The Impact of Oil Shocks on Qatar's GDP

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Abstract

This study examines the impact of oil shocks on Qatar's gross domestic product using time series data from the period 1970-2007 covering all the oil shocks. The Johansen-Juselius (JJ) cointegration test and VECM Granger causality test are employed in this study. From the results we concluded that oil price has a positive effect on Qatar's gross domestic product, but at the expense of higher inflation. Qatar seems to have suffered from financial surpluses and rapid economic growth caused by sharp increases in the oil price. At the same time, with a fixed exchange regime and tight monetary policy to deal with these events, this has caused the price of assets to increase sharply, leading to high levels of inflation in Qatar. Based on the results, we recommend that the Qatari currency (riyal) be pegged to a basket of currencies so as to increase the role of monetary policy to deal with the external shocks (oil shocks).

1. Introduction

Oil shocks are a major subject of interest for many writers over the years. Many studies have found that oil prices have significant impacts on the economic activities and growth in different countries. Oil is the cornerstone of Qatar's economy, representing more than 60% of Qatar's GDP, 85% of its exports earnings and 70% of government revenue. According to the International Monetary Fund (IMF), Qatar's GDP per capita and standard of living are the highest among the Islamic world from 2001 until 2008.

Qatar is a member of the Organization of Petroleum Oil Exporting Countries (OPEC) and one of the major oil producers in the world. It has 25,405 million barrels of crude oil reserves in 2007, representing the sixth highest in the Middle East. Besides oil, the Qatari government has also exerted many efforts to develop its natural gas industry, especially liquefied natural gas (LNG). In recent years Qatar has become the world's largest supplier of LNG.

Since petroleum plays an important role in Qatar's economy, Qatar's GDP has witnessed many fluctuations due to the changes in oil prices. Since the first oil shock in 1973-1974 to the last oil shock in 2003-2008, it seems that there is a positive relationship between the oil price and Qatar's GDP. As a result of the first oil shock in 1973-1974, Qatar's GDP rose from US$655 million in 1973 to US$2000 million in 1974 and it rose further from US$4052 million in 1978 to US$5634 million in 1979 during the second oil shock in 1978-1979.

The third oil shock took place when the Iraqi troop invaded Kuwait occupying all its territories in 1990. This event had a negative impact on the Gulf countries among which is Qatar whose GDP decreased from US$7360 million in 1990 to US$6884 million in 1991. When the fourth oil shock happened in 2003, Qatar's GDP rose again from US$19680 million in 2003 to US$23669 million in 2004. Oil prices continued to increase and the oil price per barrel reached US$100 in 2008. This led to further increases in Qatar's GDP to US$91763 million in 2008. Figure 1 below shows the relationship between oil price and Qatar's GDP from 1970-2008.

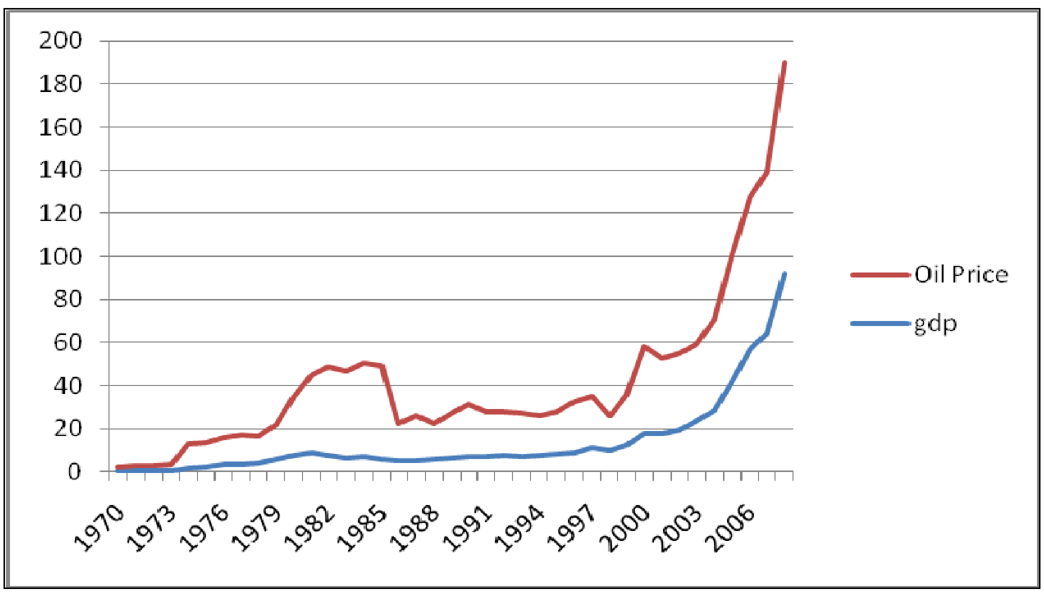

Figure 1: The Relationship between Oil Price and Qatar's GDP, 1970-2008

At the same time, the increase in oil prices is found to be the reason behind the increase in inflation. When the oil price increases, it will cause a sudden increase in liquidity. This increases the price level causing a higher level of inflation. Due to the pegged exchange rate to the US dollar, monetary policy seems to be less effective in dealing with sudden increases in liquidity. Figure 2 below shows a positive relationship between oil prices and inflation, i.e., any increase in oil prices is associated with higher inflation in Qatar's economy.

