Oil Shocks and Kuwait's Dinar Exchange Rate: the Dutch Disease Effect

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Abstract

This study investigates the impact of oil prices on the exchange rate in Kuwait which uses the fixed exchange rate regime to the US dollar. Time series data from 1970-2008 covering all the oil shocks are used. In order to achieve the results of this study, the VAR model, the Johansen-Juselius Multivariate Cointegration test and the Granger causality test are implemented. Due to the results we have arrived at, we recommend that Kuwait either maintains its exchange rate regime (pegged to a basket of currencies), or uses a crawling peg regime.

1. Introduction

The Dutch disease theory tackles the increase in a country's revenues that comes from its natural resources (oil, natural gas) causing an appreciation of the local currency. This makes the manufacturing goods less competitive and the services sector entangled with the business interests. This theory emerged in 1959 during the following of the discovery of a large natural gas field in the Netherlands.

One of the famous models that explains the Dutch disease is the Core model. This model which is used to explain the Dutch disease effect was developed by Corden and Neary in 1982. The model consists of the non-tradable sector (the services sector) and two traded sectors, the booming sector (oil or natural gas) and the non-booming sector (the manufacturing sector).

This model showed that during the natural resource boom in the natural resources there will be an increase in the demand for labor in the booming sector away from the non-booming sector (the non-tradable sector and the lagging sector) and this will cause a reduction in the production in both the lagging sector and the non-tradable sector. Also, the increase in the country's revenue will increase the demand for the goods of the non-tradable sector (the services sector) and the price of these goods will increase. To be more specific, the profitability of the lagging sector will fall, while the profitability of the non-traded sector increases due to the spending effect and fall due to the resource movement effects. However, the booming sector's profitability will increase due to the resource movement effect and fall due to the spending effects.

Many studies have investigated the impact of the Dutch disease during the oil shocks. The evidence shows that the Dutch disease exists. Examples include Corden & Neary's (1982) study of Egypt, Indonesia, and the Gulf countries, Bruno & Sachs (1982) study of the United Kingdom, Adam's study (2003) in the African countries, Égert's (2007) in Kazakhstan, Akpan's (2007) in Nigeria, and Oomes & Kalcheva's (2007) in Russia. All these researchers found that the Dutch disease exists causing a real appreciation of the national currency and reducing the share of the manufacturing sector in the countries they investigated.

Some studies found that a fixed exchange rate regime can also help to reduce the effect of the Dutch disease but with a higher inflation compared with the flexible exchange rate (Neary, 1987). Also Corden & Neary (1982) in another study found that only the labor was mobile, causing a decline in the labor in the non-booming sector and an increase in prices of non-traded and other traded goods. Neary (1982) found that for the countries that use the fixed exchange rate regime, the effect of the Dutch disease is reduced but will result in higher inflation than the countries that use the floating exchange rate. However, Lartey (2007) found that the Dutch disease exists under fixed exchange rates regime.

Looney (1991) found out that when the government reduces its expenditure, it helps to reduce the effect of the Dutch disease during a resource boom. However, Budina et. al. (2007) found that the instability in government expenditure is the cause of the reduction in the non-oil growth rather than the Dutch disease.

Roemer (1994) and Usui (1996) both found that the effect of the Dutch disease in Indonesia is small because the Indonesian government changed its exchange rate regime to the crawling peg regime in 1987 and that helped it to maintain the real value of its local currency.

In this study we will examine if the Dutch disease exists in Kuwait. We choose Kuwait because this country uses the fixed exchange rate to the US dollar for more than three decades. We would like to examine if the fixed exchange rate regime is an appropriate regime for Kuwait. Kuwait is an important OPEC member, and petroleum plays an important role in its economy. Oil contributes more that 90% of Kuwait's total exports and 95% of its foreign earnings.

2. Methodology

In this study, the Vector Autoregression (VAR) methodology will be used. The vector autoregressive (VAR) model is used for forecasting a system of interrelated time series and 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 goal of this study is to find out whether the oil price will cause the Dutch disease in a country that is using the fixed exchange rate regime like Kuwait by causing a real exchange rate appreciation. Model (1) shows the vector of endogenous variables.

$$\mathbf{Log\ REXCH_t = \alpha + \beta_1 \log OP_t + \beta_2 \log GDP + \beta_3 TB_t + \beta_4 LOEXPV_t + \varepsilon_t} \qquad (1)$$

where

α is the intercept

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

Log REXCH is the log of real exchange rate (national currency per US dollar)

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

Log GDP is the log of gross domestic product (millions of US dollar)

Log TB is the trade balance (millions of US dollars)

Log OEXPV is the value of petroleum exports (millions of US dollar)

ε is the error term.

