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THE ROLE OF OIL PRICE FLUCTUATIONS ON THE USD/EUR EXCHANGE RATE: AN ARDL BOUNDS TESTING APPROACH TO COINTEGRATION

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ABSTRACT
This paper studies the impact of global oil price fluctuations on global exchange rates of the dollar against the euro (USD/EUR), using the bounds testing approach method to test co-integration, error correction model, in the framework of the autoregressive distributed lag (ARDL) by Pesaran *et al.* (2001) during the period from 1990 to 2016. Moreover, the results of the analysis showed a positive balance relationship between the two variables in the long and short term. On the other hand, our estimates suggest that, 1% depreciation in the dollar leads to 0.58 rises in the oil price in the long run. The error correction results show that coefficient of (ECM) = -0.43, imply that deviation from the long-term exchange rate is corrected by 43% by the following year. Based on the findings of the study, the researcher recommended the need for coordination between movements of oil prices and financial policy for what needs economic political mechanism of delicate balance.

Contribution/ Originality: This study is one of few studies that have investigated the existence of long memory property as an appropriate method in forecasting the oil price volatilities which can considerably affect the exchange rate.

1. INTRODUCTION

Crude oil is considered one of the most important energy sources in the world. The association between oil prices and the dollar is very difficult. As the dollar's decline leads to higher oil prices, rising oil prices are contributing to the dollar's decline due to the US oil import bill, the increase in the balance of payments deficit, and vice versa. The link between oil and the dollar is one of the most important features of the global economy. The so-called "petrodollars" and the revenues from high oil prices have helped to deal with the large trade deficits that hit the economy by recycling the capital from the oil exports of developing countries and employing them in new investments. The US dollar is used to buy oil, because of its high value compared to other currencies in the world. Retail oil sales are also calculated based on the value of the dollar, even in foreign countries. Although the rise in oil prices is a positive indicator for the oil-producing countries, but the decline in the dollar against global currencies has contributed to the erosion of the income of oil countries from the sale of oil, which is priced in dollars and if we take into account the factor of inflation and the deterioration of the dollar exchange rate between 1986 to today it turns out that About 65% against the Japanese Yen, 60% against the Pound and 35% against the Euro. More than 50% of the world's exports are paid in US dollars and one-third of the world's foreign exchange reserves are denominated in dollars. More than 80% of the world's foreign exchange is through the US dollar, and energy and oil prices are priced in US dollars for a long time, so it is difficult to agree on a currency to replace it. Therefore, the strength of the dollar prices corresponds to the strength of oil prices.

Aimer (2016a) the rise in oil prices by 10% increases Libyan GDP by 54%. In industry, falling oil prices may not only lower the trade costs of manufacturing industries but also affect the prices of agricultural products. Since June 2014 the oil prices in world markets had fallen steadily, with Brent crude at $ 110/ barrel but falling in the first few days of January 2015 to below $ 50. Market, represented by the interaction between supply and demand, as well as the strength of the US dollar (dollar) and the impact of speculative activity in the markets, but some analysts say the decline is due to political factors. However, most analysts say that the decline in crude oil prices due to abundant supply in oil markets, especially from outside the oil-exporting countries (OPEC). Specifically, the so-called rocky oil boom in the United States. According to the IMF report the abundance of supplies contributed 60% of the steady decline in prices. Due to the low exchange rate of the dollar against many of the world currencies, which led to the demand of some countries such as China, Russia, Europe, Japan and the Gulf countries to switch the pricing of oil in dollars to a basket from the different world currencies or oil pricing in gold, so as to diversify the reserves of those countries of strong currencies. Some economists believe that the transition of pegging oil prices to the dollar will eventually happen, but slowly.