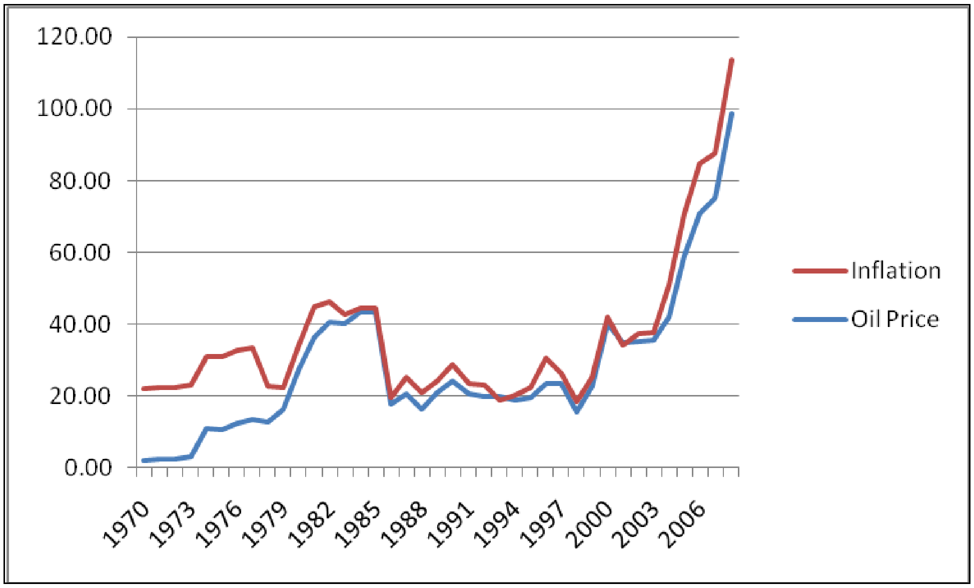

Figure 2: Oil Price and Inflation Rate, 1970-2008

2. Studies on the Impact of Oil Shocks on the Macroeconomy

Many studies have investigated the impact of oil shocks on the macroeconomy of different countries, but mostly focusing on the developed countries, while studies on the developing countries especially the oil exporting countries are very limited. In this section we will review the studies that investigated the impact of oil shocks in different countries dividing it into four sections. The first sub-section will review the studies on the impact of oil shocks on the US macroeconomy, while the second sub-section will survey the studies on the impact of oil shocks on the macroeconomy of the OECD countries. The third sub-section will review the studies that examine the impact of oil shocks on the macroeconomy of Asian countries, and finally the fourth sub-section will focus on the studies of the impact of oil shocks on the macroeconomy of the oil exporting countries.

2.1 Studies on Oil Shocks and the US Macroeconomy

Some studies like Hamilton (1983) and Singer (2007) found that oil shocks caused recessions in the US economy, while other writers like Gisser et. al (1986) and Anzuini (2007) found that oil shocks have inflationary effects on the US macroeconomy. Ferderer (1990) found that the disturbance of the oil market could affect the US macroeconomy through the increase in both the oil price and its volatility. Whereas Baumeister (2008) found that oil production has a huge impact on oil prices and much higher impact on both GDP and consumer prices in the US economy. Hooker (1996) found that the 1973-1974 oil shocks caused much fluctuation in the US macroeconomy, but after 1975 the US economy is shown to be more robust and the effect of oil shocks on its economy is small.

2.2 Studies on Oil Shocks and the OECD Countries

It seems that oil prices have a huge impact on the UK macroeconomy. Increases in oil prices cause lower output, higher domestic and foreign interest rates, and higher inflation in the UK (Garratt et al. 2003). Garratt et al. also found a long run relationship between the oil price and the UK macroeconomy. Similar results are obtained by Blanchard et. al (2007) who found that oil prices increase inflation and economic activities in the OECD countries. Similarly in Russia, Ito (2008) found that the increase in oil prices causes an increase in the Russian GDP, to the extent that a 1% increase in oil prices will bring about an increase in Russian GDP by 0.25%. However, oil shocks increased Russian inflation by 0.36%. In another study, Gounder et. al (2007) found a positive relationship between New Zealand's GDP growth and oil shocks whereas Schmidt et. al (2007) found that the impact of oil shocks on the German macro economy is insignificant. Huntington (2004) found that oil shocks helped the OECD countries to reach the full-employment level. Robalo et. al (2007) found that Portugal's macro economy is less affected by the price of oil in the mid-1980's.