3. Data Source

The nominal exchange rate, oil price, trade balance, value of petroleum exports, and the gross domestic product are taken from the OPEC data statistics.

4. Estimation Procedures

4.1 Test for Stationarity

Since we are using time series data, it is important for us to examine if the variables are stationary or not, thus we will use the unit root test in this study, namely the Augmented Dickey Fuller test (ADF). This test can help us to find out if the variables are stationary of order I (0) or I (1). If we find that all the variables are stationary at the first difference then the cointegration test will be employed to find out whether the independent variables have a long run relationship with the dependent variable.

4.2 Cointegration Test

Johansen (1988) and Johansen-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, therefore, 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 by using the Akaike Information Criteria.

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

$$y_t = \mu + \sum_{k=1}^{p} \Pi_k y_{t-k} + \varepsilon_t \qquad (2)$$

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 four independent variables and one dependent variable. In estimating the VAR, we will limit the maximum lag length to only two lags due to the limited number of observations in this study (n = 31). Equation (2) above can be rewritten in the first difference form as follows:

$$\Delta y_t = \mu + \sum_{k=1}^{p-1} \Gamma_k \, \Delta y_{t-k} + \Pi \, y_{t-1} + \varepsilon_t \qquad (3)$$

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 procedure 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:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{g} \ln(1-\lambda_i) \qquad (4)$$

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 means 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:

$$\lambda_{max}(r, r+1) = -T\ \ln(1 - \lambda_{r+1}) \qquad (5)$$

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.

4.3 Granger Causality Test

The Granger approach (1969) to answer 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 be Granger-cause variable y if the 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 (6) and the set of estimated coefficients on the lagged values of y in equation (7) below is not significantly different from zero.

$$y_t = \sum_{i=1}^{k} \alpha_i y_{t-i} + \sum_{i=1}^{k} \beta_i x_{t-i} + u_{1t} \qquad (6)$$

$$x_t = \sum_{i=1}^{n} \lambda_i x_{t-i} + \sum_{i=1}^{n} \theta_i y_{t-i} + u_{2t} \qquad (7)$$

Conversely, unidirectional causality from y to x exists if the set of lagged coefficients of y in equation (7) is statistically significantly different from zero but the set of lagged coefficients of x in equation (6) is not. Bilateral causality between x and y exists when the set of lagged coefficients of x in equation (6) and the set of lagged coefficients of y in equation (7) are both statistically significantly different from zero. Lastly, there is an independence between x and y when the lagged coefficients of x in (6) and the lagged coefficients of y in (7) 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. The direction of Granger causality in the short run and the long run can be determined by 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 that is 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 (8)):

$$\Delta REXCH_t = \alpha_1 + \beta_1 ect_{t-1} + \sum_{i=1}^{l} \xi_i \Delta REXCH_{t-1} + \sum_{i=1}^{l} \varphi_i \Delta \log(OP)_{t-1} + \sum_{i=1}^{l} \delta_i \Delta \log(OEXPV)_{t-1} + \sum_{i=1}^{l} \lambda_i \Delta \log(GDP)_{t-1} + \mu_1 \qquad (8)$$

In equation (9) above, Δ is the first difference operator, α_i is the constant term, $\beta_{i,}$ $\xi_{i,}$ $\varphi_{i,}$ $\delta_{i,}$ γ_i and λ_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 (equation (9)) as follows:

$$\Delta REXCH_t = \alpha_1 + \sum_{i=1}^{l} \xi_i \, \Delta REXCH_{t-1} + \sum_{i=1}^{l} \varphi_i \Delta \log(OP)_{t-1} + \sum_{i=1}^{l} \delta_i \Delta \log(OEXPV)_{t-1} + \sum_{i=1}^{l} \lambda_i \Delta \log(GDP)_{t-1} + \mu_1 \qquad (9)$$

5. Empirical results

The ADF tests showed that all the variables in the exchange rate model are stationary at the first difference at the 1% level of significance, with the exception of the trade balance variable which is stationary at the first difference at the 5% level of significance.

