Oil Price Shocks and Exchange Rates in Africa's Oil Exporting Countries: *Forecasting Model*

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Abstract

Research on exchange rates forecast is wanting. A few that are documented, protrude towards the advanced oil importing economies, with little attention given to the developing oil exporting market currencies, consequently having undesirable implications on the value of the countries' currencies and thus possibly hurting the negotiable terms of their economic agreement. Filling this gap, this study investigated the application of various forecasting techniques to forecast the exchange rates of the AOECs, comprising Algeria, Egypt, Gabon, Libya and Nigeria. Data are drawn from the world development indicator (WDI), World Bank, St Louis Fred, Organisation of Petroleum Exporting Countries (OPEC) and US EIA. The quarterly data regarding the AOECs, ranging from 1980Q1 to 2015Q4 are employed as sample to derive our model. The remaining observations spanning 2016Q1 to 2018Q4 are withheld for the benefit of out-of-sample forecast evaluation that we carried out. To increase the performance of our model, unit root tests are carried out to examine whether or otherwise endogenous structural breaks are present in the selected variables (i.e. exchange rates, money supply, interest rate, gross domestic product (GDP), inflation and debt to GDP), resulting to the panel ARDL model used for the static and dynamic forecasting. The Mean Absolute Error (MAE), Root Mean Square Error (RMSE), the Theil coefficient, Mean Absolute Percentage Error (MAPE) which is most commonly used measures of error magnitude, have been used as variety of measures to assess exchange rates forecasting accuracy. The various evaluation criterion supports the suitability static and dynamic model to forecast exchange rates in the AOECs. Furthermore, this outcome suggests that the forecast combination methods may have good application in the field of exchange rates modelling. The outcome also forms a basis to conclude that joint of the static and dynamic forecasting models may offer better performance than a single exchange rates forecasting model.

Key words: Oil Price Shocks; Exchange Rates; Oil Exporting Countries; Forecasting

4.1 Introduction

Consequent to the previous chapter that examines oil price shocks and its resultant effects on output growth and exchange rates behaviour, this chapter develops and estimates a forecasting model of exchange rates for the Africa's oil exporting countries (AOECs). Specifically, the findings in chapter three reveal that oil price shocks significantly impact exchange rates behaviour and that, variations in exchange rates have large impact through which oil price shocks transmit to other macroeconomic variables and influence output performance in the AOECs. This is similar to Haskamp (2017) that, the exchange rates market constitutes the largest and most liquid world financial market in an increasingly globalized world and also that, it will continue to be relevant and have significant impact on economic stabilization in the world among majority of economic agents and countries operating open economies (see Medel et al, 2015 and Etuk et al 2016). Nevertheless, these economic agents are confronted with risk of exchange rates and occupied with economic uncertainties (Canova & Marrinan, 1993 and Ahmed, 2017), which can have undesirable consequences on the value of a country's currency and thus possibly hurting the negotiable terms of any economical agreement. The high consequences of exchange rates risks may be alleviated through reliable exchange rates forecasts, giving a direction to the exchange rates market.

Though, accomplishing reliable exchange rates forecasts appears to be a puzzle of the economics profession. For instance, Meese and Rogoff (1983) find in their seminal paper that, classic exchange rates models were not able to forecast better than a naive random walk. Cheung et al. (2009) confirmed this finding for newer models and a longer sample. Consequently, the international economic agents are continuously looking for opportunities to guide themselves against these exchange rates uncertainties and fluctuations due to consequences that impact economic behaviour of an economy (see Gali and Monacelli, 2005).

In view of the previous observation that oil price shocks transmit through exchange rates, and that unexpected surge or movement in oil prices resulting to sudden fluctuations in exchange rates tend to cause imbalances on several essential macroeconomic variables like the international account balance status (see Dell'Ariccia, 1999), exchange rates forecast becomes necessary. Interestingly, it becomes a major issue, similar to Etuk et al (2016) that, the world economy is confronted with the issues of exchange rates imbalances. Coonsequently, this chapter model exchange rates for the AOECs.

Modern macroeconomics depends largely on the dynamics of foreign exchange rates (Medel et al, 2015). Nonetheless, Ames, Brown, Devarajan and Izquierdo (2001) suggest that, the stability of exchange rates contributes to the development of a safe macroeconomic arena, leading to improvement in growth and investments. Similarly, Hina and Qayyum (2015) note that, the modelling and forecasting exchange rates is crucial for decision making. According to Ramzan et al (2012), forecasting exchange rates is vital as it has substantial impacts on fundamental macroeconomic like interest rate, wage rates, the level of economic growth and unemployment.

Though, achieving exchange rates stability appears to be a difficult task (see Gali and Monacelli, 2005), as several forecasting approaches have been advanced and yet, the desire yearning in the foreign exchange markets has not been attained (see Medel et al, 2015 and Tudela, 2004). Therefore, forecasting exchange rates becomes a key subject matter to the economists' decisions formation. It is imperative to understand the exchange rates behaviour; how exchange rates mechanism works and determine what contributions can be made to any forecasting model to reach the anticipated level of confidence and trust that the market requires (see Grauwe and Schnabl, 2008), especially in the AOECs countries. Similarly, finding accurate exchange rates forecasts are key for investment opportunities, currency traders, exporters and importers of goods and services and the government sector which is man managing the economies. Furthermore, it is generally believed that the success of an economy depends on its exchange rates (see Tsen, 2011; Eslamloueyan and Kia, 2015). In another word, Kao (1999), Uz and Ketenci (2008), Kia (2013) and Kia (2015) conclude that exchange rates resrve serves as a measure of price-cost competitiveness. Understanding this background, accurate forecast would lessen the risks to currency traders as they seek to earn their profit on future exchange rates movements. Also, accurate forecast can benefit exporters and importers through better management decisions on the timing of exports and imports to coincide with accurate forecasts which can enhance the firm's profitability (see Tudela, 2004); for government sector, accurate exchange rates forecasts enables a sound management of a nation's foreign exchange reserves which directly impacts monetary policy of the economy.

This study contributes to literature in the following distinctive ways. Firstly, the study aids the understanding the understanding of the exchange rates dilemma by clarifying the roles that different variables have on the forecasting process of exchange rates. Fuerthermore, it offers understanding to what combination of technical indicators and evaluations like mean absolute percentage error (MAPE) and root mean square error (RMSE) and other fundamental macroeconomic variables that are suitable for exchange rates forecasting model. Secondly, this study pools data of the AOECs and applies panel estimating techniques which could help improve the power of various tests therein reduces loss of vital information and suitable for studying dynamic changes due to repeated cross-sectional observations (see Armsrong, 2001; Beneki and Yarmohammadi, 2014).). Thirdly, the study considers different measures of oil prices. Different from the United Arab Emirates price of oil (Dubai), the real US refiners' acquisition cost (RAC), the US West Texas Intermediate price of oil (WTI), bonny light among others which have been considered in literature (see, Alquist and Kilian, 2010; Alquist et al., 2013; Baumeister et al., 2014, 2015; Wang et al., 2015; Xiong et al., 2013; Yin and Yang, 2016; Drachal, 2016; and Naser, 2016) for the oil importing countries in previous studies, this study considers the Brent oil prices which is the most traded among the AOECs (see Musibau, 2015). Overall, study contributes to the forecasting confusion of the world financial market this day. Most importantly, to the best of our knowledge, we are not aware of any study that have assessed the role of oil prices in predicting exchange rates over long horizons focusing the AOECs context. Though, other factors like productivity differentials and interest rate differentials, have been investigated previously (see Mark and Choi, 1997). This study fills this gap and explore the ability of oil prices to explain behaviour in the exchange rates in a predictive regression framework. To this extent, this study seeks to give evidence that using information on the global oil price improves exchange rates of Africa's oil producing countries significantly, to the extent that oil producing countries can aim to stabilize their currency (purchasing power). In another word, there is a considerable amount of both theoretical and empirical evidences on the connection between oil prices and exchange rates forecast in the oil dominated economies around the world; yet, getting appropriate literature offering effective policy guide to the AOECs is still missing (see Properzio, 2017; (Chaodhuri and Daniel, 1998; Chen and Chen, 2007; Coleman, Cuestats and Mourelle, 2012; Domenico, Ken and Barbara, 2011; Habib and Kalamova, 2007). The fact that oil prices significantly account for movement in exchange rates as noted in chapter three does not preclude other macroeconomic fundamentals. Therefore, it is necessary to understand how the value of a currency can be forecasted. In doing this, this study will discuss and use appropriate theories regarding foreign exchange to outline both empirical and theoretical constructs about exchange rates[4]. Such that will draw emphasis on establishing gaps and improvements that can be used to offering explanations about what is influencing exchange rates variation in the AOECs.

After the introduction, the rest of this study is structured in seven sections. Section 4.2 presents stylized facts on exchange rates; section 4.3 reviews of literature, comprising theories and empirical literature in section 4.4; section 4.5 is the methods adopted including measurement and sources of data, description of variables employed; section 4.6 presents the results of the study; discussion and inference are contained section 4.7 and finaly, section 4.8 summarises and draws conclusion.

4.2 **Stylized Facts on Exchange Rates**

Several empirical studies have revealed an equivocal behaviour in exchange rates, consequent to unpredictable oil prices (see Volkov and Yuhn, 2015; Babatunde, 2015) and unclearly documented exchange rates forecast (Eslamloueyan and Kia, 2015). Therefore, this study analyses the ability of how various factors can forecast exchange rates. Mainly, the study seeks to ascertain whether the information on exchange rates and its determinants improves exchange rates stabilization.

[4] An exchange rates refer to movement of currency of one country against another country's currency (Mankiw, 1997). It could also be referred to as the price of a nation's currency in terms of another currency. The components of exchange rate are divided into two parts- the domestic currency and a foreign currency, and these can be quoted either directly or indirectly. Exchange rates are officially quoted in values against the US dollar (Dooley, Folkerts-Landau and Garber, 2004).

There are related debates that are on the future global role of the oil prices on global imbalances (see Kamps, 2006). For instance, “the monetary policy dilemma of oil exporters triggered by the so-called Dutch disease (see Ahmed, 2017; Hamilton, 2013; Corden and Neary, 1982) within the context of the curse of natural resources phenomenon (see Herrera and Pesavento, 2009; Sachs and Warner, 1995); the discussion over the general impact of foreign exchange rates volatility on the real economy (see Aghion et al., 2006). However, understanding the relationship of oil price developments and exchange rates might possibly alter our insight of the past and current oil price shocks, for instance, as a monetary phenomenon (Barsky and Kilian, 2001) or as an endogenous response to dollar behaviour (depreciations/appreciations). Initial submissions from the preceding section suggests that oil price movement encompasses vital additional information for exchange rates behaviour among the AOECs. Therefore, consindering that the previous chapter examines oil price shocks and its attendant effects on output growth, specifically, following its findings that oil price shocks significantly impact exchange rates behaviour and that, variations in exchange rates consequent to oil prices, transmit to other macroeconomic variables and influence output performance in the AOECs countries, a composite model of exchange rates behaviour in the AOECs can be drawn with the assumption and understanding that, amidst other factors, the exchange rates of these countries always respond to movement in oil prices. However, this follows the following vector of endogenous variables: Money Supply, Interest Rate, Gross Domestic Products, Oil Price, Inflation and Debt (see Kia, 2006; Eslamloueyan and Kia, 2015).

Based on the foregoing and findings in the previous chapter, it is therefore important for regulatory authority, policymakers and researchers to understand the following. Firstly, to know what factors that are suitable to forecast exchange rates in the Africa’s oil exporting region; have good understanding of the workings of these factors, which can help them maintain an equilibrium of the exchange rates. Secondly, to investigate how to tackle some of the consequences of exchange rates movement or misalignment. With regards to this, it is obvious that forecasting oil exchange rates within the context of Africa’s oil exporting countries may only be empirically determined.

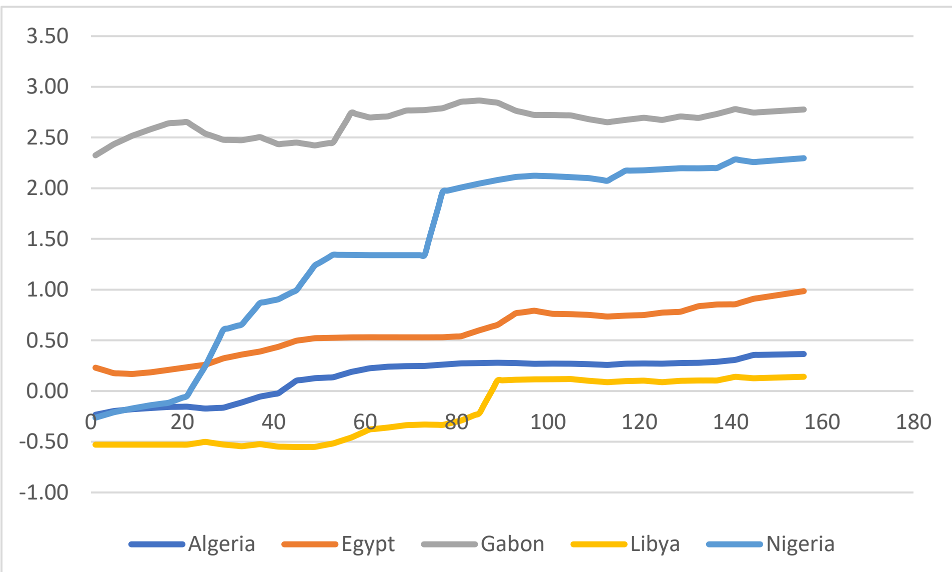
According to Kia (2006), exchange rates in a small open economy can be influenced by both internal and external factors[5]. To this end, there is evidence that exchange rate movement has significant effect on macroeconomic factors such as money supply, unemployment and trade (see Todani & Munyama, 2005; Mpofu 2013; Aye, Gupta, Moyo and Pillay 2014). However, while various studies have considered how exchange rates may impact these factors, little attention has been given to how these factors, other monetary factors (interest rates, money supply and inflation) and gross domestic products (GDP) may account for forecasting exchange rates within these developing oil exporting countries. Although, literature suggests recurrent studies which consider exchange rates forecast at country specific. Yet, studies of such are infrequently found for the developing Africa’s oil exporting countries.

