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REAL INFLUENCES OF REAL EXCHANGE RATE AND OIL PRICE CHANGES ON THE GROWTH OF REAL GDP: CASE OF BAHRAIN

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ABSTRACT

This paper attempts to identify the relationship between the growth of real GDP, real exchange rate, and oil prices in Bahrain from year 1980 to 2007. This study uses Unit Root Tests, Cointegration techniques, Engle-Granger test, Vector Error Correction Model (VECM) to analyses the short run effects, while VAR model is used to analyses the long run effects, The main findings of this paper are: (i) long run relationship exists between The growth of Real GDP, International Oil Prices, and Real Exchange Rate(REXR). (ii) the real exchange rate is an important variable to the growth of RGDP, and devaluation will improve the income growth rate of Bahrain in the long run. (iii) the model is stable in the short run according ECM. (iv) Bilateral and unilateral causality among the variables of the model is found. Bilateral causality between RGDP and REXR was found at 5% level. As implication, in order to achieve the desired effects on RGDP, Bahrain should depend on policy that focusing on the variable of real exchange rate.

KEYWORDS: Growth of RGDP, Real Exchange Rate, Oil Prices, VECM, ADF test, PP test, VAR, Granger causality test.

1. INTRODUCTION

Even though Bahrain has a more diversified economy than most of its neighbor Gulf States, with a large financial, aluminum and tourism sector, the country remains heavily dependent on the oil sector for most of its revenues. The oil sector provides 76% of total government revenues. (RABOBANK, 2006 and 2008).

Bahrain economy is heavily influence by the changes of oil prices and real exchange rate as long as most is generated by oil revenue which is affected by real exchange rate. Thus, the country is still exposed to oil price shocks through massive exportation of oil. The main objective of this paper is to examine how a Bahrain real domestic product is affected by changes in international oil prices and real exchange rate, using time series data from 1980 to 2007.

2. THEORY FRAMEWORK

Many researches suggest that oil price fluctuations have considerable consequences on economic activity. These consequences are expected to be different in oil importing and in oil exporting countries. Whereas an oil price increase should be considered good news in oil exporting countries and bad news in oil importing. countries, the reverse should be expected when the oil price decreases, Amano and Norden (1998). Accordingly, an increase of crude oil price will affect positively the real GDP for Bahrain as oil exported country. Moreover, Hamilton, (2008), Jiménez-Rodríguez and Sánchez, (2005), investigate effects of oil price fluctuations on the macroeconomic. Given that crude oil is a basic input to production, the theory normally predicts that supply-side consequences of oil price hikes include a contraction in overall economic activity and inflationary pressures. In addition, aggregate demand is expected to fall in oil importing countries, and go up in oil exporting countries.

For GCC countries, Al-Otaibi and Sylwester found that oil prices for the exporting countries are mixed and no general evidence of asymmetries. To the extent that asymmetries are not present, this then suggests that the effects of oil price movements on GDP growth rates are not only opposite but qualitatively differ between oil exporters and importers.

In addition to the influence of oil price fluctuation, the present paper examines the role of the real exchange rate in real economic growth. The real exchange rate is a relative price of two currencies domestic and foreign currency. Basically, the real exchange rate can be defined as the nominal exchange rate that takes the inflation differentials among the countries into account. Its importance stems from the fact that it can be used as an indicator of competitiveness in the foreign trade of a country. Any changes in the real exchange rates would lead to fluctuations in short term capital flows. It plays an important role in economic activities; therefore the real exchange rate has been one of the most debated issues both in theory and the practice. The effect of real exchange rate of economic growth has been examined, and found that negative relationship between the two variables. Edwards (1986) approved this relationship in the short run.

Economic theories indicate that depreciation of exchange rate tends to expand exports and reduce imports, while the appreciation of the exchange rate would discourage exports and encourage imports. Thus, exchange rate depreciation leads to income transfer from importing countries to exporting countries through a shift in the terms of trade, and this affects the economic growth of both importing and exporting nations.

Despite the theoretical ideas about the relationship between the real exchange rate and economic growth, McKenzie (1999) stresses the point that at a theoretical level, models have been constructed which lead to negative or positive effects of variability on trade, and that a priori there is no clear case that one model is superior to another.

