The Impact of Oil Prices on the Real Exchange Rate of the Dirham: a Case Study of the United Arab Emirates

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1. Introduction

In the previous three decades, the United Arab Emirates (UAE) has achieved remarkable economic success. Its economy has been transformed from an economy based on fishing and agriculture to an oil economy, resulting in it becoming a high income country. The UAE, in fact, has become one of the richest countries in the Middle East and having one of the highest incomes in the world. The UAE is an open economy which is free from income and profits taxation and it allows free capital movement. The UAE's GDP is one of the highest in the Middle East today. Its GDP was only US$17 million in 1960. By 1974, after the first oil shock, its GDP had risen to US$7,856 million. After the second oil shock, its GDP rose further to US$29,626 million in 1980. Its GDP continued to increase from US$33,193 million in 1991 after the third oil shock, to US$87,611 in 2003 after the fourth oil shock. By 2008 its GDP had increased to US$260,141 million.

The UAE's economic growth rate is one of the fastest in the world due to its huge spending on infrastructural development. At the same time, the UAE has made a lot of efforts to reduce its dependence on oil and gas, via land reclamation, industrial development, tourism, distillation of oil and free trade zone development. However, these resources still play an important role in the economy. The United Arab Emirates is still one of the biggest oil exporters and an important member of the Organization of Petroleum Exporting Countries (OPEC). In the year 2008, its crude oil exports was 2334.4 thousand barrels per day, the third highest oil exporter after Saudi Arabia and Iran.

The UAE's currency, the dirham, has been pegged to the US dollar at a price of 3.67 dirham per US dollar since 1978, and this value has been almost fixed since then but with no restriction on the exchange for other currencies. In a fixed exchange rate regime system, the government or central bank intervenes in the currency markets so that the exchange rate stays close to the targeted exchange rate. Exchange rate movements are mainly caused by fundamental factors such as the price of oil. But the nominal bilateral exchange rate does not provide any information on the change in the overall strength of the domestic currency with respect to all of the home country's trading partners. Moreover, it does not provide any indication of the real cost of acquiring foreign goods and services in a world of changing prices (Appleyard et.al (2008), p.484). Another measure of the exchange rate is the real bilateral exchange rate which embodies changes in the price level in the two countries. The real exchange rate is defined as the nominal exchange rate adjusted for the relative price levels. A change in the real exchange rate shows how the purchasing power of a currency has changed from some arbitrarily selected base year.

The main objective of this study is to investigate whether changes in oil prices have an impact on the real exchange rate of the UAE dirham to the US dollar. To achieve this objective the researcher will use data from 1977 to 2007 that covers three important oil shocks. Due to the unavailability of the necessary data on the UAE we are not able to cover the first oil shock. The dependent variable in this study is the real exchange rate of the dirham to the US dollar. And the gross domestic product per capita, foreign direct investment inflows, UAE's trade balance, and (OPEC) oil price are the independent variables.

The reasons for choosing the UAE as a case study are: (1) the UAE has achieved very rapid economic growth since 1973; (2) its economy is one of the most open economies in the Middle East region; and (3) there are very few studies that have focused on this country, especially highlighting on the issue of the effect of oil shocks on its real exchange rate.

2. Significance of the Study

Petroleum and natural gas are two important commodities in the world economy. These two resources represent the backbone of global transportation, transit, and power generation. Oil shocks is one of the major problems facing not only oil-importing but also oil-exporting countries The increase in oil prices does have a negative impact on the global economy, resulting in economic recessions especially in the industrial countries that are highly dependent on oil, such as the United States of America, Japan, France and Germany, which are among the biggest oil importers in the world.

Since oil plays an important role in the UAE economy, this study attempts to examine if oil prices have any impact on the real exchange rate of the dirham in both the long run and short run. Also, we will examine the long relationship and short run dynamics between oil prices, GDP per capita, FDI inflows, trade balance and the real exchange rate.