Table 1: ADF Unit Root Test Results

Variable	Level		First Difference	
	Intercept	Intercept and Trend	Intercept	Intercept and Trend
Log REXCH	**-2.420383**	**-0.621373**	**-2.271312**	**-4.782667*** **
Log GDP	**-0.917373**	**-1.912605**	**-5.632336*** **	**-5.489028*** **
Log OEXPV	**-1.883335**	**-2.491900**	**-6.853009*** **	**-6.296778*** **
TB	**-1.790198**	**0.266855**	**-2.915570** **	**-1.523496**
Log OP	**-2.470958**	**-2.556607**	**-5.583953*** **	**-5.631070*** **

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

5.1 Johansen-Juselius Multivariate Cointegration Test Results

Since we found all the variables are stationary at the first difference we can use the cointegration test to find whether a long run relationship exists between the independent variables and the dependent variable. Since the cointegration test is very sensitive to the lag length, hence, before we run the cointegration test we will test for the optimal lag length for the real exchange rate model. From the lag length results we find the optimal lag length is lag 4.

Table 2: Lag Length Selection from VAR Estimates

VAR Lag Order Selection Criteria
Endogenous variables: LREXCH LOP TB LOEXPV LGDP
Exogenous variables: C
Date: 07/07/10 Time: 08:13
Sample: 1972 2008
Included observations: 33

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-341.3707	NA	900.4277	20.99216	21.21891	21.06845
1	-222.5662	194.4073*	3.120834*	15.30704	16.66750*	15.76480*
2	-202.2856	27.04088	4.646346	15.59306	18.08724	16.43228
3	-171.2626	31.96304	4.407030	15.22804	18.85593	16.44871
4	-131.4962	28.92099	3.671024	14.33311*	19.09472	15.93524

* 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 3: 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 *	0.980865	265.4498	76.97277	0.0000
At most 1 *	0.841838	138.8509	54.07904	0.0000
At most 2 *	0.801009	79.83864	35.19275	0.0000
At most 3 *	0.503709	28.17477	20.26184	0.0033
At most 4	0.164619	5.755775	9.164546	0.2104

Trace test indicates 4 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: 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 *	0.980865	126.5989	34.80587	0.0000
At most 1 *	0.841838	59.01225	28.58808	0.0000
At most 2 *	0.801009	51.66387	22.29962	0.0000
At most 3 *	0.503709	22.41899	15.89210	0.0041
At most 4	0.164619	5.755775	9.164546	0.2104

Max-eigenvalue test indicates 4 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 3 shows the cointegration trace statistics results and Table 4 shows the cointegration maximum eigenvalue results. In the cointegration rank test based on the trace and the cointegration rank test maximum based on the Eigenvalue we find four cointegrating equations at the 5% level of significance. This indicates a long run relationship between EXCH and the independent variables OP, LOEXPV, GDP, and TB.

After having found a long run relationship between the dependent and the independent variables, the equation will be normalized on the exchange rate, since the objective in this study is to find out whether the long run relationship exists between the log EXCH and the other variables. Table 6 below shows the normalized cointegration vector.

Table 5: Cointegration Equation Normalized With Respect To LEXCH

LREXCH	LOP	TB	LOEXPV	LGDP	C
1.000000	-0.015831	1.82E-05	0.059738	-0.458595	5.342513
	(0.00228)	(4.3E-07)	(0.00308)	(0.00415)	(0.03094)

From Table 5, the long run log RER equation can be written as:

LEXCH= -5.342513-0.059738logLOEXPV+0.458595logGDP- 1.82E-05TB+0.015831logOP (10)

From equation 10 we find that LOP and LGDP are positively related to Kuwait's LEXCH, while TB and LOEXPV are negatively related to the LEXCH.

The relationship between Kuwait's exchange rate and the petroleum export value is negative. An increase of 1% in the consumer price will decrease the exchange rate (appreciate) by 0.059%. When petroleum exports increase the foreign capital inflows will increase and that will lead to an appreciating of Kuwait's currency.

