The impact of international crude oil price on the (USD/LD) exchange rate: An empirical study

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***Abstract**:*

The aim of this paper is to study and investigate the relationship between the price of crude oil (in USD per barrel) and the US exchange rate against the Libyan dinar for the period (1995-2017). The analysis is performed by using Johansen cointegration, Granger causality tests and vector autoregressive model. The results show that there is no long-term relationship between the crude oil price and the USD /LD exchange rate, while the relationship that happens is only in short-term one. Granger causality test result also shows that there exists no causality between the crude oil price and the USD /LD exchange rate.

***Keywords:** International crude oil price as West Texas Intermediate (WIT) ; Exchange rate; Vector Autoregressive Model (VAR).*

1-Introduction

In the global economy, oil is one of the most widely used sources of energyand important commodities. This importance of crude oil comes from relative abundance and its concentration of energy, and also, it constitutes an international strategic commodity with high economic value,so what makes oil price study interesting is not only the direct impact on economic performance, but also how the fluctuations in oil prices might reflect changes in international financial variables, such as exchange rates. (Brahmasrene, Ju Huang, & Sissoko, Crude oil prices and exchange rates: Causality, variance decomposition, 2014), inparticular, the exchange rate is considered as the primary channel through which the fluctuations of oil prices traded in US dollars are transmitted to the real economy and financial markets (Ridha, Amor, & Rault, 2018). Therefore, a change of exchange rate can cause the change in crude oil price and other commodities. As a result of the international standing of the dollar and its role position in the international monetary system, that considered an international pricing currency for most strategic commodities, including crude oil as well.

The goal of the study is to determine the behavior of oil price against changes in the exchange rate on Libyan dinar.It is important to know the short-run and long-run relationships between exchange rates and oil price movements, which refer to changes in currency value, may have some effect on crude oil prices in the short run.More and over, the short-run crude oil price shocks may have the long-run effect on the exchange rates(Beckmann, Czudaj, & Arora, 2017).

2. REVIEW OF LITERATURE

Oil price and exchange rate has been discussed by several studies, Policymakers and academics, whose focusing on different markets worldwide. They have frequently discussed the relationship between oil prices and exchange rates in recent years, particularly the idea that an appreciation of

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the US dollar triggers a dip in oil prices. Researchers have been founda different relationship between them in oil exports and oil importers on developing, developed countries, emerging economies and vice versa. So, these studies is not so clear on the direction of causation, due to evidence for bidirectional causality. Some studies find that an increase in the real oil price leads decrease in a real of the US dollar, while others show that a nominal appreciation of the US dollar triggers decreases in the oil price. (Narayan 2013) studied a number of Asian economies and he found that a higher oil price leads to the appreciation or depreciation of local currencies. In fact, in theory, many studies said: oil price shocks should have a direct effect on exchange rates (Eshak, Maha Yasser; 2018) or suggested a positive relationship, while others found a negative. Moreover, Oil is priced against the US dollar and so, a dollar depreciation lowers oil prices, potentially inducing oil producers and exporters to reduce oil supply to force the price upward (Yousefi and Wirjanto, 2003; 2005).on the other hand, the depreciation of the US dollar may cause the demand for oil to increase (Akram, 2009; Beckmann et al., 2016) (Albaity and Mustafa 2018). (Adam, et al. 2018) from the results of cointegration testing, is found that there is no long-term cointegration between crude oil prices, the IDR/EUR exchange rate (Albaity and Mustafa 2018) by using a panel and time-series cointegration and causality, the analysis have found the same result by (Altarturi et al., 2016; Arfaoui and Ben, 2016; Beckmann et al., 2016), on the other hand (Eshak, 2018) has suggested to remodeling the data by using West Texas Intermediate (WIT) because of finding that the use of oil prices nominated in USD do not necessarily account for endogeneity which can be attributed to reverse causality.

