Can oil prices forecast the Algerian exchange rate?

Kamel Si MOHAMMED, Sidahmed ZENAGUI, Abderrezak BENHABIB

Abstract— **The goal of this study is to investigate the relationship between oil price and nominal US Dollar/Algerian Dinar exchange rate through an empirical analysis using a VECM Model (Vector Error Correction Model) upon monthly data for the period 2008-2015. Results show that a cointegration relationship is detected between oil and exchange rate in Algeria, with bilateral trend causality in short and long run time horizon. Furthermore, the out-of sample predictive indicates that a change in oil price would tend to depreciate Algerian Dinar against US Dollar. This negative impact emphasizes how the Algerian dinar is a non-oil currency and explains how the foreign exchange receipts from hydrocarbon exports help swell Algerian public spending that would cater for public budget deficit curtailment.**

Index Terms— **oil price, Algerian Dinar, exchange rate, VEC Model.**

I. INTRODUCTION

Oil and gas revenues constitute the dominant income of the Algerian economy. This sector accounted, between "2002 – 2014", for 98% of exports, more than 40 % of GDP and 46 to 70 % of government revenue, see **Figure 1,** while trade openness, **see Table 1,** exhibits a high figure of 60% in the same period.

As far as the Algerian exchange rate is concerned, the central bank adopted, since 1996, a managed floating exchange rate after a long experience with the former regime (1974-1995)[1] that was built upon a strong concentration of the US dollar that played an important role due to its 98% in hydrocarbon export receipts. Between January 2003 and January 2013, the Algerian exchange rate has varied continuously; from January 2003 to September 2008, the U.S dollar depreciated monthly against the Algerian Dinar by about 19%, followed by a depreciation of 6% during the financial crisis. Between January 2010 and January 2013, the Algerian dinar depreciated against the U.S. dollar by 4.2%. Oil price showed during these periods' remarkable changes with +152%, -9%, +37%.

This contradictory situation between oil price and the US/Algerian Dinar exchange rate remains the main issue to be dealt with in this paper.

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[1] Algerian exchange rate was based upon a basket of 14 currencies.

The goal of this study is to investigate whether the oil prices can forecast the nominal US Dollar/Algerian Dinar exchange rate through an empirical analysis using a VECM Model (Vector Error Correction Model) upon monthly data for the period 2008-2015.

The rest of the paper is organized as follows. In section 2 we present a Literature Review on the relationship; Section 3 presents the Model and the Methodology, followed by the results and discussion showed in Section 4, and finally, Section 5 presents the main conclusion.

II. LITERATURE REVIEW

The oil price and the US dollar are the most attractive indices in the financial market. As the Algerian economy is highly vulnerable to oil price and US dollar fluctuations, we shall investigate, in this section, the dynamic relationship between oil price and exchange rates.

Firstly, Oil price plays a strategic role in the global economy. Many studies have highlighted its different impacts on macroeconomic variables such as GDP growth, unemployment rates, inflation, Stock market...(see: **Rasche, R. H. and J. A. Tatom (1977)[i],Darby (1982)[ii], Hamilton (1983 [iii], 1996 [iv], 2003 [v]), Rotemberg and Woodford (1996)[vi],Eltony and Al-Awadi (2001)[vii], Brown and Yücel (2000[viii]), Blanchard and Gali (2007)[ix], Bjørland (2008)[x].**

Secondly, the U.S. dollar is the most important currency in the world economy. It plays a major role in the pricing of oil and other commodities in the financial market. The domination of the US dollar in international trade as a currency commodity lets this currency serve as a central currency in the exchange rate arrangements of many countries in each area **(Linda S. G 2010)[xi].**

In the past years, particularly before 2002, oil price and US Dollar were moving in the same direction, when the US dollar rises, the price of oil is pushed up, and conversely, when the oil price increases, the US Dollar is appreciated. Since this period, the relationship between the two variables has changed because of the advent of many factors such as oil companies' targets, the role of the Euro currency, geopolitics, alternative sources of energy, speculators and Federal Reserve policy, and so forth…