Peter B. Clark, *et al*, (2004), stated that at an aggregate level there is no evidence of a negative effect of exchange rates on world trade. Once one examines the data on trade and exchange rate volatility at a bilateral level, a negative relationship between the two is borne out by some of the empirical evidence in this study. This negative relationship, however, is not robust to a more general specification of the equation linking bilateral trade to its determinants that embodies the recent theoretical advances in a gravity model. Thus, if there is a negative impact of exchange rate volatility on trade, it is not likely to be quantitatively large and the effect is not robust.

It was indicated by Jin in (2008), that an appreciation of the real exchange rate it might lead to a positive or negative GDP grow growth, while Eichengreen, and Leblang (2003), found a strong negative relationship between exchange rate stability and growth. Accordingly, empirical studies have explored different point of views or findings about the relationship nature between economic growth, exchange rate, and oil price fluctuations. In this work, case of Bahrain is going to be investigated.

3. METHODOLOGY

In order to estimate the relationship between economic growth, exchange rate and, oil price shock, the following model is adopted.

$$LGDP = f\,(LREXR,\ LOILP) + u$$

$$LRGDPt = \alpha + \beta 1\ LROIP_t + \beta 2\ LREXR_t + \varepsilon t \qquad (1)$$

Where, (*LGDP*) is log of Real GDP of Bahrain, (*LREXR*) is log of Real Exchange Rate, and *LOILP* is log of Oil Price. Data for all the variables used in this paper is from the Word Development Indicators WDI for the period 1980-2007 and Statistical Abstract of Kingdom of Bahrain (1999), United Nations Statistical Yearbooks. This model could includes more variables such as proxy for fiscal and monetary policies variables that enhance the confidence of this analysis. But because of data limitations and the objective of the study is concern about the effects of only two variables on the growth of RGDP; this model is adopted.

Time series modeling and forecasting became quite popular following the publication of the text Time Series Analysis Forecasting and Control by George Box and Gwilym Jenkins in 1976. They suggested some properties of time series that would suggest departures from stationarity, that is, these would suggest nonstationarity. The two main properties were visual cues. First, if a series does not seem to have a constant mean (part of the definition of stationarity) when graphed, that is a visible symptom of nonstationarity.

The stationarity or otherwise of a series can strongly influence its behavior and properties -e.g. persistence of shocks will be infinite for non-stationary series. If the variables in the regression model are not stationary, then it can be proved that the standard assumptions for asymptotic analysis will not valid. In other words, the usual "*t*-ratios" will not follow a *t*-distribution, so we cannot validly undertake hypothesis tests about the regression parameters. If a non-stationary series, it must be differences d times before it becomes stationary, then it is said to be integrated of order d. We write y_t~I (d). So if y_t~I (d) then $\Delta^d y_t$~I (0).

An I(0) series is a stationary series

An I(1) series contains one unit root,

E.g. $y_t = y_{t-1} + u_t$

A series is said to be trend stationary when it is stationary around a trend:

$$y_t = \beta_0 + \beta_1 t + u_t \tag{2}$$

t – *trend*

Accordingly, differencing variable might be required. If the results of the model such as high R^2, but DW value is less than R^2 the results cannot be interpreted as there is clear evidence of autocorrelation. However this option may not be acceptable as, the variables in this form may not be in accordance with the original theory or this model could be omitting important long-run information, or this model may not have the correct functional form. Differenced variables are usually thought of as representing the short-run. But if the built model does not belong to the above circumstances, so the problem could be referred non-stationarity. Therefore, before running the model such series have to be tested for stationary. The majority of economic and financial series contain a single unit root, although some are stationary and consumer prices have been argued to have 2 unit roots.

4. UNIT ROOT TEST

The most important tests for stationarity are the Dickey-Fuller Test or Augmented Dickey-Fuller Test (ADF) and Phillips Perron (PP). Both tests are used in this study for stationarity (Unit Root Test). The testing procedure for the ADF test is the same as for the *Dickey–Fuller test* but it is applied to the model.