3. Literature Review on Oil Price and the Real Exchange Rate

The increase in oil prices has a substantial impact on the world economy and national economic policies. Oil booms have caused increases in the financial surpluses of the oil-exporting countries, resulting in significant changes in their patterns of spending and investment. The large and sudden effect of liquidity changes to these economies following oil price shocks have led to increases in asset prices, reduced control on price stability, and resulted in high levels of inflation, which in turn may weaken the real value of the domestic currency.

A number of studies have investigated the relationship between oil shocks and the real exchange rate. Some studies have used OLS, while others have used the VAR methodology, the VECM, or panel regression. The period covered in these studies is mainly between 1970 and 2005. Some writers focus only on a particular country while others examined the effect of oil price shocks on a group of countries. **Amano (1998*)*** found a stable link between oil price shocks and the US real effective exchange rate over the post Bretton Woods period. His results suggested that oil prices may have been the dominant source of persistent real exchange rate shocks and that energy prices may have important implications on exchange rate behavior. In **Coudert's (2008)** investigation of the relationship between the oil price and the value of the US dollar, he found that causality runs from oil prices to the exchange rate and that the link between oil price and the dollar value is through the U.S. net foreign asset position. **Rautava (2004)** found that the Russian economy is influenced significantly by fluctuations in oil prices and the real exchange rate through both long-run equilibrium conditions and short-run direct impacts. **Dawson (2006)** investigated the impact of oil price on the Dominican Republic's real effective exchange rate, using oil price, consumer price index, trade balance, gross domestic product, and real interest rates, from 1991 to 2005. She found that the increase in oil price causes the domestic currency to depreciate. **Ozturk (2008)** found that the international oil price Granger caused the real effective exchange rate of the Turkish currency (riyal). Contrary to other studies, **Huang et. al (2006)** showed that real oil price shocks led to a minor appreciation of the long-term real exchange rate due to China's lesser dependence on imported oil than its trading partners included in the RMB basket peg. Besides, they found that real shocks, as opposed to nominal shocks, to be the dominant factor causing variations of the real exchange rate. **Chen et. al (2006)** investigated the long run relationship between oil shocks and the real exchange rate in seven developed countries. Their study suggested that real oil prices may have been the dominant source of real exchange rate movements and that there is a link between real oil prices and real exchange rates. According to **Shiu's (2006)** findings, oil prices are a dominant source of the real exchange rate movement in the G7 countries. **Al-Abri's (2008)** study on a number of OECD countries found feedback effects between the real effective exchange rate, inflation rate and the domestic-currency real oil-price, supporting the growing notion that oil-price shocks are not purely exogenous to developed economies. In addition, he found that countries that are under the fixed exchange rate regime suffered higher inflation when oil prices increase compared to those countries that are under flexible exchange rate regimes. **Abdelaziz (2008)** found that oil prices have a significant effect on the real exchange rate and stock market in Egypt, Kuwait, Saudi Arabia, and Oman. All the above studies seem to indicate a significant relationship between real exchange rate and oil shocks. **Eisa et. al (2003)**, on the other hand, found oil production shocks rather than real oil price shocks are responsible for Saudi Arabia's real exchange rate movements. Hence, they suggested that Saudi Arabia should focus on stabilizing oil production to stabilize its real exchange rate.

4. Methodology

In this study, the Vector Autoregression (VAR) methodology will be utilized. The vector autoregressive (VAR) model is used for forecasting a system of interrelated time series and for analyzing the dynamic impact of random disturbances on the system of variables. The

VAR model is useful in this situation as it is less restrictive compared to other models. The VAR model introduced by Sims (1980) can be written as follows:

$$\mathbf{y_t = A_1 y_{t-1} + \ldots + A_p y_{t-p} + B x_t + \varepsilon_t} \quad (1)$$

where $\mathbf{y_t}$ is the k-vector of endogenous variables, $\mathbf{x_t}$ is a **d**-vector of exogenous variables, $\mathbf{A_{1,..,}}$ $\mathbf{A_p}$ and **B** are the matrices of coefficients to be estimated, and $\boldsymbol{\varepsilon_t}$ is a vector of novelty that may be contemporaneously correlated but are uncorrelated with their own lagged values and uncorrelated with all of the right hand side variables.