- (Qiang W., Lin, Zhao, Liu, Liu, & Wang, 2019) analyzed the relationship between international crude oil price volatility and the exchange rate of oil-importing countries, and Due to the different methods of use such as VAR, VECM and GARCH, they find the GARCH models are suitable to study the volatility spillover, also the relationship between this two variable is not conclusive.
-While, by using (GARCH) method (Saddiqui, Jawad, Naz, & Niazi, 2018) have rejected that exchange rate effecting the oil prices and Granger Causality test indicate that oil price volatility does not granger cause on public sector investment.

- (Revisiting the Effects of Oil price on Exchange Rate: Asymmetric, 2018) concluded by testing the causality direction between oil price and exchange rate, using the Toda and Yamamoto non-causality test. The test showed mixed results, bidirectional causality between oil price increase and decrease on one side and exchange rate on the other side, and unidirectional running from either oil price increase or decrease to exchange rate.

- (Usama & Al-mulali, 2010)examine the impact of oil shocks on the real exchange rate of Norway using cointegration,Granger causality tests and vector autoregressive model, they showed that due to its real exchange rate depreciation brought about by the increase in the price of oil, that because of Norway uses the floating exchange rate regime and smaller share of the world's oil production.

- (Pasrun, wintang, Saidi, Tondi, & Sani, 2018)Showed by using vector autoregressive model that there is no long-term relationship between crude oil price, IDR/EUR exchange rate unless in short – term.

- (Brahmasrene, Huang, & Sissoko, Energy Economics, 2014) by empirical results indicate that relationship between the U.S. imported crude oil prices and exchange rates, that the exchange rates Granger-caused crude oil prices in the short run while the crude oil prices Granger-caused the

exchange rates in the long run, these study are very with and the same results that mentioned by (Beckmann, Czudaj, & Arora, 2017).

After a brief review on theoretical and empirical studies surrounding this research area which mentioned no clear-cut relationship between variables related.

This study takes a closer look at the research dealing with the relationship between oil prices and exchange rates in Libya