There is no doubt that the relationship between the exchange rate of the dollar and oil prices is strong, distinct and interrelated. The dollar always affects oil prices and reflects the increasing demand for oil and other commodities. Most oil-producing countries also sell in dollars, most analysts agree that there is a positive relationship between changes in the real exchange rate of the dollar and oil prices, while the decline in the dollar raises oil prices and makes the relationship between the dollar and oil prices subject to many studies and analyzes with different results. The relationship between the price of oil and the US dollar is a reciprocal relationship. This means that when demand for oil is at high prices, there is also an increase in the value of the US dollar. In this case the oil-importing country is heavily affected by the high of the dollar in addition to oil prices as well.

The rapid increase in oil prices in recent years in global oil markets is the result of political unrest such as North Africa and the Middle East, but does not mean that the rise in the price of oil because of the decline in the dollar, because there are several other factors involved in the increase in the price of oil, such as rising demand for global oil, fears of rising inflation in the US economy, and the decline of the dollar, which contributes to the increase in the US balance of payments deficit and weaken the US economy.

Oil price movements during Jan 1986 to Nov 2016 are interesting, given their large size and unpredictable effects. The Figure 1 shows movements in oil prices.

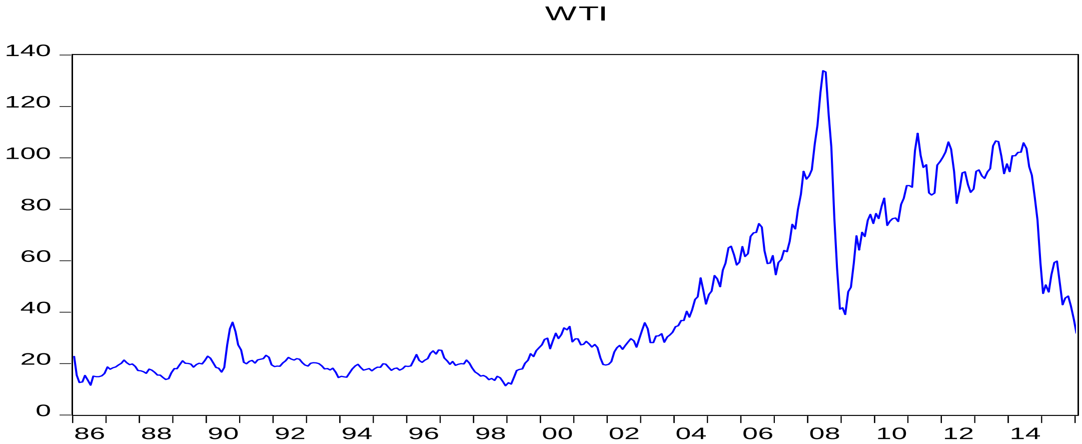


Figure-1. Dynamics of monthly prices of West Texas intermediate (US Dollar/Barrel)
Source: US. Energy Information Administration

It seems that the problem of determining the price of crude oil on the basis of supply and demand in the global market, prospects, speculation and exchange rate of the dollar. The paper is organized as follows: Section II provides an overview of literature review. Section III presents the econometric methodology. Section IV describes the results and discussions. The study ends with the last part of the paper with the results of the study.

2. LITERATURE REVIEW

The issue of oil price movements has attracted many academics to investigate the adverse effects of oil price movements on the dollar exchange rate. As a result, there are many models used by previous literature to study the effects of oil price volatility.

Sadorsky (2000) addressed the relationship between price crude oil and the dollar exchange rate. Using (VECM) model. The results show a long-run equilibrium relationship between these variables, and the causality is from exchange rate to those price crude oil.

Chen and Chen (2007) study on the long-term relationship between global oil prices and dollar exchange rates using monthly data for countries (G7). The results have been that oil prices are an important source for explaining the movements of the dollar exchange rate. There is a stable relationship between them and the possibility of using international oil prices to predict future exchange rate returns.

Shakibaei *et al.* (2009) study the long-term relationship between oil prices Currency exchange rates OPEC countries against the dollar, monthly data for the period from Jan 2000 to Dec 2007, using common integration model and Granger causality. Researcher found that dollar exchange rates the source of very influential in world oil prices movements, the existence of a long-term link relationship between oil price and real exchange rate.