The motivation for unit root testing and cointegration analysis arises from two key reasons. First, the risk of spurious correlation precludes the study of long-run relationships among levels of nonstationary variables using ordinary estimation methods. Second, using only first differences of the variables, i.e. stationary I (0) series, runs the risk of losing relevant information. Thus, unit root tests are necessary to examine the time-series properties of the variables. If the series are found to be nonstationary, cointegration techniques should be applied to study the possible long-run dependencies among the variables, which are essential to understand the actual behavior of the variables.

$$\Delta y_t = \alpha + \beta_t + \gamma y_{t-1} + \delta_1 \, \Delta y_{t-1} + \ldots + \delta_p \, \Delta y_{t-p} + \varepsilon_t, \tag{3}$$

Where α is a constant, β the coefficient on a time trend and p the lag order of the autoregressive process. Imposing the constraints $\alpha = 0$ and $\beta = 0$ corresponds to modeling a random walk with a drift. Phillips and Perron (1988), have developed a more comprehensive theory of unit root nonstationarity. The tests are similar to ADF tests, but they incorporate an automatic correction to the DF procedure to allow for autocorrelated residuals. The tests usually give the same conclusions as the ADF tests, and the calculation of the test statistics is complex.

Tables 1 and 2 report the results of ADF and PP tests. The results suggest that all variables are non-stationary in levels and stationary in first differences, i.e. they are I (1) variables. In order to see the robustness of the ADF test, the Phillips-Perron (PP) unit root test is also adopted. We can verify the results of the PP test in table 2 which indicates that all of the variables are I (1). Thus, it is reasonable to assume that all variables are actually non-stationary I (1) variables and continue our long-run cointegration analysis.

Table 1
Augmented Dickey and Fuller (ADF) Results

	ADF		
Variable	*Constant*	*Const and Trend*	*No Const. & No Trend*
Log Level			
RGDP_BAHRAIN	-1.582482	-2.312316	2.407141
LROILP	-1.319278	-2.193057	-0.450188
VOLREER	-4.006598*	-5.164903*	-1.534135
Log 1st Difference			
RGDP_BAHRAIN	-4.845340*	-4.254166*	-4.588344*
LROILP	-3.948072*	-3.805047**	-4.041185*
VOLREER	-3.964476*	-3.975811**	-2.038207**

Table 2
Phillips Perron (PP) Results

Variable	*Constant*	*Const &Trend*	*No Const & No Trend*
Log Level			
RGDP_BAHRAIN	1.645259	-2.585097	2.407141
LROILP	-1.392378	-2.243922	-0.46143
VOLREER	-0.994524	-2.953287	-0.929416
Log 1st Difference			
RGDP_BAHRAIN	-5.033498*	-10.04379*	-4.615830*
LROILP	-3.807247*	-3.647135**	-3.927472*
VOLREER	-3.815105*	-3.824995**	-3.90636**

*Reject Null Hypothesis (unit root) at 1%
**Reject Null Hypothesis (unit root) at 5%
***Reject Null Hypothesis (unit root) at 10%

5. LONG-RUN ANALYSIS: VAR AND COINTEGRATION TEST

In the time series analysis, if all variables are found to be integrated of the same order, the following process is generally employed. The first step is to estimate whether stable long-run dependencies exist among the variables, i.e. whether the variables are cointegrated. If the cointegrating relations are identified, the next step is to determine the number of long-run equilibrium relationships or cointegrating vectors among the variables, so we can analysis the results and make a conclusions. As stated above, it was found that real GDP, real exchange rate, and real oil price are in levels non-stationary I (1) variables.

The vector autoregressive (VAR) modeling with cointegration techniques is applied to examine how real GDP of Bahrain is affected by changes in international oil prices and the real exchange in the long-run. The two most widely used tests for cointegration are the Engle-Granger (1987) two-step estimator and the Johansen (1988) and Johansen and Juselius (1990) maximum likelihood estimator. Since the long-run cointegrating relation is found between the variables, the estimation of cointegrating vectors is executed at the same time. The results are presented in the following tables:

Table 3
Unrestricted Cointegration Rank Test (Trace)

Hypothesized		*Trace*	*0.05*	
No. of CE(s)	*Eigenvalue*	*Statistic*	*Critical Value*	*Prob.***
None*	0.588611	31.04529	29.79707	0.0357
At most 1	0.297901	9.728117	15.49471	0.3022
At most 2	0.050346	1.239784	3.841466	0.2655

Trace test indicates 1 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 4
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized		*Max-Eigen*	*0.05*	
No. of CE(s)	*Eigenvalue*	*Statistic*	*Critical Value*	*Prob.***
None *	0.588611	21.31717	21.13162	0.0471
At most 1	0.297901	8.488332	14.26460	0.3312
At most 2	0.050346	1.239784	3.841466	0.2655

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
** MacKinnon-Haug-Michelis (1999) p-values.

