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Modelling the Equilibrium Real Exchange Rate: Evidence from Oil-Exporting Country

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Abstract

This study aims to specify the best model to estimate the real equilibrium exchange rate of the Libyan dinner during the period 1985-2020 utilizing ARDL model. The results of this study indicate that the best model explains the determinants of the actual exchange rate (ARE) and predicts the equilibrium real exchange rate (ERER) is the one that consists of oil revenues (OR), terms of trade (TOT), ration of bored money supply to gross domestic product (M2/GDP), ratio of domestic inflation to forging inflation (DINF/FINF) and DUMMY. They also point out that OR is the domino force as it drives the exchange rate of the Libyan dollar against the US dollar. The results also reveal that the misalignment between the AER and the ERER had notably increased since the 2002 devaluation. This study provides valuable information for monetary policy makers by establishing a benchmark for the ERER. This information would assist them to reasonably set the exchange rate for future economic purposes.

Keywords

Modelling, Equilibrium Real Exchange Rate, Misalignment, Libyan, ARDL Model

1. Introduction

Libyan economy is well-known by the least diversified economies in the world because it relies heavily on exporting crude oil. The Libyan oil revenue which is the prime source of foreign currency represents an average of about 70% of GDP and 90% of government revenues during the last forty years (World Bank, 2020). Also, the Libyan economy is characterized by the fact that oil exports constitute 95% of the Libyan exports, while the bulk of domestic demand for commodities is met by imports (International Trade Centre, 2021). Moreover, the Libyan

economy, which is a rentier one, is distinguished by a higher degree of economic openness. This makes it vulnerable to fluctuations in the international environment, particularly in the oil market, which implies that oil revenues are substantially affected by fluctuations in oil prices. This indicates that oil revenues play a major role in growing the Libyan economy, in the sense that increasing the level of oil revues is associated with economic growth, whereas oil revenue reductions are accompanied with economic contraction. On the other side, higher level of general expenditure is more pronounced during the times of oil revenues abundance. This leads to increase of the level of prices and imports in most of oil exporting economies with fixed exchange rate. While there is no room for increasing government expenditure when the oil revenues decline and too much of real depreciation of exchange rate is needed (Setser, 2007). To sum up, oil revenue is more likely to influence most of macroeconomic variables in Libya even the foreign exchange rate of the Libyan diner.

Libyan economy has encountered many setbacks during the post-uprising broke out in 2011. One of these setbacks is the dramatic plummet in oil revenues. According to the Central Bank of Libya (CBL), oil revenues recorded around 66,932 million dollars and 51,775 million dollars in 2012 and 2013 respectively, whereas they reached to 6665 million dollars in 2016. They continued to decline reaching the lowest historical level in 2020 with only 2409 million dollars (Central Bank of Libya & Economic Bulletin, 2020). The substantial decline in oil revenues causes a deficit in balance of payments and public budget. In addition, the Libyan economy had experienced local public debt for the first time since 2013. Furthermore, foreign treasury bills, which account for the vast majority of foreign reserve had remarkably reduced during the period 2014-2020 relatively to 2011. More spastically, between 2011 and 2014 foreign treasury bill reduced from 117,143.6 million dinars to 96,444.6 million dinars respectively. In 2015, the reduction in foreign treasury bills continued to reach 75,228.9 million dinars relatively to 2011.The decline in foreign treasury bills has reached to its higher level in 2016, where the decline was from 117,143.6 million dinars to 62,818.9 million dinars between 2011 and 2016 respectively. In 2017 and 2018 foreign treasury bill slightly improved to reached 65,816 million dinars and 71,802 million dinars relatively to 2016, while it still in lower levels comparatively to 2011. In 2019 and 2020, foreign treasury bills recorded lower levels of 67,250.2 million dinars and 67,195.8 million dinars relatively to 117,143.6 million dinars in 2011 (**Figure 1**).

Moreover, the Libyan economy has been experienced higher levels of money supply and public expenditure over the period 2012-2020. **Figure 2** illustrates that money supply remarkably soured to 108,496.7 million dinars in 2019 comparatively to 63,731.5 million dinars in 2012, resulting in increasing the ration of M2 to GDP grown by more than 6 times in 2016 and about 3times in 2020 comparatively to 0.5 in 2012. This was partially a result of the expansion of printing cash and Interest rate prevention in 2013. In the same way, consumer public expenditure raised to 41,175.5 million dinars in 2019 comparatively to 30,769.4 million dinars in 2010. It is worth to mention that consumer public expenditure as

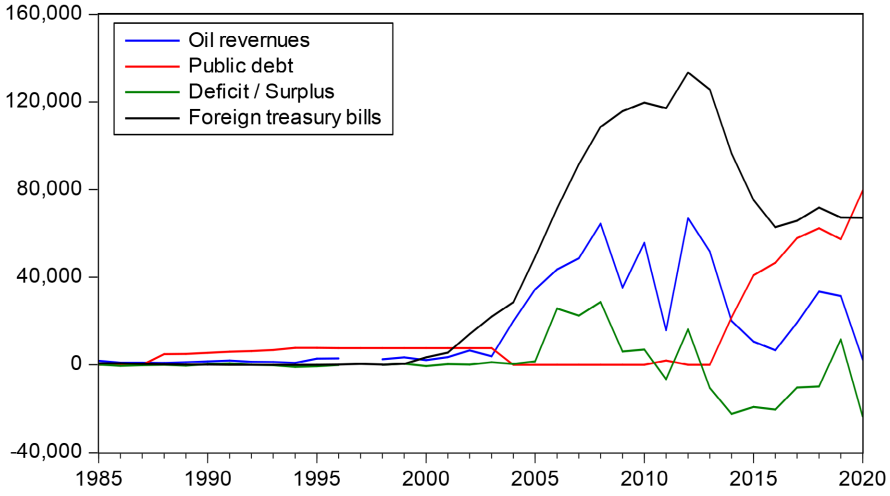


Figure 1. Macroeconomic indicators during the period 1985-2020.

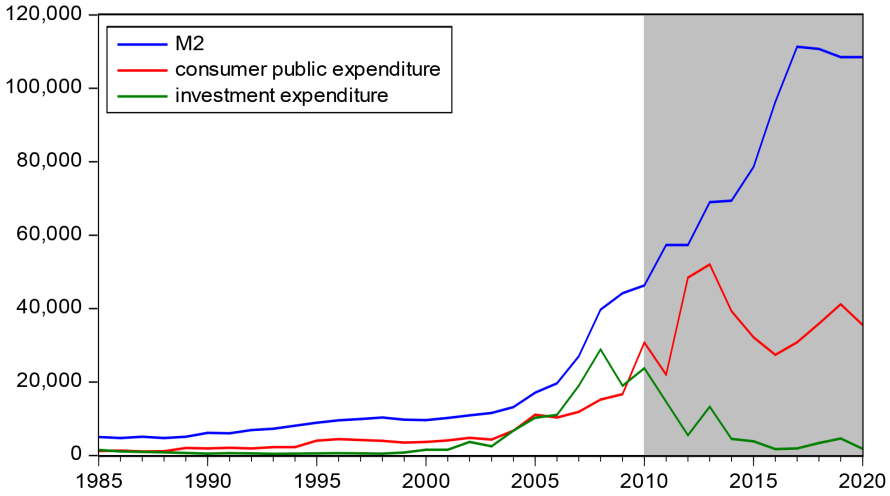


Figure 2. Money supply and public expenditure in Libya during the period 1985-2020.

dominated more than 80% of the public expenditure since 2011 whereas it was only 55% in 2010 (Central Bank of Libya & Economic Bulletin, 2021). However, investment expenditure experienced large decline over the period 2012-2020 with level of 1747.6 and 4637.5 million dinars in 2016 and 2020 respectively.

Because the economic setbacks have been encountered by the Libyan economy since 2012 and CBL reconsidered the exchange rate policy at the end of 2020 in order to alleviate the negative consequences generated by these setbacks. CBL devaluated the Libyan dinar by approximately 70% to SDR (i.e. one Libyan dinner = 0.1555 SDR instead of 0.5551 SDR) namely, 1 $ = 4.48 Libyan dinar. This devaluation is one of the most controversial issues that caught the attention of policymakers, especially monetary policy makers and academics. They wondered how the new exchange rate of the Libyan exchange rate is set by the CBL in the absence of a benchmark that can be relied on by which the new exchange rate of the Libyan dinner is close to its real equilibrium value. The misalignment between the actual exchange rate (AER) and the equilibrium real exchange rate

(ERER) could have serious repercussions on local economy in developing countries. Edwards (1989) indicated that the misalignments are usually overvaluation that negatively impacts the tradable sector by shrinking production, decreasing investments, and declining especially non-oil-exports competitiveness and thereby their volume. Also, lower economic growth rate and productivity are linked to overvalued real exchange rate (Chøwdhury & Ali, 2012). In addition, overvalued real exchange rate can increase the cost of imports and the encourage government to increase in public consumer expenditure causing an increase in inflation rate.

Based on above, this study aims to answer the following questions:

1) What are the main fundamentals of the Libyan exchange rate against the US dollar during the period 1985-2020?

2) What is the estimating ERER during the period of the study?

3) Is there a misalignment between ERER and AER?