In this study, the researcher will use the VAR model to test for cointegration and investigate the impact of oil price shocks on the real exchange rate of the dirham. The model will have five variables: the real exchange rate (RER), gross domestic product per capita (GDP), UAE's trade balance (TB), foreign direct investment of the UAE (FDI) and OPEC oil price (OP). The real exchange rate will be our dependent variable. The model is presented as follows:

$$Log\ RER_t = \alpha + \beta_1 \log OP_t + \beta_2 \log GDP_t + \beta_3 TB_t + \beta_4 FDI_t + \varepsilon_t \qquad (2)$$

where

α is the intercept

$\beta_1, \beta_2, \beta_3, \beta_4$ are the slope coefficients of the model

Log RER is the log of the real exchange rate (units of UAE dirham per US dollar adjusted for relative prices)

Log OP is the log of oil price (US dollars per barrel)

Log GDP is the log of gross domestic product per capita (millions of US dollars)

FDI is the foreign direct investment inflows (millions of US dollars)

TB is the UAE's trade balance (millions of US dollars)

ε_t is the error term.

Table 1: Definition of variables

Variable	Definition	Expected Relationship
RER	The real exchange rate (RER) is the nominal bilateral exchange rate (NER) adjusted for differences in the price level or inflation. It is computed as follows: RER_t (dirham/US\$) = NER_t (dirham/US\$) x ($P_{US,t}$ /$P_{UAE,t}$) where P_{US} and P_{UAE} are the price levels of the US and the UAE respectively.	
OP	Crude oil price adjusted for the inflation rate, in US dollars per barrel.	Positive
GDP	GDP per capita, is gross domestic product divided by the mid-year population. 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. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in millions of US dollars.	Positive
FDI	Inflows of FDI comprise capital provided (either directly or through other related enterprises) by a foreign direct investor to an enterprise resident in the economy (FDI enterprise). The data are in millions of US dollars.	Negative
TB	Trade balance is the difference between exports and imports (exports minus imports) of goods and services. The data are measured in millions of US dollars.	Positive

4.1 Data Sources

The data source for GDP per capita is from the Nationmaster website (www.NATIONMASTER.com), while the data on exchange rate, trade balance, consumer price index in the United States of America and the United Arab Emirates, and foreign direct investment inflows are taken from the International Monetary Fund (IMF) data base. The data on oil price is taken from the OPEC website (www.OPEC.com).

4.2 Estimation Procedures

Because we are using time series data, the analysis will begin with the unit root test to determine whether the time series data are stationary at levels or first difference. The unit root test will be conducted on each variable in the model, namely the real exchange rate, gross domestic product per capita, foreign direct investment inflows, UAE's trade balance, and OPEC oil price. The Augmented Dickey-Fuller test will be used to test for the stationarity of the variables.

After determining the order of integration of each of the time series, and if the variables are integrated of the same order, the Johansen-Juselius co-integration test will be used in this study to determine whether there is any long run or equilibrium relationship between the real exchange rate and the other independent variables in the model, namely, the gross domestic product per capita, foreign direct investment inflows, UAE's trade balance, and OPEC oil price. If the variables are found to be cointegrated, we will then estimate the Vector Error Correction model (VECM) to model the short-run dynamics. Lastly we will then conduct the Granger causality tests, which are based on the VECM, to determine whether oil prices (oil shocks) do Granger cause the real exchange rate or vice versa.

4.2.1 Unit Root Test

Most economic time series are not stationary because they contain a time trend. To avoid the possibility of spurious regressions and erroneous inferences, the first step in time series regression analysis involves determining the order of integration of the time series data. In other words, we need to test for the stationarity of the time series, y_t. The meaning of "stationary" is that the mean, variance and covariance of y_t do not change over time, and "non-stationary" means that its mean, variance or covariance is time-varying.

In this study we will use the Augmented Dickey-Fuller test to determine whether the series at the level is stationary or it has a unit root. 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 again. If it is stationary at the first difference then the series is said to be integrated of order 1, that is $y_t \sim I(1)$. In general, a series y_t is said to be integrated of order d, that is $y_t \sim I(d)$, if it has to be differenced d times to attain stationarity (Gujarati & Porter, 2009).