2.3 Studies on Oil Shocks and the Asian Countries

Oil prices have a minor effect on Singapore's macroeconomy in the mid-1980's due to the declining trend of oil intensity in Singapore and the declining shares of Singapore's expenditure on oil consumption as a percentage of its nominal GDP (Chang, 2003). While Cunado et. al (2005) found that oil prices have a significant impact on the economic activities and inflation in Japan, Singapore, South Korea, Malaysia, Thailand and the Philippines, but only in the short run. Similar results have been found by Cristina (2005) who stated that oil prices significantly contributed to the variability of the real GDP and inflation in the Philippines. However, it was found that the increase in oil prices causes a reduction in India's industrial output and GDP (Kumar, 2005).

2.4 Studies on Oil Shocks and the Oil Exporting Countries

Oil shocks are also a major source of macroeconomic fluctuation in the oil exporting countries. Mehrara et. al (2006) found that oil prices are a major source of fluctuations in Iran's and Saudi Arabia's macroeconomy, but not in Kuwait and Indonesia. Kuwait is able to cushion the effect of oil shocks by using its stabilization and savings fund and the right structural reforms. While Indonesia's good fiscal policies have helped the country to avoid major mistakes and allowed structural reforms, leading the country to faster and expanding growth, away from resource-based production, including oil. Kuwait fiscal policy is more effective than its monetary policy in stimulating Kuwait's macroeconomy after oil shocks (Eltony, 2002). Reza (2007) found that oil shocks increase Iran's industrial output and government expenditure, causing high inflation in Iran. Omisakin (2008) found that oil prices have a sustainable impact on Nigeria's money supply, government consumption expenditure, and the consumer price index. Moreover, they have no negative impact on inflation.

3. Methodology

In this study, the vector autoregressive (VAR) model is used to study the impact of oil shocks on Qatar's GDP growth. The VAR model is useful for forecasting a system of interrelated time series and for analyzing the dynamic impact of random disturbances on the system of variables. The four variables that are used in the study are total trade value, oil price, and inflation rate as the independent variables and GDP as the dependent variable. The model is presented as follows:

$$\boldsymbol{Log\ GDP_t = \alpha + \beta_1 \log OP_t + \beta_2 \log TDV_t + \beta_3\ INF + \varepsilon_t} \qquad (1)$$

Where α is the intercept, $\beta_1, \beta_2, \beta_3,$ are the slope coefficients of the model, Log GDP is the log of gross domestic product (millions of US dollars), Log OP is the log of oil price (US dollars per barrel), Log TDV is the total trade value (millions of US dollars), INF is the inflation rate (annual percentage change), and ε is the error term.

Table 1: Definition of Variables

Variable	Definition	Expected Relationship
GDP	GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products, and the data is in current millions of U.S. dollars.	
OP	Oil price is defined as the nominal crude oil price adjusted for the inflation rate.	**Positive**
INF	Inflation rate is the annual percentage change of the consumer price index.	**Negative**
LTDV	Total trade value has been measured in millions of US dollar. This variable has been calculated by summing the total export value and total import value.	**Positive**

4. Data Sources

The variables gross domestic product (GDP), oil price (OP), and total trade value (TDV) are taken from the OPEC data statistics, while the inflation rate is taken from the International Monetary Fund (IMF).

5. Estimation Procedures

Since this study is based on time series data, we should use the unit root test to find out if the variables GDP, OP, TDV, and INF are stationary or not. The Augmented Dickey-Fuller test will be used to test for the stationary of the variables. If all the variables are found to be stationary of the same order, the cointegration test will be used to determine the long run relationship between the dependent and the independent variables. After having found cointegration, the vector error-correction model (VECM) will be used to investigate the temporal short-run causality between the variables. The VEC model allows us to capture both the short-run and long-run relationships.

5.1 Unit Root Test

To know whether a series is stationary or not, we can apply the unit root test. The Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) tests are considered as the most popular unit root tests despite their shortcomings. The ADF test takes into account that the error terms are correlated. In this study, the Augmented Dickey-Fuller test will be used to determine whether the series at the level is stationary or has a unit root if the error terms are correlated. Otherwise the DF test would suffice. If the series is stationary at the level, then it is integrated of order 0, that is $y_t \sim I(0)$. However, if the series at the level has a unit root, we will then take the first difference of the series and repeat the unit root test. If it is stationary at the first difference then the series is said to be integrated of order 1, that is $y_t \sim I(1)$.

