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The Relationship Between Oil Price and the Algerian Exchange Rate

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Abstract

The goal of this study is to investigate the relationship between oil price and the nominal US Dollar/Algerian Dinar exchange rate through an empirical analysis using a VAR Model (Vector Autoregressive Model) upon monthly data for the period 2003-2013. Results show that a cointegration relationship is not detected between the oil and exchange rate in Algeria. However, the estimation of a VAR model indicates that a 1% increase in oil price would tend to depreciate Algerian Dinar against US Dollar by nearly 0.35%. 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.

Keywords: *oil price, Algerian Dinar, exchange rate, VAR Model.*

JEL Classification: C32, F31, Q43

I. Introduction

Oil and gas revenues constitute the dominant income of the Algerian economy. Between 2002 and 2011 this sector accounted for 97% of exports, 32% to 45% 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.

Table 1: GDP and government revenue dependency on oil

	2004	2005	2006	2007	2008	2009	2010	2011	2012
Share of oil in GDP (%)	35.5	45	45.4	43.3	45.4	31.6	32.5	39	31.7
Government expenditure (billions of dollars)	44.4	46.1	50.8	57.6	73.9	67.4	79.5	81	91.4
Trade Openness (%)	58,1	64,8	64,9	64,6	69,4	60,2	61,1	71	53,9

Source:* IMF Country Report of Algeria from 2004-2012

As far as the Algerian exchange rate is concerned, since 1996 the central bank adopted 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 2008 financial crisis. Between January 2010 and January 2013, the Algerian dinar depreciated against the U.S. dollar by 4.2%. During these periods oil prices show remarkable changes, with +152%, -9%, and +37% (see Figure 3).

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

The goal of this study is to investigate the relationship between the oil price and the nominal US Dollar/Algerian Dinar exchange rate with an empirical analysis using a VAR Model (Vector Autoregressive Model) on monthly data for the period 2003-2013.

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

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 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 the oil price and exchange rates.

Firstly, the price of oil 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, the stock market, etc. (See: Rasche and Tatom (1977), Darby (1982), Hamilton (1983, 1996, 2003), Lee et al. (1995), Rotemberg and Woodford (1996), Eltony and Al-Awadi (2001), Brown and Yücel (2002, 2010), Blanchard and Gali (2007), Bjørland (2008), Wang, Wu, and Yang (2013), Basher, Haug, and Sadorsky (2012)).

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

In past years, particularly before 2002, oil prices and US Dollar moved in the same direction, so that when the US dollar rose, the price of oil was pushed up, and conversely, when the oil price increased, the US Dollar 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, 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 is negative reverse causality between the U.S dollar and the oil price during the last period (See, Coull, 2009, Verleger

(2008), Setser (2008), Virginie (2008), Akram (2008), Melhem and Terraza (2007), Bénassy-Quéré, et al. (2007)).

The study of Chen and Rogoff (2003) 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) used a cointegration technique to arrive at the conclusion that there is a relationship between oil price and the exchange rate in Colombia and Mexico. Akram (2004) found that there is a non–linear negative relationship between the 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) 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. (2008) 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) used a vector error correction model to determine the impact of oil prices on the real equilibrium exchange rate in Venezuela. Habib & Kalamova (2007) 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, results for Norway and Saudi Arabia show that there is no relationship between the two variables.

In Nigeria, many studies have used different empirical methods and examined the impact of the oil price on the exchange rate. While Olomola and Adejumo (2006) observed a positive impact, where oil price shocks led to an exchange rate appreciation, Iwayemi and Fawowe (2010), and Adeniyi, Omisakin, Yaqub, and Oyinlola (2011) presented a negative relationship between the oil price and the exchange rate.

Korhonen et al. (2007) 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) 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 results show that there is a long-run and positive linkage between real oil prices and real exchange rates in OPEC countries.Chen and Chen (2007) 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) found that shocks in the real price of oil are particularly important in determining real exchange rates, even in the long run for a pool of African countries.

All of these contributions are presented in Table 2.