Tables 3 and 4, show the results of both the maximum eigenvalue and the trace statistic which suggest the presence of one cointegrating equation among the three variables in this model at the 5 per cent level in line with the critical values. This reveals the existence of a long run equilibrium relationship between real GDP and the variables used in the model.

Since the long-run cointegrating relation is found among the variables, estimation of cointegrating vectors is executed at the same time. The value of the cointegrating vectors or normalized (β) are presents in Table 5. Therefore cointegration equation is derived from the this table.

Table 5
Cointegration Vector of Bahrain

One Cointegrating Equation	Log likelihood	95.19335
Normalized cointegrating coefficients (standard error in parentheses)		
LRGDP	*LROILP*	*LREXR*
1.000000	1.955862	-0.806320
SE	(0.45494)	(0.24021)

According to Tables 3, 4, and 5, we can derive a cointegrating equation among the LGDP, LROILP, and LREXR as follows:

$$LRGDP_t = 3.841466 + 1.956\ LROILP_t - 0.806320\ LREXR_t \quad (4)$$

The signs of the two parameters are as expected and highly significant. The cointegrating vector indicates a stationary long-run relationship in which the level of RGDP depends on the real exchange rate and the real oil price. This means 1% permanent increase in the level of international oil prices causes the level of RGDP of Bahrain to increase by 1.96%. At the same time, a permanent 1% depreciation of the real exchange rate is associated with a 0.81% growth in the real GDP of Bahrain. We can conclude from the above equation that the real GDP of Bahrain is more elastic to changes in international oil prices than of real exchange rate.

The level of RGDP increases as a result of an oil price shock for linear and asymmetric oil price specifications. This is expected, as a positive shock to oil price represents a positive supply shock for a major oil-producing economy. It induces an increase in incomes and wealth and supports consumption, given a constant propensity to consumption from income and wealth. Also the level of real exchange rate effect on the level of Real GDP is examined. As long as Bahrain is the oil producing country, It is generally recognized that the depreciation of the exchange rate would encourage exports and reduce imports.

6. SHORT-RUN ANALYSIS: AN ERROR-CORRECTION MODEL

According to Granger, if there is evidence of cointegration between two or more variables, then a valid error correction model should also exist between the two variables. The error correction model is then a representation of the short-run dynamic relationship between X and Y, in which the error correction term incorporates the long-run information about X and Y into our model. This implies that the error correction term will be significant, if cointegration exists. In the previous section the cointegrating relationships of the variables are identified, and it will be included explicitly as error-correction terms into a short-run system.

The estimated bi-variate ECM for the country takes the following form:

$$\Delta RGDP_{it} = \alpha_{+} \Sigma \beta_{1i} \Delta ROILP_{it-1} {}_{+} \Sigma \beta_{2i} \Delta REXR_{it-1} + \varphi ECT_{it-1} + u_{1it} \quad (5)$$

$(i = 1 \ldots n_1)$ $(i = 1 \ldots n_2)$

Where Δ is the difference operator, $RGDP_t$, $ROILP_t$ and $REXR_t$ are as defined before, ECT_{it-1} is the error correction term derived from the long-run co integrating relationship, u_{1t} is the white noise error terms t denotes the years and n_1 is the lag orders of α's and β's respectively. The VECM results distinguish between short-run and long-run Granger causality. The coefficients of the lagged error correction term show that there is a long-run causal relationship between economic growth and independent variables. The coefficients (and the magnitudes) of the ECM indicate the speed of adjustment to the long-run equilibrium relationship. The following ECM was formed, using 25 observations:

$$DRGDP_{it} = 0.077 + 0.14\ DLROILP_{t-4} + 1.74\ DLREXR_{t-4} - 0.145\ ECT_{t-1} \quad (6)$$

Se. (0.0774)* (0.054)** (0.477)* (0.0818)***

All coefficients of the model parameters are significant at 1%(*), 5%(**) and 10%(***). The sign of international oil price as expected and support the cointegration equation, but the sign of real exchange rate is not as expected. The error correction term is negative and significant at 10%, so the model is stable and supporting the cointegration results. A value of "0. 145 of the coefficient of error correction terms suggests that the Bahrain economy 14.5% movement back toward equilibrium following a back towards long run equilibrium, after the shock of oil price or the fluctuation of exchange rate.