The basic equation for the unit root test is specified as follows:

$$y_t = \alpha + \rho y_{t-1} + \varepsilon_t \quad (2)$$

Where y_t is the time series, t is the time index, α and ρ are the coefficients and ε_t is the error term. The Dickey-Fuller test is based on the following regression forms:

1. Without a Constant term and Trend: $\Delta y_t = \delta y_{t-1} + u_t$ (3)

2. With a Constant term: $\Delta y_t = \alpha + \delta\, y_{t-1} + u_t$ (4)

3. With a Constant term and Trend: $\Delta y_t = \alpha + \beta T + \delta\, y_{t-1} + u_t$ (5)

The null and alternative hypotheses for each of the three cases are as follows:

H_0: $\delta = 0$ (y_t is non-stationary)

H_1: $\delta < 0$ (y_t is stationary)

The decision rule of this test is:

If τ > DF critical value, we do not reject the null hypothesis, and that means a unit root exists, where τ is the *t*-statistic.

If τ < DF critical value, we will reject the null hypothesis, i.e., a unit root does not exist.

We need to run each regression equation separately in order to determine the correct specification.

In this study, the Augmented Dickey-Fuller test has to be used because the error terms are autocorrelated. There are three variations of the ADF test. These three cases are considered below:

1. Without constant and trend: $\Delta y_t = \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + \ldots + \delta_p \Delta y_{t-p} + \varepsilon_t$ (6)

2. with constant but no trend: $\Delta y_t = \alpha + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + \ldots + \delta_p \Delta y_{t-p} + \varepsilon_t$ (7)

3. With constant and trend: $\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \delta_1 \Delta y_{t-2} + \ldots + \delta_p \Delta y_{t-p} + \varepsilon_t$ (8)

Where α is a constant, β is the coefficient on a time trend, Δ is the difference operator, ε_t is the white noise error, and p is the lag order of the autoregressive process. The optimal lag length is determined using the Akaike Information Criterion (AIC).

The null and alternative hypotheses for each of the three cases are as follows:

H_0: $\gamma = 0$ (y_t is non-stationary)

H_1: $\gamma < 0$ (y_t is stationary)

The Augmented Dickey-Fuller (ADF) τ statistic used in the test is a negative number. The more negative it is, the stronger the rejection of the null hypothesis, which means that there is a unit root at some chosen level of significance. Since γ is generally expected to be negative, the estimated τ statistic will have a negative sign. Therefore a larger negative τ value is an indication of stationarity. If we can reject the null hypothesis, we will then conclude that the series y_t is integrated of order 0, that is $y_t \sim I(0)$, and is stationary. On the other hand, if we cannot reject the null hypothesis, we conclude that the series at levels is not stationary. If the series at levels is found to be non-stationary, the test procedure will be repeated on the first differenced series. If the first differenced series Δy_t is stationary, then the series y_t is integrated of order 1, that is $y_t \sim I(1)$.

5.2 Cointegration Test

If the time series variables in the regression model are individually non-stationary at levels, but they are integrated of the same order I(d), and there exists a linear combination of them, that is integrated of a lower order I(d−b) where $b > 0$, then these variables are said to be cointegrated of order (d−b). In other words, if the variables are all I(1) and a linear combination of them is I(0), then the variables are cointegrated, that is CI(1,1). Cointegration means that these variables have a long run, equilibrium relationship in the economic sense.

Johansen (1988) and Johanson-Juselius (1990) have developed an approach that can be used to find out if there is a long run relationship between the variables in a regression model. The Johansen-Juselius (JJ) cointegration test will be used in this study. The JJ procedure is based on the vector autoregressive (VAR) model and the lag length is determined by using the Akaike Information Criteria.

The VAR model of order p that allows for the cointegration process can be written as follows:

$$y_t = \mu + \sum_{k=1}^{p} \Pi_k y_{t-k} + \varepsilon_t \tag{9}$$

where y_t is a g-vector of I(1) variables, μ is a g-vector of constants, and ε_t is a g-vector of white noise residuals at time t with zero mean and constant variance. For this study, the regression model has g = 4 variables with 3 independent variables and 1 dependent variable. In estimating the VAR, we will limit the maximum lag length to only 2 lags due to the limited number of observations in this study (n = 37). Equation (9) above can be rewritten in the first difference form as follows:

$$\Delta y_t = \mu + \sum_{k=1}^{p-1} \Gamma_k \, \Delta y_{t-k} + \Pi \, y_{t-1} + \varepsilon_t \tag{10}$$

where $\Gamma_k = -(I - A_1 - \ldots - A_k)$, $(k = 1 \ldots, p - 1)$ *and* $\Pi = -(I - A_1 - A_2 - \ldots - A_k)$ is called the impact matrix that can give us information about the long run relationship between the variables. The rank (r) of Π is equal to the number of cointegrating vectors. If Π is of full-rank, that is r = g, then there are g cointegrating vectors. If $0 < r < g$, there exist r cointegrating vectors, which means that there are r stationary linear combinations of y_t. If the rank of Π is 1, there exists only 1 cointegrating vector. But if the rank of Π is zero, there is no cointegrating equation and the variables are not cointegrated.