Answering these questions would provide valuable information and implication for monetary policy makers in that they accurately set the appropriate exchange rate based on the estimated ERER by the study's model and thus avoid unfavorable consequences related to setting a new exchange rate. This paper would contribute to the literature that addressed the Libyan exchange rate determinants and misalignments by modelling the related fundamentals to estimating Equilibrium AER and its fundamentals in Libyan economy. It would also provide robust analysis to confirm results and avoid misspecification problem. Moreover, this study is the first of its kind since last devaluation of AER of the Libyan dinar at the beginning of 2021. Thus the significance of this paper lies in the urgent need to explore the equilibrium AER in Libyan economy and its determinants. Its results would assist the monetary policy makers in Libya economy to be fully aware of the ERER and the degree of its deviation from the AER in order to pursue economic policies that ensure the stability of macroeconomic variables such as inflation and economic growth.

2. Literature Review

First literature that has addressed real exchange rates misalignment. In this aspect, Devarajan (1997) used the purchasing power parity approach (PPP) to measure the misalignment in real exchange rate prior to and post the 1994 devaluation in 12 countries of the West and Central Africa. He pointed out that AER was about 30% overvalued on average before the 1994 devaluation with significant differences across the 12 countries. The AER of larger crude oil countries such as Gabon and Cameroon were the most overvalued. While one year after the devaluation, the real exchange rate was undervalued in most of these countries, nevertheless real exchange rates remained substantially overvalued in Cameroon and Gabon. Zhang (2001) used the Behavioral Equilibrium Exchange Rate approach (BEER) to assess the misalignment of real exchange rate in China. Results showed that the actual real exchange rate was overvalued

during the period from 1957 to 1977 while in years such as 1971, 1972 and 1973 the real exchange rate was undervalued as a result of adopting floating exchange rates. More importantly, real exchange rate was closer to its equilibrium due to economic reforms that had been adopted by China government after 1987. Jongwanich (2009) utilized the PPP approach to examine the misalignment in the AER in developing Asian countries over 1995-2008. They found out that in the pre-financial crisis 1997-1998, AER was overvalued, whereas, it was undervalued in the post-crisis in many Asian countries such as Republic of China, Thailand and Malaysia. Elhendawy (2012) investigated the RER Misalignment in Saudi Arabia based on BEER approach. Results showed that the actual RER of Saudi Riyal over valued in the years 1980, 1981 and 1982 by 25%, 16% and 7% respectively. Conversely, it was undervalued since 1983 till 2009 and it hit an all-time low of about 84 percent below estimated equilibrium in 2006. Besides, GDP growth, gross capital formation and government consumption expenditure were identified the main determinants of the Saudi Riyal. Nassif (2011) studied the misalignment of AER in Brazil. He indicated that the AER of Brazil overvalued by 80 per cent in comparison to its equilibrium level; furthermore, GDP per capita and terms of trade was found to be the most variables that drive real exchange rate in the long run. Coppola, Lagerborg and Mustafaoglu (2016) estimated the equilibrium value of the Argentine peso exchange rate using the BEER model findings revealed that the main determinants of the Argentine peso are: terms of trade, productivity differentials, trade openness and foreign currency reserves, more importantly, the Argentine peso was overvalued by about 39 percent during the period of study. Wu Renhong (2016) estimated the equilibrium real exchange rate of the Chinese Yuan. They added the human development index to the differences in non-tradable goods and services between developing and developed countries. Results showed that the Chinese yuan was undervalued during the period of study. Fidora, Giordano, & Schmitz (2021) used BEER model to estimate the misalignment of AER in the euro area during the period from 1999 to 2015 with a sample consist of 57 countries.GDP per capita, trade openness, TOT, government expenditure, and interest rate were the main variables used in this model. The finding showed the existence of smaller misalignments of AER in the euro area in comparison to its major trading partner. This implies that countries adopted a currency union has better outcomes than countries have a different regime of exchange rate in order of keeping ERER to its equilibrium.

Second part of Literature has investigated the fundamentals of real exchange rates. Elbadawi and Soto (2008) examined the determinants of the long-run equilibrium real exchange rates for a sample of 84 developing countries. Findings revealed that productivity was the first and foremost influential determinants, followed by: 1) current account, 2) the combined instruments of fiscal policy, 3) TOT, 4) openness and 5) financial depth Cashin, Céspedes and Sahay (2004) examined the relationship between the real exchange rates of commodi-

ty-exporting economics and the real prices of their commodity export. A long-run relationship between real exchange rates and real commodity prices was captured for approximately 33 per cent of the commodity-exporting countries. That is, when the international price of primary commodity raise, wages in this sector raise accordingly leading to an increase of non-tradable good's price, which subsequently result in an appreciation of the real exchange rate. It is worthy to add that the long run of real exchange rate in these countries was found a time varying which depends on the movements of the real price of commodity exports. Olaniyi (2013) tested the validity of the monetary exchange rate model in Nigerian economy which consists of money supply, interest rate differentials and income as explanatory variables. He discovered a long-run relationship among the variables of this model. Tashu (2015) analysed the determinants of Peru's equilibrium real exchange rate based on BEER. Results showed that productivity and government consumption are the most drivers of equilibrium real exchange rate.

Third segment of Literature shed light on the relationship between oil price and real exchange. In this side, Nikbakht (2010) used PPP to examine the relationship between oil price and real exchange rate among a few members of the OPEC countries specifically, Saudi Arabia Iran, Kuwait, Algeria, Nigeria, Indonesia, and Venezuela. Findings revealed that there is a long-run relationship between the real exchange rate and oil price. That is, the increase of oil prices causes the increase of tradable goods' price in a home country that depends on oil imports relatively to forging countries and this lead to a real depreciation of real exchange rate. Also, oil prices found to be the main explanatory variable of real exchange rate. Also, Ferraro, Rogoff and Rossi (2015) investigated whether oil price can forecast exchange rate in Canadian economy. Using daily data on Canadian-U.S. dollar nominal exchange rates, oil prices, and Canadian and U.S. interest rates from 12/14/1984 to 11/05/2010, results showed that there was a short-term relationship between oil price and nominal exchange rate. In other words, if one had a fit model to forecast oil prices, one could exploit it to forecast future exchange rates. Basher, Haug and Sadorsky (2016), utilized Markov-switching models to assess the impact of oil demand and supply shocks on AER in a sample consist of 9 oil exporting and importing countries namely; the United Kingdom Canada, Norway, Brazil, Mexico, Russia, Japan India and South Korea. They indicated that exchange rate appreciate dafter oil demand shocks in oil exporting countries, whereas oil supply shocks had no effect on exchange rate. In the same way, Mohammed Suliman and Abid (2020) examined the existence of a relationship between exchange rates and oil price in the kingdom of Saudi Arabia. Results revealed that in the long-run, there was a strong bidirectional causal relationship between oil price and real exchange rate. While in the short term, a unidirectional causal relationship ranging from the oil price to the exchange rate was marked. Ji et al., (2020) investigated the dynamic effects of oil shocks on AERs in net oil exporters and importers in the sample of three oil importers (Japan, India and South Korea) and three oil exporters (the United

Kingdom, Canada and Norway) utilising Structural Vector Autoregression model (SVAR) and involving three sources of oil shocks. The results showed that oil supply shocks had a larger negative effect (depreciating) on exchange rates in oil exporters than in importers countries. Recently, Ayad (2021) examined the relationship between oil prices and the Algerian Dinar exchange rate. Results showed that there was no long relationship between oil prices and exchange rate in Algeria. This was attributed to the sterilization policy had adopted by the Central Bank of Algeria to Isolate the effect of oil revenue on the exchange rate, among other factors.

Regarding to the Libyan exchange rate, there were three studies conducted to explore the equilibrium AER and its fundamentals. First, Bhattarai and Ben-Naser (2020) employed Markov Switching Model to explain the misalignments of ERER of the Libyan dinar. Findings showed that Libyan dinar was overvalued during (1974, 1978), (1986, 1999) and (2011, 2015), while it was undervalued during (1962, 1973), (1979, 1985) and (2000, 2010). Second, Ben-Naser, Bhattarai and Elheddad (2018) estimated ERER over 1975-2015, utilizing co-integration technique and VECM model to detect the long and short relationship. They pointed out that real oil prices, real relative productivity and the degree of openness were the main determinants of AER. Also, they found that AER was overvalued by more than 40%. Third, Chøwdhury and Ali (2012) studied the main determinants of AER 1970-2007 by applying the ARDL. Results revealed that terms of trade, government expenditure, local and global interest differential, net foreign asset and trade openness were the fundamentals of AER in Libyan economy. In addition, a long-run equilibrium relation between these fundamental and AER was detected.

3. Methodology

3.1. Data Description

This study aims to estimate the real equilibrium of the Libyan dinner by modelling all fundamentals affecting the Libyan exchange rate during the period 1986-2020. Thus, dependent and independent variables needed to be described before starting analysis.