4.2.2 Cointegration Test

As a general rule, non-stationary time series variables should not be used in a regression model as it can lead to the problem of spurious correlation or nonsense regression. But there is an exception to this rule. However, 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 Johansen and 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. We will use the Johansen-Juselius (JJ) cointegration test in this study. The JJ procedure is based on the vector autoregressive (VAR) model and the lag length is determined using the Akaike Information Criteria.

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

$$y_t = \mu + \sum_{k=1}^{p} \Pi_k y_{t-k} + \varepsilon_t \tag{3}$$

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 = 5 variables with 4 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 = 31). Equation (3) above can be rewritten in the first difference form as follows:

$$\Delta y_t = \mu + \sum_{k=1}^{p-1} \Gamma_k \, \Delta y_{t-k} + \Pi \, y_{t-1} + \varepsilon_t \qquad (4)$$

where $\Gamma_k = -(I - A_1 - \ldots - A_k)$, $(k = 1,\ldots,p-1)$ and $\Pi = -(I - A_1 - A_2 - \ldots - A_k)$. Π 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 exists 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:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{g} \ln(1-\lambda_i) \qquad (5)$$

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:

$$\lambda_{max}(r, r+1) = -T \ln(1 - \lambda_{r+1}) \tag{6}$$

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 for 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.

4.2.3 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 in 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 (7) and the set of estimated coefficients on the lagged values of y in equation (8) below is not significantly different from zero.

$$y_t = \sum_{i=1}^{k} \alpha_i y_{t-i} + \sum_{i=1}^{k} \beta_i x_{t-i} + u_{1t} \tag{7}$$

$$x_t = \sum_{i=1}^{n} \lambda_i x_{t-i} + \sum_{i=1}^{n} \theta_i y_{t-i} + u_{2t} \qquad (8)$$

Conversely, unidirectional causality from y to x exists if the set of lagged coefficients of y in equation (8) is statistically significantly different from zero but the set of lagged coefficients of x in equation (7) is not. Bilateral causality between x and y exists when the set of lagged coefficients of x in equation (7) and the set of lagged coefficients of y in equation (8) are both statistically significantly different from zero. Lastly, there is independence between x and y when the lagged coefficients of x in (7) and the lagged coefficients of y in (8) are both insignificantly different from zero.

If there is at least one cointegration vector among the variables of the model in this study, we will proceed with the estimation of the vector error-correction model (VECM) to investigate the temporal short-run causality between the variables. On the other hand, if there is no long run relationship (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 RER 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.

5. Empirical results and discussion

From the ADF unit root test results in Table 2 we found that all the five variables are not stationary at the levels but became stationary after first differencing at least at the 5% 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	No Intercept No Trend
Log RER	1.826266	-0.424091	-2.366661	-3.094977	-2.148653**
Log OP	-1.277275	-1.586704	-5.011022***	-4.923835***	
Log GDP	-1.970754	-1.079515	-4.535548***	-4.106768***	
FDI	0.363352	0.492599	-3.343852**	-3.939038**	
TB	-0.956146	-1.521678	-5.411710***	-5.492780***	

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

5.1 Johansen-Juselius Multivariate Cointegration Test Results

It has been found that all the variables are stationary in the first difference. In other words, the variables are all I(1) and we can then proceed with the cointegration test to determine the presence of any cointegration or long run relationship between the variables based on the Johansen-Juselius multivariate cointegration procedure.

The cointegration results are sensitive to lag length. Therefore, before running the cointegration test, we run the VAR model first in order to determine the optimal lag length, based on the minimum AIC. Due to the limited number of observations, we have limited the maximum lag to 3 in the lag length selection process. The optimal lag length selection as given in Table 3 below is 3 lags based on the AIC but 1 lag based on the LR, FPE, SC and HQ criteria. We decided to choose 3 lags as the optimal lag length for the cointegration test.