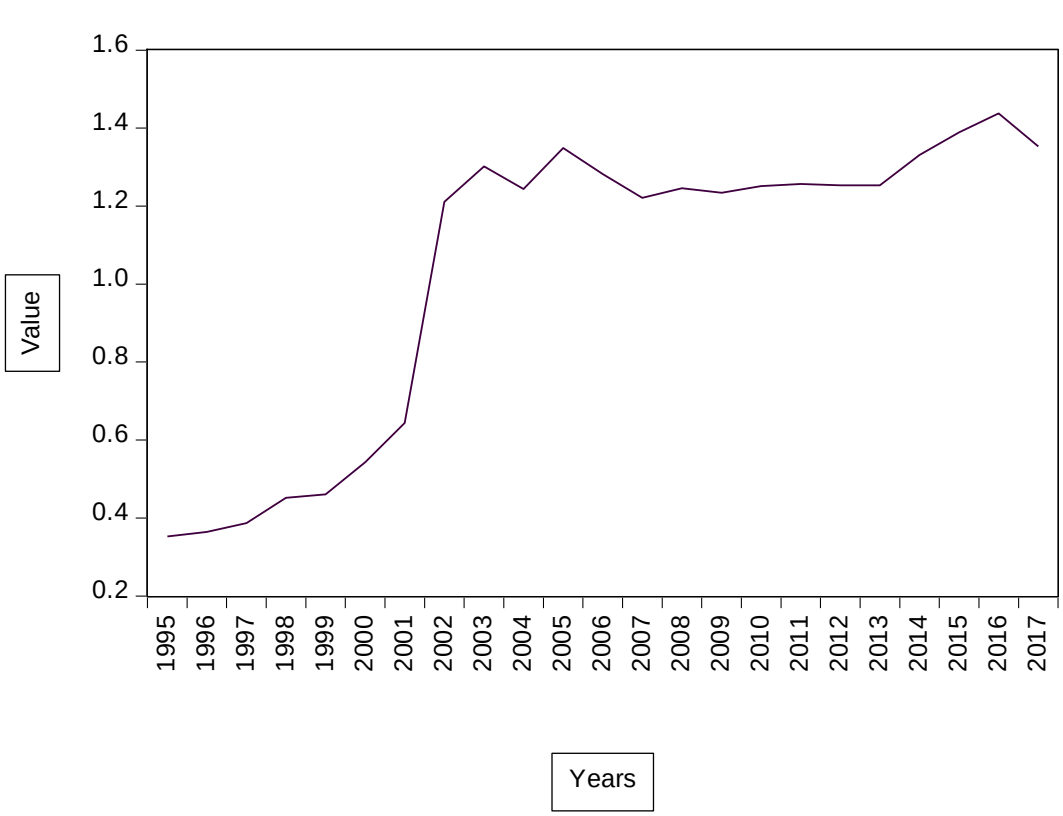
3. DATA AND METHODOLOGY

3.1.Data: (X) Crude oil price (WTI) and**(Y)** LD/USD exchange rate.

We observe a differentiated and not well defined relationshipbetween these two variables(Crude oil price and exchange rate) during the study period, which is noticeable at first sight in figure (1 and 2), shows that the relationshipbetween oil prices(WTI)and the exchange rate are unknown. Therefore, we need to assess this relationship in the long term and causality in the short term to design suitable policies for Libyan economies in the future.

Figure 1: Crude oil price(WTI)from1995 to2017

Figure 2: LD/USA Exchange rate from1995 to2017



The data used in this study is time series data for crude oil price (WIT in USD per barrel), LD/USD exchange rate in Libya.

The two types of data range from (1995 to 2017) by years. Crude oil price is stated as oil price and LD/ USD is stated as EXC.

3.2.METHADOLOGY

In this study we have adopted a set of statistical tools to analyzed the data, represented by cointegration test, vector autoregressive (VAR) model without trend, with stationary endogenous variable at the level or integrated of order one and Causality test for granger .

Due to all endogenous variables(X_t) are integrated of order one (1) but do not cointegrate, then, the following equation can be stated in Vector autoregressive model VAR (p-1):

$$D(X_t) = C + \Pi X_{t-1} + \sum_{i=1}^{p=1} \Gamma_i D(X_{t-1}) + \varepsilon_t \qquad (1)$$

$$\text{To} \rightarrow C + \sum_{i=1}^{p=1} \Gamma_i D(X_{t-1}) + \varepsilon_t \ (2)$$

Where Coefficient Π is called as long-term matrix coefficient,Γ_i is called as short-term matrix coefficient, C is constant vector and $\varepsilon_t = [\varepsilon_{1t}, \varepsilon_{2t}, \varepsilon_{3t}]'$ is white noise vector (Brahmasrene, Huang, &Sissoko, Energy Economics, 2014).

In this study, the Endogenous variables are OIL and EXC, thus vector X_t in equation (1) and (2) is, OILt, EXCt', that means k =2.To estimate the VAR (p) model, we have some steps for estimation: the first step is determining the length of time lag using Akaike Information Criteria (AIC). Next

step is testing stationerity to detect the integration order for endogenous variable (OIL, EXC). Integration order test used is Augmented Dickey-Fueller (ADF) and Phillips-Perron test .Acoording to these two tests, one variable is integrated of order d (I(d)), if the P-value of test statistics is smaller than its critical values (1%, 5% or 10%). If all endogenous variables are integrated of order one, I(1), in this case we have to test the cointegration as a third step between the two variables that by using Johansen cointegration. The Johansen cointegration test uses a trace test or max-eigen test). (Brahmasrene, Huang, & Sissoko, Energy Economics, 2014).