The Johansen process is based on two kinds of likelihood ratio tests, the trace test and the maximum eigenvalue test. The test statistic for the trace test is given in the following equation:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{g} \ln(1-\lambda_i) \tag{11}$$

where λ_i is the largest eigenvalue of the Π matrix, r is the number of cointegration vectors, g is the number of variables and T is the number of observations. The null hypothesis under this test is that there are less than or equal to r cointegrating vectors and the alternative hypothesis is a general one. For example, to test if there is at most only 1 cointegrating vector, the null and alternative hypotheses will be as follows:

H_0: $r \leq 1$ (there is at most 1 cointegrating vector) against

H_1: $r \geq 2$ (there are at least 2 cointegrating vectors)

If the test statistic is greater than the critical value, H_0 will be rejected.

The test statistic for the second test, the maximum eigenvalue test, is written as follows:

$$\lambda_{max}(r, r+1) = -T\, ln(1 - \lambda_{r+1}) \qquad (12)$$

The null hypothesis in this test is that there are exactly r cointegration vectors against the alternative hypothesis of $(r + 1)$ cointegrated vectors where r = 1, 2, ..., $g - 1$, g. For example, to test the existence of 1 cointegrating vector, the null and alternative hypotheses are as follows:

H_0: $r = 1$ (there is exactly 1 cointegrating vector) against

H_1: $r = 2$ (there are exactly 2 cointegrating vectors)

If the value of the test statistic is greater than the critical value, then H_0 will be rejected.

5.3 Granger Causality Test

The Granger approach (1969) to the question of whether a variable *x* causes a variable y is to see how much of the current value of *y* can be explained by past values of y and whether adding past values of *x* can improve the explanation of y. The variable *x* is said to Granger-cause variable *y* if past values of *x* help in the prediction of the present value of *y*. There is unidirectional causality running from x to y if the estimated coefficients on the lagged values of *x* are statistically significantly different from zero as a group in equation (13) and the set of estimated coefficients on the lagged values of *y* in equation (14) below is not significantly different from zero.

$$y_t = \sum_{i=1}^{k} \alpha_i y_{t-i} + \sum_{i=1}^{k} \beta_i x_{t-i} + u_{1t} \tag{13}$$

$$x_t = \sum_{i=1}^{n} \lambda_i x_{t-i} + \sum_{i=1}^{n} \theta_i y_{t-i} + u_{2t} \tag{14}$$

Conversely, unidirectional causality from y to x exists if the set of lagged coefficients of y in equation (14) is statistically significantly different from zero but the set of lagged coefficients of x in equation (13) is not. Bilateral causality between x and y exists when the set of lagged coefficients of x in equation (15) and the set of lagged coefficients of y in equation (14) are both statistically significantly different from zero. Finally, there is independence between x and y when the lagged coefficients of x in (13) and the lagged coefficients of y in (14) are both insignificantly different from zero.

If in this study we find cointegration among the variables of the model, the vector error-correction model (VECM) will be used to investigate the temporal short-run causality between the variables. However, if there is no cointegration between the variables in the model, the vector autoregressive (VAR) model will be employed to examine the short-run causality between the variables.

The VECM is a special form of the VAR for I(1) variables that are cointegrated. The VEC model allows us to capture both the short-run and long-run relationships. For example, we can examine how much GDP will change in response to a change in the other variables (the cointegration part) as well as the speed of change (the error correction part). The direction of Granger causality in the short run and the long run can be determined based on the VECM. The short-run Granger causality can be established by conducting a joint test of the coefficients in the VECM, which is based on the F-test and χ^2 test. The long-run causal relationship, on the other hand, is implied through the significance of the lagged error correction term in the VECM, based on the t test.

For the purpose of this study, if the variables are I(1) and cointegrated, the Granger causality tests will be based on the following VECM model with uniform lag length (equations (15), (16), (17),and (18)):

$$\Delta GDP_t = \alpha_1 + \beta_1 ect_{t-1} + \sum_{i=1}^{l} \xi_i \Delta GDP_{t-1} + \sum_{i=1}^{l} \varphi_i \Delta log(OP)_{t-1} + \sum_{i=1}^{l} \delta_i \Delta log(TDV)_{t-1} + \sum_{i=1}^{l} \gamma_i \Delta (INF)_{t-1} + \mu_1 \quad (15)$$