Table 2: The relationship between oil price and exchange rate: A Literature Survey

Study	Sample Period	Countries and Estimation Technique Used	Variables	Main Results
Chaudhuri and Daniel (1998)	Over the post-Bretton Woods era	OECD, cointegration and causality tests	Dollar real exchange rates and real oil prices.	Non stationarity of relationship
Akram (2002)	January 1, 1986 - August 12, 1998	Norway,OLS estimates	Oil price and the Norwegian Krone	Negative correlation
Ilhan, et al. (2008)	1982:12-2006:5.	Turkey, Johansen cointegration and Granger causality tests	Oil prices and USD/YTL real exchange rate	Oil prices Granger cause exchange rate
Chen and Chen (2007)	1972:1 to 2005:10	G7 countries, panel	Real oil prices real exchange rates	Long run relationship
Zalduendo (2006)	1950–2004	Venezuela, vector error correction	Official and parallel market rate, REER, Real GDP and oil prices	Oil prices on the real
Habib and Kalamova (2007)	(1980-2006)	Russia, Norway and Saudi Arabia, error Correction model	Real effective exchange rate (REER) , oil price and the productivity differential	Positive long-run relationship in Russia; no impact in Norway and Saudi Arabia
Korhonen et al. (2007)	1975 to 2005	OPEC countries , panel co-integration methods	The real oil price and real effective exchange rate (REER)	Oil price has a direct effect on the equilibrium exchange rate
Nikbakht (2010)	2000 to 2007	7 countries of OPEC members, panel	oil prices and real exchange rates	Positive linkage
Coleman et al. (2012)	1970Q1-2004Q4	Pool of African countries(30), cointegration techniques	Oil price shocks and (REER)	Oil prices are particularly important in determining the (REER)
Adeniyi et al. (2012)	January 2, 2009 to September 28, 2010.	Nigeria, (GARCH/EGARCH models	Oil price and the nominal exchange rate	Increase in the price of oil culminates in an appreciation naira - dollar
Aviral Ketal (2013)	1986-2009	Romania, Granger causality tests	Oil prices and real effective exchange rate	Oil prices have no influence on the (REER)

Note: A annual, Q quarterly and M monthly, REER real effective exchange rate.

III. Model and Methodology

1. Data source

In our analysis we use two macroeconomic variables: oil prices (oil) and US dollar/Algerian Dinar (us/dz). The sample comprises 121 monthly observations for the period 2003-2013. These variables are collected from different issues of the IMF's International Financial Statistics and World Development Indicators.

2. Definition of the VAR Model

The Vector Auto Regression (VAR) is commonly used for forecasting systems of interrelated time series and for analyzing the dynamic impact of random disturbances on the system of variables. The VAR approach sidesteps the need for structural modeling by treating every endogenous variable in the system as a function of the lagged values of all of the endogenous variables in the system.

The mathematical representation of a VAR is:

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

Where y_t is a k vector of endogenous variables, x_t is a d vector of exogenous variables, A_1, A_p and B are matrices of coefficients to be estimated, ε_t and is a vector of innovations that may be contemporaneously correlated but are uncorrelated with their own lagged values and uncorrelated with all of the right-hand side variables.

IV. Results and Comment

Before presenting the results from the empirical VAR model, we will apply the following econometric steps:

- Test the stationary of the time series data by Augmented Dickey-Fuller & Phillips and Perron test.
- Analyze the co-integration tests
- The impulse responses and the variance decomposition analysis estimated by the VAR model.

1. Stationarity and Cointegration tests

Most classical econometric estimations, which use the least square method (GLS) based on non-stationary time series, produce spurious regression and their statistics may simply indicate only correlated trends rather than a true relationship (Granger and Newbold, 1974). Augmented Dickey-Fuller (1979, 1981) and Phillips and Perron, (1988) tests can help avoid false results through stationarity tests of times series**.** Our results, drawn from the stationarity tests represented in Table 3, allow a rejection of the null hypothesis in the first difference that signifies no stationarity in all our series, but enables an acceptance at a level that signifies integration of the variables at order 1.

Table 3: Stationarity test results

Variables	ADF		PP	
	Level	First difference	Level	First difference t
logoil	-2.082	-9.62***	-2.145	-9.782***
Iogusdz	-2. 26	-8.17***	-1.626	-8.08***
Test critical values	-3.84 at 1% -2.88 at 5%			

2. Analysis of co-integration tests

In order to explain the relationship between oil price and the Algerian exchange rate in the long run, the Johansen cointegration approach (Johansen, 1988; Johansen and Juselius,1990) develops two test statistics: Trace statistics ((λtrace) and maximum eigenvalue statistic (λmax).

The results of trace and Max-eigenvalue tests indicate that there is no long or short run relationship between the Algerian exchange rate and the oil price (no cointegration at the 0.05 level, see Tables 4and 5).