In contrast, oil prices have risen while the dollar continued to weaken against other major currencies and the depreciation of the dollar could explain, therefore, the increase in oil prices. Since 2002, the price of a barrel of oil has increased fourfold, moving from $26 in 2002 to $107 in 2012. On the other hand, the U.S Dollar/Euro declined annually from 0.944 $US to $1.43 in 2010. Hence, many studies believe there are negative reverse causality between the U.S dollar and oil price during the last period (See, **Coull, 2009[xii], Verleger (2008)[xiii], Setser (2008)[xiv],Virginie (2008)[xv]).**

The study of Chen and **Rogoff (2003)[xvi]** detected a strong and stable influence of the US dollar price of non-energy

commodity exports on the real exchange rates in two countries (Australia, New Zealand). **Joyce and Kamas (2003)** [xvii] used a cointegration technique to arrive at the conclusion that there is a relationship between oil price and exchange rate in Colombia and Mexico. **Akram (2004)** [xviii], found out that there is a non–linear negative relationship between oil price and the Norwegian Krone over the sample between January 1986 and August 1998. Furthermore, this negative correlation varies along with the level and the trend in oil prices.

Koranchelian (2005) [xix] finds that in the long-run, Algeria's real exchange rate is time varying, and depends on movements in relative productivity and real oil price. **Issa et al. (2006)** [xx] pointed out in their study the depreciating effect of the energy price on the Canadian dollar before 1993 and the appreciation of the Canadian currency after this year. **Zalduendo (2006)** [xxi] used a vector error correction model to determine the impact of oil prices on the real equilibrium exchange rate in Venezuela. **Habib & Kalamova (2007)** [xxii] investigated whether the real oil price has an impact on the real exchange rates of three main oil-exporting countries: Russia (1995-2006), Norway and Saudi Arabia (1980-2006). In the first country, the authors found a positive long-run relationship between the real oil price and the real exchange rate. On the Contrary, for Norway and Saudi Arabia, results show that there is no impact between the two variables.

In Nigeria, many studies have used different types of empirical methods and examined the impact of oil price on exchange rate. While, **Olomola and Adejumo (2006)** [xxiii] observed a positive impact where the oil price Shocks led to an exchange rate appreciation, **Iwayemi and Fawowe (2010)** [xxiv], and **Adeniyi (2011)** [xxv] presented a negative relationship between oil price and exchange rate.

Korhonen et al. (2007) [xxvi] estimated the real exchange rate in OPEC countries from 1975 to 2005 and three oil-producing Commonwealth Independent States (CIS) from1993 to 2005 using panel co-integration methods. Their results show that real oil price has a direct effect on the equilibrium exchange rate in oil-producing countries. **Nikbakht (2010)** [xxvii] studied the long-run relationship between real oil prices and real exchange rates from 2000 to 2007 by using monthly panel of seven OPEC countries (Algeria, Indonesia, Iran, Kuwait, Nigeria, Saudi Arabia, and Venezuela). His result show there is a long-run and positive linkage between real oil prices and real exchange rates in the OPEC countries.**Chen and Chen (2007)** [xxviii] carried out a similar analysis for G7 countries and they found a long run relationship between real oil prices and real exchange rates.

Colemanet all (2012) [xxix] found that shocks in the real price of oil are particularly important in determining the real exchange rates, even in the long run for a pool of African countries.

Beckmanna and Czudaj (2013) [xxx] pointed out in their study causality relationship between from effective dollar prices to oil prices through Markov-switching vector error correction model.

Nicolas Apergis (2014) [xxxi] examined whether gold prices can be forecast the real and nominal Australian dollar exchange rate using daily and quarterly data via error correction model (ECM) during the period 2000-2012 , his results provided that gold price contain information about future development of the Australian dollar exchange rate.

Ferraro , Regoff and Rosi (2015) [xxxii] investigated the existence of very short term relationship at the daily data between commodity prices and exchange rate, with their results indicated the out of sample forecasting have been appropriately taken into account.

All of these contributions are presented in Table 2.