Doğan *et al.* (2012) examined the relationship between oil price movements and exchange rates at constant prices for the period from February 2001 to July 2011, by means of joint integration tests. The study showed that high oil prices have negative effects on exchange rates during the financial crisis in 2008.
Aimer (2016b) examined the effect of oil price fluctuations on the nominal exchange rate of the US dollar in the Libyan economy for the period from January 2000 to December 2015. Using the error correction model, the paper found that the two-way causality between the two variables. In addition, the results show that the 10% rise in the price of oil in the long run coincides with a 27% drop in the exchange rate, and that causality runs from oil to the dollar and vice versa.

Jahangard *et al.* 2017) investigated the effect of oil price fluctuations on the exchange rate in Iran during the period 1961-2014 using the ARDL approach. They found that high oil prices lead to an exchange rate rise. In addition, oil prices have short and long-term effects on the real exchange rate.

Generally, oil price fluctuations play a major role in exchange rate fluctuations. Many studies have found that there is a long-term relationship between oil prices and the dollar exchange rate, although the causality goes mostly from the price of oil to the exchange rate. The aim at our study is to investigate the effects of oil price volatility on global exchange rate by the bounds testing approach method to test co-integration, error correction model, in the framework of the (ARDL) for the period from 1990 to 2016.

3. METHODOLOGY AND EMPIRICAL RESULTS

This study uses the framework of the self-regression model of the distributed time gaps (ARDL) developed by Pesaran and Shin (2002); Pesaran *et al.* (1996) and Pesaran and Pesaran, (1997) to determine the amount of causal relationship between variables and their direction. This methodology does not require a pre-test of the variables. This means that the examination of the relationship between the variables at the levels is done regardless of whether all independent variables I(0), I(1) or a combination of the two.. This empirical analysis and focuses on two variables (crude oil prices, global exchange rates) by the time series data from 1990 to 2016.

First, the conditional error correction model Pesaran *et al.* (2001) is estimated as follows:

$$lnEX_t = f(ln\, oilp_t\, , v_t) \qquad \text{..........................(1)}$$

$$\Delta\ln(EX)_t = \alpha_0 + \sum_{i=1}^{p} \phi_i \Delta\ln(EX)_{t-i} + \sum_{i=0}^{p} \theta_i \Delta\ln(oilp)_{t-i} + \delta_1 \ln(EX)_{t-1} + \delta_2 \ln(oilp)_{t-1} + v_t \qquad \text{.......................... (2)}$$

LnEX is logarithm of the global exchange rate of the dollar against the euro, lnOILP is logarithm of oil prices (West Texas Intermediate WTI), Δ is the first difference and p is the optimal delay length.

The F test is used to test the existence of a long-run relationship between the variables for the basic hypothesis of the lack of common integration between the variables as in the following equation:

$H_0: \delta_1 = \delta_2 = 0$

Versus the alternative hypothesis $H_1: \delta_1 \neq 0, \delta_2 \neq 0 \neq 0$

Because of the relatively small size of the sample in this study (25), Narayan (2005) observations can be used to estimate the critical values of small sample samples or use the Wald test, Long-term relationship between the variables regardless of the degree of integration between the variables.

If the F test statistic is lower than the upper bound value, we can't reject the basic hypothesis (lack of common integration). If the F value occurs between the two extremes, we can't infer without knowing the order of integration of the basic explanatory variables.

The gradient is selected in the ARDL model according to the Akaike standard (AIC) or Schwarz Bayesian criterion (SBC), before the model is estimated by OLS method. For annual data Pesaran (1999) recommended that two periods are chosen to slow down of a maximum, so the length of the least delay is determined by the SBC standard.