$$\Delta OP_t = \alpha_2 + \beta_2 ect_{t-1} + \sum_{i=1}^{l} \xi_i OP_{t-1} + \sum_{i=1}^{l} \varphi_i \Delta log(GDP)_{t-1} + \sum_{i=1}^{l} \delta_i \Delta log(TDV)_{t-1} + \sum_{i=1}^{l} \gamma_i \Delta (INF)_{t-1} + \mu_2 \quad (16)$$

$$\Delta TDV_t = \alpha_3 + \beta_3 ect_{t-1} + \sum_{i=1}^{l} \xi_i TDV_{t-1} + \sum_{i=1}^{l} \varphi_i \Delta log(OP)_{t-1} + \sum_{i=1}^{l} \delta_i \Delta log(GDP)_{t-1} + \sum_{i=1}^{l} \gamma_i \Delta (INF)_{t-1} + \mu_3 \quad (17)$$

$$\Delta INF_t = \alpha_3 + \beta_3 ect_{t-1} + \sum_{i=1}^{l} \xi_i INF_{t-1} + \sum_{i=1}^{l} \varphi_i \Delta log(OP)_{t-1} + \sum_{i=1}^{l} \delta_i \Delta log(GDP)_{t-1} + \sum_{i=1}^{l} \gamma_i \Delta log(TDV)_{t-1} + \mu_3 \quad (18)$$

In equations (15) through (18) above, Δ is the first difference operator, α_i is the constant term, $\beta_{i,}$ $\xi_{i,}$ $\varphi_{i,}$ $\delta_{i,}$ and γ_i are the parameters, ect_{t-1} is the lagged error correction term obtained from the cointegrating equation and μ_i is the white noise error.

On the other hand, if we do not find cointegration, we would not be able to use the VECM to examine the short-run dynamic relationship between the variables of the model. Instead, we will estimate a VAR model (equations (19), (20), (21), and (22)) as follows:

$$\Delta GDP_t = \alpha_1 + \sum_{i=1}^{l} \xi_i \, \Delta GDP_{t-1} + \sum_{i=1}^{l} \varphi_i \Delta log(OP)_{t-1} + \sum_{i=1}^{l} \delta_i \Delta log(TDV)_{t-1} + \sum_{i=1}^{l} \gamma_i \Delta (INF)_{t-1} + \mu_1 \quad (19)$$

$$\Delta OP_t = \alpha_2 + \sum_{i=1}^{l} \xi_i \, \Delta OP_{t-1} + \sum_{i=1}^{l} \varphi_i \Delta log(GDP)_{t-1} + \sum_{i=1}^{l} \delta_i \Delta log(TDV)_{t-1} + \sum_{i=1}^{l} \gamma_i \Delta (INF)_{t-1} + \mu_2 \quad (20)$$

$$\Delta TDV_t = \alpha_3 + \sum_{i=1}^{l} \xi_i \Delta TDV_{t-1} + \sum_{i=1}^{l} \varphi_i \Delta log(OP)_{t-1} + \sum_{i=1}^{l} \delta_i \Delta log(GDP)_{t-1} + \sum_{i=1}^{l} \gamma_i \Delta (INF)_{t-1} + \mu_3 \quad (21)$$

$$\Delta INF_t = \alpha_3 + \sum_{i=1}^{l} \xi_i \Delta INF_{t-1} + \sum_{i=1}^{l} \varphi_i \Delta log(OP)_{t-1} + \sum_{i=1}^{l} \delta_i \Delta log(GDP)_{t-1} + \sum_{i=1}^{l} \gamma_i \Delta log(TDV)_{t-1} + \mu_3 \quad (22)$$

This study aims at finding out: (1) whether the oil price, total trade value, and the inflation rate Granger cause the gross domestic product. (2) Whether the gross domestic product, total trade value, and inflation Granger causes the oil price. (3) Whether the oil price, gross domestic product, and inflation rate Granger cause total trade value. (4) Whether the oil price, gross domestic product, and total trade value Granger causes inflation rate.

6. Empirical Results and Discussion

The ADF test results show that all the variables are stationary at the first difference at the 1% level of significance This means that all the variables are integrated of order 1, that is I(1).

Table 2: ADF Unit Root Test Results

Variable	Level		First Difference	
	Intercept	Intercept and Trend	Intercept	Intercept and Trend
Log GDP	**-1.794498**	**-2.283370**	**-4.246608*****	**-4.164630*****
Log OP	**-2.109801**	**-2.319434**	**-5.748852*****	**-5.730080*****
Log TDV	**-1.154418**	**-1.759431**	**-4.676993*****	**-4.600185*****
INF	**-1.595832**	**-0.531396**	**-4.964484*****	**-4.915910*****

Note: *** denotes significance at the 1% level and ** at the 5% level.

6.1 Johansen-Juselius Multivariate Cointegration Test Results

After all the variables have been found to be stationary at the first difference, the cointegration test can be used to find the long run relationship between the dependent and the independent variables.