However, due to the fundamental features of these countries such as, open developing monocultural economies as well as high dependence on oil revenues, being in possession of huge amount of

[5]Internal factors include, debt financing, government deficits, institutional economics (opportunism, economic freedom, shirking, risk) and structural regime changes (policy constraints, political regime changes, revolution) among others. External factors include foreign interest rate as well as the attitude of the rest of the world (sanctions, conflicts, risk generating activities, wars) toward the country, oil prices movement and terms of trade of a country.

foreign reserves could stand a good case for empirical investigation. In another word, a few studies have empirically analyzed the determinants of exchange rates in developed and emerging countries, but little attention has been given to the developing oil exporting countries (see Mauro et al, 2008; Rodrik, 2008; Acosta et al, 2009; Goudarzi et al, 2012; Khan et al, 2012; Cruz, 2013; Twarowska and Kakol, 2014; Patel et al, 2014). Therefore, this study fills this gap and contributes to the extant literature by forecasting exchange rates and shedding more light on these empirical concerns within the context of the Africa's oil exporting countries. In addition, it examines historic trend of the foreign exchange markets of the Africa's oil exporting countries. In carrying out this empirical examination, why we appreciate theoretical underpinning exchange rates determinants, we are also mindful of those theories, adopting the Behavioural Equilibrium Exchange Rate (BEER) approach, where typically, several reasonable variables are introduced as determinants of exchange rates (see Korhonen and Juurikkala, 2007).

Figure 4.1: Exchange Rates Movement (1980Q1-2018Q4)



Source: Author's computation (2019)

Figure 4.1 presents the movement in the exchange rates of the AOECs considered in this study. The trend is positive and steadily rising over the period, except Nigeria that shows a steep rise during the period under consideration.

4.2.1 **Key concepts used in exchange rates**

This section discusses key concepts to describe and discuss various measures of exchange rates.

Nominal Exchange Rates (NER)

It expresses the price of one currency in terms of another (see Edwards, 1989). For instance, the exchange rates of a dollar to the currencies of the selected AOECs at the end of 2014 average: Algeria ($1/80.58 Peso); Egypt ($1/7.08 pound); Gabon ($1/494.41 franc); Libya ($1/1.3 Dinar) and Nigeria ($1/158.55 Naira). Another term used for nominal exchange rates is the bilateral exchange rates. This is computed by central bank of each country on regular basis.

Nominal Effective Exchange Rates (NEER)
It offers a view of the development in the exchange rates of a country, by measuring the development of the currency against a weighted average of other currencies, making it unnecessary to study several bilateral exchange rates (see Patel et al, 2014). The size of a country's trade with a foreign country is used as a weight in the calculation. The NEERs are computed by the Organization for Economic Co-operation and Development (OECD) and the International Monetary Fund (IMF). The NEER is an index that uses actual rates to create the index on weighted basis over time, but it does not indicate anything about the true value of the currency or anything related to purchasing power. However, it is used to calculate the real effective exchange rates, which is also an index. According to Edwards (1989), the real exchange rates (q) accounts for the deviation from Purchasing Power Parity (PPP). It can be defined in the equation that follows:

$$q_t = \left(\frac{1 + \text{ɧ}_i}{(1+v)(1+\text{ɧ}_{US})}\right)$$

where q is the real exchange rate; v represents the rate of change in the exchange rates; ɧ_i is the price of standard commodity as per country specific; ɧ_{US} is the price of standard commodity in the United States of America (US).

Real Effective Exchange Rates (REER)
Measures the competitiveness of an economy compared with her trading partners. Similarly, the REER deals with the development in the price level of the domestic country relative to an average price level of foreign countries computed in the same currency. The same weights for foreign trade as used in computing the NEER are used in computing the REER. Real appreciation occurs when an economy loses her competitiveness which is measured by the REER. The REER of an oil exporting country is measured in relation to its trading partners, indicated by the price level rising relative to that of other countries, measured in the same currency. Inversely, we have a situation with real depreciation when the price level decreases. In this case the outcome is gain of competitiveness for the domestic country exporting oil.

There are several methods to calculate the REER: The first is the relative wholesale prices, measuring the development in the relative wholesale prices, relative to that of the trading partners. The second is the relative export unit values, which measures the development in the price level of a country's export compared to the trading partners' export price levels. The third method is called the relative GDP deflators or total production, since it measures the development in the price level of a country's GDP deflator relative to the GDP deflators in other countries. The GDP deflator is calculated as follows: $\left(\frac{\text{nominal GDP}}{\text{real GDP}} \text{x} \frac{100}{1}\right)$. The fourth method, measures the development in the labour cost of producing one unit in relation to the cost in the country's trading partners, and the method is consequently called relative unit labour cost.

The volatility of an exchange rates can be measured in two ways. The first involves taking the standard deviation over a certain period, which will result in a representation of the historic volatility that may not be repeated in the future. The second way is to measure the volatility, based on the premium on foreign currency options that are traded in the foreign exchange market. Contrasting to the second method, this method is referred to as implicit exchange rates volatility and it gives a depiction of the future exchange rates volatility that is expected by the traders.

4.3 **Review of Literature**

4.3.1 **Theoretical Literature**

There are quite a few theories in literature guiding exchange rates and offering explanations to circumstances on variations in exchange rates across various economies.

Theoretically, it is well established in literature that an oil-exporting country might experience appreciation in exchange rates when there is increase in oil prices and depreciation when the oil prices decline (see Golub, 1983; Corden, 1984; De Grauwe, 1996; Alexander et al., 1997; Tsen, 2011; Eslamloueyan and Kia, 2015). For instance, the strong currency appreciation in Nigerian naira and Algerian dinar in 1996/1997 and the subsequent depreciation in 1998/1999 are generally attributed to the increase and decrease of oil prices during these periods (see Alexander et al., 1997; Haldane, 1997 and Norges Bank, 1998). Similarly, the devaluation in the currencies of these countries and some other oil exporting countries in 1986 is often explained with reference to low oil prices in 1985/1986 (see Norges Bank, 1987).

However, this study is based on the theoretical framework of exchange rates determination developed by Cashin et al. (2004), premised on De Gregorio and Wolf (1994); Obstfeld and Rogoff (1996). The framework emphasizes that, an improvement in the terms of trade (the relative price of exports in terms of imports) - produces an appreciation of the domestic currency. According to this model, the economy comprises two different sectors: one produces an exportable good, and the other producing a non-traded good. In this context, a positive shock to the terms of trade leads to an increase in wages in the exporting sector and vice versa. Similar to the dynamics of the Balassa-Samuelson model of exchange rates, under the assumption of wage equalization across the two sectors, this translates into an increase in wages and prices in the non-traded goods sector and an appreciation of the real exchange rate (see Habib and Kalamova, 2007; Omojimite, 2011; Uddin et al, 2013 and Cunado et al, 2016).

There are several other hypotheses resulting to equal conclusions regarding the relationship between oil prices and exchange rates (see Cheng, 2008). For example, aside the described supply side purchasing power channel, there is debatably also a demand side local price channel at work. According to Austvik (1987), disequilibrium happens in the crude oil market when the exchange rates of the US dollar fluctuates. Depreciation in dollar causes oil to be less expensive for consumers in nondollar regions (in local currency), thereby resulting to increase in their commodity demand, which ultimately creates adjustments in the prices of oil denominated in US dollars. An added asset channel is put in motion, as US dollar decreases, the returns on dollar-denominated financial assets in foreign currencies, consequently heighten the attractiveness of oil and other commodities as a class of alternative assets to foreign investors (see Breitenfellner and Cuaresma, 2008). In addition, their attractiveness increases as well as a hedge against inflation, since depreciation in dollar increases risks of inflationary pressures in the dollar denominated economy (such as United States). Also, co-movements could also be reduced by a monetary channel, as dollar depreciation entails monetary easing elsewhere, including oil producing countries with currencies pegged to the dollar. Subsequently, Cheng (2008) asserts that, lower interest rates increase liquidity, thereby stimulating demand, together with that for oil. Lastly, a currency market channel may be at work as well, since foreign exchange markets are possibly more efficient than oil markets and hence anticipate developments in the real economy that affect the demand and supply of oil (Chen et al., 2008).

As noted and applauded in literature, failure to forecast exchange rates has negative consequences on international transactions and prices (see Brignall & Modell, 2000). For these consequences to be averted, theoretical constructs have given various thinkable understandings that could help to identify what drives the movement of exchange rates and those likely measures to contain such movement within advantageous ranges. The classical theories that will be discussed include the traditional approach (TA), purchasing power parity (PPP), balance of payments (BOP), Quantity Theory of Money (QTM) and monetary approach (MA) to develop model that is suitable to offer explanation to the forecasting exchange rates in this study. Common with these theories is the fact that they highlight interest rates as significant factor in the value of currency of a country which is considered in this study. The study explains how price forecasts exchange rates within the context of theories. It is necessary to understand and appreciate that these theories do not eliminate one another or other theories on the subject, neither do the theories nullify added factors, other macroeconomic changes influencing exchange rates.

4.3.1.1 **Traditional Approach (TA)**

According to Dornbusch (2004), the traditional theory is rooted on the premise that movement in exchange rates is consequential to changes in demand and supply of foreign currency. This implies that equilibrium is attained when the demand for foreign currency equals the supply of foreign currency. Therefore, exchange rates equilibrium is attained at a point of convergence and it is disequilibrium state when it is otherwise. For instance, if demand for foreign currency is greater that its supply and vice versa. The implications of the scenario of this disequilibrium is that whenever any of the oil exporting countries experiences oil price surge, leading to more importation from other countries relative to the available supply of foreign currency, will initiate a depreciation of the domestic currency. This theory is premised on the claim that interest rate and income trigger exchange rates movements. For example, if the domestic income rises, the demand by the nationals of the affected countries is assumed by this theory to rise as well and vice versa. The attendant effects of this trigger exchange depreciation and vice versa (see Heinrich, 2012). On the other hand, a rise in the movement of interest rates in an oil exporting country will suggest that, it is profitable to invest in the local economies of the oil exporting countries. As a result, foreign investors will demand for more local currencies for their transactions. In return, this will bring about a rise in the value of the local currencies compared with the exchange rates of their counterpart oil importing countries.

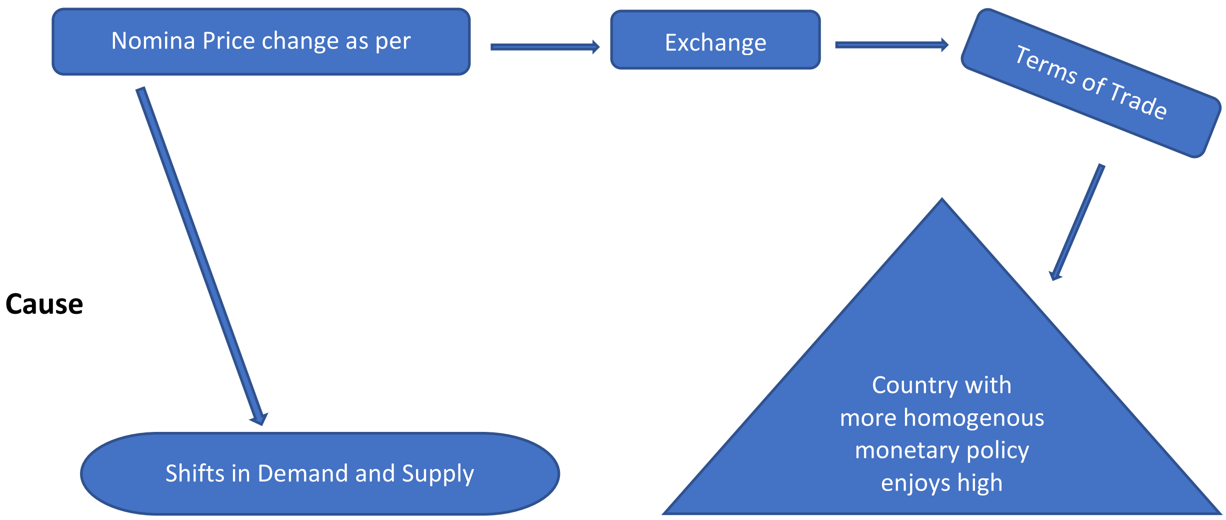
4.3.1.2 **Monetary Approach (MA)**

The idea of monetary approach evolves after efforts to correct weaknesses of the portfolio approach. The MA places emphasis on the monetary policies of two countries to determine their currency exchange rates. It uses two dynamics to determine an exchange rate: the price dynamics and the interest rates dynamics. The approach argues that, change in the domestic money supply leads to a change in the level of prices, and a change in the level of prices leads to a change in the exchange rates. Hence, Frankel (1978) contends that changes in money stock have implications on other economic activities and the effects are reflected through changes in relevant economic indicators. Such indicators are presumed to include domestic output and inflation rate and it is these economic indicators that will also cause exchange rates to change. This is important in economies such as the oil exporting countries in which exchange rate movements are not only a functional of portfolio balances but of other economic activities. The MA assumes that, there a freely-floating exchange rates regime (not a fixed exchange rate regime); minimal interventions by central banks; the aggregate supply curve is vertical; the prices of tradable goods are immediately adjusted to any change in the dynamics that affect them and the transmission mechanism through prices to the exchange rates is immediate.