III. Model and Methodology

- **Data source**

In our analysis, we make use of two macroeconomic variables: oil prices (oil) and US dollar/Algerian Dinar (US/DZ). The sample comprises 85 Monthly observations for the period 2008 - 2015.The sources of these variables are collected from different issues of International financial Statistics, IMF and world development indicators.

- **Definition of the VECM Model**

In this case, non-stationary and bilateral co integrated series, the vector error correction (VECM) would be best to use in this case and for forecasting systems of interrelated time series and for analyzing the dynamic impact of random disturbances on the system of variables.

The mathematical representation of a VECM is:

$$\Delta y_{1,t} = a_1 (y_{2,t-1} - b y_{1,t-1}) + e_{1,t}$$

$$\Delta y_{2,t} = a_2 (y_{2,t} - 1 - b_{y1,t-1}) + e_{2,t}$$

Where y_1 and y_2 deviate from the long run equilibrium, the error correction term will be nonzero and each variable adjusts to partially restore the equilibrium relation. The coefficient measures the speed of adjustment of the *i*-th endogenous variable towards the equilibrium.

1- Results and Comment

Before presenting the results from the empirical VEC Model, we shall be applying the following econometric steps:

- ✓ Test the stationary of the time series data by Augmented Dickey-Fuller& Philips and Perron.
- ✓ Analysis co-integration tests
- ✓ Causality test.
- ✓ Forecasting exercise

2-Stationarity tests

Most classical econometric estimations as least square method (GLS) based on non-stationary time series produce spurious regression and statistics may simply indicate only correlated trends rather than a true relationship **(Granger and Newbold, 1974)** [xxxiii]. Augmented **Dickey-Fuller (1979, 1981)** [xxxiv]and **Philips and Perron, (1988)** [xxxv] tests can help avoid false results through stationary test of times series**.** Our results drawn from stationary tests represented in tables (2) and (3) allow a rejection of the null hypothesis in first difference that signify no stationarity in all our series, but enable an acceptation at a level, that signify integration of the variables at order 1.

Table 2: Stationary test results

Variables	ADF		PP	
	Level	First difference	Level	First difference

Lnoil	-1.49	-5.423280	-2.420484	-5.257452
Lnusdz	-1. 07	--5.189394	- 0.312659	-5.327423
Test critical values	-3.51 at 1% -2.88 at 5%			

3-Analysis of co-integration tests

In order to explain the relationship between oil price and the Algerian exchange rate in long run, **Engle and Granger (1981, 1987)** [xxxvi], in their paper, estimated cointegration of non-stationary time-series variables for demonstrating the existence of cointegration between two macroeconomic variables implies "a true long-run economic relationship" which prevents the residuals

The results of the Signal-equation co-integration test indicate that there is one minimum short run relationship between exchange rate of Algerian and oil price (no cointegration at the 0.05 level, (**see Tables 3**).

Table 3: Cointegration test

Dependent	tau-statistic	Prob.*	z-statistic	Prob.*
LN_PRICE_	-2.653672	0.2349	-20.79026	0.0241
LN_USD_DZD_	-0.518784	0.9618	-0.993626	0.9685
*MacKinnon (1996) p-values.				

4-Granger causality

In this case, we use Granger causality tests of Clive Granger (1969) for determining whether oil prices is useful in causing the Algerian exchange rate with lagged values of two variables included. Granger causality test reported in table 4 made it clear that two directional flow at 5% significance level for oil prices to Algerian exchange rate and the reverse. This bidirectional relationship can be clarified how the Algerian Dinar is depend on oil prices change to the effect that the foreign exchange receipts from hydrocarbon exports.