Since the cointegration test is very sensitive to the lag length, the VAR Lag Order Selection Criteria will be used to determine the optimal lag length. Table 3 below shows that lag four is the optimal lag length for the model of this study based on the AIC.

Table 3 Lag Length Selection from VAR Estimates

VAR Lag Order Selection Criteria
Endogenous variables: LGDP LOP LTDV INF
Exogenous variables: C
Date: 12/03/10 Time: 08:19
Sample: 1970 2008
Included observations: 35

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-137.7578	NA	0.038736	8.100448	8.278202	8.161809
1	-12.99719	213.8754	7.81e-05	1.885554	2.774324*	2.192357*
2	-1.246442	17.45825	0.000104	2.128368	3.728155	2.680614
3	21.96200	29.17632*	7.59e-05*	1.716457	4.027260	2.514146
4	38.04391	16.54139	9.31e-05	1.711777*	4.733596	2.754908

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

While Table 4 shows the cointegration test results based on the trace statistic, Table 5 shows the results based on the maximum eigenvalue statistic. Both trace and maximum eigenvalue statistics in Table 4 and Table 5 respectively show that there are two cointegrating equations at the 0.05 level. This indicates a long run relationship between the dependent variable LGDP and the independent variables LOP, LTDV, and INF. Table 6 below shows the normalized cointegrating vector.

Table 4 Johansen-Juselius Cointegration Test Results Based on the Trace Statistic

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.696844	93.95304	54.07904	0.0000
At most 1 *	0.634245	53.37380	35.19275	0.0002
At most 2	0.321841	19.17691	20.26184	0.0700
At most 3	0.161092	5.972226	9.164546	0.1929

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 5 Johansen-Juselius Cointegration Test Results Based on the Maximum Eigenvalue Statistic

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.696844	40.57924	28.58808	0.0009
At most 1 *	0.634245	34.19689	22.29962	0.0007
At most 2	0.321841	13.20468	15.89210	0.1264
At most 3	0.161092	5.972226	9.164546	0.1929

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 6 Cointegration Equation Normalized With Respect To LGDP

LGDP	LOP	LTDV	INF	C
1.000000	-0.384967	-0.696099	0.025281	-1.760109
	(0.04734)	(0.02995)	(0.00294)	(0.12493)

From Table 6, the long run GDP equation can be written as:

$$Log\ GDP = 1.760109 + 0.384967 Log\ OP + 0.696099\ Log\ TDV - 0.025281 INF \qquad (23)$$

The cointegration equation (23) shows that the gross domestic product is positively related to the oil price and total trade value, and negatively related to the inflation rate. All the signs of the coefficients are correct and satisfy the a priori, theoretical expectations.

The coefficient of the oil price shows that one percentage increase in the price of oil will increase the GDP by 0.39%. This means that the increase in oil prices will lead to an increase in Qatar's GDP. The coefficient of the total trade value shows that one percentage increase in total trade value will increase Qatar's GDP by 0.70%, while the coefficient of the inflation rate shows that one percentage increase in inflation rate will decrease Qatar's GDP by 25%. This country is suffering from high levels of inflation that reached to 16% in 2008; also its consumer price index reached to 208. So definitely the inflation rate has a significant negative impact on Qatar's GDP.

6.2 Results from the Granger Causality Tests

After cointegration is found in our model, the Granger causality test based on the VECM will be used. First, the Granger causality test with LGDP as the dependent variable will be tested. Then the Granger causality for LOP, followed by LTDV and lastly INF as the dependent variable will be tested as well.

All the Granger test results based on the VECM are shown in Tables 7, 8, 9, and 10. The F-test results show the significance of the short run causal effects, while the significance of the lagged error correction term (ect (-1)) shows the long run causal effect.

Table 7 shows that the oil price and total trade value Granger cause the gross domestic product with the exception of the inflation rate in the short run. Both the oil price and total trade value have positive effects on the gross domestic product. The significance of the ect (-1) coefficient indicates that all the variables Granger cause the GDP in the long run.

Table 7: Granger Causality Results with LGDP as the Dependent Variable

	∑DLGDP	∑DLOP	∑DLTDV	∑DINF	ect(-1)
F-stats.	3.588867** (2)	3.552897** (2)	20.27454** (1)	1.513871(1)	11.13270**

Notes: ect (-1) represents the error correction term lagged one period. The numbers in the brackets show the optimal lag based on the AIC. D represents the first difference. Only F-statistics for the explanatory lagged variables in first differences are reported here. For the ect(-1) the t-statistic is reported instead. ** denotes significance at the 5% level and * indicates significance at the 10% level.