4.3.1.3 **Purchasing Power Parity model (PPP)**

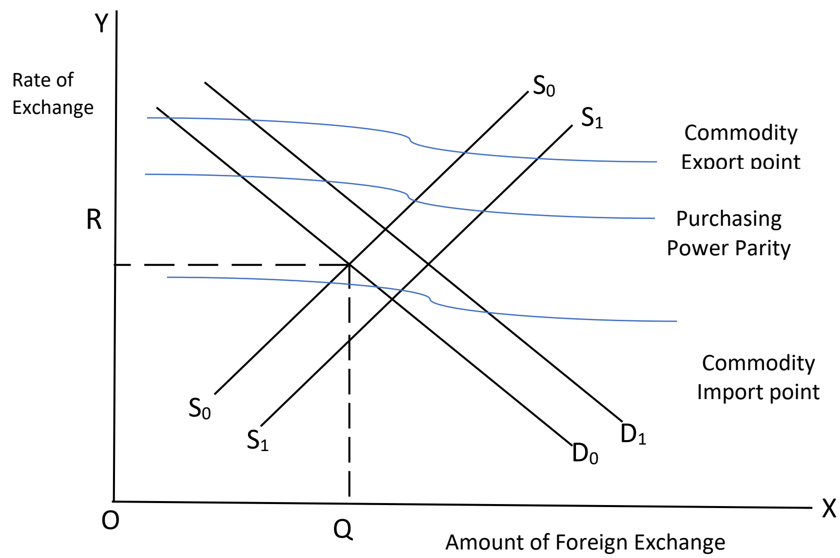
The PPP also refers to as the law of one price, assumes that exchange rates are proportional to relative prices between two countries. Thus, relative international prices between two countries will closely reflect the exchange rate between those countries (Samo and Valente, 2006). The PPP approach argues in favour of making necessary adjustment on the exchange rates between countries, for the exchange to be equivalent to each currency's purchasing power. It is important to note that, the PPP advocates the existence of "the law of one price" in which similar goods are opposed to give the same price outside one nation's boarder. The PPP expresses how the variable, inflation may cause movements in the domestic currency of the oil exporting countries. The PPP is upheld on the assumptions that, there is homogeneous products and absence of trade restrictions. However, the approach has been criticized on several grounds. For example, the PPP analysis is limited to tradeable goods and not for non-tradeable goods such as services. Only the prices of internationally traded goods tend to balance out; PPP analysis is useful in forecasting long-term currency valuation; PPP analysis is particularly useful for corporations, carry traders, and other long-term thinkers and PPP analysis is useless for short-term currency traders (see Van Thiel & Leeuw, 2002).

Figure 4.2: **Relative Effects of Price Changes on Exchange Rates**



Source: Adopted from Van Thiel and Leeuw (2002)

Figure 4.3: Purchasing Power Parity (PPP) theory is explained through



Looking at figure 3, the PPP curve is characterized with fluctuations, suggesting parity movement. Alongside, the curves indicate both commodity export and commodity import points are proned to fluctuation. Therefore, the intersection of the demand (DD) and supply (SS) determines the foreign exchange rates. For instance, the market rates of exchange is OR while the quantity of foreign exchange demanded and supplied is expressed at OQ. Whenever there is a change in the demand for and supply of foreign exchange, the demand and supply curves can undergo shifts as shown by D_1 and S_1 curves. The direction of the shift depends on the activities and forces of the market. If the demand for oil commodity by importers rises, the exchange rates of the oil commodity exporter appreciate and vice versa all other things held constatnt. Samo & Taylor (2002) assert that, the phenomenon leads to variations in the market rates of exchange around the normal rates of exchange, determined by the purchasing power parity. The market rates of exchange, however, will invariably lie between the limits specified by the commodity exports and commodity import points.

4.3.1.3.1 **Criticisms**

The main criticism surrounding the PPP theory stems from the idea of substitutability being a mechanism that is employed to realign domestic prices with internal prices of products whose prices are adjusted according to changes in exchange rates (Samo & Taylor, 2002). This is usually feasible when commodities being traded are identical in which spatial arbitrage takes place, but commodities can differ in quality, quantity and specifications which makes it very feasible for a high degree of arbitrage pricing. Regardless of the criticisms levelled against the PPP, it continues to serve as an invaluable tool in economics (see Samo & Taylor, 2002). Butteresing this, some studies argue that a model must not be criticized on the bases of its assumptions but on its ability to explain situations at hand (see Lewis, 1983 and Kia, 2013). According to this theory, the exchange rates or the price parity between two countries is formulated and can be determined as expressed below:

Fundamentally,

$$E = {}^{P_d}/_{P_f}$$

Applying simple mathematic manipulation, this can also be written as:

$$P_d = E * P_f$$

Where, E is the PPP equilibrium exchange rates value; P_d is the domestic price level of a commodity and P_f is the foreign price level of a commodity.

4.3.1.4 **Balance of Payment (BOP) Approach**

The BOP theory argues that the rate at which exchange rates vary can be determined by those factors that are autonomous of internal money supply and price level. The theory stresses that the position of balance of payment of a country significantly accounts for variations in exchange rates. According to Frenkel and Johnson (2013), the explanations of the BOP differ from the PPP theory, in the sense that, the BOP theory is premised on the view that, there exists both external and internal equilibrium. While the former assumes the existence of full employment in the economy, the later postulates BOP equilibrium. According to Brignall & Modell (2000) the external equilibrium comes in to deal with weakness of the PPP.

Whenever the exchange rate changes, it is either it appreciates or depreciates. The depreciation of the exchange value of home currency of an oil exporting country results to an increase in exports and a fall in imports. Therefore, the BOP shortfall is lessened, leading to appreciation in exchange rates until it eventually attains equilibrium.

Similarly, if demand or supply, or both vary, the rate of exchange will consequently be influenced. Apart from the changes in demand and supply, the exchange rates are affected by the foreign elasticity of demand for exports, the domestic elasticity of supply of exports and the foreign elasticity of supply of imports, the domestic elasticity of demand for imports. It is required that for the equilibrium rate of exchange to be stable, the supply elasticities should be low, but the demand elasticities should be high (see Samo & Taylor, 2002). According to them, the BOP theory of exchange rate determination is associated with a few advantages- the theory tries to determine exchange rates using the market forces of demand and supply, bringing exchange rates determination in purview of the general theory of value; this theory relates the exchange rates to the balance of payment situation. This implies that unlike PPP theory, this theory does not restrict the determination of exchange rates only to merchandise trade, but to those forces that may have some effects on the demand for and supply of foreign currency or the position of balance of payment; it is also superior to the PPP theory from the policy point of view. Therefore, it suggests that the disequilibrium in the BOP can be adjusted through marginal variations in the exchange rates, viz, devaluation or revaluation (see Brignall and Modell, 2000).

Nevertheless, a few criticisms account for the weakness of the BOP theory: the BOP rests on the assumption of Perfect Competition and free international trade which is unrealistic; no causal connection between rate of exchange and price level: the variations in the internal price level can certainly have their impact on the balance of payments situation which in turn can affect the rate of exchange (see Rodrick, 2008); the theory neglects basic value of currency: under the gold standard, the metallic content of the standard unit of money shows the basic or optimum value of the currency. Therefore, the demand and supply theory apply to the inconvertible paper currency cannot measure the optimum or basic value of the currency.

4.3.1.5 **Quantity Theory of Money (QTM)**

It is one of the models to determining long run equilibrium exchange rates. This theory hinges on the monetarist school of thought, stipulating that any change in the quantity of money affects only the price level, leaving the real sector of the economy wholly unaffected. In the framework of international economics, the rise in money supply manifests through a proportional rise in the exchange rates (see Nyomi, 2018 and Oleka et al, 2014). Therefore, the exchange rates can be viewed as determined by the demand for money, which is positively influenced by the growth rate of the real economy and negatively by the inflation rate. Thus, it could not be ruled out that, the growth of the real economy impacts significantly on a nation's currency position. According to Ude (1999), a defect of the international QTM is that it cannot account for fluctuations in the real exchange rates as opposed to simply the nominal exchange rate.

4.3.2 **Empirical Literature Review**

There are various studies and econometric models to produce efficient forecast and estimation of the equilibrium of exchange rates from the twenties to the recent years. Yet, exchange rates prediction remains one of the most challenging applications of modern time series forecasting as the rates are fundamentally noise, non-stationary and deterministically chaotic (see Grossmann, Simpsone, Brown, 2009; Kim, Kim and Oh, 2009; Taylor, 2009; Albae Papell, 2007; MacDonald, 1999; Rogoff, 1999; Frankel and Mussa, 1985; Allen and Kenen, 1980; Dornbusch, 1973 and 1979; Mundell, 1968; Samuelson, 1964). These features suggest that there is no perfect information that is obtainable from the previous behavior of such markets to fully capture the dependency between the future rates and that of the past. In such situations, it is widely assumed that the historical data captures the past behavior up to some extent. As a result, the historical data is the major player or the input in the prediction process. Time series modeling is the conventional technique used to model the exchange rates. However, these techniques have limitations as the exchange rate series are non-stationary and noisy (Pan et al., 2005 and Grossmann et al, 2009).

There are also studies that have observed the predictability of the dynamics of exchange rates of non-linear models like the Artificial Neural Networks (ANN), Genetic Algorithms (GA), expert systems or fuzzy models, leading however to conflicting results (see Bereau, Lopez and Villavicencio, 2010; Bildirici, Alp and Ersen, 2010; Anastakis and Mort, 2009; Majhi, Panda and Sahoo, 2009; Alvarez-Diaz, 2008; Reitz and Taylor, Alvarez and Alvarez-Diaz, 2003; 2005 and 2007; 2008; Gabbi, 1999; Gencay, 1999; Soofi and Cao, 1999; Lawrence, Giles and Tsoi, 1997; Nabney, Dunis, Dallaway, Leong, Redshaw, 1996; Brooks, 1996 and 1997; Tenti, 1996; Refenes, Azema-Barac, Chen, Karoussous, 1993; Hsieh, 1989).

There are also studies that have been carried out to compare traditional time series models with computational models for forecasting. These models are unsatisfactory because they are parametric, and some are based on the assumption that the time series been forecasted are linear and stationary. Many past studies (for instance, Binner et al.**,** 2005; Hill et al., 1996; Kohara et al., 1997; Yao et al., 1999; Giles et al., 2001; Kaboudan, 2005; Tilakaratne et al., 2007) suggest that non-linear models such as neural network models perform better than traditional time series linear models. Regardless of these views, several studies relating to financial market predictions nowadays have suggested that foreign exchange rates are predictable with high accuracy (see Haskamp, 2017 and Macdonald, 1995). Empirical studies on oil prices and exchange rates establish that the duo are important macroeconomic variables. Their variations may impair economic growth. Supporting this claim, Bagella et al (2006) give evidence that variations in real exchange rates lead to decreases in per capita income.

Exchange rates volatility is one of the central mechanisms in the so-called Dutch Disease. A resource rich country has the tendency to contract this disease when a higher resource price activates real exchange rate appreciation which, in turn, undercuts the competitiveness of the domestic industry producing traded goods (Neary and van Wijnbergen, 1986, Cunado et al, 2016). A decrease in competitiveness causes the tradable goods industry to lessen and the lost industry is problematic to regain in the ultimate price slump. Not only may firms be unwilling to invest in the face of future volatility, they may also have lost their comparative advantages during the period of contraction. This may lead to de-industrialization which may consequently inhibits long term growth as the manufacturing industry tends to be more competitive and innovative than other sectors.