If Johansen cointegration test uses a trace test, thus it use statistics as follows:

$$\eta_r = -T\sum_{i=r+1}^{k}\log(1+\lambda_i), r = 0, 1, \dots k-1.$$

Where; $\lambda_i \rightarrow$ biggest eigen value from matriks Π

$\eta_r \rightarrow$The trace test statistics value

If Johansen cointegration uses Max-eigen test statistics as follows:

$\xi = \log(1+\lambda_i)$), $r = 0, 1, \dots k-1.$,$\xi \rightarrow$ Johansen cointegration value, r = hypotheses

K = number of Endogenous variables

All the last tests which represented by cointegration test (VAR) Model with Causality test for granger as statistical tools to obtain the information regarding the relationship among variables for this study.

4. RESULTS AND DISCUSSION

4.1. Stationary Test

A first step is stationery test to estimate the integration order of each endogenous variable(oil price,exchange rate), by used Augmented Dickey-Fueller (ADF)and Phillips-Perron(PP) tests. The estimation results with statistical values of the ADF and PP test are summarized in the tables below:

Table 1:Results for the unit root tests of(WTI) Crude oil price

	ADF		PP	
	t-Statistics	**Prob.**	**t-Statistics**	**Prob.**
Levels				
Intercept	− 1.49 1672	0.5189	− 1.498 737	0.5155
Intercept and trend	− 1.316848	0.8563	− 1.316848	0.8563
First-difference				
Intercept	− 4.524099	0.0020	− 4.525020	0.0020
Intercept and trend	− 4.564074	0.0082	− 4.578643	0.0080

*5% significant. ADF: Augmented Dickey-Fueller, PP: Phillips-Perron. Source: Eviews 10

Table 2:Results for the unit root tests of Exchange rate

	ADF		PP	
	t-Statistics	**Prob.**	**t-Statistics**	**Prob.**
Levels				
Intercept	− 1.596 912	0.4673	− 1.596 912	0.4673
Intercept and trend	−1.181780	0.8894	− 1.181780	0.8894
First-difference				
Intercept	− 3.580236	0.0156	− 3.585644	0.0154

Intercept and trend	−3.749959	0.0410	−3.711406	0.0441
Intercept and trend	−4.564074	0.0082	−4.578643	0.0080

*5% significant. ADF: Augmented Dickey-Fueller, PP: Phillips-Perron. Source: Eviews 10

The unit root was determined for the variables in Table(1,2) shows the results that the crude oil price and exchange rate, are not stationary at the level, but stationary at the first difference. Thus, OIL and EXC are integrated of order one,I(1).

4.2. Cointegration Test

As we showed, all the variables are integrated of order one,I(1), so, we have to perform a cointegration test using the Johansen cointegration. The statistical determination results of the cointegration test are summarized in the Tables(3,4)below:

Table3:Cointegration Rank Test(Trace)

Hypothesized no. of CE(s)	Eigenvalue	Trace statistic	0.05 critical value	Prob.*
None	0.314800	8.360451	12.32090	0.2101
At most 1	0.019872	0.421515	4.129906	0.5796

Source: E Views10

Table4:Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized no. of CE(s)	Eigenvalue	Max-Eigen statistic	0.05 critical value	Prob.*
None	0.314800	7.938936	11.22480	0.1783
At most 1	0.019872	0.421515	4.129906	0.5796

Source: EViews10

The statistical values of the trace test and the max-eigen test are smaller than their critical values at the 5% significance level. This indicates to and reinforce that there is no long-term countegraction relationship between crude oil prices, LD/ USD the exchange rate.

4. 3. Causal Relationship Test

Due to endogenous variables are integrated of order one (1) and not cointegrate, thus the model for VAR is(p-1). A first step is determining the length of the lag time according to the AIC criterion, and the estimation results of the criteria values for determining the length of the lag time showed the minimum time lag length of the VAR model is p =1.The above resultsaresummarized in Table 5 below:

Table 5:Information criteria'sstatistic values;

Lag	AIC	SC	HQ
0	**10.07731**	**10.17650**	**10.10068**
1	**7.224339***	**7.521896***	**7.294434***