Table 3 Lag Length Selection from VAR Estimates

VAR Lag Order Selection Criteria
Endogenous variables: LRER LOP LGDP FDI TB
Exogenous variables: C
Date: 05/31/09 Time: 15:56
Sample: 1977 2007
Included observations: 28

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-137.3115	NA	0.017879	10.16510	10.40300	10.23783
1	-15.98903	190.6495*	1.90e-05*	3.284931	4.712293*	3.721290*
2	0.157053	19.60596	4.32e-05	3.917353	6.534184	4.717344
3	34.33370	29.29427	3.93e-05	3.261879*	7.068177	4.425502

* 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

Table 4 and Table 5 show the cointegration test results based on the trace statistic and on the maximum eigenvalue statistic, respectively. Both the trace and maximum eigenvalue tests indicate that there are at most 3 cointegration equations in the model at the 5% level of significance. In other words, the results indicate that there is a long run relationship between log RER and log OP, log GDP, FDI and TB.

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 *	0.992647	227.7192	76.97277	0.0000
At most 1 *	0.837342	95.07741	54.07904	0.0000
At most 2 *	0.662173	46.04251	35.19275	0.0024
At most 3	0.383685	16.74151	20.26184	0.1425
At most 4	0.127208	3.673577	9.164546	0.4629

Trace test indicates 3 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 *	0.992647	132.6418	34.80587	0.0000
At most 1 *	0.837342	49.03490	28.58808	0.0000
At most 2 *	0.662173	29.30101	22.29962	0.0045
At most 3	0.383685	13.06793	15.89210	0.1322
At most 4	0.127208	3.673577	9.164546	0.4629

Max-eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

After having found three cointegration relationships between the variables log RER, log OP, log GDP, FDI and TB, we chose the cointegrating equation which best meets our a priori expectations. The selected cointegration equation is normalized on the real exchange rate variable since the objective of this study is to determine whether a long run relationship exists between log RER and the other variables. Table 6 shows the normalized cointegrating vector.

Table 6: Cointegration Equation Normalized With Respect To LRER

LRER	LOP	LGDP	FDI	TB	C
1.000000	-0.156934 (0.01149)	-0.070678 (0.00696)	0.014579 (0.00044)	-0.010085 (0.00054)	-0.516603 (0.03357)

Note: The values in parentheses are the standard errors.

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

$$\text{Log RER} = 0.51660 + 0.156934 \log OP + 0.070678 \log GDP - 0.014579\ FDI + 0.010085\ TB \quad (8)$$

The cointegration equation given by equation (9) shows that the real exchange rate is positively related to the oil price, GDP per capita and the trade balance of the UAE, but it has a negative relationship with foreign direct investment inflows. All the signs are correct based on a priori, theoretical expectations.

The coefficient for log OP indicates that for every one percent increase in the oil price from 1977 to 2007, the real exchange rate will increase by 0.16%. This means that an increase in oil prices will lead to a real depreciation of the UAE dirham. Higher oil prices cause a rapid growth of liquidity, high money inflows and inflation in the UAE economy. And since the UAE has adopted a fixed exchange rate regime whereby the UAE dirham has been rigidly pegged to the US dollar since 1978 at 3.67 dirham per US dollar, the relatively higher inflation in the UAE economy compared to the US thus leads to a real depreciation of the dirham.

The relationship between LRER and LGDP is positive. For every one percent increase in the gross domestic product per capita, the real exchange rate will increase by 0.07%. Since the oil sector plays an important role in the UAE economy, an increase in oil revenue following an oil price increase will cause government consumption expenditure and investment to increase and thus lead to higher GDP per capita. The higher level of government spending will lead to higher inflation and a depreciation of the real exchange rate of the dirham.

We also found a positive relationship between the LRER and TB. When the trade balance increases by one unit (one million US dollars) the real exchange rate will increase by 1.0%. Increases in the trade surplus are mainly attributed to higher oil exports, as 80% of the UAE's total exports come from oil (IMF, 2005). Oil exports increase due to the increase in its price as well as the quantity exported driven by the higher prices. This will cause a sudden increase in liquidity and increase the price level causing higher inflation and depreciation of the real exchange rate of the dirham.

