. In the short run, the results showed a negative relationship between oil price and agricultural GDP with slow speed of adjustment of 0.6%. The negative relationship between oil prices and growth of agricultural GDP in the short run can be justified by the fact that increasing of government revenue from oil export in short run may decrease food supply from domestic sources and depends more on imports.

REFERENCES

1. Johansen, S. (1995). Likelihood-based inference in co-integrated vector autoregressive models. Book published by Oxford Univ. Press.
2. Engle, R. F., & Granger, C. W. (1987). Co-integration and error correction: representation, estimation, and testing. *Econometrica: journal of the Econometric Society*, 251-276.
3. Granger, C. W. (1981). Some properties of time series data and their use in econometric model specification. *Journal of econometrics*, *16*(1), 121-130.
4. Granger, C. J. (1986). Developments in the study of cointegrated economic variables. *Oxford Bulletin of economics and statistics*, *48*(3), 213-228.
5. Sims, C. A. (1980). Macroeconomics and reality. Econometrica, 48, 1-48.
6. Jacobs, J. P., & Wallis, K. F. (2010). Cointegration, long-run structural modelling and weak exogeneity: Two models of the UK economy. *Journal of Econometrics*, *158*(1), 108-116.
7. Sargan, J. D. (1964). Wages and prices in the United Kingdom: a study in econometric methodology. *Econometric analysis for national economic planning*, *16*, 25-54.
8. Davidson, J., Hendry, D., Srba, F., & Yeo, S. (1978). Econometric modelling of time series relationship between consumers' expenditure and income in United Kingdom. *The Economic Journal*, 88(352), 661-692.
9. Malik, N. (2010). Pakistan agricultural export performance in the light of trade liberalization and economic reforms. *World Journal of Agricultural Science*s, 6 (1): 29-38.
10. Hendry, D. F. (1986). Econometric modelling with cointegrated variables: an overview. *Oxford bulletin of economics and statistics*, *48*(3), 201-212.
11. Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of economic dynamics and control*, *12*(2-3), 231-254.

12. Johansen, S., & Juselius, K. (1990). Identification of the long-run and the short-run structure: An application to the ISLM model, *Journal of Econometrics*, 54: 159-178.
13. Goodwin, B. K., & Schroeder, T. C. (1991). Cointegration tests and spatial price linkages in regional cattle markets. *American Journal of Agricultural Economics*, *73*(2), 452-464.
14. Ftiti, Z., Guesmi, K., Teulon, F., & Chouachi, S. (2016). Relationship between crude oil prices and economic growth in selected OPEC countries. *Journal of Applied Business Research*, *32*(1), 11.
15. Ben-Kaabia, M., Gil Roig, J. M., & Chebbi, H. (2002). The effect of long-run identification on impulse-response functions: An application to the relationship between macroeconomics and agriculture in Tunisia.
16. Kazem, H. A., Yousif, J. H., & Chaichan, M. T. (2016). Modeling of daily solar energy system prediction using support vector machine for Oman. *International Journal of Applied Engineering Research*, *11*(20), 10166-10172.
17. Anwar, S., Shaukat, F., & Hussain, Z. (2010). Impact of trade liberalization on export of cotton from Pakistan: a time series analysis. *Sarhad Journal of agriculture*, *26*(2), 297-304.