If there is evidence of a long-term co-integration between two variables, the model is estimated according to the following equation:

$$\ln(EX)_t = \alpha_1 + \sum_{i=1}^{P} \phi_{1i}\ln(EX)_{t-i} + \sum_{i=0}^{p} \beta_{1i}\ln(oilp)_{t-i} + \mu_t \quad \text{.......................... (3)}$$

The ARDL specification can be used for short-term dynamics by constructing an error correction model (ECM) as described:

$$\Delta\ln(EX)_t = \alpha_2 + \sum_{i=1}^{P} \phi_{2i}\Delta\ln(EX)_{t-i} + \sum_{i=0}^{p} \theta_{2i}\Delta\ln(oilp)_{t-i} + \psi l(ECT)_{t-1} + \vartheta_t \quad \text{.... (4)}$$

Where, ECT_{t-1} error correction, which is known as the following:

$$\sum_{i=1}^{P} \phi_{1i}\ln(EX)_{t-i} - \sum_{i=0}^{p} \beta_{1i}\ln(oilp)_{t-i} \quad \text{.......................... (5)}$$

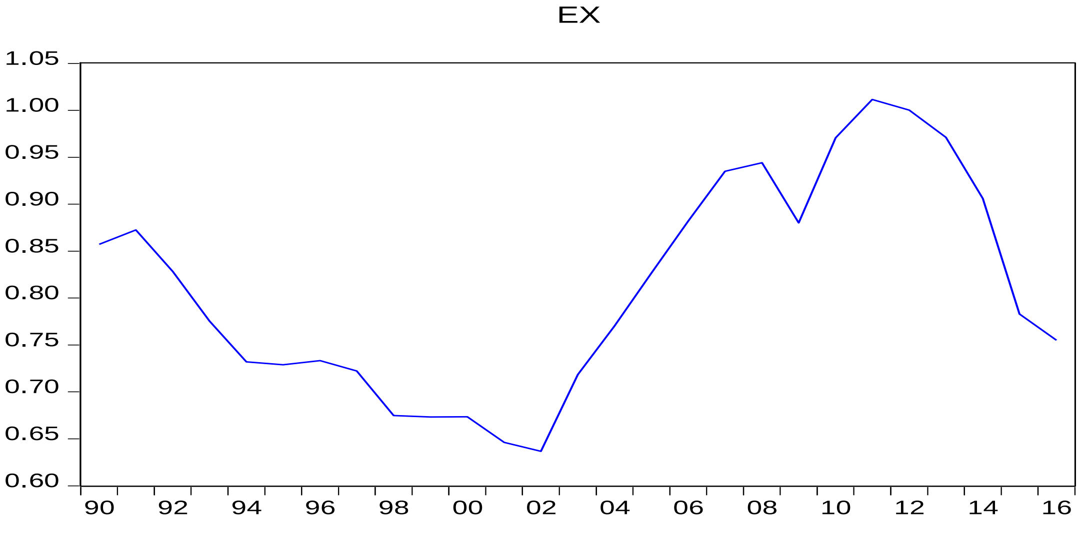
All short-term equation transactions are short term movements of the model's approximation of the equilibrium state, and ψ represent the speed of adjustment. All variables are in the natural logarithm format.

3.1. Data sources and description of variables

All series in this study are annual data from 1990 to 2016 for world oil prices and global exchange rates.

The time series data from 1990 to 2016. U.S. Crude Oil First Purchase Price, Source: U.S. Energy Information.

Yearly average exchange rates for dollars.