Table 4: Trace test

Hypothesized No. of CE(s)	Trace Statistic	0.05 Critical Value
None	11.44554	15.49471
At most 1	0.036971	3.841466

Table 5: Maximum Eigenvalue test

Hypothesized No. of CE(s)	Max-Eigen Statistic	0.05 Critical Value
None	11.40857	14.26460
At most 1	0.036971	3.841466

**MacKinnon-Haug-Michelis (1999) p-values

3. The Impulse responses

The impulse responses present the dynamic responses of the exogenous variables in relation to the time of variation of the endogenous variable (See Doan (1992), Sims and Zha (1999)). It shows the response of the Algerian exchange rate to a percent change in oil price. The impulse response is reported in Table 4, and shows a negative sign for the US-DZ exchange rate to a response of oil prices in the 12's first time Horizon, which implies that a rise in oil prices leads to a depreciation in the US-DZ exchange rate, while an oil price increase tends to appreciate the national currency against US dollar by about 0.29 percent in the first year, then the national currency begins to depreciate at about a 0.35% deviation over the rest of the years (See: Akram (2004) and Olomola and Adejumo (2006), Oluwatosin A et al. (2012)). This is paradoxical, because actually, we expect the impulse response of the US-DZ during the period (2004-2013) to reacts to a rise of oil price by an appreciation, for the main reason that the Algerian exchange rate regime, which is classified as a managed floating exchange rate system, should trigger an appreciation of the Algerian currency on the basis of a weaker Dollar.

Table 6: Response to Cholesky of the U.S dollar/ Algerian DZ of oil price.

Response	Horizon (Month)	Response to Cholesky	Period
Response of responses of US-DZ Algeria to oil price	1 – 12	-0, 29	2003
Response of responses of US-DZ Algeria to oil price	12 – 67	+0, 31	2004-M9/2008. Before Financial crisis
Response of responses of US-DZ Algeria to oil price	68 – 82	+0, 37	Financial crisis
Response of responses of US-DZ Algeria to oil price	83-119	+0, 38	2010-2013

4. 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 the oil price. In fact, high oil prices generally provoke a large appreciation of exchange rates in oil-exporting countries, but this evidence is not clearly established in the Algerian case. This is evident over the last decade, as a co-integration relationship between the Algerian exchange rate and oil price does not exist.On the contrary, oil prices depreciate the Algerian Dinar against the US dollar by about 0.35% during the period from 2004 to 2013. Our empirical analysis helps explain how the Algerian policymaker chooses his strategy to serve ever expanding public spending.

V. Conclusion

In this paper, we investigated if the oil price in US dollars and the nominal exchange rate USD/Algerian Dinar have a cointegrated relationship in the run long. Our results show that there is not a cointegrated relationship. However, the estimation of a VAR model indicates that a 1% increase in oil price would lead the Algerian Dinar to depreciate to 0.35% against US Dollar. This inverse impact between oil price and the Algerian Dinar reflects the puzzling role of the exchange rate policy in Algeria.

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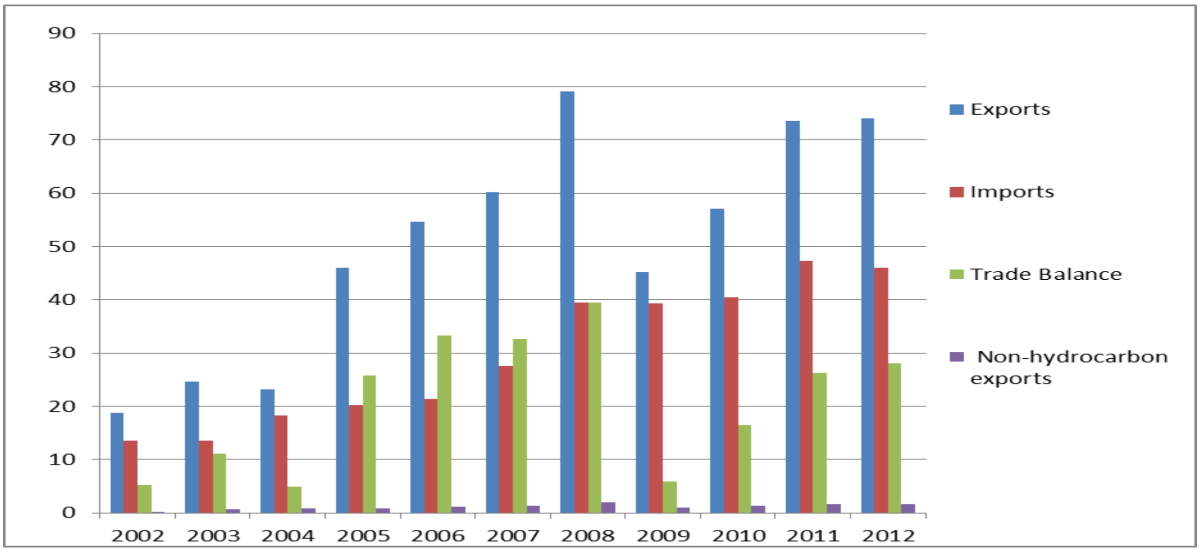
APPENDIX

Figure 1: Trade (billions of dollars)



Source: World Development Indicators.