***Indicates lag order selected by the criterias. AIC: Akaike Information Criteria ,**
HQ: Hannan-Quinn information criterion
SC: Schwarz information criterion

As we mentioned above the endogenous variables in this study are integrated of order one, I(1)but not integrated, so the estimated VAR model well be VAR (p-1) model, and the length of the time lag is (1). The estimation results of VAR become in level as follows:

$D(X_t)= C+\sum_{i=1}^{p-1} \Gamma_i D(X_{t-i}) +\epsilon,$

Table6: VAR model

	X	Y
X(-1)	0.688687	-0.000747
	(0.23177)	(0.00201)
	[2.97141]	[-0.37252]
X(-2)	-0.136557	0.001446
	(0.22015)	(0.00190)
	[-0.62030]	[0.75925]
Y(-1)	-23.22225	1.047706
	(27.8528)	(0.24097)
	[-0.83375]	[4.34794]
Y(-2)	47.65962	-0.221771
	(29.2175)	(0.25277)
	[1.63120]	[-0.87735]
C	1.490085	0.184031
	(9.97818)	(0.08633)
	[0.14933]	[2.13183]

Standard errors in ( ) & t-statistics in [ ])

The results in table (6) showed that only values that significant are the coefficient values of the variables (X-1)) and (C)),thus, there is a week short-term relationship between the price of crude oil and the exchange rate with negative effect.To reinforce the results we have also continued with causality test for direction of the relationship. The results are appeared and illustrated at the bottom in Table (7, 8) that in the short-term, there is onlyone-way direction and very week, andseems to be no relationship between crude oil prices and exchange rate.

Table7: Granger Causality Test

Null Hypothesis	**Obs**	**F-Statistic**	**Prob**
Y does not Granger cause X	**22**	**0.04086**	**0.8420**
X does not Granger cause		**1.31283**	**0.2661**

Table 8: VAR Granger Causality/Block Exogeneity Wald Tests

Dependent variable: X

Excluded	Chi-sq	df	Prob.
Y	4.829202	2	0.0894
All	4.829202	2	0.0894

Dependent variable: Y

Excluded	Chi-sq	df	Prob.
X	0.636312	2	0.7275
All	0.636312	2	0.7275

5. CONCLUSION

The goal of this study has been to investigate the relationship between the fluctuation of international crude oil price and LD/US exchange rate. We have used time series data from 1995 to 2017. The use of VAR model is to analyze the relationship between the variables, and Granger causality test is used to determine the direction of causality relation.

The Empirical results indicate that all endogenous variables of the VAR model are integrated of order one, and, the cointegration test was done by using Johansen cointegration test. From the results of this cointegration testing, it is found that there is no long-term cointegration between crude oil prices and the LD/US exchange rate. Thus, the estimation of VAR model is performed on the VAR model in the first difference showed that there is a relationship between the variables. The Granger causality test estimation has shown that there is one way direction relation from a price of crude oil to exchange rate. Meanwhile, the relationship between current value of oil price and previous value of it has a positive effect with 0.68%, and the exchange rate in short run is increased with approximately 0.18%.

The findings of this study provide insight into the dynamic relationship between oil price movements and exchange rate behaviorfor twovariables' performance. We have noticed that the fluctuations and behavior of the oil price does not explain the fluctuations and behaviors of the Libyan dinar exchange rate and vice versa, which confirms that, the two variablesare independent of each other and this is due to the presence of other variables outside the twovariables, otherwise this empirical evidence can be considered that a local internal economy for Libya are very weak and consumption economy compared with production, external international economy and factors might be influencing oil prices as all (Muradov, Hasanli&Hajiyev, 2018).

Further research will be pursued for the study of the impact of the exchange policy adopted in the Libyan economy on macro-economic indicators and its effectiveness in sustainable growth.

Finally, the study recommends that policy makers should consider the oil prices in the global market when they are formulating their exchange rate policy in and also take into account the influence of significant events during the period of structural change in order to achieve sustainable development and rational economic policy.

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