Table 4: Granger causality

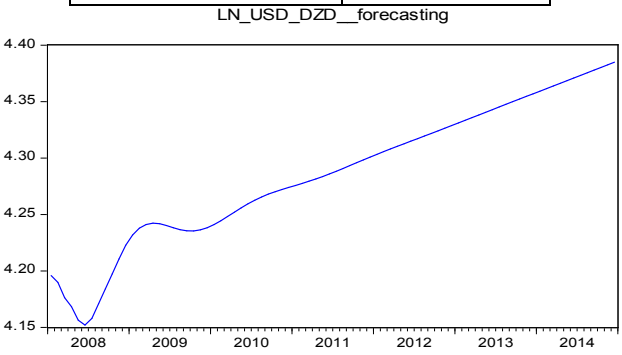
Pairwise Granger Causality Tests			
Lags: 2			
NullHypothesis:	Obs	F-Statistic	Prob.
LN_USD_DZD_ does not Granger Cause LN_PRICE_	46	8.54778	0.0008
LN_PRICE_ does not Granger Cause LN_USD_DZD_		3.80746	0.0304

- **Oil prices and the Algerian exchange rate: a forecasting exercise**

The final step consist of forecasting the future values of the Algerian exchange rate by using past values of the oil prices for prediction. Usually through a series from M1 2008 to M12 2011 as period estimation and resample the full period (M1 2012) to M1 2015 as out-of sample forecast period. Then, we compare forecasts and real the Algerian exchange rate by using Root Mean Squared Error and Theil Inequality Coefficient. The main result is that the Algerian exchange rate can be forecasting by fundamentals complemented with oil price, when change in prices contain information about future movement Algerian exchange rate.

Table 5: Forecasting results

Forecast:	LN_USD_DZD___f
Actual:	LN_USD_DZD_
Forecast sample:	2008M05 2014M12
Root Mean Squared Error:	0.032886
Mean Absolute Error:	0.024193
Mean Abs. Percent Error:	0.572894
Theil Inequality Coefficient:	0.003871



- **Accounting for the findings**

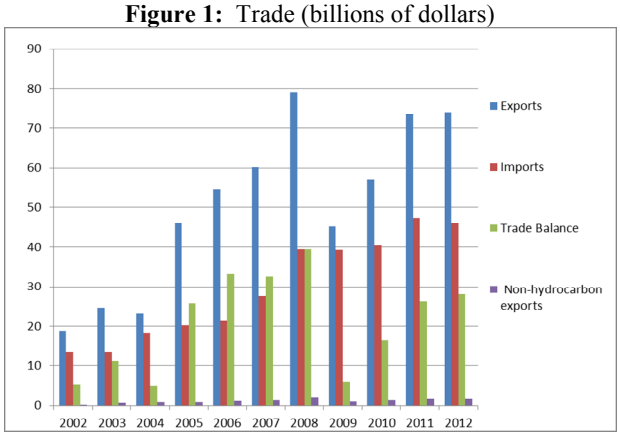
In the case of Algeria, The main conclusion is that the Algerian exchange rate can be explained by fundamentals complemented with oil price. In fact, high prices of oil generally provoke a large appreciation of exchange rates in oil-exporting countries, but this evidence is not clearly established in the Algerian case, evidenced over the last decade with the non-existence of a co-integration relationship between the Algerian exchange rate and oil price.

IV. Conclusion

In this paper, we investigated if the oil price in US dollar and nominal exchange rate USD/ Algerian Dinar have a cointegrated relationship in the run long. Our results show that there is a cointegrated relationship. However, the estimation of a VECM model indicates that a 1% increase in oil price would lead the Algerian Dinar to depreciate to 0.25% against US Dollar. Finally, we concluded that change in oil prices contain information about future movement Algerian exchange rate.

Appendix

Figure 1: Trade (billions of dollars)



Source: World Development Indicators.

Table (1): GDP & government revenues dependency on oil

	2004	2005	2006	2007	2008	2009	2011	2012	2013
Share of oil in GDP (%)	35.5	45	45.4	43.3	45.4	31.6	39	31.7	34
government expenditure (billions of dollars)	44.4	46.1	50.8	57.6	73.9	67.4	81	91.4	100
Trade Openness (%)	58,1	64,8	64,9	64,6	69,4	60,2	71	53,9	64

Source:* IMF Country Report of Algeria from 2004-2012.
**Statistics Algeria, The ministry of Finance: http://www.mf.gov.dz/rubriques/15/Activités.html.

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