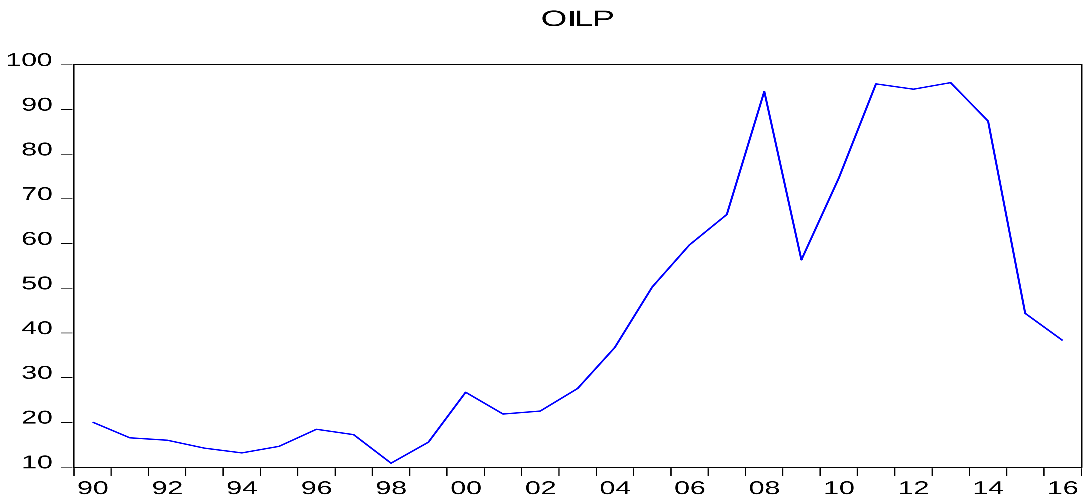


Figure-2. The price of WTI and the exchange rate of the US dollar against the euro
Source: U.S. Energy Information

Table-1. Unit root test results on the log values of the variables

Unit root test results (PP)			
At Level			
		LNOILP	**LNEX**
With Constant	t-Statistic	-1.0793	-1.4045
	Prob.	*0.7083*	*0.5645*
Without Constant & Trend	t-Statistic	0.2262	-0.5039
	Prob.	*0.7440*	*0.4882*
At First Difference			
		d(LNOILP)	**d(LNEX)**
With Constant	t-Statistic	-4.5468	-2.9663
	Prob.	*0.0014*	*0.0521*
		***	*
Without Constant & Trend	t-Statistic	-4.5883	-3.0034
	Prob.	*0.0001*	*0.0043*
		***	***
Unit root test results (ADF)			
At Level			
		LNOILP	**LNEX**
With Constant	t-Statistic	-1.0774	-1.8158
	Prob.	*0.7090*	*0.3646*
Without Constant & Trend	t-Statistic	0.2124	-0.6366
	Prob.	*0.7399*	*0.4313*
At First Difference			
		d(LNOILP)	**d(LNEX)**
With Constant	t-Statistic	-4.5639	-2.9341
	Prob.	*0.0014*	*0.0556*
		***	*
Without Constant & Trend	t-Statistic	-4.6013	-2.9718
	Prob.	*0.0001*	*0.0046*
		***	***

Notes: (*) significant at 10% and (***) significant at the 1%, *MacKinnon (1996) one-sided p-values

Through the two curves we note that fluctuations in oil prices and exchange rate were the result of the instability of the world oil markets, leaving clear effects, whether positive or negative.

3.2. Stationary Test (Unit roots Tests)
In order to ensure the requirement of applying the ARDL test of the degree of integration of time series for the variables of the study, so that the degree of integration of the variables either I(0) or I(1).

The following table shows the degree of integration of the time series under study, which was determined based on the ADF, PP tests.

Table 1 shows that all variables are integrated from the first differences, thus the ARDL test can be applied. As a result, in order to test the existence of the long-term relationship between the variables, the Bounds approach is used based on the ARDL model. In the first step of the test, the Wald test is used, using the F statistic, the results of which are shown in Table 2.

3.3. ARDL long run
After checking for the combined integration of the dependent variable (exchange rate) and the independent variable (oil price) we can estimate the long-term equilibrium equation and the results as follows

Table-2. Estimated long run coefficients using the ARDL approach

Long Run Coefficients				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
LNOILP	0.3516	0.0668	5.2632	0.0001
C	-1.2010	0.1554	-7.7271	0.0000
@TREND	-0.0191	0.0064	-2.9626	0.0083

Dependent Variable: D(LNEX)
Cointeq = LNEX - (0.3516*LNOILP -1.2011 -0.0191*@TREND)

The Long run coefficients show that in the long run, the coefficient of oil price has a significant impact on exchange rate, and a one percentage increase in oil price leads to a 0.35% increase in exchange rate in long run.