Various empirical studies concentrating on exchange rate forecast among individual and collection of oil-exporting nations have emphasized the importance of factors like the terms of trade or the Balassa-Samuelson “productivity hypothesis”. In these studies, terms of trade are commonly approximated by the real oil prices (see Backus and Crucini, 1998; Baxter and Kourparitsas, 2000), and some studies have used labels like “petro-currency” or “oil currency” to describe the apparently significance of this factor in explaining real exchange rates movements. Nonetheless, empirical evidences have not been consistent (see Kourparitsas, 2000; Korhonen and Juurikkala, 2007; Tiwari, Mustascu and Albulescu, 2013 and Cunado et al, 2016).

On the account of the individual-country settings, there have been attempts made to find explanations for changes over time in the estimated extent of covariation occurring between the real oil prices and real exchange rates. For example, after oil price hikes, Sosunov and Zamulin (2006) and Issa et al (2006) point to the relative importance of oil exports in the domestic economy to account for the degree of appreciation. Habib and Kalamova (2007) informally discuss the likely importance of policy responses and revenue management. From the perspective of monetary approach, the rise in money supply reduces purchasing power which gives increase to price level as a result reduces real exchange rates. Same is the case with debt to GDP of foreign country, decreasing the demand for foreign currency, leading to lower real exchange rates of domestic country (Kia, 2012).

While variations in the oil prices appear to trigger currency movements in some countries, there seems to be little evidence for that relationship for some of the biggest oil exporters in the world. A few of the studies that document an important role for the oil price exchange rates determination is Korhonen and Juurikkala (2007), focusing on a panel of nine OPEC countries which include Venezuela, Saudi Arabia, Kuwait, Nigeria, Iran, Indonesia, Gabon, Ecuador, and Algeria. Also, Rickne (2016) examines the role of institutions on oil prices and real exchange rates movements in oil-exporting countries. From the contexts of country-specific, Mongardini (1998), Koranchelian (2005) and Zalduendo (2006) respectively document a key role of the oil price as a trigger of real exchange rates movements in countries such as Egypt, Algeria and Venezuela. Some other studies also document empirical evidence in favour of the Russian Rouble being an oil currency (see Oomes and Kalacheva, 2007; Spatafora and Stavrev, 2003). Contrary to these findings, some studies have reported either numerically weak or statistically insignificant relationships between the Norwegian Krone and the oil prices (see Bjorvik et al., 1998; Akram 2004 and Bjornland and Hungnes, 2008). Similarly, there has been considerable unwillingness in labelling the Canadian dollar as a petrocurrency, with researchers again reporting negative (Amano and van Norden, 1995) or even insignificant relationships (Gauthier and Tessier, 2002).

Lastly, in empirical study of the world's largest oil exporters, Russia, Norway and Saudi Arabia, Habib and Kalamova (2007) find that the oil price influences the movements of the Russian rouble, but that the currencies of major oil producers Norway and Saudi Arabia remain unaffected by price shocks.

Empirical studies about the relationship on oil prices and exchange rates conducted in different countries using various estimating techniques have advocated that there is no consistent answer to say that prices really affect the movement of the real exchange rate (see Coleman et. al., 2011; Bouoiyour and Selmi, 2014). Using a combination of nonlinear causality tests and wavelet analysis, Behnmad (2012) on the US dollar exchange rates and oil prices, reveals that the relationship of the two variables is very complex, and this depends on the frequency range or time scale.

The study of Aziz et al (2013) involving five ASEAN countries: Indonesia, Malaysia, Philippines, Singapore and Thailand employ a Panel Study Approach. Their findings reveal significant impact of real oil prices on exchange rates. This indicates that if oil price increases, it will lead to real appreciation in exchange rates. Similarly, the study of Al-mulali & Sab (2009) focusing on the impact of oil prices on the real exchange rates of the Dirham of the UAE, shows that for every one percent rise in the oil price from 1977-2007, the exchange rates will increase by 0.16%. In a different study, Tiwari et al (2013) using the Discrete Wavelet Transform (DWT), find a strong effect of the oil prices on the real exchange rates in both the short and long run in Romania, where a rise in oil prices result to a real appreciation of the national currency.

Goudarzi et al (2012) using VAR model suggest that oil price accounts for about 29 percent of the real exchange movement in Iran from 1978-2008 through variance decomposition, it also reveals that oil price has a positive impact on real exchange rates.

Ahmad and Hernandez (2013) examine long-run relationship and asymmetric adjustment between the real oil prices and the real bilateral exchange rates of twelve major oil producers and consumers in the world. They employ monthly data set and implement threshold autoregressive (TAR) and momentum threshold autoregressive (M-TAR) models. Their finding shows that, rise in oil prices leads to real appreciation of exchange rates. Beckmann and Czudaj (2012) empirically examines the effect of oil prices on effective dollar exchange rates using data of Trade-weighted and real effective exchange rates from the Federal Reserve in the US. Their finding shows that, there is a relationship between oil prices and real exchange rates where real dollar value appreciates after a rise in oil prices.

Jahan-Parvar and Mohammadi (2008) examine the relationship between real exchange rates and real oil prices in oil-exporting countries using a Bounds Testing Approach, to test the validity of their Dutch disease hypothesis. The authors consider the "autoregressive distributive lag" (ARDL) model. The results show a stable long run relationship between real exchange rates and real oil prices in the fourteen oil exporting countries used. Using the VAR model, Al-mulali (2010) examines the impact of oil prices on exchange rates and economic growth in Norway, the findings reveal that an increase in oil prices leads to real exchange rates depreciation. His findings are like Fowowe (2014), who use the

GARCH-type models to analyze the relationship between oil prices and exchange rate in South Africa. His results reveal depreciation of the South African rand against the US Dollar, when the oil price increases.

Using various causality tests and time domain tests, Tiwari et al (2012) investigate the connection between oil price and exchange rate and their results show that oil prices have no significant effect on exchange rates and vice versa. Lizardo & Mollick (2009) find that, a rise in real oil prices lead to depreciation of US dollar relative to net oil exporter nations and a decline in the currency value to importing countries.

Considerable number of empirical studies have recognized a positive relationship between the stock prices and the real exchange rates (see Lee 2012 and Kasman, 2003). Lee (2012) uses monthly data and employs cointegration and Granger causality estimating techniques to empirically investigate the causal relationship between real exchange rate of Renminbi (RMB) in terms of Hong Kong dollars (REX) and Hong Kong Stock Market Index in terms of the Hang Seng Index (HSI). Their results reveal that, there is a long run equilibrium relationship between the REX and HSI. Their study concludes that, the movement of the real exchange rates of RMB leads to a movement of Hang Seng Index to a certain degree. However, when RMB witnesses appreciation against Hong Kong dollars (HKD), Hang Seng Index also appreciates. It might imply that the positive effect of capital flows to goods and assets markets in Hong Kong stock market is leading due to the revaluation of the RMB against the HKD. Buttressing this claim, Kasman (2003) avows to the existence of the long run relationship between Stock price and Exchange rate using high-frequently data of exchange rates and aggregate stock indices in Turkey, involving time series techniques. That means, stock indices of HSI and exchange rates move together in the long run.

On the relationship between GDP and exchange rates, a few studies like Patosa and Cruz (2013), Acosta et al (2009), Goudarzi et al (2012) and Rodrik (2008) argue that, a rise in GDP leads to appreciation in real exchange rates. Patosa and Cruz (2013) conduct a research about the factors affecting exchange rate movements in selected Asian countries namely China, Malaysia, Thailand, Philippines and Singapore using the data that came from the World Bank for the period 1977– 2010. The real interest differential (RID) model, supported by the Keynesian and Chicago price theories (K&CPT) was used in the study. their result showed that Industrial production or GDP has a negative coefficient sign in the RID model, indicating that when the amount of industrial production increases, the currency appreciates. This is true for all five countries in the study. A rise in domestic industrial production or output level raises domestic money demand leading by the fall in the long-run domestic price level. Similarly, the study of Acosta et al (2009) tackle the Dutch Disease phenomenon. They emphasized in their study that the real exchange rates tend to appreciate as the price of non-tradables increases.

In practice, analysis of the factors influencing the exchange rate must consider their interdependence, the connection between them, which ultimately leads to currency appreciation or depreciation. Parveen et al (2012) make a study about the factors affecting exchange rate changes in Pakistan during the year 1975-2000. The stationarity of data is determined by using Augmented Dickey-Fuller (ADF) test and the ordinary least Square (OLS) method to analyze the results. The main factors determined in the study are exports, imports, economic growth and inflation. Finding from their model reveal that 98.2% changes in exchange rates is associated to the four factors that is exports, imports, growth rate and Inflation. The finding further reveals economic growth as the second variable that brings more variation in exchange rates. Contrary to this claim, previous studies like Mauro et al (2008), Twarowska and Kakol (2014) and Patel et al (2014) reveal that, as GDP increases, exchange rates depreciate. Although, the studies have similar results despite that they use different methodologies. For instance, Mauro et. al (2008) use the evolution of the thirty-quarter rolling correlation coefficient between the cyclical components of the real GDP and real effective exchange rates (REER), obtained by using HP-filtered series and their findings suggest that the real exchange rate depreciates when the economic growth is strong.

However, in this section, the study shows the fundamental macroeconomic variables, especially the oil prices, affecting exchange rates in oil-producing countries even over the long run.

There are various lines of empirical studies in literature, focusing on exchange rates forecast. For instance, the asset approach focuses on the importance of asset prices in exchange rate forecast. With this approach, interest rates differential is identified as the main driving force behind the exchange rates movement between countries. Therefore, the covered and uncovered interest parity conditions are used to forecast exchange rates. Another line of research uses the PPP hypothesis to study exchange rates dynamics. In these models, the relative price level mainly forecast exchange rates movement. This line of research can be linked to money market to examine how money supply and demand can influence the exchange rates through changing the interest rates, price levels, and our expectations about future exchange rates variations. In brief, many monetary models of exchange rates forecast are derived from the PPP hypothesis, interest parity condition, money demand and supply functions.

Monetary approach has also been used to examine the exchange rates forecast and these studies have found evidence in support of monetary models as factors that can forecast exchange rates (see Sarno et al, 2004; Crespo-Cuaresma et al, 2005; Bitzenis and Marangos, 2007; Uz and Ketenci, 2008; Hsing, 2008; Loria et al, 2010). Most empirical studies have used time series models to determine exchange rates between two countries. Nonetheless, the focus has shifted to using panel data models. For instance, Camarero and Tamarit (2002), Crespo-Cuaresma et al. (2005) among others, use panel cointegration models to examine the exchange rates movement and lately, Uz and Ketenci (2008). More precisely, Camarero and Tamarit (2002) use a monetary approach in the determination of the bilateral real exchange rates of the peseta relative to nine EU members. Their results show that both supply and demand variables were important in the evolution of the Peseta during the study period.

Crespo-Cuaresma et al. (2005) use a panel data set for six Central and Eastern European countries (CEECs) to estimate the monetary exchange rate model with the panel cointegration method. They show that the monetary model can explain the long-run exchanges rate relationships of a group of CEECs. Uz and Ketenci (2008) use different panel cointegration tests and show that there is a long-run relationship between nominal exchange rates and monetary variables such as interest rate differential, price differential, monetary differential and output differential in the newly entered ten EU members and Turkey.

Jahan-Parvar and Mohammadi (2011) use the autoregressive distributed lag (ARDL) bounds testing approach to examine the validity of the Dutch disease hypothesis by examining the relationship between real oil prices and real exchange rates in a sample of fourteen oil-exporting countries. Their results support the existence of a relationship between real exchange rates and real oil prices in the countries under investigation. Tsen (2011) studies the effect of oil price, through the terms of trade, on the real exchange rate in Hong Kong, Japan, and Korea. The study finds the real oil price, along with productivity differential, terms of trade, and reserve differential, as important factors to forecast exchange rates.

The existing literature on exchange rates forecast ignores the fact that external factors such as foreign countries' debt and debt management (how governments finance their debt) as well as crisis can affect the degree of competitiveness (exchange rates) of an oil-producing country. In addition, it not impossible that a small deviation from a long-run equilibrium is ignored, but agents react substantially to a large deviation. To the best of our knowledge, this situation is also ignored in the existing literature. In addition to our focus, this study extends literature, focusing on those factors that may forecast exchange rates of the oil-producing countries, who heavily rely on revenue from the exports of oil resource. More precisely, we narrow our focus to those factors within the context of AOECs (Algeria, Egypt, Gabon, Libya and Nigeria). Our model is also capable to investigating the effect of what was ignored in the literature on the exchange rates forecast for these countries.

It is found that, over the long run, besides money supply, domestic GDP, and government expenditure, price level and interest rates also influence the exchange rates. The results of the study by Eslamloueyan and Kia (2015) on MENA shows that, over the short run, the changes in the domestic and US interest rates as well as the US debt per GDP, the US stock market crisis of 1987, and the economic crisis of 2008 are factors affecting exchange rates in these countries. Furthermore, their study reveals that economic agents in these countries ignore a small deviation from equilibrium but react considerably to a huge deviation in such a way to depart more from the long-run equilibrium. Their study also shows that, over two periods, market forces and/or monetary or fiscal policy bring the exchange rates back to equilibrium.