Figure 2: GDP and government revenue dependency on oil (Based on Table 1)

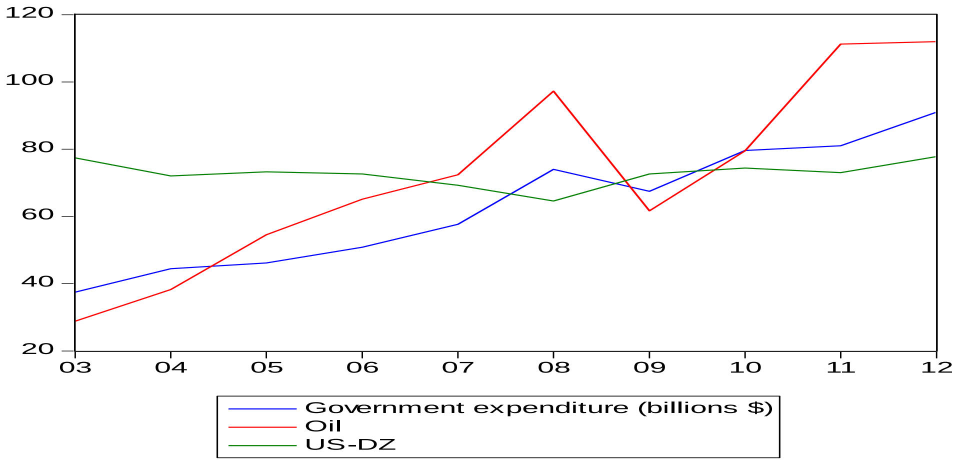
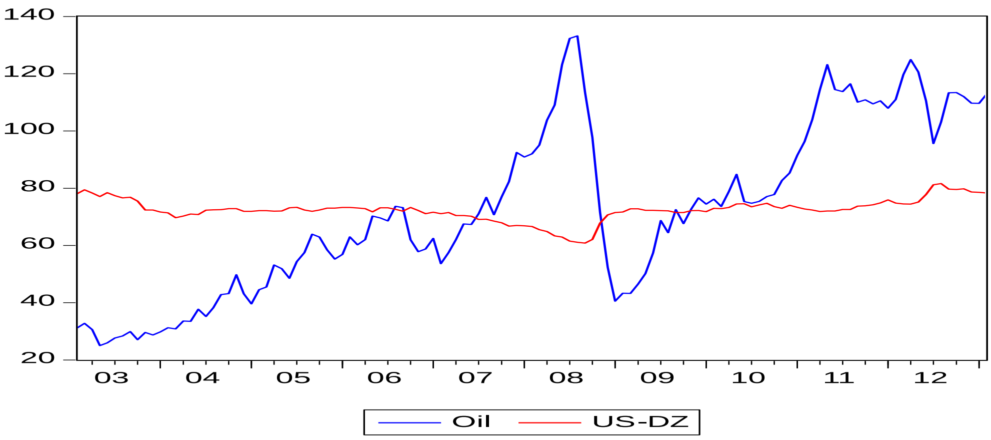