There is a negative relationship between the LRER and FDI. An increase in foreign direct investment inflows in the UAE by one unit (one million US dollars) reduces the real exchange rate by 1.51%. The decrease of the RER means a real appreciation of the dirham. When foreign investment increases in the UAE there will be an increase in the domestic money supply. An increase in domestic money supply growth will tend to increase the domestic money demand and in the process will increase the rate of inflation. A higher domestic inflation, without an offsetting depreciation of the dirham will then lead to a real appreciation of the dirham.

5.2 Results from the Granger Causality Tests

After having identified the existence of a long run relationship between the real exchange rate and the oil price, gross domestic product per capita, trade balance, and foreign direct investment inflows, in this section we will show the results of the short run dynamics between the variables based on the VECM. First we will test for Granger causality with log real exchange rate as the dependent variable, followed by log oil price, log GDP and finally TB as the dependent variable. 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: Granger Causality Results with LOG RER as the Dependent Variable

	∑DLOG RER	∑DLOG OP	∑DLOG GDP	∑DFDI	∑DTB	ect(-1)
F-stats.	3.844927* (1)	3.964921** (2)	2.577652* (2)	2.054468** (2)	2.851115** (1)	-2.016995*

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: Granger Causality Results with LOG OP as the Dependent Variable.

	∑DLOG OP	∑DLOG RER	∑DLOG GDP	∑DFDI	∑DTB	ect(-1)
F-stats.	6.461967*(1)	5.672070**(2)	4.862561*(1)	7.435727 (1)	5.645578**(1)	-2.580604**

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: Granger Causality Results with LOG GDP as the dependent variable.

	∑DLOG GDP	∑DLOG RER	∑DLOG OP	∑DFDI	∑DTB	ect(-1)
F-stats.	3.195865*(2)	1.552430(2)	4.653126**(1)	5.615486** (3)	7.863933**(1)	-2.531715**

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 10: Granger Causality Results with TB as the Dependent Variable

	∑DTB	∑DLOG RER	∑DLOG GDP	∑DLOG OP	∑DFDI	ect(-1)
F-stats.	5.402075 * (1)	5.927652** (1)	0.401265 (1)	2.902368 (1)	1.945696 (1)	2.239467*

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.

It is clear from Table 7 above that log OP, log GDP, FDI, and TB all Granger caused log RER and they are all significant at least at the 10% level. In addition the coefficient of the ect (-1) term is also significant but only at the 10% level; this indicates there is a long run impact of log OP, log GDP, FDI, and TB on log RER.

Table 8 shows that the real exchange rate and the trade balance have significant short run causal effects on the oil price at the 5% level and for gross domestic product per capita at the 10% level. The only exception is FDI inflows which do not seem to have any significant short run causal effect on the oil price, but this result is expected. Also the ect(-1) term is significant at the 5% level, which indicates long run causality running from log RER, log GDP, FDI and TB to the oil price.

It is obvious from Table 9 above that the oil price, FDI inflows and trade balance Granger caused the GDP in the short-run at the 5% level of significance except for the real exchange rate, which has no significant short run causal effect on GDP. Also the coefficient of ect(-1) is significant at the 5% level, indicating long run causality from the real exchange rate, foreign direct investment inflows, oil price, and trade balance to GDP.

Finally, it is clear from Table 10 that log RER Granger caused the TB in the short-run at the 5% level of significance, while log OP, log GDP, and FDI have no significant short-run causal effect on TB. Also the coefficient of the ect(-1) term is significant at the 5% level, indicating long run causality from log RER, log OP, log GDP, and FDI to TB.

From the above analysis, we found bi-directional short-run causality between (1) the real exchange rate and the oil price; (2) oil price and GDP per capita; and (3) RER and the trade balance, There is also evidence of unidirectional causality from (1) GDP to RER and (2) FDI to RER. In summary, all the four variables, log OP, log GDP, FDI and TB Granger causes RER in both the short run and the long run. The coefficient of the lagged ect term is - 0.281532, thus satisfying our a priori expectations.