4.4 **Methodology**

This study majorly aims at forecasting exchange rates within of the AOECs. Therefore, in realising this objective, the study uses a panel dataset covering five countries over the period 1980-2018. Data availability dictates the choice of both the starting and cut-off date as well as the number of countries. Also, the choice of the country chosen follows the OPEC benchmark classification of the net exporting countries (See OPEC, 2014). The study begins with all the oil producing countries in Africa as defined by OPEC and eliminates all countries where data for selected macroeconomic indicators are not available, reducing the countries to five which is consistent with OPEC net exports benchmarking. The five Africa's developing oil exporting countries under investigation are Algeria, Egypt, Gabon, Libya and Nigeria. Though, country like Angola is notable for huge oil deposits and constitutes a major net exporter in Africa, but we drop it from our sample consideration due to lack of data needed for this study. For our estimation, we opt for panel model.

Existing literature has employed several estimating techniques in forecasting fundamental macroeconomic variables Prominent among these techniques are Autoregressives and Seasonal Exponential Smoothing (see Mojekwu et al, 2011), SARIMA model (see Etuk et al, 2016; Osarumwese and Waziri, 2013; Onasanya and Adeniji, 2013) GARCH models (see Musa et al, 2014), State Space Model (see Khashif et al, 2008), ARIMA (see Biswajit, 2015 and Ajao et al, 2017), Time series and

NEURAL Neural Networks Approaches (Nanayakkara et al, 2014 and Pedram and Ebahimi, 2014), ARFIMA and SVM (Chi et al, 2015). Each of these techniques come with its own strengths and weaknesses.

Following studies like Eslamloueyan and Kia (2015) and Asghar, Qureshi and Nadeem (2015), this study employs the Panel Autoregressive Distributive Lag (P-ARDL) of Chudik and Pesaran (2013). The choice of this technique is influenced by several reasons discussed below under estimating technique.

4.4.1 **Model Specification**

For simplicity sake, following other studies like (2006), Hueng (1999), Drazen and Helpman (1990), Cox (1983) and the model formulated by Goudarzi et al (2012), the model is based on a few assumptions that: economy is a single consumer, representing many consumers, labor is inelastically supplied (see Drazen and Helpman, 1990)), total output is given exogenously. Note that none of the results will be affected if we relax these assumptions. However, the consumer maximizes the following utility function:

$$\exists \left\{\sum_{t=0}^{\infty} \propto^{t} U\left(\dot{C}_t, \dot{C}_t^*, \varpi_t, {n_t}/{k_t}, {n_t^*}/{k_t^*}\right)\right\} \quad (1)$$

$$\varpi = \omega/p \quad (1.2)$$

Where: $\dot{C}_t$ and $\dot{C}_t^*$ respectively represent single, non-storable, real domestic and foreign consumption goods; n_t and n_t^* respectively represents the holdings of domestic real $\left({n}/{p}\right)$ and foreign real $\left({n^*}/{p^*}\right)$ cash balances; $\exists$ symbolizes the expectation operator, and the discount factor satisfies $0 <\propto< 1$ condition; ω represents the real government expenditure on services and goods, and it is assumed to be a “good” itself.

This study also follows Hueng (1999) and Kia (2013 and 2006), to assume that buying of domestic and foreign goods are respectively made with domestic and foreign currencies. Then this suggests that, the services of both domestic and foreign currencies can go into the utility function. Consequently, we select the units such that, the services of domestic money and the services of foreign money are respectively equal to n and n^*. Then risks inherent for holding n and n^* are respectively reflected by k_t and k_t^*. This implies that, if the associated risks for holding n and n^*increase, the quantity of services that domestic currency and its counterpart foreign currency could purchase will weakens.

If we assume that the services of domestic money change for oil-exporting countries as the oil price changes. We specifically postulate that over the long run,

$$\log(k_t) = k_0 + k_1 \log(OP_t) \quad (2)$$

Where:
k_0 and $k_1$are constant parameters, OP denotes oil price. The variable oil price is the price at which oil is sold at the international market and it is considered as exogenous. Catris paribus, it is expected that, as the prices of oil rise, the associated risks with holding the currency of an oil-exporting economy declines, suggesting that that $k_1 < 0$. Inversely, the associated risks with holding the currency of an oil-importing economy increase, implying that $k_1 > 0$. Undoubtedly, as the prices of

oil rise, the demand for money of net oil-exporting countries will simultaneously rise, resulting to appreciation in the value of the currency of the oil exporting countries.

Following Kia (2013), this study assumes that (k^*) summarizes the risk associated with holding foreign currency (e.g., US dollars), has the following specification:

$$\log(\mathrm{k}_t^*) = \mathrm{k}_0^* + \mathrm{k}_1^* \xi \mathrm{gdp}_t^* + \mathrm{k}_2^* \zeta \mathrm{gdp}_t^* \quad (3)$$

Where, k_0^*, k_1^* and k_2^* denote constant parameters. Variables $\xi \mathrm{gdp}^*$ and $\zeta \mathrm{gdp}$ respectively represents the outstanding foreign debt per GDP, and the internationally foreign-government financed debt per foreign GDP. A rise in foreign debt is assumed to associate with future monetization of debts and a decline in the value of foreign currency (i.e., a fall in demand for foreign currency), and thus, $\mathrm{k}_1^* > 0$. Similarly, a rise in the amount of government debt held by foreign investors/governments may be considered a reason for future foreign currency devaluation, inferring that $\mathrm{k}_2^* > 0$. It is necessary to note that currency holders of net oil importing nations consider that deficit and/or outstanding debt of these countries increase the risk of holding the currency of these countries (see Eslamloueyan and Kia, 2015 and Kia, 2006). Conversely, currency holders of net oil exporting countries do not. The associated cause is that investors expect the various governments of net oil exporting nations to finance their debt obligations and deficits simply by crude oil exports. Therefore, the change in oil price is only relevant to the risk associated with the currency holding of these countries.

Thus (3) holds, subject to the short-run dynamics of the system. To be specific, it is assumed that the short-run dynamics of the risk variable associated with holding foreign currency, $[\log(\mathrm{k})^*]$ includes a set of interventional dummies that account for political changes, economic crisis, and policy regime changes that influence the value of money. According to Kia (2015), the utility function (U) is assumed to be rising in all its claims (except variables k and k*, which are declining), and is stringently concave and uninterruptedly differentiable. Accordingly, following Kia (2013) and Sidrauski (1967), the demand for services of money (both domestic and foreign), $\text{ƀ}[=\mathrm{n}]$ and $\text{ƀ}^*[=\mathrm{n}^*]$, will always be greater than zero $(\mathrm{i.e} > 0)$, if only we assume that $\lim_{\text{ƀ}\to 0} \mathrm{U}_{\text{ƀ}}\left(\dot{\mathrm{C}}_t, \dot{\mathrm{C}}_t^*, \varpi_t, {}^{\mathrm{n}_t}/_{\mathrm{k}_t}, {}^{\mathrm{n}_t^*}/_{\mathrm{k}_t^*}\right) = \infty$ and $\lim_{\text{ƀ}^*\to 0} \mathrm{U}_{\text{ƀ}}\left(\dot{\mathrm{C}}_t, \dot{\mathrm{C}}_t^*, \varpi_t, {}^{\mathrm{n}_t}/_{\mathrm{k}_t}, {}^{\mathrm{n}_t^*}/_{\mathrm{k}_t^*}\right) = \infty$, for all $\dot{\mathrm{C}}$ and $\dot{\mathrm{C}}^*$, where, for instance, $\mathrm{U}_{\text{ƀ}} = \partial \mathrm{U}\left(\dot{\mathrm{C}}_t, \dot{\mathrm{C}}_t^*, \varpi_t, {}^{\mathrm{n}_t}/_{\mathrm{k}_t}, {}^{\mathrm{n}_t^*}/_{\mathrm{k}_t^*}\right) \partial \text{ƀ}$. Similarly, let assume that the USD denotes the foreign currency. Therefore, given ϖ, the consumer will maximize equation 1, subject to the following budget constraint:

$$\phi_t + \mathrm{z}_t + (1+\Delta_t)^{-1}\mathrm{n}_{t-1} + \mathrm{q}_t(1+\Delta_t^*)^{-1}\mathrm{n}_{t-1}^* + (1+\Delta_t)^{-1}(1+\text{И}_{t-1})\mathrm{d}_{t-1} + \mathrm{q}_t(1+\Delta_t^*)^{-1}(1+\text{И}_{t-1}^*)\mathrm{d}_{t-1}^* = \dot{\mathrm{C}}_t + \mathrm{q}_t\dot{\mathrm{C}}_t^* + \mathrm{n}_t + \mathrm{q}_t\mathrm{n}_t^* + \mathrm{q}_t\mathrm{d}_t^* \quad (4)$$

Where: ϕ denotes the real value of any lump-sum transfers/taxes received/paid by consumers; z_t represents the current real endowment (income) received by the individual; Δ denotes the price level proxied with the consumer price index; q denotes the real exchange rate[6]. n_{t-1}^* represents the foreign real money holdings at the beginning of the period; d_t is the one-period real domestically funded government debt, which pays И rate of returns; and d_t^* symbolizes the real foreign issued

[6] Defined as $q_t = E_t\left(\frac{P_t^*}{p_t}\right)$ where: E_t represents the nominal market (nonofficial/black-market rate in some developing countries) exchange rate (domestic price of foreign currency); P_t^* and P_t are the foreign and domestic price levels of foreign and domestic goods, respectively (see Kia, 2013).

one-period bond, which pays a risk-free interest rate $И_t^*$. Assume further that d_t and d_t^* are the only two storable financial assets.

Defining $U_{\dot{C}} = \partial U\left(\dot{C}, \dot{C}_t^*, \varpi_t, {n_t}/{k_t}, {n_t^*}/{k_t^*}\right)\partial\dot{C}$; $U_{\dot{C}^*} = \partial U\left(\dot{C}_t, \dot{C}_t^*, \varpi_t, {n_t}/{k_t}, {n_t^*}/{k_t^*}\right)\partial\dot{C}^*$; $U_n = \partial U\left(\dot{C}_t, \dot{C}_t^*, \varpi_t, {n_t}/{k_t}, {n_t^*}/{k_t^*}\right)\partial n$; $U_{n^*} = \partial U\left(\dot{C}_t, \dot{C}_t^*, \varpi_t, {n_t}/{k_t}, {n_t^*}/{k_t^*}\right)\partial n^*$ and $\lambda_t =$ marginal utility (MU) of wealth in period t. To derive the first order conditions, maximize the preferences with respect to $\dot{C}$, $\dot{C}^*$, n, n^*, d, and d^*, subject to the budget constraints (4) for the given output and fiscal variables.

$$U_{\dot{C}_t} = \lambda_t \quad (5)$$

$$U_{\dot{C}_t^*} = \lambda_t q_t \quad (6)$$

$$U_{n_t} + \lambda_t - \alpha\lambda_{t+1}^e\,(1 + \Delta_{t+1}^e)^{-1} = 0 \quad (7)$$

$$U_{n_t^*} + \lambda_t q_t - \alpha\lambda_{t+1}^e q_{t+1}^e\,(1 + \Delta_{t+1}^{*e})^{-1} = 0 \quad (8)$$

$$\lambda_t - \alpha\lambda_{t+1}^e(1 + И_t)\,(1 + \Delta_{t+1}^e)^{-1} = 0 \quad (9)$$

$$\lambda_t q_t - \alpha\lambda_{t+1}^e q_{t+1}^e(1 + И_t^*)\,(1 + \Delta_{t+1}^{*e})^{-1} = 0 \quad (10)$$

We derive equation (11) from (5) and (6)[7]. The equation shows that, the marginal rate of substitution (MRS) between domestic and foreign goods equals their relative price.

$$\frac{U_{\dot{C}_t}}{U_{\dot{C}_t^*}} = \frac{1}{q_t} \quad (11)$$

However, equation 12 evolves by solving (6), (8) and (10):

$$U_{\dot{C}_t^*}\,(1 + И_t^*)^{-1} + U_{n_t^*} = U_{\dot{C}_t^*} \quad (12)$$

Budding from these equations (i.e. (6), (8) and (10)) to derive (12), it suggests that expected marginal advantage of adding to holdings at time t must be equal to the marginal utility from consuming foreign goods at time t. Note that the holding of foreign currency directly yields utility through its services($U_{n_t^*}$). Consequently, from (6) and (10), we have$(-U_{\dot{C}_t^*}) = \alpha\lambda_{t+1}^e q_{t+1}^e(1 + И_t^*)\,(1 + \Delta_{t+1}^{*e})^{-1}$. This implies that the probable real foreign currency invested in foreign bonds has a forgone value of $U_{\dot{C}_t^*}$. Thus, the total marginal benefit (TMB) of holding money at period t is $U_{\dot{C}_t^*} + U_{n_t^*}$.