3.1.1. Dependent Variable

The main aim of this paper is to estimate the ERER of Libyan dinar against the US dollar. Thus, the dependent variable in this study is the AER of the Libyan dinner against the US dollar during the period 1985-2020. Data on the dependent variable constructed from CBL. The bilateral AER is measured by the quantity of the Libyan dinar per unit of the US dollar which means that an increase of the bilateral AER implies its depreciation against the US dollar. The dependant variable covers the period 1985-2020 where the Libyan dinar had been devaluated four times. The first devaluation during the period 1985-2020 was in 1986 where the Libyan dinar pegged to special drawing rights (SDR) rather than the US dollar at a rate equivalent to 2.8 SDR (3.236 dollar) per one Libyan dinar. In

other words, in 1986 the Libyan exchange rate against the US dollar decreased from 3.369 dollar in 1973 to 3.326 dollar reflecting a reduction in the Libyan dinar value. The devaluation in 1986 was implemented for the following reasons; the deficit the trade balance, the lack in foreign income, the emergence of parallel market of foreign currencies, encouraging non-oil exports and reducing imports. During the first years of the third millennium namely, during 2001, 2002, 2003, the Libyan dinar value had experienced remarkable reduction resulting from the reduction in the Libyan exchange rate against the SDR during 2001, 2002, 2003. This significant decline in the value of the dinar during these years was because of Libya's orientation towards trade liberalization, and in implementation of the recommendations of the International Monetary Fund mission in order to adapt the exchange rate system that suitable for the economic and structural reforms in that period. In 2001, the Libyan dinner was devaluated by reducing the Libyan dinar exchange rate dinar against the SDR to 1.224. Also, in 2002, the Libyan dinar had been devaluated by more than 50% comparatively to 2001 according to the Resolution No 49 issued CBL on 24 December 2001 that reduced the exchange rate of the Libyan dinar against the SDR to 0.608 which equivalent to 0.77 US dollar. The 2002 devaluation was implemented: to avoid the negative effects resulting from the multiplicity of exchange rates; to reduce the difference between the official exchange rate and the parallel exchange rate of the Libyan dinar; encourage the non-oil exports. This rate was further devaluated on 14 June 2003 when the CBL issued the Resolution No. 17 that set the exchange rate of the Libyan dinner at = 0.5175 SDR in order to reduce the industrial river project tax, which was imposed on all letter of credits and transfers in foreign currencies. Finally, the last devaluation was in 2020 which was the biggest devolution in the history of the Libyan dinar where the exchange rate of the Libyan dinner was reduced to 0.1555 SDR (0.22 US dollar). This devaluation was because of the large decline in the oil revenues, the soared increase in the money supply, the remarkable deficit in the balance of payment, and the noticeable reduction in the foreign reserves. Table 1 illustrates the devaluation of the Libyan dinar against SDU and US dollar during period of the study.

Last not least, the study period covers the period of the 2011 uprising in which resulted in petroleum production to be decreased from 1.8 million barrels/day in 2009 to between (0.4 - 0.5) Million barrels/day during 2014-2015 that causes a

Table 1. The devolution of Libyan Exchange Rate against SDR and US dollar.

Year	Dollar	SDR	LDY
1986	3.236	2.8	1
2001	1.55	1.224	1
2002	1.3	0.608	1
2003	1.29	0.5175	1
2020	0.22	0.1555	1

sharp black market foreign currency (Central Bank of Libya & Economic Bulletin, 2015). The starting and ending date for the sample period were chosen due to data availability. **Figure 3** shows the trend of AER and parallel exchange rate of the Libyan dinar during the period of the study.

3.1.2. Independent Variables

Salvatore (2008) and Salvatore (2016) pointed out that in the long-run, the exchange rate is affected by the commercial flows of services and commodities, that is the increase in a country exports relatively to the country's imports would induce the value of the country's currency to appreciate (a decline in the country's currency exchange rate against the foreign currencies). Since oil sector represents the sole source of foreign currency supply to the Libyan economy, and accounts for more than 95 % of Libya's total public revenues. Thus a change in oil revenues is one of the main channels that primarily influence the Libyan exchange rate against the US dollar. In the sense, oil revues increase as results of oil price increase. This would lead to the supply of dollars for the government and thereby decreasing the exchange rate of the Libyan dinar against the US dollar (appreciation the value of the Libyan dinar) specifically in the short-run. Also, the international prices (International terms of trade) is one of most important external fundamental of the RER fundamentals that affects the ERER in the long-run according to Edwards (1989). Indeed, commodity prices are generally found to drive AER fluctuations in commodity-exporting countries (Chen & Rogoff, 2003; Cashin et al., 2004) and econometric models of ERER often include this series among their explanatory variables (Isard, 2007; Ricci et al., 2008; Elbadawi & Soto, 2008; Elbadawi, Kaltani, & Soto, 2012). Therefore, as long as the price of exports are greater than the price of imports, the country's currency value is more likely to appreciate and thus the terms of trade (TOT) are measured by the ratio of export prices to import prices is used as an explanatory variable that determine RER (Zhang, 2001). The Mundell-Fleming effect of fiscal

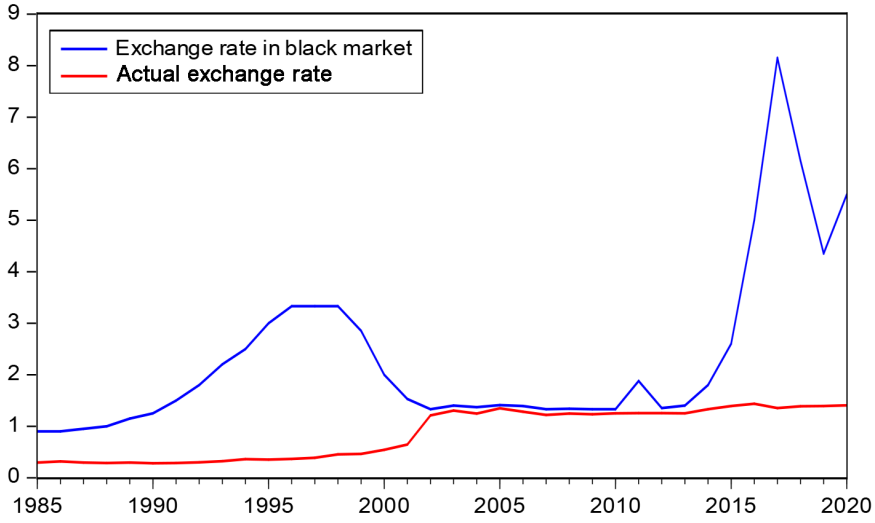


Figure 3. Trend of AER and its value in the black market during the period of the study.

policy and Dutch disease hypothesis states that government spending raises the price of domestic goods as result of increasing the domestic demand for domestic goods. On other side, the demand for the domestic goods by foreigners would decrease leading to deprecation in the AER. Therefore, we added government expenditure into the study model following pervious literature (Ricci, Milesi-Ferretti, & Lee, 2008; Ravn, Schmitt-Grohe, & Uribe, 2012). Finally, foreign reserves FR are included as government may resort to use them to affect the AER and thus influence the exchange rate[1].

Based on the quantity theory of money by David Ricardo, it states that the rise in money supply induces the level of domestic price to increase and thereby causes a reduction (rise) in the value of the country's currency (AER). However, if the increase in the money supply was accompanied with rises in the level of productivity (GDP), the level of prices are unlikely to increase, thus the ratio of board money supply to gross domestic product (M2/GDP) is employed to account for the potential influence of the monetary stability on ER. In addition, the degree of commercial openness (COP) is considered one the factors that has an influence on ERwhich computed as (exports + imports)/GDP following (Zhang, 2001; Elbadawi, Kaltani, & Soto, 2012; Ben-Naser et al., 2018). The purchasing power party postulates that the exchange rate is function of the ratio of domestic and foreign prices, therefore, we used the ratio of inflation rate in Libya to the inflation rate in the US (DINF/FINF). Finally, we included a dummy variable that account for the period of uprising that has broken out since 2011 by given the period from 1985-2010 value of 1 and otherwise zero. All variables constructed from the Central Bank of Libya.

3.1.3. Variables Correlation Matrix

Table 2 shows the correlation matrix among all variables. As indicated by Table 2, all variables are not correlated to each variables except for (OR, COP), (OR, GEX), (OR, FR), (GEX, COP), (GEX, FR) and (FR, COP) as the correlation degree between the two is above 0.50 specifically 0.633, 0.791, 0.845, 0.844, 0.912 and 0.813 respectively, implying the existing of multicollinearity problem if

Table 2. Correlation matrix.

Correlation	OR	TOT	M2/GDP	GEX	COP	FR	DINF/FINF
OR	1	0.485	−0.134	0.791	0.663	0.845	−0.217
TOT	0.485	1	−0.458	0.090	0.098	0.185	0.417
M2/GDP	−0.134	−0.458	1	0.314	0.275	0.201	−0.380
GEX	0.791	0.090	0.314	1	0.844	0.912	−0.503
COP	0.663	0.098	0.275	0.844	1	0.813	−0.478
FR	0.845	0.185	0.201	0.921	0.813	1	−0.463
DINF/FINF	−0.217	0.417	−0.380	−0.503	−0.478	−0.463	1

[1]Foreign Treasury Bills, Securities and Balances in Convertible Currencies, is used as a proxy of foreign reserves.

those variables used together in one model.

3.2. Data Analysis

3.2.1. Stationarity Test

Before a regression model be run, all variables must be tested for stationarity. To do so, the Augmented Dickey-Fuller (ADF) (Dickey & Fuller, 1981) and Phillips-Perron (PP) (Phillips & Perron, 1988) unit root tests are employed in order to determine whether the variables are stationary or not. **Table 3** indicated

Table 3. Stationarity test results.