Table 8 shows that the gross domestic product and total trade value Granger cause the oil price with the exception of the inflation rate in the short run. GDP seems to have a negative effect on oil price in the short run while total trade value has a positive impact on oil price. Also the insignificance of the ect(-1) coefficient indicates that all the variables do not Granger cause the oil price in the long run. This is expected as the price of oil is determined by supply and demand factors in the world oil market rather than the condition of the Qatari economy.

Table 8: Granger Causality Results with LOP as the Dependent Variable

	∑DLOP	∑DLGDP	∑DLTDV	∑DINF	ect(-1)
F-stats.	1.105065 (2)	2.948053**(2)	3.195471**(1)	1.314194(3)	0.022057

Notes: ect (-1) represents the error correction term lagged one period. The numbers in the brackets show the optimal lag based on the AIC. D represents the first difference. Only F-statistics for the explanatory lagged variables in first differences are reported here. For the ect(-1) the t-statistic is reported instead. ** denotes significance at the 5% level and * indicates significance at the 10% level.

Table 9 shows that the oil price, gross domestic product, and the inflation rate Granger cause the total trade value in the short run. All three variables have a positive effect on the total trade value. The significance of the error correction term (ect (-1)) indicates that all the variables Granger cause the total trade value in the long run.

Table 9: Granger Causality Results with LTDV as the Dependent Variable

	∑DLTDV	∑DLOP	∑DLGDP	∑DINF	ect(-1)
F-stats.	1.761799 (5)	2.565936* (1)	6.935522** (-3)	2.207674* (-3)	-3.246361**

Notes: ect (-1) represents the error correction term lagged one period. The numbers in the brackets show the optimal lag based on the AIC. D represents the first difference. Only F-statistics for the explanatory lagged variables in first differences are reported here. For the ect(-1) the t-statistic is reported instead. ** denotes significance at the 5% level and * indicates significance at the 10% level

From Table 10, it is clear that the results show that all the variables do not Granger cause the inflation rate in the short run. However, the error correction term is significant, indicating that total trade value, gross domestic product, and the oil price Granger cause the inflation rate in the long run.

Table 10: Granger Causality Results with INF as the Dependent Variable

	∑D INF	∑DLOP	∑DLGDP	∑DLTDV	ect(-1)
F-stats.	2.780151**(2)	0.553432 (4)	1.209823 (4)	1.149167 (5)	-2.973129**

Notes: ect (-1) represents the error correction term lagged one period. The numbers in the brackets show the optimal lag based on the AIC. D represents the first difference. Only F-statistics for the explanatory lagged variables in first differences are reported here. For the ect(-1) the t-statistic is reported instead. ** denotes significance at the 5% level and * indicates significance at the 10% level.

In summary, the Granger causality results indicate bi-directional Granger causality between the oil price and the gross domestic product of Qatar, between oil price and total trade, and also between total trade and the gross domestic product.

7. Conclusion

This study aims at investigating the impact of oil shocks on Qatar's gross domestic product using time series data from 1970-2008, covering all the oil shocks. To achieve the objective of the study, we used four variables, namely the gross domestic product, the oil price, total trade value, and inflation rate. The cointegration test and the Granger causality test were used. The most important finding that we arrived at was that oil prices have a long run positive relationship with the gross domestic product. We also found two-way Granger causality between the oil price and the gross domestic product. This means that oil price granger causes Qatar's gross domestic product in the short run and in the long run as well.

It is obvious that the increase in oil prices will lead to increases in Qatar's GDP in both the long run and the short run. However, there is a long run negative relationship between the inflation rate and the gross domestic product, so it is clear that an increase in the inflation rate will lead to a fall in Qatar's GDP. Qatar seems to have suffered from financial surpluses and rapid economic growth caused by sharp increases in the oil price. At the same time, with a fixed exchange regime and tight monetary policy to deal with these events, this has caused the price of assets to increase sharply, leading to high levels of inflation in Qatar.

Since Qatar uses a pegged exchange rate regime to the US dollar, it seems that the fixed exchange rate regime can manage to cushion the effect of oil shocks by maintaining the value of the local currency (riyal) at the fixed rate but at the expense of higher inflation. In addition, the fixed exchange rate regime has performed well in the last three decades by maintaining stable inflation in Qatar, but the sharp increase in oil prices during the fourth oil shock which started in 2003 and reached to phenomenal levels in 2008 has caused consumer prices to increase to a higher level than that in the US. It is likely that the fixed exchange rate regime is not able to stabilize the price level during the fourth oil shock.

The above mentioned finding has motivated the researchers to recommend the pegging of Qatar's currency, the riyal, to a basket of currencies instead of a single peg to the US dollar which makes monetary policy much tighter than it should be. By adopting this new exchange rate regime, the role of monetary policy could be made more effective in dealing with the external shocks (oil shocks). The researchers also recommend that the Qatari government uses its oil revenues to develop the other economic sectors in order to reduce its dependency on the petroleum sector.

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