Similar to (12), we derive (13) below by solving (6), (8) and (10):

$$U_{\dot{C}_t}\,(1 + И_t)^{-1} + U_{n_t} = U_{\dot{C}_t} \quad (13)$$

This equation (13) evolves with the implication that the expected marginal benefit from adding to domestic currency holdings at time (t) must be equal to the marginal utility (MU) of consuming domestic goods at time (t). Consequently, we assume that, the utility has an immediate function to construct a parametric demand for real balances. Therefore, given that:

[7] Note that, $y_{t-1}^e = E(y_{t+1}|I_t)$is the conditional expectation ofy_{t+1}, given current informationI_t.

$$U(\dot{C}_t, \dot{C}_t^*, \varpi_t, n_t, k_t, n_t^*, k_t^*) = (1-\varphi)^{-1}\left(\dot{C}_t^{\varphi_1}\dot{C}_t^{*\varphi_2}\ \varpi_t^{\varphi_3}\right)^{1-\varphi} + v(1-r)^{-1}\left[\left({n_t}/{k_t}\right)^{r_1}\left({n_t^*}/{k_t^*}\right)^{r_2}\right]^{1-r} \quad (14)$$

Where: $\varphi_1 > 0, \varphi_2 > 0, \varphi_3 > 0, \varphi > 0, r_1 > 0, r_2 > 0, r > 0$ and $v > 0$. They are all positive parameters. $0.5 < \varphi < 1$ and $0.5 < r < 1$. For convenience sake, these parameters are all assumed to be equal to one (1), since none of the following results is sensitive to the magnitude of $\varphi_1, \varphi_2, \varphi_3, r_1$ and r_2.[8] The utility function derived in equation (14) is similar to what Kia (2006) assumes. Nevertheless, the fact that there is also risk associated with holding foreign currency is ignored (see Kia, 2006). Using equations 11 and 14, we have equation (15) below:

$$\dot{C}_t^* = \left({\varphi_2}/{\varphi_1}\right)\dot{C}_t q_t^{-1}$$

Given that ${\varphi_2}/{\varphi_1} = 1$, we can express (15) as:

$\dot{C}_t^* = \dot{C}_t q_t^{-1}$, or linearize, $\log\dot{C}_t^* = \log\dot{C}_t + \log(q_t^{-1})$

$$\log\dot{C}_t^* = \log\dot{C}_t + \log q_t \quad (15)$$

Following Kia (2006) and the assumption that $\varphi_1 = \varphi_2 = \varphi_3 = r_1 = r_2 = 1$, we solve (12), (14) and (15) to derive below:

$$\left({v}/{k_t^*}\left({n_t}/{k_t}\right)^{r_1(1-r)}\left({n_t^*}/{k_t^*}\right)^{-r} \Big/ \left[\varphi_2\dot{C}_t^{\varphi_1(1-\varphi)}\dot{C}_t^{*(\varphi_2-1)-\varphi_2\varphi}\varpi_t^{\varphi_3(1-\varphi)}\right] \right) = \left({И_t^*}/{1-И_t^*}\right) \quad (15.1)$$

Substitute (15) in (15.1) and solve for n_t^*,

$$n_t^* = k_t^{*\,{(r-1)}/{r}}\left({И_t^*}/{(1+И_t^*)}\right)^{(-1/r)}\left(\beta_t^{(1-2\varphi)}\omega_t^{(1-\varphi)}q_t^{\varphi}\right)^{(-1/r)}v^{(-1/r)}(k_t^{-1}n_t)^{(1-r/r)}, \text{ or}$$

$$\log(n_t^*) = {(r-1)}/{r}\log(k_t^*) - (r^{-1})\log\left({И_t^*}/{(1+И_t^*)}\right) - (r^{-1})(1-2\varphi)\log(\dot{C}_t) - (r^{-1})\varphi\log(q_t) - (r^{-1})(1-\varphi)\log(\varpi_t) + (r^{-1})\log(v) + (r^{-1}-1)\log(n_t) - (r^{-1}-1)\log(k_t) \quad (16)$$

As noted in (16), $r < 1$. Therefore, a rise in the foreign risk leads to a reduction in demand for foreign currency while a rise in the domestic risk leads to a rise in the demand for foreign currency. It should be noted that (16) is not a final equilibrium condition. Reference to our assumption on utility function that is found in (14), a representative consumer must have both currencies in his satisfaction function (see Kia, 2006). The elimination of one leads to the elimination of the other. Consequently, using (13), (14), (15), and (16), and assume that the domestic real consumption$(\dot{C}_t)$ is some constant proportion (Ʊ) of the domestic real income z_t. Therefore, we follow Eslamloueyan and Kia (2015) simplicity sake, to assume that $Ʊ = 1$, we will then have:

[8] However, if the assumption of inelastic supply of labour (income is exogenous) is relaxed, there would be need to add an extra term: for instance, $-(1-\varphi_3)^{-1}(N_t)^{1-\varphi_3}$ (14). N denotes hours worked and $\varphi_3 \geq 0$, denotes Frisch labour elasticity of supply. In occasion like this, one can easily verify that none of our results will be different.

$\log((n_t) = n_0 + n_1 Int_t + n_2\log(z_t) + n_3\log(\varpi_t) + n_4\log(k_t) + n_5\log(q_t) + n_6\log(I_t) + n_7\log(k_t^*)$ (17)

Where; $I_t^* = \log\left[{И_t^*}/{(1+И_t^*)}\right]; I_t = \log\left[{И_t}/{(1+И_t)}\right]$, using $0.5 < \varphi < 0.5$ and $0.5 < r < 1$, we will have

$n_0 = -1\left({1}/{(1-2r)}\right)\log(v) > 0;\ n_1 = r(1-2r)^{-1} < 0;\ n_2 = (1-2r)^{-1}(1-2\varphi) > 0;\ n_3 = -(1-\varphi) < 0;\ n_4 = (1-2r)^{-1}(1-r) < 0;\ n_5 = -(1-2r)^{-1}(r-1)\varphi - r(1-r)] < 0;\ n_6 = -(r-1)(r-2r)^{-1} < 0$ and $n_7 = (1-2r)^{-1}(1-r) < 0$.

Note[9]. Consequently, it is important to understand that, as risk associated with any of these currencies goes up, demand for bond, as well as goods and services, will go up. At the equilibrium, we will have $\log((n_t) = \log(n_t^s)$, where m^s denotes the supply of money. Substituting $\log(n^s)$ for $\log(n)$ in Equation (17) and Equations (2) and (3), for $\log(k)$ and $\log(k^*)$ in Equation (17), and solving for $\log(q_t)$ gives:

$$\log(q_t) = ȥ_0 + ȥ_1 lnms_t + ȥ_2(int_t) + ȥ_3 lngdp_t + ȥ_4 lnop_t + ȥ_5 I_t + ȥ_6 dbtgdp_t + U_t \quad (18)$$

Where, q is the exchange rates, ȥ represents the parameters of the forecasting model; lnms denotes log of money supply; int represents interest rates; lngdp denotes log of gross domestic products; lnop is the log of price of oil at the international market; I denotes inflation, the dbtgdp is the percent of external debt to gdp.

Defining further the parameters, they are expressed below:

$$ȥ_0 = -\left({n_0}/{n_5}\right) - \left({n_4}/{n_5k_0}\right) - \left({n_7}/{n_5k_0^*}\right) > 0;\ ȥ_1 = \left({1}/{n_5}\right) < 0;\ ȥ_2 = -\left({n_1}/{n_5}\right) < 0;$$

$$ȥ_3 = -\left({n_2}/{n_5}\right) > 0;\ ȥ_4 = -\left({n_4}/{n_5k_1}\right) > 0;\ ȥ_5 = -\left({n_6}/{n_5}\right) > 0;\ ȥ_6 = -\left({n_7}/{n_5k_1^*}\right) < 0$$

Equation (18) expresses a long run real exchange rates relationship. Similarly, error term U is added and assumed to be the white noise or random walk in the model. Following Eslamloueyan and Kia (2015) and Kia (2006), this equation assumes that, increase in interest rate and money supply may lead to lower exchange rates over the long run period. This occurrence is associated with the fact that, a rise in the interest rate or money supply, could cause a rise in price over the long run, which eventually results in a lower real exchange rates. This validates the view of Sargent (1986) and Kia (2006) that, given the time path of fiscal policy and given that government interest bearing debt can be sold only at a real interest rate above the growth rate n, the tighter is the current monetary policy, the higher must the inflation eventually becomes. A higher real income leads to higher real exchange rates in the long run. Similarly, a higher real income may also result into a higher real demand for money and a lower price level and so, a higher exchange rates (See Eslamloueyan and Kia, 2015). A higher oil price leads to a higher demand for domestic currency and a lower demand for goods and services and price. Subsequently, a higher oil price results in appreciation of the real exchange rates.

[9] The coefficients of both k_t and k_t^* are negative. This implies that, both domestic and foreign risks associated with holding domestic and foreign currencies reduce the demand for domestic currency. This is because, as indicated in (16), the demand for domestic currency (n) has a positive relationship with the demand for foreign currency(n^*). Therefore, as (k^*) goes up, (n^*) will fall, which results in a fall of (n).

Higher oil price leading to a rise in exchange rates affects those factors that affect the risk associated with holding foreign currency. This factor comprising foreign debt will lead to lower real exchange rates. The reason for this occurrence may be because these factors reduce demand for money, which may result in a higher demand for goods and services and price level (a lower real exchange rates). It should be emphasised that the long-run Equation (18) is also subject to a short-run dynamic system, which includes stationary variables that represent crisis as well as policy regime changes and other exogenous factors that affect the system in both domestic and foreign countries (See Eslamloueyan and Kia, 2015).

Considering the choice of the long-run exchange rates relationship specified in equation 18 above, it varies from other one that may be found in the literature of real exchange rates for commodity-resource-oriented countries. For instance, Cashin et al (2004) real exchange rate model is a function of the productivity differentials between the export and import (foreign) sectors, the commodity terms of trade (or the price of the primary commodity with respect to the intermediate foreign good) and the productivity differentials between the local and foreign nontraded sectors; Chen and Rogoffs (2003) real exchange rates model is a function of commodity prices and terms of trade; Bodart et al (2012) real exchange rates model only a function of the commodity price. Though, none of these models incorporate foreign debt. Although, Musyoki et al. (2012) and Basirat et al. 2014) argue in favour of foreign debt in any economy, especially the developing countries that, developing countries could resort to foreign financing to foster internal growth and increase resources available for investment. This is because savings in these countries are low. Most of these countries do not borrow in their own currencies in the international capital markets, but instead borrow in one of the major currencies and thus affect the exchange rates. Nevertheless, Cavallo et al. (2005) avow that, these factors may contribute to the occurrence of exchange rates fluctuations, sudden stop of capital flow and output drop in the domestic market because the size of the foreign currency denominate debt of the oil exporting countries. Furthermore, their study points that, the exposure to foreign liabilities was also seen to magnify the exchange rates depreciation cost especially in a situation where the foreign debt is in the public sector.

This model though very similar but different from Kia (2013). Kia (2013) supports country like Canada that has the highest degree of openness. His model incorporates both foreign and domestic external (US) fiscal variables, which includes commodity price rather than oil prices. Our model varies by focusing on the developing net oil exporting countries, in which their fiscal variables are solely financed with proceeds from crude oil exports. This explains why the risk associated with holding domestic money is only a function of the international oil prices which may necessarily has nothing to do with the fiscal domestic variables. However, due to the indispensable nature and heavy reliance of the oil exporting countries on oil production and exports, oil price is essential to decide economic performance. It is used as a basis to determine how much the government of these countries can spend and how they can finance and manage their debts. This position or approach differentiates this study from Kia (2013) and other earlier studies.

Following Chudik and Pesaran (2013), supposing the Panel ARDL regression model for the Africa's oil exporting countries is specified as:

$$\Delta q_{it} = \varphi_{i0} + \varphi_1 \Delta\vartheta_{it-1} + \varphi_2 \Delta\vartheta_{it-2} + \ldots \ldots + \varphi_p \Delta\vartheta_{it-p} + \Pi_1 \Delta q_{it-1} + \Pi_2 \Delta q_{it-2} + \ldots \ldots + \Pi_q \Delta q_{it-q} + v_{it} \quad (20)$$

where q_{it} is a (k x 1) vector of endogenous variables capturing the exchange rates; φ_{i0} is a vector of intercept/drift components of the constant term; i represents index of a country; Δ represents the first difference operator; ϑ_i and q_i are lagged explanatory variables in the long and short run and in the long run respectively$\varphi_1 - \varphi_p$ represent short run dynamics of the model; $\Pi_1 - \Pi_p$ represent the long run relationships; and v_1 vector of disturbance terms/random walk.

However, equation 18 is suitably adjusted for our panel data below:

$$\log(q_{it}) = \mathfrak{g}_0 + \mathfrak{g}_1 \text{lnms}_{it} + \mathfrak{g}_2 \text{Int}_t + \mathfrak{g}_3 \text{lngdp}_{it} + \mathfrak{g}_4 \text{lnop}_{it} + \mathfrak{g}_5 \text{I}_{it} + \mathfrak{g}_6 \text{dbtgdp}_{it} + \text{U}_{it} \quad (21)$$

Where ln denotes logarithm of a variable. $q_{it} = LNEXR_{it}$

As earlier expressed, recall that,

$\mathfrak{g}_0 > 0;\ \mathfrak{g}_1 < 0; \mathfrak{g}_2 < 0; \mathfrak{g}_3 > 0; \mathfrak{g}_4 > 0; \mathfrak{g}_5 < 0; \mathfrak{g}_6 < 0.$

In addition, to examining the factors forecasting exchange rates in the AOECs this study analyses the short run and long run relationships between exchange rates and these factors; examining whether the effect of these factors in the long run may foster output growth.