Variable	Model	ADF		PPP	
		Level	First difference	Level	First difference
AER	τ_μ	−0.685	−4.565***	−0.737	−4.641***
	τ_T	−1.572	−4.584***	−1.906	−4.567**
	T	1.234	−4.385***	−0.930	−4.374***
OR	τ_μ	−2.437	−8.275***	−2.256	−9.091***
	τ_T	−2.742	−8.192***	−2.742	−9.587***
	T	−1.803*	−8.403***	−1.604	−9.171***
TOT	τ_μ	−2.931*	−6.080***	−2.849*	−12.148***
	τ_T	−2.898	−5.984***	−2.818	−11.735***
	T	−0.920	−6.175***	0.621	−12.724***
M2/GDP	τ_μ	2.057	−3.719***	1.568	−8.175***
	τ_T	−0.981	−4.277***	−0.582	−9.465***
	T	3.958	−3.042**	2.568	−7.838***
COP	τ_μ	−1.405	−5.519***	−1.230	−9.119***
	τ_T	−2.863	−5.442***	−2.665	−9.237***
	T	0.068	−2.549***	0.740	−6.050***
GEX	τ_μ	−1.246	−8.314***	−1.246	−9.321***
	τ_T	−3.314*	−5.334***	−3.260*	−9.147***
	T	0.239	−8.301***	0.182	−8.486***
FR	τ_μ	−1.548	−9.655***	1.235	8.541***
	τ_T	−3.966*	6.231***	3.987*	6.147***
	T	−0.806	5.321***	−0.895	6.0124***
DINF/FINF	τ_μ	−3.342**	−6.077***	−3.341**	−10.223***
	τ_T	−3.342***	−5.970***	−4.183**	−9.903***
	T	−4.051***	−6.159***	−4.112**	−10.363***

Note: ***, **, * indicate rejection of null hypothesis of unit root at significance levels 1%, 5%, 10% respectively. τ_μ: tests equation is with a drift and without trend; τ_μ is with a drift and trend; τ is without a drift and trend.

that the depend variable AER is stationary at the first difference I (1), while the independent variables are stationary at different orders, in the sense that variables including OR, TOT, M2/GDP, GEX, FR, and COP are stationary at the first difference while DINF/FINF is stationary at level I (0).

3.2.2. Estimation Approach

This paper aims to define the fundamentals of ERER in Libyan economy and subsequently estimate the value of it against the US dollar during the period 1985-2020. According to stationarity tests, the study's independent variables are stationary at different (mixed) order namely, some of the independent variables are stationary at the first difference and the others are at the second difference orders, while the dependent variable is stationary at the first difference. Consequently, this paper utilizes the autoregressive distributed lagged model (ARDL) to estimate the ERER of Libya dinar against the US dollar. Based on the correlation matrix, four models will be estimated using ARDL model to make sure that the estimated the ERER of Libya dinar against the US dollar is not subject to model specification, and also to provide soled and robust results. One model will be selected among the three models according to Akaike criteria. The four models to be estimated are as followings:

The first model:

$$\begin{aligned}\mathrm{AER}_t &= \alpha_0 + \alpha_1 \mathrm{AER}_{t-1} + \mathrm{OR}_{t-1} + \mathrm{TOT}_{t-1} + \mathrm{M2/GDP}_{t-1} + \mathrm{DINF/FINF}_{t-1} \\ &\quad + \mathrm{DUMMY}_{t-1} + \sum_{t=1}^{p} B_2 \Delta \mathrm{AER}_{t-i} + \sum_{t=0}^{q} B_2 \Delta \mathrm{OR}_{t-i} \\ &\quad + \sum_{t=0}^{q} B_2 \Delta \mathrm{TOT}_{t-i} + \sum_{t=0}^{q} B_2 \Delta \mathrm{M2/GDP}_{t-i} + \sum_{t=0}^{q} B_2 \Delta \mathrm{DINF/FINF}_{t-i} \\ &\quad + \sum_{t=0}^{q} B_2 \Delta \mathrm{DUMMY}_{t-i} + \pi \mathrm{ECM}_{t-1} + e_t\end{aligned}$$

The second model:

$$\begin{aligned}\mathrm{AER}_t &= \alpha_0 + \alpha_1 \mathrm{AER}_{t-1} + \alpha_2 \mathrm{GEX}_{t-1} + \alpha_3 \mathrm{TOT}_{t-1} + \alpha_4 \mathrm{M2/GDP}_{t-1} \\ &\quad + \alpha_5 \mathrm{DINF/FINF}_{t-1} + \alpha_6 \mathrm{DUMMY}_{t-1} + \sum_{t=1}^{p} B_1 \Delta \mathrm{AER}_{t-i} \\ &\quad + \sum_{t=0}^{q} B_2 \Delta \mathrm{GEX}_{t-i} + \sum_{t=0}^{q} B_3 \Delta \mathrm{TOT}_{t-i} + \sum_{t=0}^{q} B_4 \Delta \mathrm{M2/GDP}_{t-i} \\ &\quad + \sum_{t=0}^{q} B_5 \Delta \mathrm{DINF/FINF}_{t-i} + \sum_{t=0}^{q} B_6 \Delta \mathrm{DUMMY}_{t-i} + \pi \mathrm{ECM}_{t-1} + e_t\end{aligned}$$

The third model:

$$\begin{aligned}\mathrm{AER}_t &= \alpha_0 + \alpha_1 \mathrm{AER}_{t-1} + \alpha_2 \mathrm{FR}_{t-1} + \alpha_3 \mathrm{TOT}_{t-1} + \alpha_4 \mathrm{M2/GDP}_{t-1} \\ &\quad + \alpha_5 \mathrm{DINF/FINF}_{t-1} + \alpha_6 \mathrm{DUMMY}_{t-1} + \sum_{t=1}^{p} B_1 \Delta \mathrm{AER}_{t-i} \\ &\quad + \sum_{t=0}^{q} B_2 \Delta \mathrm{FR}_{t-i} + \sum_{t=0}^{q} B_3 \Delta \mathrm{TOT}_{t-i} + \sum_{t=0}^{q} B_4 \Delta \mathrm{M2/GDP}_{t-i} \\ &\quad + \sum_{t=0}^{q} B_5 \Delta \mathrm{DINF/FINF}_{t-i} + \sum_{t=0}^{q} B_6 \Delta \mathrm{DUMMY}_{t-i} + \pi ECM_{t-1} + e_t\end{aligned}$$

The forth model:

$$\begin{aligned}\mathrm{AER}_t &= \alpha_0 + \alpha_1 \mathrm{AER}_{t-1} + \alpha_2 \mathrm{COP}_{t-1} + \alpha_3 \mathrm{TOT}_{t-1} + \alpha_4 \mathrm{M2/GDP}_{t-1} \\ &\quad + \alpha_5 \mathrm{DINF/FINF}_{t-1} + \alpha_6 \mathrm{DUMMY}_{t-1} + \sum_{t=1}^{p} B_1 \Delta \mathrm{AER}_{t-i} \\ &\quad + \sum_{t=0}^{q} B_2 \Delta \mathrm{COP}_{t-i} + \sum_{t=0}^{q} B_3 \Delta \mathrm{TOT}_{t-i} + \sum_{t=0}^{q} B_4 \Delta \mathrm{M2/GDP}_{t-i} \\ &\quad + \sum_{t=0}^{q} B_5 \Delta \mathrm{DINF/FINF}_{t-i} + \sum_{t=0}^{q} B_6 \Delta \mathrm{DUMMY}_{t-i} + \pi ECM_{t-1} + e_t\end{aligned}$$

where: AER_t is the actual exchange rate of the Libyan dinar against the US dollar, α_0 is the constant, $\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5, \alpha_6$ are the coefficients of variables in the long-run, $B_1, B_2, B_3, B_4, B_5, B_6$ are the coefficients of variables in the short-run. OR represents oil revenues; TOT stands for terms of trade; M2/GDP is the ration of board money supply to gross domestic product; DINF/FINF is the ratio of domestic inflation to forging inflation; DUMMY accounts for the uprising in 2011; GEX is the government expenditure; FR represents foreign assets; COP is the commercial openness; ECM is the error correction factor; π is the coefficient of ECM that shows how much of the disequilibrium in the short-run is being corrected towards the long-run.

3.2.3. Estimating ARDL Model and Specifying the Optimal Lag ARDL (p, q)

For specifying the optimal lag for each model, we rely on Akaike information criterion where the selection of the lag is according to the lowest value of this criterion for each variable in the model. After estimating ARDL model, the appropriate lag in the first model(AER, OR, TOT, M2/GDP, DINF/FINF, DUMMY) is (1, 2, 2, 1, 2, 2) respectively, second model (AER, GEX, TOT, M2/GDP, DINF/FINF, DUMMY) is (2, 1, 3, 3, 2, 2) respectively. While for the third model (AER, FR, TOT, M2/GDP, DINF/FINF, DUMMY) is (3, 3, 3, 1, 2, 3). Finally, for the fourth model (AER, COP, TOT, M2/GDP, DINF/FINF, DUMMY) is (3, 0, 2, 0, 3, 2).