3.4. ARDL Bounds tests for co integration
In this step we will investigate whether there is a long-term co-correlation between oil prices and the exchange rate

Table 3 shows the results of the Bounds approach test for a long-term relationship. The following table shows the following:

Table-3. ARDL Bounds tests for co integration

Test Statistic	Value	k
F-statistic	6.414038	1

Null Hypothesis: No long-run relationships exist

The F-statistic value calculated in Form 6.41 is greater than the critical value of the 6.02% maximum at 5%. Thus, the zero hypothesis, where there is no common integration between variables, is rejected. This means a long-term equilibrium relationship between the two variables.

3.5. ARDL short run
For the purpose of measuring the short-term relationship, the error correction model was used. This model has two advantages:

The first is to measure the short-term relationship. Second: It measures the speed of the adjustment to rebalance the dynamic model.

Table-4. ARDL error correction regression

ECM Regression				
Case 5: Unrestricted Constant and Unrestricted Trend				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-0.5159	0.1353	-3.8126	0.0013
@TREND	-0.0082	0.0026	-3.1108	0.0060
D(LNEX(-1))	0.3613	0.1765	2.0465	0.0556
D(LNOILP)	0.1559	0.0258	6.0209	0.0000
D(LNOILP(-1))	-0.1081	0.0403	-2.6829	0.0152
ECM(-1)*	-0.4296	0.1167	-3.6797	0.0017

Source: Results obtained using the Eviews10 program

The annual result (above table) for the exchange rate shows that the expected negative sign of the ECM is of great importance. The tables indicate that there is a balance relationship in the short and long term between the two variables. The coefficient of ECM = -0.43, imply that deviation from the long-term exchange rate is corrected by 43% by the following year, and a one percentage increase in oil price leads to a 0.15% increase in exchange rate in short- run.

3.6. Breusch-Godfrey serial correlation lm test

Before relying on the result, one must make sure that the errors are independent (Lack of self-association of errors), depending on the LM test statistic.

Table-5. Breusch-Godfrey serial correlation LM Test

F-statistic	0.135839	Prob. F(2,16)	0.8740
Obs*R-squared	0.417411	Prob. Chi-Square(2)	0.8116

Source: Results obtained using the Eviews10 program

The LM test shows that there is no autocorrelation in the regression equation, so that the probability corresponding to this test is greater than the 1%, 5%, and 10%.

3.7. Test long-run parameter stability

According to Pesaran and Pesaran (1997), the long-term parameter must be validated based on the ECM error estimation results (CUSUM and CUSUMSQ. test).