Figure 3: Oil price and U.S Dollar/ Algerian Dinar (2003-2013)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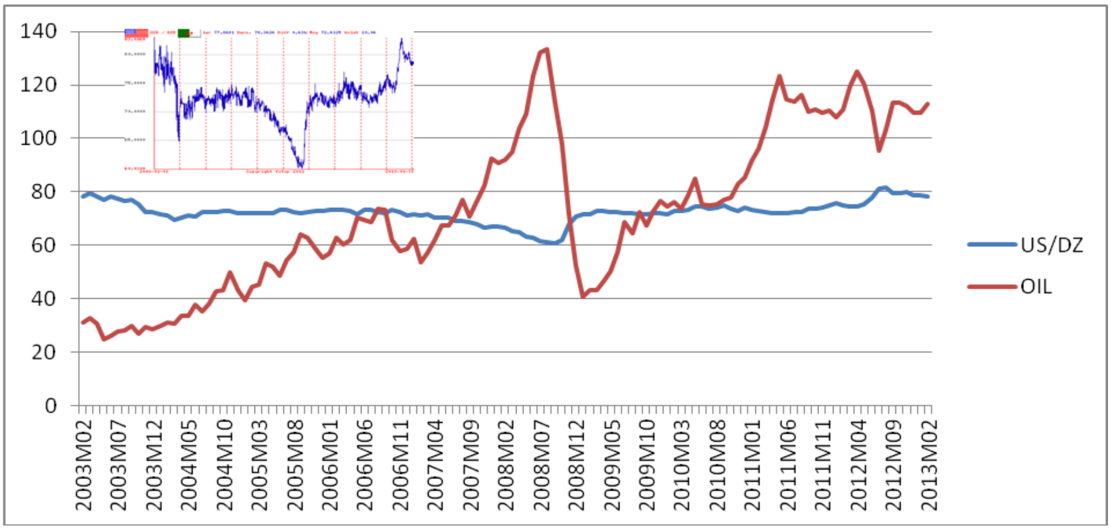
Oil
US-DZ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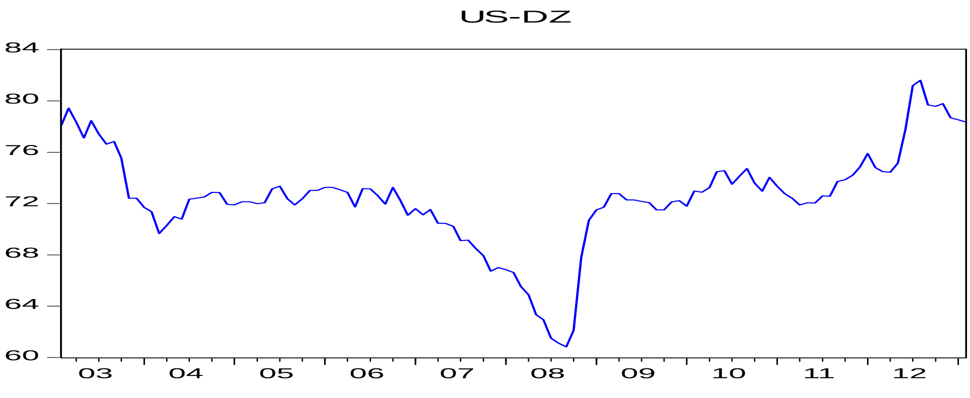
US/DZ
OIL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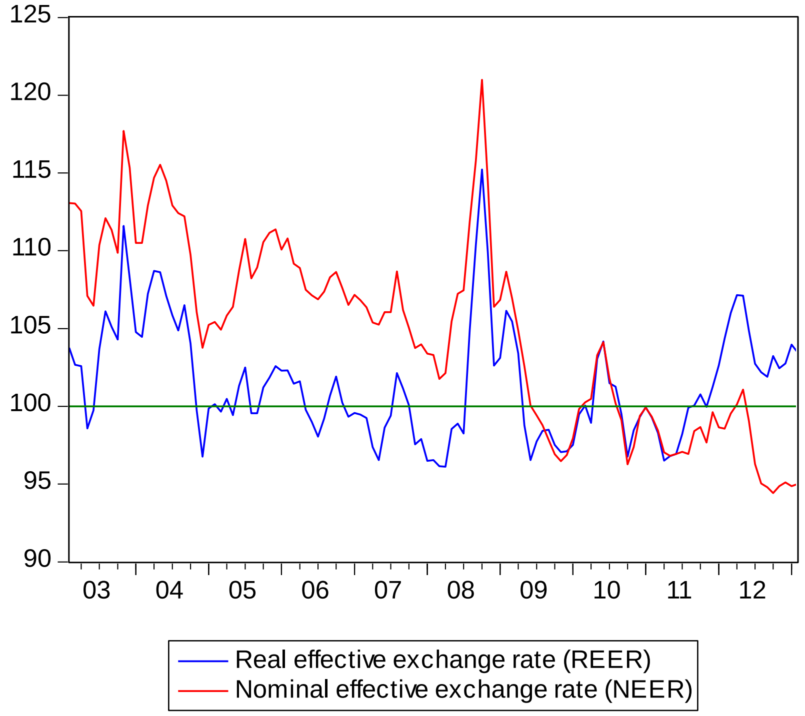
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Real effective exchange rate (REER)
Nominal effective exchange rate (NEER)