3.2.4. Co-Integration Test

Before estimating the four models, co-integration test models must be examined to confirm whether there is a long-run relationship between AER and the explanatory variables in each model. As long as all variables in the four above models are co-integrated at different order I (0) and I (1), the best choice to test for the existence of long-run relationship in each model is Bonds Testing Approach according to the methodology of ARDL model. Results in **Table 4** indicate that all variables in each model in the first and fourth models have a long-run relationship with AER, while this long-run relationship with AER does not appear in the second and third models.

4. Results and Discussion

After insuring that there is a long-run relationship between the AER against the US dollar and all explanatory variables in the first and forth models, we can estimate the short and long-rum coefficients for each model according to the number of lags that have been selected above. **Table 4** indicated that the oil revenues (OR) is the dominant force that drives the ERER in Libya economy in short- and long-run. Implying that increases in oil revues as result of oil prices improvements would lead to increase the domestic supply of foreign currencies and thus reflected in a decline in the AER of Libyan dinar (improvement in the value of the Libyan dinner). In other words, shocks associated with oil sector in Libya substantially influence the Libyan dinner value. For example, the AER of

Table 4. Co-integration test results for each model

	Value	lower bond $I(0)$	upper bond $I(1)$	level of significant
First model				
F-statistic	5.165	2.26	3.35	10%
K	5	2.62	3.79	5%
		2.96	4.18	2.5%
		3.41	4.68	1%
Second model				
F-statistic	2.113	2.26	3.35	10%
K	5	2.62	3.79	5%
		2.96	4.18	2.5%
		3.41	4.68	1%
Third model				
F-statistic	1.356	2.26	3.35	10%
K	5	2.62	3.79	5%
		2.96	4.18	2.5%
		3.41	4.68	1%
Forth model				
F-statistic	4.635	2.26	3.35	10%
K	5	2.62	3.79	5%
		2.96	4.18	2.5%
		3.41	4.86	1%

Libyan dinner against the US dollar was 3.33/$ during the first quarter of 1973 and continued to be at this rate until the first quarter of 1986. This is due to the abundance in foreign currencies and the substantial increase in foreign reserves as result of oil price improvements, as well as the lack of any managerial and quantitative restriction on the freedom to deal in foreign currencies. In countries where oil exports account for large share to total exports, local currency values are more likely to have an appreciation pressure by accumulating foreign exchange reserves (Buetzer, Habib, & Stracca, 2012) and (Ben-Naser et al., 2018). This view is supported by Basher, Haug and Sadorsky (2016) who found out among oil-exporting countries, and oil price positive shocks have a substantial negative impact on exchange rates in Russia, indicating an appreciation of the value of Robel relative to the US dollar. However, in March, 1986, the Libyan monetary authority devaluated the Libyan dinner against the US dollar by 4.3% as result of plummet in oil prices which in turn causes a deficit in the balance payment, and declines in revenues in foreign currencies.

The negative effect of oil revenues on the Libyan RER is in accordance with

Basher, Haug, and Sadorsky, (2016) who indicated that in short-run, oil price shocks lead to a decrease (appreciation) in the exchange rate of Canadian dollar against the US dollar (The Canadian dollar value). In the same way, Mohammed Suliman, and Abid, (2020) confirmed that shocks related to oil sector transmitted to the Saudi Riyal and found a negative relationship between oil price and the exchange rate of the Saudi Riyal against the US dollar in both short and long-runs. This is also the case for the advanced oil-exporting countries, Ji, Shahzad, Bouri, and Suleman, (2020) pointed out that there is negative response of real exchange rates of Canadian dollar, Norwegian and the Britch Poundagainst US dollar to oil-specific demand shocks implying that oil-specific demand shocks causes apperceptions in the values of Canadian dollar, Norwegian and the Britch Pound. The negative effect of oil revenues on AER of Libyan dinar against the US dollar in short and long-runs and, the shortcomings of the exchange rate policy adopted by the Libyan monetary authorities that do not allow the AER to go up and down according to oil revenue levels. All those force the Libyan monetary authorities to overvalue the AER of Libyan dinner to obtain imports at the lowest cost as the Libyan economy heavily relies on exporting a single commodity (oil) and highly imports of the majority of commodities.

Regarding the influence of TOT on the AER in Libyan economy, **Table 5** shows that TOT has negative effect on the AER of Libyan dinar against the US dollar in short and long-runs. This implies that a positive shocks in TOT (i.e. an increase in TOT as result of oil price increases comparatively to import prices) leads to an appreciation in the value of the Libyan dinner as the average of TOT during the study period was greater than one of 1.765. This result is in accordance with Coudert, Couharde and Mignon (2008) who indicated that positive (negative) shocks in TOT are linked to appreciation (depreciation) in oil-exporting countries exchange rate values. Moreover, positive shocks associated with terms of trade can generate the Dutch disease phenomenon with rising non-tradable prices and a real exchange rate appreciation specifically in oil-exporting countries. The effect of TOT is similar to Balassa-Samuelson effect with the difference in relative productivity between the two sectors, tradable and non-tradable goods (Mohammed Suliman & Abid, 2020). Balassa-Samuelson effect considers that the price of tradable is fixed internationally by the law of one price. It states that the productivity gains made in the tradable sector as result of increasing export prices induces wage to rises which in turn spread to the whole economy and make the AER appreciate (Balassa, 1964). However, the Dutch dieses did not cause deprecation in the value of the Libyan dinner since the expected increase in the local demand that fulfils form imports is covered by oil exports. In the since that the Dutch daises do not play role in deprecation in the value of the Libyan dinner as the elasticity of imports is lesser response than the elasticity of oil-exports and foreigner serves to oil price increases. This is the case for some oil-exporting countries such as Kuwait and Saudi Arabia, where the increase in oil price in early 2000s did not induce their AER to appreciate because of policy measurements such as the constitution of sovereign funds have helped to stabil-

ize the effects of oil price on the economy (Coudert, Couharde, & Mignon, 2008).

Moreover, the dummy variable (DUMMY) that accounts for the 2011 uprising has positive significant effect on the AER of Libyan dinner in the first and fourth models. This result confirms that the negative shocks related to oil sector in Libya would have negative implications on the AER of Libyan dinner. The 2011 uprising resulted in oil production to be decreased from 1.8 million barrels/day in 2009 to between (0.4 - 0.5) Million barrels/day during 2014-2015 causing oil revenues to significantly decline from 35,347 billion dollars in 2009 to 19976 billion dollars and 10,597 billion dollars in 2014 and 2015 respectively. Also, in 2020 the reduction in oil production had recorded significant levels leading to significant decline in the oil revenues of 4523 billion dollars. This leads the monetary authorities to devaluate the Libyan dinner against the US dollar by 70% which supports the view that oil revenues one of the major factor participating in changing the bilateral of the AER of Libyan dinner against the US dollar. This result implies that political stability is among the most important factors that influence AER in Libya. Regarding the ratio of domestic price to foreign price (DINF/FINF), results indicate that this variable is irrelevant to the RER of Libyan dinner against the US dollar. Since the Libyan economy heavily depends on producing one commodity (oil) which priced in the US dollar thus growing the level of domestic prices relatively to foreign prices would not lead to diminish the demand for oil which in turn, cause a raising(reduction) in the RER of Libyan dinner (value in the Libyan currency).Finally, the ratio of board money supply to gross domestic product (M2/GDP) positively and strongly affects the AER of Libyan dinner against the US dollar in long-run relatively to short-run. Growing the level of M2 relatively to GDP implies lower level of monetary stability because of large part of domestic currency outside the banking system specifically over the period 2014-2020. The large increase in M2 would lead to increase the domestic demand for the US dollar in the black market (Pinto, 1991) casing a raising (reduction) in the AER of Libyan dinner against the US dollar (value in the Libyan currency). As shown in **Table 5**, the estimated coefficient for the ECM_{t-1} is −0.155 is highly significant, indicating that the deviation in AER in the short-run from the long-run equilibrium path is corrected by nearly 16% over the following year, implying that the speed of adjustment in the long-run equilibrium is about (1/16%) = 6 years.

According to **Table 5** the first model does not suffer from econometrics problem such serial correlation and heteroscedasticity as the P-value corresponding to Breusch-Godfrey and Breusch-Pagan-Godfrey are less than 5% respectively. Also the first model is free of autocorrelation in the residuals since the value of Durbin Watson testis 1.87 close to 2. In addition, Juarque-Bera test indicates that the residuals are normally distributed. Moreover, CUSUM and squared CUSUM tests signify that there are not structural changes (or structural breaks) in the first model has been estimated. As shown in **Figure 4** the first model does not suffer from structural changes during the study's period. The first model considered

Table 5. Estimated short- and long-run coefficients for first model

First model (AER, OR, TOT, M2/GDP, DINF/FINF, DUMMY) ARDL (1, 2, 2, 1, 2, 2)	
Long-run coefficients	
Variables	**Coefficient**
c	1.120***
ARE_{t-1}	−1.157
OR_{t-1}	−0.249***
TOT_{t-1}	−0.389***
$M2/GDP_{t-1}$	0.225**
$DINF/FINF_{t-1}$	−0.159
$DUMMY_{t-1}$	0.273***
Short-run Coefficients	
D(OR)	−0.72
$D(OR_{t-1})$	−0.894***
D(TOT)	0.186
$D(TOT_{t-1})$	−0.275***
D(M2/GDP)	0.099**
D(DINF/FINF)	0.106
$D(DINF/FINF_{t-1})$	0.053
D(DUMMY)	0.369***
$D(DUMMY_{t-1})$	−0.271
ECM_{t-1}	−0.155***
Residual diagnostic tests	
Durbin-Watson	1.847
Akaike Information Criteria	−2.138
Juarque-Bera	0.175, P(0.915)
Breusch-Godfrey	F−statistic 1.329, P (2,16) 0.292
Breusch-Pagan-Godfrey	F−statistic 0.698, P (15,18) 0.589

to be better than the forth model as Akaike information criterion for the first model is less than Akaike information criteria corresponding to the fourth model.