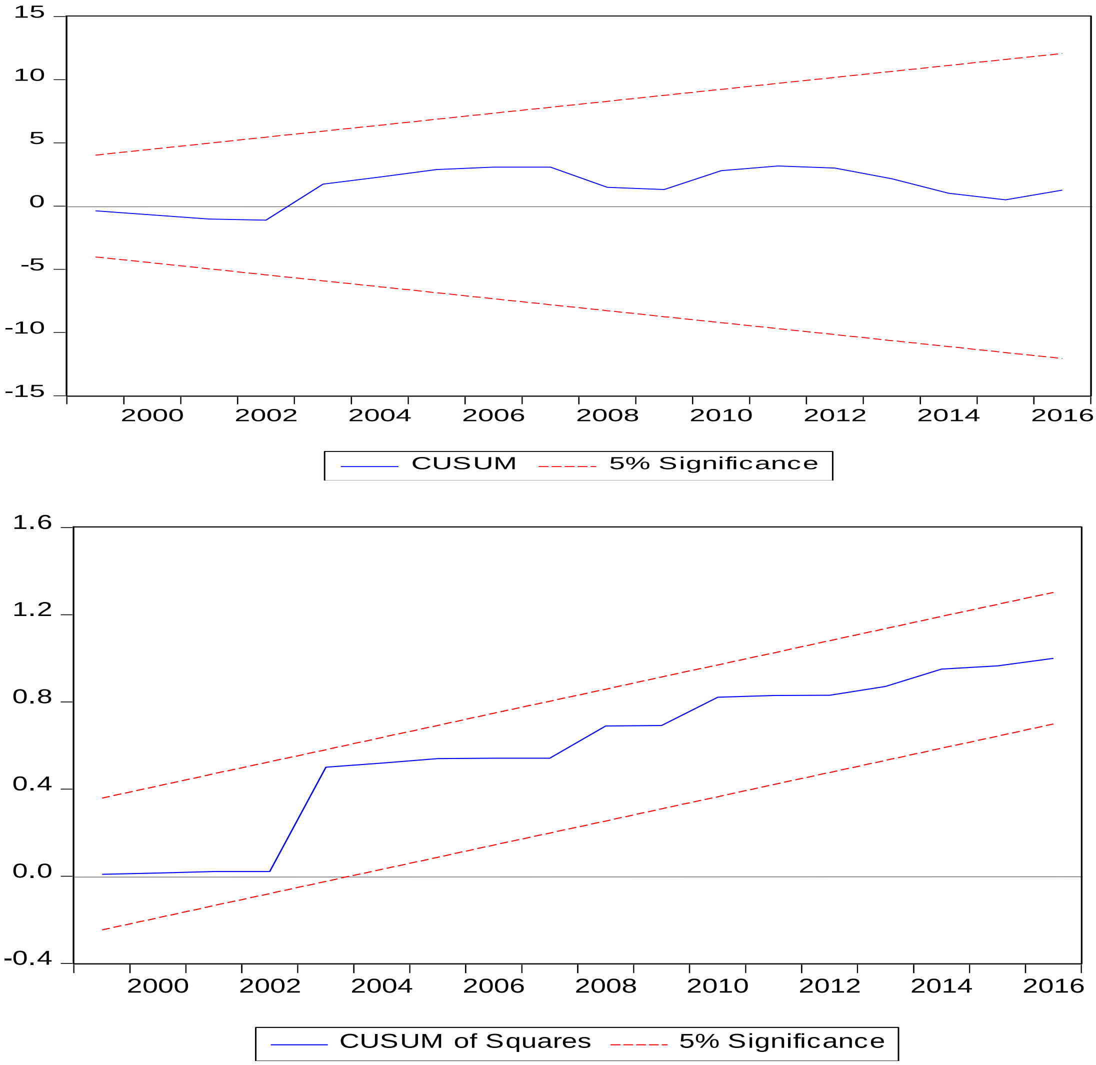


Figure-3. Results of the CUSUM and CUSUM of Squares test

The Figure 3 shows the stability of long-term coefficients, where we observe a statistical curve CUSUM and CUSUM of Squares did not exceed the limits of confidence at a significant level of 5%, which also confirms the significance of the relationship between oil prices and exchange rate.

4. CONCLUSION

In this study, we tried to determine the impact of oil prices fluctuations on the dollar exchange prices over the period from 1990 to 2016. The long-term appreciation of the oil price function was derived from the use of the ARDL approach by Pesaran *et al.* (2001). The unit root test for stability testing showed that the variables were unstable at levels, but stable at the first difference at 5%, which means the variables integrated in the first difference. Furthermore, there is a positive relationship between the variables in the short and long term. On the other hand, our estimates suggest that a 1% rise in oil prices will lead to a higher exchange rate of 0.35% in the long term. The vector error correction results show an equilibrium relationship between oil prices and the exchange rate in the long term. The coefficient of ECT = -0.43, imply that deviation from the long-term exchange rate is corrected by 43% by the following year. Based on the findings of the study, the researcher recommended the need for coordination between movements of oil prices and financial policy for what needs economic political mechanism of delicate balance.

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