6. Discussion of the Results

The cointegration results indicate there is a long run relationship between the real exchange rate of the dirham against the dollar and the oil price, GDP per capita, FDI inflows and the trade balance of the UAE. The most important finding in the cointegration test is that oil price has a positive long run relationship with the real exchange rate and that an increase in the price of oil will lead to a real depreciation of the UAE dirham.

From the Granger causality test we found that the oil price, GDP per capita, trade balance, and FDI inflows Granger cause the real exchange rate in the short run and that 28.2% of the disequilibrium in the real exchange rate is corrected within a year. In other words, it takes 3½ years for the real exchange rate to return to its long run equilibrium level. In addition, the empirical results indicate two-way causality between the oil price and real exchange, thus indicating that both the real exchange rate and the oil price are endogenously determined.

The pegged exchange rate to the US dollar seems to have worked well up to 2002 in stabilizing inflation in the UAE. Before 2003, the rate of inflation in the UAE has tracked closely with the U.S. inflation rate. However, since the fourth oil shock in 2003 the fixed exchange rate does not seem to be effective in controlling inflation and stabilizing the dirham real exchange rate any more. In recent years, the UAE has been facing high levels of 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 the UAE.

In view of these events, we recommend that the UAE monetary authority pegs the dirham to a basket of currencies including the US dollar, Japanese yen and euro to control for the high levels of inflation caused by the increase in oil prices, because pegging the dirham to only one currency will make the stance of monetary policy tighter. We suggest that the yen, UK pound and the euro, besides the US dollar to be included in the basket because Japan is the most important trade partner of the UAE followed by the European Union member countries, especially the United Kingdom. By adopting this regime we expect that when the US dollar depreciates, the other currencies in the basket can help reduce the negative effect of the dollar depreciation on the dirham and the UAE economy. For instance, Kuwait has adopted a basket peg since 2003 by pegging its currency (dinar) to the yen, euro, UK pound and the US dollar (the National Bank of Kuwait, 2003) and this seems to be successful in reducing the level of domestic inflation.

In addition, we suggest that the UAE uses the revenue derived from petroleum to develop the other economic sectors, so as to reduce its dependency on oil and to decrease the impact of oil price fluctuations on its economy. It is important for the UAE to develop its financial market so that the role of monetary policy can be made more effective in dealing with the high levels of inflation, the huge financial surpluses, the economic cycles and hence achieve the goal of price and economic stability. These financial surpluses are a result of the sharp rise in oil prices, which in turn caused unexpected increases in its economic activities. Also increases in the oil price have caused increases in asset prices, and in turn, increases in the cost of living and inflation, with inflation reaching 134% in 2007.

It is suggested that future studies preferably cover all the oil shocks to get a better picture of the relationship between the oil shocks and the real exchange rate. We also support that future studies dealing with the effect of oil shocks on the exchange rate also includes oil production as one of the variables, as it may have a significant effect on the real exchange rate.

7. Conclusion

This study investigated the impact of oil shocks on the real exchange rate of the UAE dirham, using annual time series data from 1977 to 2007. The model has five variables with the real exchange rate as the dependent variable and oil price, gross domestic product per capita, trade balance, and foreign direct investment inflows as the independent variables. We used the Johansen-Juselius cointegration procedure, and conducted the Granger causality tests based on the VECM. In the cointegration analysis we found that the oil price, GDP per capita, trade balance and FDI inflows have a long run relationship with the real exchange rate, while in the Granger causality test we found bi-directional short-run causality between (1) the real exchange rate and the oil price; (2) oil price and GDP per capita; and (3) the real exchange rate and the trade balance, There is also evidence of unidirectional causality from (1) GDP to the real exchange rate and (2) FDI inflows to the real exchange rate. In summary, all the four variables Granger causes the real exchange rate in both the short run and the long run.

We concluded in this study that the pegged exchange rate to the US dollar is not an appropriate regime for the UAE, as it was found to have a negative impact on the UAE economy. When the oil price increased, with a tightly fixed exchange rate regime, the resulting financial surpluses were found to have a significant impact on the patterns of spending and investment, and also resulted in large and sudden increases in liquidity, high asset prices, lack of control on consumer prices and thus resulting in high levels of inflation and instability to its economy.

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