We estimated the forth model as robust model for the first model. Table 6 indicated that TOT, M2/GDP, DINF/FINF, and DUMMY variable have the same signeffects in short- and long-run have been estimated in the first model. Also, the forecasted value of ERER in the fourth mode is close those corresponding to the first model (see Figure 6 and Figure 8) implying that our results are robust and there is no model specification problem. This result suggests that as the international trade increases the domestic currency depreciates as indicated by

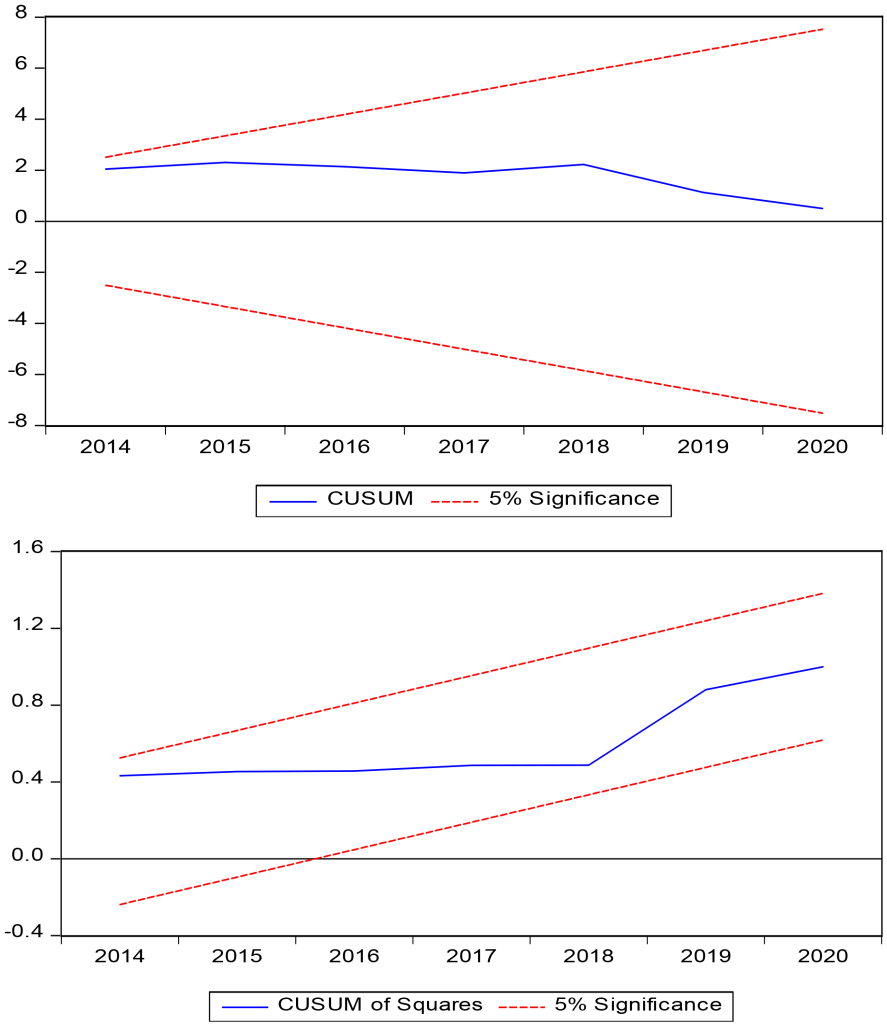


Figure 4. CUSUM and Squared CUSUM tests

Gantman and Dabós (2018).

To check whether the forth model is free of econometrics problems or not, we have done the following tests as shown in **Table 6**. Results in **Table 6** signifies that the forth model does not suffer from serial correlation and Heteroscedasticity problems as the F-statistic corresponding to Breusch-Godfrey and Breusch-Pagan-Godfrey tests are not statically significant. Also, Juarque-Bera indicates that the residual in the four models are normally distributed. Finally, CUSUM and squared CUSUN tests were employed to examine whether there are structural changes (or structural breaks) in the fourth model have been estimated. As shown in **Figure 5** the fourth model does not suffer from structural changes during the study's period.

4.1. Forecasting the Equilibrium Real Exchange Rate of Libyan Dinar against the US Dollar

Figure 6 and **Figure 8** showed the estimated value of the real equilibrium exchange rate using the first and the fourth models respectively. The two figures indicated

Table 6. Estimated short- and long-rum coefficients for the fourth model.

Fourth model (AER, COP, TOT, M2/GDP, DINF/FINF, DUMMY)ARDL (3, 0, 2, 0, 3, 2)	
Long-run coefficients	
Variables	**Coefficient**
c	0.090
ARE_{t-1}	−0.587***
COP_{t-1}	0.386***
TOT_{t-1}	−0.233***
$M2/GDP_{t-1}$	0.186***
$DINF/FINF_{t-1}$	0.144
$DUMMY_{t-1}$	0.114***
Short−run Coefficients	
ARE_{t-1}	0.465***
ARE_{t-2}	0.369***
D(TOT)	−0.098*
$D(TOT_{t-1})$	−0.180***
D(DINF/FINF)	0.046*
$D(DINF/FINF_{t-1})$	0.110
$D(DINF/FINF_{t-2})$	0.087
D(DUMMY)	0.311
$D(DUMMY_{t-1})$	0.244**
ECM_{t-1}	−0.587***
Durbin-Watson	2.188
Akaike Information Criteria	−2.490
Juarque-Bera	0.136, P (0.933)
Breusch-Godfrey	F-statistic 1.109, P (2.15) 0.355
Breusch-Pagan-Godfrey	F-statistic 0.701, P (15,18) 0.685

that the value of root mean squared error and mean absolute error are small. Also the Thiel inequality coefficients in both model are less than 1, implying that the differences between values of the ERER predicted by the two models and the AER values of the Libyan dinar is small which in turn, reflects a better fit to the data used in both models and small forecast errors involved using the two models. The estimated ERER by the first and second models is almost the same over the study's period (see Figure 10). However, according to Figure 6 and Figure 8 the forecasting quality for the first model is superior relatively to the forth model as Root Mean squared error, Mean Absolut Error, Thiel Inequality Coefficient

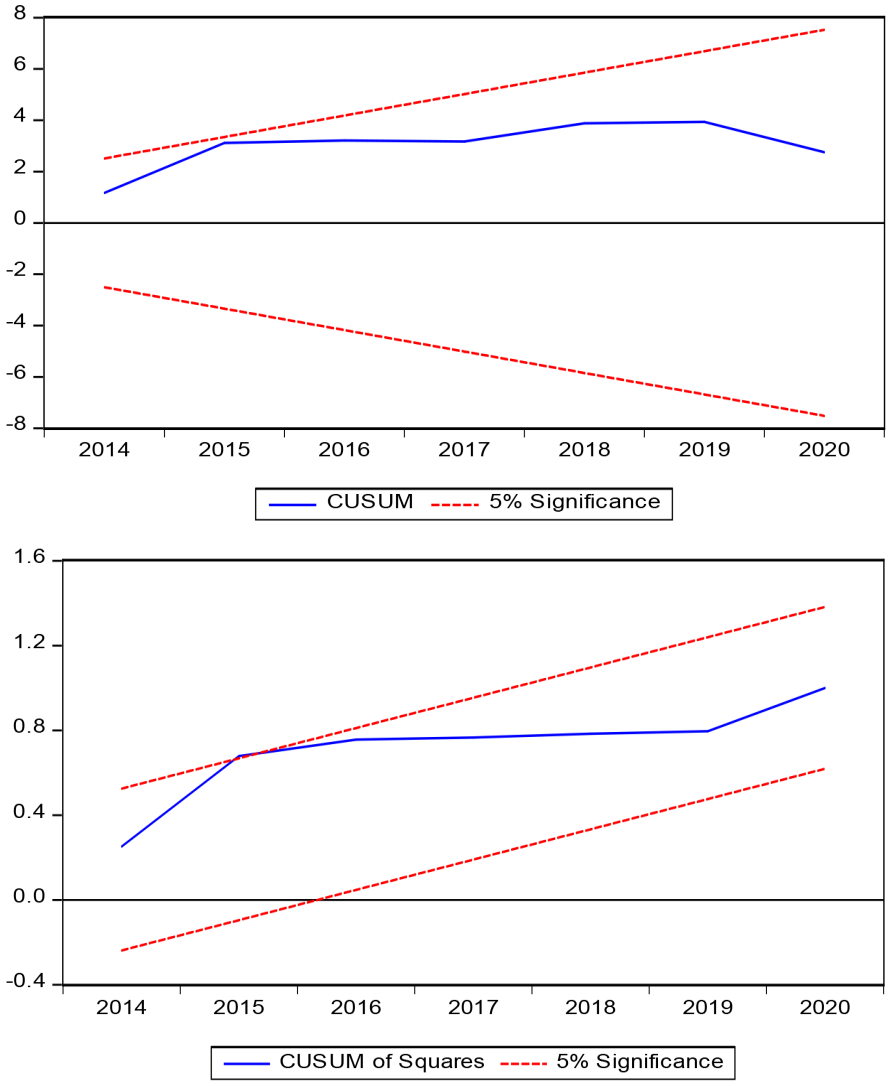
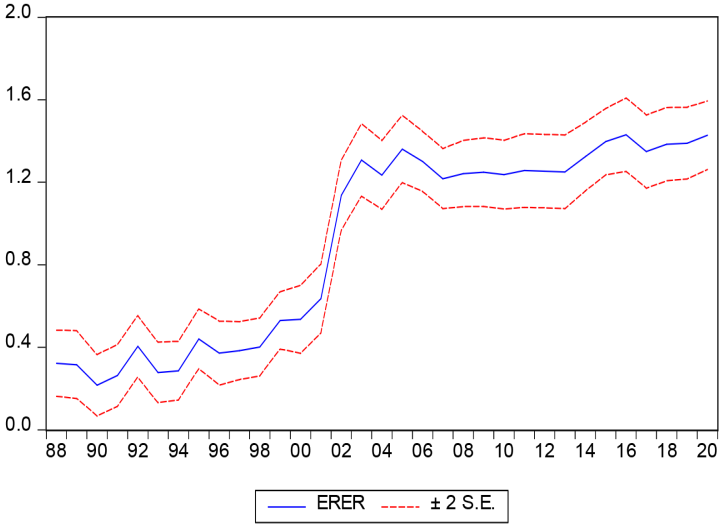