The relationship between Kuwait's exchange rate and the gross domestic product is positive. An increase of 1% in its gross domestic product will increase the exchange rate (depreciate) by 0.458595%.

The increase in oil prices especially during the fourth oil shocks of 2003-2008 caused a rapid economic growth and liquidity in Kuwait. With the fixed exchange rate to the US dollar, this made the monetary policy less effective to deal with those events, hence, the price level increases and this leads to higher inflation. According to this, the oil price is positively related to the exchange rate with an increase of 1% in the oil price. This will cause Kuwait's exchange rate to increase (depreciate) by 0.015831%.

We find that the trade balance is negatively related to Kuwait's exchange rate with an increase of one million dollars in the trade balance. This leads to a fall in the exchange rate by 0.0000182%. Since the increase in the trade balance causes an increase in the foreign earnings' this will cause an appreciation in Kuwait's exchange rate.

5.2 Granger Causality Results

The F-test results show that due to the two variables, namely the oil price and the petroleum export value Granger causes Kuwait's exchange rate in the short run. The t-test is significant for the lagged error correction term (ect (-1)). This indicates that all the variables Granger causes the exchange rate in the long run. The most important finding in the Granger causality test is that the oil prices Granger causes Kuwait's exchange rate positively. This means that the increase in oil prices will cause Kuwait's exchange rate to depreciate in the short run. Table 6 shows the results for the granger causality test.

Table 6: Granger Causality Results with LOG EXCH as the Dependent Variable

	∑DLOGREH	∑DLOGOP	∑DLOGOEXV	∑DLOGGDP	∑DTB	ect(-1)
f-stats	**5.018717****	**3.050987****	**3.822362****	**1.843909**	**0.153179**	**-7.368983****

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.

6. Discussion of results

This study aims at finding out whether the Dutch disease exists in Kuwait using time series data from 1972-2008 covering all the oil shocks. Kuwait uses a fixed exchange rate regime. Since the Dutch disease theory can be explained by the increase in a country's revenues that come from its natural resources (oil, natural gas) causing an appreciation in the local currency. From the cointegration analysis, we found no evidence that the Dutch disease exists in Kuwait because the increase in oil prices caused Kuwait's exchange rate to depreciate. Also there is no effect of the Dutch disease in the short run. This can be seen from the Granger causality results that the increase in oil prices Granger causes Kuwait's exchange rate positively in the short run. This means that the oil price causes Kuwait's exchange rate to depreciate. The explanation above shows that the Dutch disease does not exist in the short run and the long run in Kuwait's case.

the results above show that the fixed exchange rate regime can help to caution the Dutch disease effect on the economy. Neary's (1982) results support the results of this study because he found that the fixed exchange rate can help to absorb the Dutch disease effect but the consequence is high inflation. This can be seen in the oil exporting countries that are pegging its exchange rate to the US dollar like the UAE, Iraq, Qatar, and Saudi Arabia during the recent years especially in the last oil shocks of 2003-2008. These countries suffered from high levels of inflation than the US. Kuwait government has been using the basket peg (yen, UK pound and the euro, besides the US dollar) since 2002. This exchange rate regime seems to have been successful in reducing the level of domestic inflation. So it is better for Kuwait to maintain its exchange rate regime (pegged to a basket of currencies) or use a crawling peg regime which helped Indonesia reduce the Dutch disease effect and maintain its currency value (Roemer, 1994) and (Usui, 1996).

7. Conclusion

This study investigated the impact of oil prices on the exchange rate in Kuwait which uses the fixed exchange rate regime to the US dollar. We used time series data from 1970-2008 covering all the oil shocks. In this study, the VAR model, the Johansen-Juselius Multivariate Cointegration test and the Granger causality test are implemented. In the cointegration test, we found that the two variables, namely, oil price and the gross domestic product have a long run positive relationship with the exchange rate in Kuwait, while the trade balance and the oil exports value have a long run negative relationship with Kuwait's exchange rate.

According to the Granger causality test results we found that all the variables granger causes Kuwait's exchange rate in the long run, while the oil price Granger causes Kuwait's exchange rate in both the short and the long run. Based on our results, we recommend that Kuwait either maintains its exchange rate regime (pegged to a basket of currencies), or uses a crawling peg regime.

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