7. GRANGER CAUSALITY TEST

It must be noted that whilst these models examine the determinants of Real GDP it may be argued that they do not fully explore the causal relationship between the variables. Simple correlation does not necessarily indicate causation. One theoretical implication of cointegration is that if two variables, say, real GDP and real oil price, are integrated of order one and cointegrated, there must be a Granger-causality (Granger, 1969) between real GDP and Real Oil Price in at least one direction as one variable can help determine the other.

Testing for temporal causality between prices and volumes traded is centered on a bi-variate VAR model comprising two stationary series, x and y. The model can be written as:

$$x_t = \alpha + \sum_{i=1}^{p} \beta_i\ x_{t-i} + \sum_{j=1}^{q} \gamma_j\ y_{t-j} + u_{x,t} \quad (7)$$

$$y_t = \delta + \sum_{i=1}^{p} \theta_i\ y_{t-i} + \sum_{j=1}^{q} \phi_j\ x_{t-j} + u_{y,t} \quad (8)$$

For example, if x and y are stationary variables and p and q are the lag lengths for x and y respectively. Equations (7) and (8) are valid for testing the causality of lagged changes in Oil price (where x is the stationary oil price series) and lagged price changes on RGDP (where y is the stationary RGDP series).

The Pairwise Granger Causality Test results are presented in Table 6. According to the results of Granger-causality test, we found bilateral and unilateral causality between the variables of the model. The bilateral causality between RGDP and REXR was found at 5% level. As implication, in order to achieve the desired effect on RGDP, Bahrain should depend on the policy that focusing on the variable of real exchange rate. On the other hand, the results also indicate that the real GDP granger oil price, which is not meaningful. These findings suggest that the real exchange rate is very important factor for the economic growth of Bahrain.

Table 6
Pairwise Granger Causality Tests: Lags: 4

Null Hypothesis	*F-Statistic*	*Probability*
DLO does not Granger Cause DLRGDP	1.52033	0.26291
DLRGDP does not Granger Cause DLO	3.33062	0.05006
DRXL does not Granger Cause DLRGDP	5.03448	0.01490
DLRGDP does not Granger Cause DRXL	4.92965	0.01596
DRXL does not Granger Cause DLO	1.30011	0.32888
DLO does not Granger Cause DRXL	1.52678	0.26121

8. FINDINGS AND CONCLUSIONS

This paper studies output (RGDP) of Bahrain response to changing oil prices and changing real exchange rate. The time series of the model have been examined in terms of stationarity, using ADF and PP tests. This was followed by applying the Johansen cointegration test and the estimation of the long run cointegrating vectors. An Error Correction Model is used to examine the short run analysis, followed by running the pairwise Granger causality test. It is found that the variables of the model were characterized by a unit root at level, but, the hypothesis of nonstationarity were rejected at first difference.

In this study the Johansen's cointegration test is used to examine the cointegrating relationship between the real GDP, real effective exchange rate, and the real oil price of the country. According to Tables 3 and 4 both the maximum eigenvalue tests and the trace tests indicate that there is one cointegrating equation at 5% significant level among the real GDP, real effective exchange rate and real oil price in the sample.

The long run vector coefficients indicate that 1% permanent increase in the level of international oil prices causes the level of RGDP of Bahrain to increase by 1.96%. At the same time, a permanent 1% depreciation of the real exchange rate is associated with a 0.81% growth in the real GDP of Bahrain. We can conclude from the above equation that the real GDP of Bahrain is more elastic to changes in international oil prices (more elastic) than of real exchange rate (inelastic). The estimated coefficients of the error correction terms is - 0.145, suggesting that suggests that the Bahrain economy 14.5% movement back toward equilibrium following a back towards long run equilibrium, after the shock of oil price or the fluctuation of exchange rate.

Finally, we found bilateral and unilateral causality between the variables of the model. The bilateral causality between RGDP and REXR was found at 5% level. As implication, in order to achieve the desired effect on RGDP, Bahrain should depend on the policy that focusing on the variable of real exchange rate. On the other hand, the results also indicate that the real GDP granger oil price, which is not meaningful. These findings suggest that the real exchange is a very important factor for the economic growth of Bahrain.

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