Figure 5. CUSUM and CUSUM tests.



Forecast: ERER	
Actual: AER	
Forecast sample: 1985 2020	
Adjusted sample: 1988 2020	
Included observations: 33	
Root Mean Squared Error	0.038047
Mean Absolute Error	0.024602
Mean Abs. Percent Error	5.884088
Theil Inequality Coefficient	0.018571
Bias Proportion	0.000000
Variance Proportion	0.001678
Covariance Proportion	0.998322
Theil U2 Coefficient	0.649267
Symmetric MAPE	5.803594

Figure 6. Forecasting results using the first model.

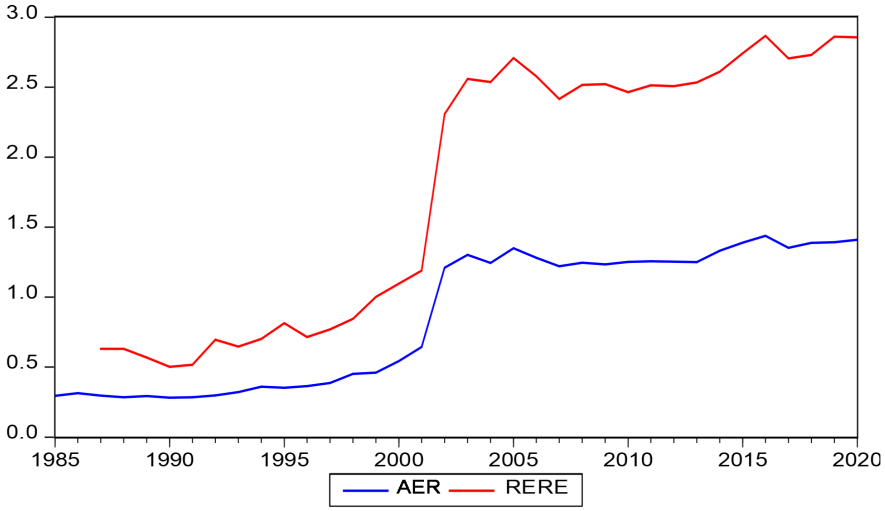
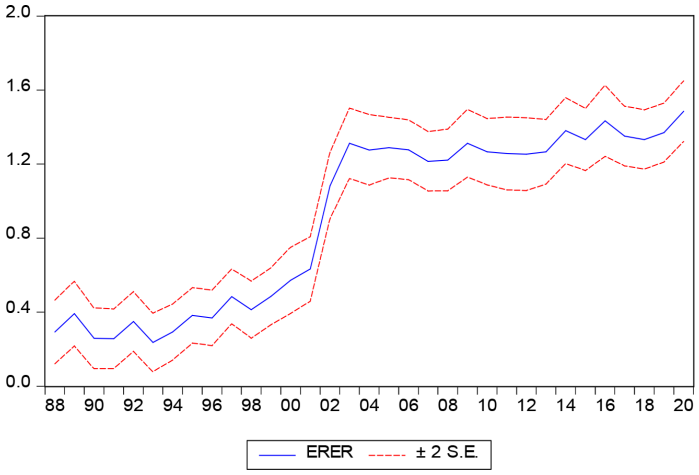


Figure 7. The ERER and AER of Libyan dinar against the US dollar using the first model.



Forecast: ERER	
Actual: AER	
Forecast sample: 1985 2020	
Adjusted sample: 1988 2020	
Included observations: 33	
Root Mean Squared Error	0.049908
Mean Absolute Error	0.037435
Mean Abs. Percent Error	6.722120
Theil Inequality Coefficient	0.024367
Bias Proportion	0.000000
Variance Proportion	0.002894
Covariance Proportion	0.997106
Theil U2 Coefficient	0.691312
Symmetric MAPE	6.665821

Figure 8. Forecasting results using the fourth model.

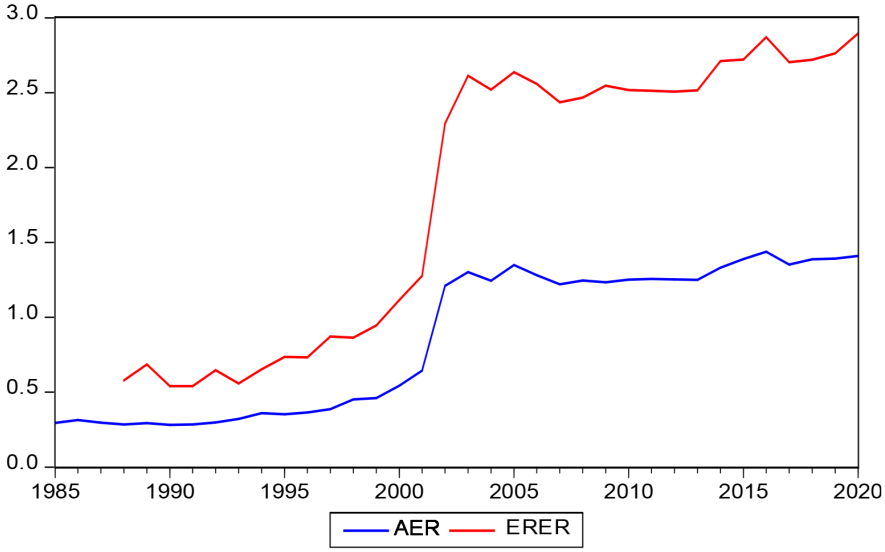


Figure 9. The ERER and AER of Libyan dinar against the US dollar using the forth model.

are less than those corresponding to the forth model.

The equilibrium real value of Libyan dinar exchange rate against the US dollar (RERE) and the actural value of Libyan dinar exchange rate against the US dollar (AER) using the forth model.

4.2 The AER of Libyan Dinar and Its Equilibrium Value (1985-2020)

The deviations of the AER from their real equilibrium values (ERERE) estimated by the first and forth models are called currency misalignments (MS)= (AER – ERER). Table 7 and Table 8 report the misalignments calculated by the first and the fourth models over the period 1985-2020. Both modelsyield unevenly similar misalignments during the period 1985-2020 (see Figure 11). According to Table 7

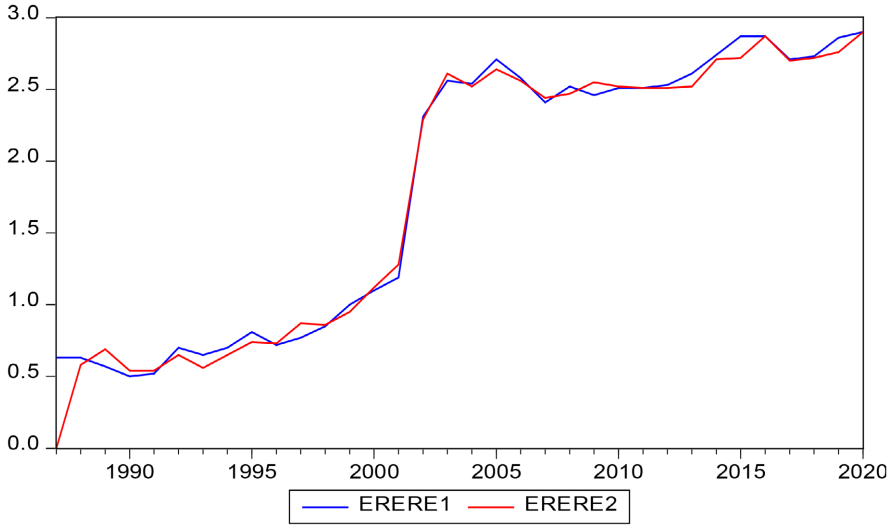


Figure 10. The estimated ERER by the first model (ERER1) and the second model (ERER2).