For suitable modelling of the data to establish both the short and long run connections existing between exchange rates and the selected macroeconomic variables, this study considers the existence of panel unit roots and cointegration of data to determine the proper methodology for the study. To achieve these preliminary tests, we follow previous study like Giles (2013) that enumerates four circumstances that usually confront data and afterward determine the choice of technique used:

i. The Ordinary Least Square (OLS) estimating technique is suitable for analysis, when all data series are I(0) order and thus stationary.
ii. When data are not cointegrated, but series are proven integrated of the same order like I(1), the appropriate estimating technique suggested is an estimation in first differences comprising no long run elements;
iii. When all data series are found to be integrated of the same order as well as cointegrated, the two types of regression estimating models suggested are: a) a Vector Error Correction Model (VECM) or Error Correction Model (ECM), estimated by ordinary least squares technique (see Gujarati, 2004). This approach represents the short-run dynamics of the connection between the selected variables; and b) an OLS regression approach, using the levels of the data. This approach is advantageous because, it is believed to provide long run equilibrium connections between the examined variables.
iv. The forth situation differs from the three scenarios earlier mentioned and it is seen to be more complex. In this situation, some of the variables examined are stationary at levels (i.e. I(0)) while some are stationary at first difference (i.e. I(1)) or even proportionally integrated, resulting to no definite integration order like in the former scenarios above. Consequently, in addition to Giles (2013), Chudik and Pesaran (2013) suggest a more advanced estimating technique suitable to handle fractional integration order. Therefore, our study falls in that category, necessitating our choice of Panel ARDL estimating technique which is suggested and introduced in Chudik and Pesaran (2013). Various studies have considered this estimating approach suitable for capturing series with varied integration order. For instance, Mercan et al., 2013 use the Panel ARDL data analysis technique to examine the effect of openness on economic growth in BRIC-T countries;

Al Mamun et al. (2013) employ a dynamic panel analysis technique to the financial determinants of CSR in Bangladesh banking industry; while Gerni et al. (2013) use panel estimating technique to analyze competitiveness and Economic Growth on the transition countries and Bakar et al. (2013) also employ the Panel ARDL to examine the determinants of fertility in Malaysia and the selected ASEAN countries.

4.4.2 **Data, Data Sources and Measurement of Data**

This study relies on quarterly time series data spanning 1980Q1 to 2018Q4. The commencement date captures the period of major oil price shocks, remarkably causing imbalance in the world economy and exchange rates of the oil exporting countries. Data paucity dictates the cut-off date. Major sources of data include the world development indicator (WDI), World Bank database of economic and St Fred Louis- http://research.stlouisfed.org/fred2/, Organisation of Petroleum Exporting Countries (OPEC) and US EIA. The choice of the variables employed in this study is informed by theory and previous studies like (see Yin, Peng and Tang (2018); Eslamloueyan, Karim and Kia, 2015; Lee and Huh (2017). In addition, these variables are drawn from literature and modelled in the ARDL forecasting model. Exchange rates is the dependent variable and it is proxied with Brent crude. Other variables are World money supply, interest rate, GDP, debtgdp and Inflation proxied with consumer price index (CPI). Apart from interest rate other variables are expressed in their natural logarithms. Resulting from the requirement for using panel autoregressive distributive lag (P-ARDL) model, variables are subjected further to a test for stationarity, revealing that the variables are mixture of I(0) and I(1) but not I(2) (see table 1). Consequently, the study, proceeds with estimation of the P-ARDL forecasting technique in equation 21.

4.4.3 **Brief Description of Variables**

4.5.3.1 *Exchange Rates*

The exchange rates measure the expression of the price of each country's currency in another country's currency. The US dollar exchange rates is selected as the benchmark in this study due to its wider acceptability and the fact that US dollar is is the most traded currency on the foreign exchange market (Kutu and Ngalawa, 2016 and Kia, 2006). Following Eslamloueyan and Kia (2015), the study uses the Consumer Price Index (CPI) as a basis to construct the real exchange rates q[10].

4.4.3.2 *Money Supply*

It is also referred to as money stock comprising the M2, which is the amount of currency in circulation and other liquid instruments, savings, checking deposits and time deposits in each country. In another word, following Ihsan and Anjum (2013), M2 is a combination of M1 and short-range time deposits in banks and twenty-hour money market funds. The M2 is employed in this study to determine and assess the process through which the monetary authorities employ operating tools of monetary policy to achieve their targets (see Ngalawa and Viegi, 2011).

4.4.3.3 *Interest Rate*

The interest rate represents the average monthly real REPO rate sets by the central bank of individual country as a monetary policy indicator. As found in Bernanke et al (2004), Iturriaga (2000) and

[10] The real exchange rate is denoted with q. This is based on the US dollar, being the most traded currency in the world. Note that, the United States dominates the trade relation with these countries. (i.e., $\mathrm{q} = \psi \left({}^{\mathrm{CPI}^*}/_{\mathrm{CPI}} \right)$, where ψ denotes the nominal exchange rates, CPI^* is the international consumer price index and CPI is the domestic price index.

Disyatat and Vongsinsirikul (2003), the interest rate is used as a benchmark at which the central or reserve bank of a country provides short term credit to the commercial banks and discount houses in its function as lender of last resort. The choice of interest rate in this study is to allow us to determine the extent of inflation caused by movement in in exchange rates and vice versa.

4.4.3.4 *Gross Domestic Products*

GDP refers to an inflation-adjusted measure of all goods and services produced at constant national prices for each country annually at a given base year for all the selected countries. Following Berkelmans (2005) and Dungey and Pagan (2000), the study includes this variable to examine the impact the extent to which it impacts exchange rates. In addition, the inclusion of GDP seeks to assess the validity of the view that the stabilization of output and inflation can be left to monetary policy to achieve Pareto optimality (see Mishkin, 1995 and Erceg, et al., 2000). However, the growth rate of the GDP is considered for this study.

4.4.3.5 *Oil Price*

Oil price refers to the amount or price in dollar to which per barrel of crude oil is sold each day in the global oil market. The Brent Blend (also known as Brent Crude) is used as the oil price measure, because it is the largest in Africa among many major classifications of oil consisting of Brent Sweet Light Crude, Brent Crude, Forties crude and Oseberg crude (OPEC, 2016). This variable is treated in the model as exogenous because it is externally determined. It is added to the model as suggested in our earlier chapter that oil price variations hugely account for fluctuations in exchange rates among the AOECs.

4.4.3.6 *Inflation*

Inflation refers to persistent increase in the general price level. It is proxied with consumer price index (CPI), measuring all items national composite price using 2010 as the base year. It is key as a monetary policy, empirically stated to impact exchange rates. Hence, it enters the model as a monetary policy goal. Also, the inflation serves as a control variable having link with monetary policy decisions, more especially with the interest rates through which economic stability and equilibrium is attained (see Kia, 2006).

4.4.3.7 Debt to GDP

Debt simply means the sum of money that is owed. Therefore, external debt comprises the portion of a debt of a country borrowed from foreign lenders. These consist of commercial banks, governments or international financial institutions. These loans, comprising interest, must usually be paid in the currency in which the loan was made within the agreed terms. It is usually measured as a ratio of the GDP. The external debt could act as severe constraint on economic growth particularly, when the interest elements on loans take up huge percentage of the country's exports proceeds, thus reducing domestic currency. It is brought into the study to capture the capital mobility among partnering countries, specifically to account for the effect of the view that, it is the supply of and demand for currencies with flow concept that determines the equilibrium value of currencies (Eslamloueyan and Kia, 2015).

Table 4.1: Description of Variables Forecasting Oil Price

Variables	**Abbreviation**	**Description**
Exchange Rates	LNEXCH	Quarterly average Rate
Money Supply	LNMS	Quarterly average supply
Interest Rate	INT	Quarterly Average Rate
Gross Domestic Products	LNGDP	Quarterly average Amount
Oil Price	LNOP	Quarterly average price, $/barrel
Inflation	INF	Quarterly average Rate
Debt to GDP	LNDBT	Quarterly average Amount

***Source**: Author's computation (2019)*

4.4.4 Estimation Technique

To determine our model for forecasting, this study adopts a Panel ARDL estimating technique of Chudik and Pesaran (2013). In addition to the forecasting, the model examines whether short run and long run relationships exist between exchange rates and the identified forecasting variables of exchange rates. The choice of this technique is premised on Al Mamun et al. (2013), Mohaddes and Raissi (2014) and Eslamloueyan and Kia (2015). Specifically, the reasons discussed in these studies for preferring Panel ARDL to other conventional short run and long run techniques are stated below:

i. The Panel ARDL is suitable for combining the I(0) and I(1) series, implying that both data integrated at order I(0) and I(1) can jointly be used in the analysis of Panel ARDL. They can be cointegrated mutually, disregarding their integration order but not I(2) (see Katircioglu, 2009: Sari et al., 2008). This claim makes the Pane ARDL a more advantageous estimating technique over other approaches available to estimate short run and long run relationships.
ii. The Panel ARDL has the capacity to concurrently estimates the long run and short run parameters of a model (Dritsakis, 2011; Shin et al., 2014);
iii. It is suitable for both large and small sample sizes (Narayan, 2005; Rafindadi and Yosuf, 2013).
iv. According to Giles (2013), it is a contemporary method to examine the short run and long run dynamics.
v. Variables under the Panel ARDL estimating technique can be assigned different lags. (see Giles, 2013).
vi. The Panel ARDL involves a single-equation set-up, making it easy to implement and interpret (Giles, 2013).
vii. The Panel ARDL can accept more than two lags and up to seven variables (see Giles, 2013).
viii. Overall, the Panel ARDL estimating technique is suitable for panel analysis because it accounts for cross-sectional dependence and can permit one or two structural breaks when carrying out the test for stationarity (Chudik and Pesaran, 2013).

4.4.5 Rationales for Panel Data Technique

The study employs a panel data estimating technique, following several studies like Eslamloueyan and Kia (2015), Hasio (2014), Mahembe (2014), Baltagi (2008) and Kia (2006). For clarity purpose, Baltagi (2008) and Gujarati (2004) highlight the following reasons to support the choice of panel estimating approach, which are found suitable for our study:

i. It regulates for heterogeneity in specific data
ii. It is appropriate for the study of dynamic adjustments
iii. It is suitable to ascertain and evaluate the impact that are not noticeable in pure cross-sectional analysis or time-series data
iv. It provides additional variability, more explanatory power and less collinearity among variables in the model
v. It offers more degrees of freedom (DoF) and found more efficient when compared to cross-sectional data or time-series.
vi. It allows for the creation and analysis of more complex behavioral models like the economies of scale and technological change
vii. It can remove the problem of non-standard distributions that characterizes the test for variable stationarity in a time series analysis.

In a similar view, buttressing the above, Golsch and Schmidt (2013) advances the following about panel estimating technique:

i. Panel data provides efficient means to measure changing behaviors over time
ii. The temporal order of effect and cause is known when using panel data.
iii. It can control for sample selectivity and biases arising from omitted variables.
iv. Recurring observations of the same individuals over time demonstrate processes of variation.

There are lines of arguments amidst scholars concerning the extent that panel data could be used in analysis. Why some studies uphold that, in addition to learning about individual variation, panel data can help to evaluate the levels and trends of variables over time which is similar to how the cross-sectional data analysis does (though, it is noted that cross-sectional analysis does not provide information about change at the individual level). Nevertheless, others contend that panel data should purely be used to analyze change, as there can be challenge of “panel attrition” (i.e. individuals falling off the observation/survey) when it is used to examine the long-term trends. It is considered uneconomical to put attention on analyzing specific change. Therefore, using panel data estimating technique is a rich source of information on trends and levels, as cross-sectional surveys often don’t capture certain variables of interest (see Golsch and Schmidt, 2013).

4.4.5.1 **Unit Root Tests- panel**

The concept of unit root test is emphasized in literature (see The Bornhorst & Baum (2006), Moon, Perron, and Phillips (2007), and Im, Pesaran, and Shin (2003). Following these studies, to conduct an P-ARDL analysis, it is required that the properties of the variables to be estimated are examined. This is necessary because if the variables are non-stationary as well as non-co-integrated, it may lead to wrong specification of a model, which may eventually lead to misleading values of R-square, F and t statistics (see Al-Yousef, 2005; Hamid, and Shabri, 2017) and spurious results. To investigate this, the study also follows Bornhorst and Baum (2006) and Im et al. (2003) to conduct the Im, Pesaran and Phillips (IPP), Levin-Lin and Chu (LLC) and the Fisher-Augmented Dickey-Fuller (ADF) unit root tests on the stationary of levels and the first differences of the variables included in the study to forecast exchange rates, using both the Akaike and Schwarz Information criteria. The choice for various criteria used is informed by the need to confirm the validity and reliability of our results as well as its consistency (see Moon and Perron, 2004; Ishibashi, 2012; Demetriades and Fielding, 2012; Frimpong, 2012).