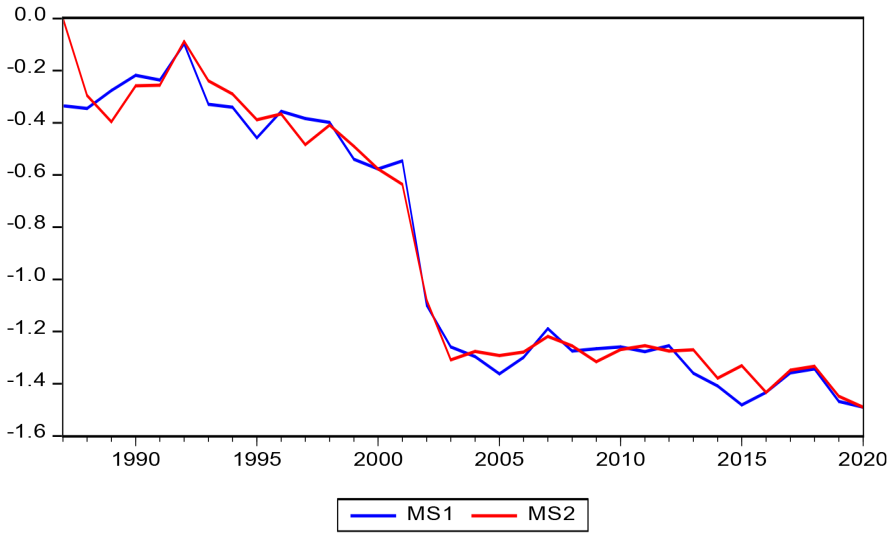


Figure 11. The misalignments between AER and the ERER of the Libyan dinner using the first model (MS1) and the forth model (MS2).

Table 7. The deviation of the AER of Libyan dinar against the US dollar from its equilibrium value using the first model.

Year	AER	ERER	MS = (AER − ERER)
1985	0.295	-	-
1986	0.314	-	-
1987	0.295	0.63	−0.335
1988	0.285	0.63	−0.345
1989	0.294	0.57	−0.276
1990	0.282	0.50	−0.218
1991	0.284	0.52	−0.236
1992	0.797	0.70	−0.097
1993	0.321	0.65	−0.329
1994	0.360	0.70	−0.340
1995	0.352	0.81	−0.458
1996	0.364	0.72	−0.356
1997	0.386	0.77	−0.384
1998	0.451	0.85	−0.399
1999	0.460	1.00	−0.540
2000	0.543	1.10	−0.577
2001	0.644	1.19	−0.546
2002	1.210	2.31	−1.1
2003	1.301	2.56	−1.259
2004	1.244	2.54	−1.296
2005	1.348	2.71	−1.362
2006	1.281	2.58	−1.299
2007	1.221	2.41	−1.189
2008	1.245	2.52	−1.275
2009	1.234	2.46	−1.266
2010	1.251	2.51	−1.259
2011	1.256	2.51	−1.277
2012	1.253	2.53	−1.254
2013	1.250	2.61	−1.360
2014	1.331	2.74	−1.409
2015	1.389	2.87	−1.481
2016	1.437	2.87	−1.433
2017	1.352	2.71	−1.358
2018	1.387	2.73	−1.343
2019	1.392	2.86	−1.468
2020	1.410	2.90	−1.49

Table 8. The deviation of the AER of Libyan dinar against the US dollar from its equilibrium value using the fourth model.

Year	(AER)	(ERER)	MS = (AER − ERER)
1985	0.295	-	-
1986	0.314	-	-
1987	0.295	-	-
1988	0.285	0.58	−0.295
1989	0.294	0.69	−0.396
1990	0.282	0.54	−0.258
1991	0.284	0.54	−0.256
1992	0.797	0.	−0.088
1993	0.321	0.56	−0.239
1994	0.360	0.65	−0.29
1995	0.352	0.74	−0.388
1996	0.364	0.73	−0.366
1997	0.386	0.87	−0.484
1998	0.451	0.86	−0.409
1999	0.460	0.95	−0.49
2000	0.543	1.12	−0.577
2001	0.644	1.28	−0.636
2002	1.210	2.29	−1.08
2003	1.301	2.61	−1.309
2004	1.244	2.52	−1.276
2005	1.348	2.64	−1.292
2006	1.281	2.56	−1.279
2007	1.221	2.44	−1.219
2008	1.245	2.47	−1.255
2009	1.234	2.55	−1.316
2010	1.251	2.52	−1.269
2011	1.256	2.51	−1.254
2012	1.253	2.51	−1.275
2013	1.250	2.52	−1.270
2014	1.331	2.71	−1.379
2015	1.389	2.72	−1.331
2016	1.437	2.87	−1.433
2017	1.352	2.70	−1.348
2018	1.387	2.72	−1.333
2019	1.392	2.87	−1.478
2020	1.410	2.90	−1.49

and 8 the estimated negative misalignments pointed to large undervaluation in the AER (overvaluation in the Libyan dinner) in both models over the whole period except year 1992 being close to its equilibrium value(ERERE where the misalignments were −0.097 and −0.088 using the first and the fourth models respectively (see **Figure 7** and **Figure 9**). This result is in consistent with Coudert, Couharde, Mignon (2008) who found out that in 2007 domestic currencies in oil-exporting countries such as Algeria, Bahrain, Kuwait, Libya, Oman, Saudi Arabia are overvalued. The difference between ERER of the Libyan dinner and its AER had reached overvaluation peak in 2002 not experienced before with a level that greater than one dinner (see **Table 7** and **Table 8**). This indicates that the overvaluation of the Libyan dinner is more pronounced since 2002 when the Central bank of Libya devaluated it in the second time. In this regard, Elbadawi, Kaltani and Soto (2012) pointed out that in 2002 overvaluation in African country currencies has spiked up, largely reflecting the devaluation in their currencies that took place in 2002. The misalignment between AER of the Libyan dinner and its (ERERE) continued to be more sever during the period 2014-2020 when the oil revenues has recorded a remarkable decline suggesting that adjustment of the RER of Libyan dinner to its (ERERE) is substantially lower. Moreover, due to structural imbalance in the Libyan economy as oil exports account for more than 95% of GDP and, the heavy dependence on imports to meet the domestic demand for goods, the Libyan monetary policy overvalues the Libyan dinner which in turn, induced the AER to get out of its real equilibrium value. The large misalignment can be attributed to the adopting fixed exchange rate regime which in turn, makes the monetary authorities unable to adjust the AER to accelerate the convergence of it toward the equilibrium (Elbadawi et al., 2012). As the deviation of the AER from its equilibrium widens, the competitiveness of domestic products comparatively of imports would decline and limit the ability of the private sector in Libya to grow and participate in diversifying the Libyan economy. In this aspect, Shatz and Tarr (2000) pointed out that the deviation of AER from its equilibrium is associated with lower level of productivity in the agriculture sector and sluggish in the GDP per capita.

5. Conclusion

This study investigates the most important detriments of the AER of Libyan dinar against the US dollar and computes misalignments between the AER and ERER during the period 1985-2020 using ARDL model. Results indicated that the first model that consistent of OR, TOT, M2/GDP, DINF/FINF, DUMMY is better not only to explain the determinants of the AER but also to predict the ERER value relatively to the fourth model that consistent of COP, TOT, M2/GDP, DINF/FINF, DUMMY. According to the first model, the dominant force that drives the RER in short and long-runs is the oil revenues (OR) where the increase in oil revenues negatively and substantially affects the AER of Libyan dinar against the US dollar. This result implies that increases in oil reve-

nues improvements would lead to an increase in the domestic supply of foreign currencies and thus reflected in a decline in the RER (improvement in the value of the Libyan dinner). Also, results showed that monetary stability represented by the ratio of M2/GDP and political instability accounted by (DUMMY) positively drives the ERER against the US dollar, implying that growing the level of political instability and the lack of political stability weakens the value of the Libyan dinner relatively to the US dollar. Moreover, results documented that terms of trade (TOT) have negative effect on the AER OF Libyan dinar against the US dollar in short and long-runs indicating that positive shocks in TOT participate in improving the Libyan dinner against the US dollar.

In addition, results pointed out that there are negative misalignments in Libyan dinner, implying that the AER is lesser than its real equilibrium value in particular since 2002 when the Libyan central bank devaluated that Libyan dinner. These results have valuable implications for monetary policy makers in that they should keep the AER reasonably close to its equilibrium by increasing oil exports to provide more foreign currency and improve the level of foreign reserves, and avoid any negative shocks that reduce the oil revenues such as shutting down oil fields and refineries or decreasing oil prices. Also, to mitigate this misalignment, policy makers should reduce money supply and provide more political stability to the country as it is the prime factor that is backing the increasing of oil production. Moreover, policy maker can use the first model which estimated ERER of Libyan dinar as benchmark for possible devaluation in the Libyan dinner in the future. In addition, Libyan government should focus on diversifying the Libyan economy as the diversification would provide a source of foreign currencies that contribute to stabilizing the AER from any negative shocks resulting from oil revenues reduction. Future research should consider whether the impact of positive and negative shocks of oil revenues varies has the same effect on the Libyan exchange rate. The study's limitations can be concentrated in the unavailability of monthly or quarterly data on all variables during the period 1985-2020 which would have enabled authors to provide other results using higher frequency data.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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