Testing whether a series, say π_t, is integrated or equivalent to testing for the significance of α_2 i. e. $H_0: \alpha_2 = 0$, in the regression below where ∀ is a linear trend.

$$\Delta\pi_t = \alpha_0 + \alpha_1\forall + \alpha_2\pi_{t-1} + \sum_{i=1}^{k}(\zeta\pi_{t-1} + \pi_t)$$

4.4.5.2 **Panel lag length**

The lag length indicates the number of times between exchange rates action responses to changes in the factors that forecast it. It refers to how many terms back down the AR process to examine for serial correlation. The information criteria for optimal lag length is contingent on the number of observations. While the Akaike Information Criterion (AIC) and Final Prediction Error (FPE) are more suitable when there are less than sixty (60) observations; the Hannan-Quin is more appropriate when there are more than one hundred and twenty (120) observations (see Lutkepohl, 2006). Since the series are quarterly, the study tests for various order lag selection criteria to allow for adjustments in the model and the attainment of well-behaved residuals. Therefore, in this study, the number of lags considered appropriate to be adopted for this model follows the standard Hannan-Quinn Criteria (HQ), Schwartz Information Criteria (SC), and Akaike Information Criteria (AIC), suggesting that an optimal lag length of six would be appropriate for several models (see Ali and Ali, 2008; Raza et al., 2015). Accordingly, the ARDL optimal lag order selection, using various lag lengths is presented in table 4.4 below.

4.4.5.3 **Diagnostic Tests**

Contrary to study like Alquist *et al*. (2013), offering evidence that a shorter lag length may provide more accurate forecasts than longer lag length, this study finds lag 6 suitable for the ARDL model without necessarily loosing vital information. This also suggests that, the selected variables therein are suitable to predict exchange rates. This idea is supported by Baumeister and Kilian (2015) who argue contrary to Alquist *et al*. (2013). They argue in favour of longer lag length that, longer lag lengths provides more accurate forecasts than shorter lag length.

It is required that basic diagnostic tests are conducted. These tests are the P-ARDL serial correlation, heteroscedasticity and normality tests to demonstrate the suitability, robustness and reliability of the model.

This study tests for null and alternative hypotheses of serial correlation, heteroscedasticity and normality which are hypothesized as:

Null Hypothesis: $H_0: \theta = 0$, there is no serial correlation; no heteroskedasticity and; residuals are normally distributed

Alternative Hypothesis: $H_1: \theta \neq 0$, there is serial correlation, heteroskedasticity and residuals are not normally distributed.

4.4.6 **Forecasting: An overview**

Data forecasting procedure is well discussed in the literature and it is common with institutions like stocks exchange and central banks (see Jackson, 2016). Data forecast is usually done using high and aggregation of data relating to GDP, inflation, and in some scenarios, disaggregated level where comparison is likely to be made between sectors of an economy, or institutional performances (see

Jackson, 2016). However, the accuracy of data forecast as a means of making judgment about (economic) performances is one that has lately come under huge scrutiny by professionals across the world (see Batchelor, 2000; Friedman, 2013).

However, Heizer and Render (2004) refers to forecasting as the science and art of predicting a future event. "It is the estimating of a future outcome of a random process". The main assumption guiding forecasting is that the outcome obtained from a random process provides accurate and dependable evidence of the future. Therefore, there is a limitation to the outcome of a forecast. Although, it may offer a great sum of insight and yet it is hardly ever flawless (Mendenhall, Reinmuth, & Beaver, 1993). Various unpredictable situations could affect the actual result of a forecast. Nonetheless, economy and businesses cannot afford to eliminate the procedure of forecasting, as effective policy making and planning in both the shortrun and longrun regularly rely significantly on a forecast (see Heizer & Render, 2004; Mendenhall, Reinmuth and Beaver, 1993).

4.4.6.1 **P-ARDL Forecasting of Variables**

This study forecasts the panel data used in the P-ARDL model, specifically the exchange rates of the AOECs to examine the accuracy and predictive power of the model. This approach follows the graphical technique of Harvey (1989), Batten and Thornton (1983), Beneki and Masoud Yarmohammadi (2014) and Haskamp (2017). Therefore, the study employs the out-of-sample forecasting procedure to illustrate the different trend types that comprise irregular components, seasonal components and trend components. The forecasting process is majorly based on Diebold and Li (2006) to advance a regression model using panel data spanning 1980Q1 to 2015Q4 to estimate the model and sample data, and 2016Q1 to 2018Q4 for the ex-post or out-of-sample data, identifying all as either static or dynamic forecasting. Following Cuaresma and Breitenfellner (2008) and MacDonald and Taylor (1994), our models are computed and compared based on several evaluation forecast statistic, comprising the mean absolute error (MAE), Root mean squared error (RMSE), Mean Absolute percentage Error (MAPE), Theil Inequality Coefficient (TIE). These statistics were derived for a forecast horizon of twelve periods, for the three year out-of-sample space.

4.4.6.2 **Root Mean Square Error (RMSE)**

The "root mean squared error" is a benchmark to evaluate an estimated regression model ascertain the variance between the forecasted and the actual values (see Clarida et al., 2003 and Harvey, 1989). According to Hassani, Soofi and Zhigljavsky (2010) and Pradhan and Kumar (2010), the RMSE is now a prevalent technique to estimate forecasting accuracy and this is cited frequently in forecasting literature. The approach suggests that, the lower the RMSE (value), the lesser the error margin line (i.e., the gap between the forecasted value and the actual value), henceforth the more satisfactory the predictive power of the model. On the other hand, the higher the RMSE (value), the broader the gap between the forecasted and actual values, and the lesser the satisfactory power of the model. In addition, the forecasting procedure presents line graph obtained with the use of the e-views software. This procedure verifies the true correlation and movement path existing between the forecasted and actual values to substantiate and validate the forecasting strength of the model, basically to enhance policy recommendations. However, given that $P_i^r(n)$ is the $i-th$ prediction of a given model for oil price for $n-$ steps into the future, and $P_i^{\propto}$ is the actual output realized in the future, then the RMSE and Theil U statistics can be expressed as:

$$\mathrm{RMSE(n)} = \sqrt{\frac{1}{T}\sum_{i}^{T}(P_i^{\propto} - P_i^{f}(n))^2} \quad (22)$$

4.4.6.3 **Theil's U Inequality Test (TUIT)**

This test suggests that if the RMSE of the unrestricted Autoregressive Distributive Lag model (RMSEUR) is less than the RMSE of the restricted model (RMSFER), that is $(\mathrm{RMSE_{UR}} < \mathrm{RMSE_R}$, then the model is "better" forecasting model with lesser forecasting error. Consequently, if $U(n)$ in (23) below holds, such that $U(n) < 1$, it shows the unrestricted ARDL model forecast is good and reliable[11]. The Theil's U coefficient is expressed as follow:

$$U(n) = \sqrt{\frac{1}{T}\sum_{i}^{T}(P_i^{\propto} - P_i^{f}(n))^2} \Bigg/ \sqrt{\frac{1}{T}\sum_{i}^{T}(P_i^{\propto} - P_i^{*}(n))^2} \quad (23)$$

where T is the forecast computed and $P_i^{*}(n)$ is the forecasted value based on "naive forecast" $n -$ steps into the future, using the data ranging up to $i - T$. T is the number of out-of-sample forecasts that is carried out. Root Mean Squared Errors (RMSE) are computed for forecasting horizons (n), spanning from one quarter ahead to quarter twelve ahead. It is apparent that a Theil U statistic greater than 1 $(U > 1)$ suggests that the used model for forecast is worse in terms of quality of forecasting than a "naive forecast"[12]. However, a Theil U statistic less than one $(U < 1)$ suggests that the used model for forecast is appropriate and reliable in terms of predictability or quality of forecasting (see Doan, 2007; Gupta and Sichei, 2006; Dua et al., 1999).

4.4.6.4 **Mean Absolute Percentage Error (MAPE)**

The MAPE overcomes one shortcoming of using the mean absolute deviation (MAD) and mean square error (MSE) in estimating forecasting accuracy (see Heizer & Render, 2004). This shortcoming occurs because the values of the duo dependent on the magnitude of the items that are forecasted. The values of MSE and MAD have a tendency to be very large, when a forecasted item is measured in great terms. Therefore, using the MAPE, eliminates this shortcoming. On the contrary, the MAPE may not be effective when a forecasted item is measured in very insignificant terms. Following (Mendenhall, Reinmuth, and Beaver (1993) and Heizer & Render (2004), the MAPE is estimated, using the formula below:

$$\mathrm{MAPE} = \frac{100 * \left(\sum_{i=1}^{n} \frac{|\eth_i - g_i|}{\eth_i}\right)}{n} \quad (24)$$

Sternly speaking, the Theil's U inequality coefficient employs a random walk model procedure as a benchmark. However, this study follows Rapach and Weber (2004) in the applications of the Theil's U coefficient, using the Autoregressive (AR) model as benchmark. However, the study still refers to the ratio of the RMSE from the restricted and unrestricted models as Theil's U coefficient.

[12]Naive Forecast: estimating method in which the actual values of the previous period are used as the present period's forecast, without having to adjust them or attempt to establish causal factors those values (present and past). Usually, it is only used for comparison with the forecasts generated by the better (sophisticated) methods.

where MAPE=> the mean absolute error; $\sum_{i=1}^{n}$ => the summation of the nth period; $ð_i$ is the actual value in the nth period; g_i is the forecasted value in the nth period; $|ð_i - g_i|$ is the absolute value of the difference in absolute and actual values. Given that MAPE is estimated as a percentage, it is very easier to interpret its outcome. According to Heizer & Render (2004), the application of the MAPE method is predominantly useful to compare the performance of a model for a variety of series.

4.4.7 **Forecasting Variables: The Static and Dynamic**

Majorly, this study forecasts exchange rates of the AOECs. Consequent to our previous chapter, oil price significantly determines exchange rates movement in the AOECs owned to its spillover effects. Therefore, this section performs a forecasting analysis to show whether changes in the oil prices and other factors forcasting exchange rates in the AOECs. In view of this, exchange rates and other variables are forecasted within the P-ARDL framework, using the RMSE evaluation technique. Following Eslamloueyan and Kia (2015) and Kia (2013), the specification may be interpreted as a monetary model of exchange rates determination that is augmented with oil price variable (see Cuaresma and Breitenfellner, 2008; MacDonald and Taylor, 1994), where the exchange rates behaviour is assumed to be influenced by changes in the relative money supply, variations in interest rate, inflation rate, debt, output and oil price. In achieving this, two major approaches well discussed in literature for forecasting are employed. They are dynamic forecasting model (DFM) and static forecasting model (SFM). This have been employed in Raftery et al (2010) and Koop and Korobilis (2012) to forecast economic variables. Similarly, other studies on forecasting such as Drachal (2016), Naser (2016) and Wang et al. (2015) have employed the DFM model for forecasting economic variables. According to them, the DFM and SFM are found superior and suitable for forecasting economic variables. Naser (2016) agreed with them and revealed that, the superiority of these techniques do not only capture the time-varying property of the variables but could automatically select the optimum model also. Nevertheless, these procedures will meet the curse of dimensionality when the predictor variables are larger, making it not suitable for forecasting economic variables. Furthermore, Baumeister and Kilian (2015) propose these techniques with inverse recursive mean-squared prediction error (MSPE). Similarly, Manescu and Van Robays (2016) utilize this method to predict real Brent oil prices. The methods significantly improves the accuracy with a combination of six models: a VAR model of the global oil market, a forecast based on the price of non-oil industrial raw materials, a no-change forecast, a forecast based on oil futures prices, the spread between the spot prices of gasoline and crude oil, and the time-varying parameter model of the gasoline and heating oil spreads.

However, this study carries out combined forecasting, differentiating between the dynamic and static methods using the RMSE, Theil coefficient and MAE as benchmark. Bates and Granger (1969) introduces the combined forecasting technique and since then, it has been widely applied in literature, believing strongly that it can improve predictivity and accuracy (see Clemen, 1989; Armstrong, 1989; Haskamp, 2017; Yin, Peng and Tang 2018). In addition, this procedure adheres to strict scientific means of empirical outcomes which is usually done using robust Popperian style methodological approach(es) as a way of proving its scientific existence (see Jackson, 2016). Generally, the static forecasting (simulation modelling) technique is based on existing exposures and therefore assumes a constant balance with no new growth. The procedure uses actual in place of forecasted values (this is possible only when there is availability of actual data or series). On the other hand, dynamic forecasting depends on detailed assumptions concerning distinctions (rises or falls) in the economy. It relies on a formerly forecasted outcome of a lagged variable. According to Menezes et al. (2000), a review of the two techniques leads to different preferences. Besides, Hibon and Evgeniou (2005) avow that, it is not that combined forecast is more beneficial than possible individual forecasts, but only that it could be less risky, in practice, because it combines more forecasts method than selecting forecasting methods individually. Nevertheless, using both static and dynamic forecasting in this study offers researchers the chance to make a choice from the forecasting techniques and choosing the outcome with the most predictability and accuracy, offering a more reliable information on future events and behaviour, such that could serve as a guide in enabling objective decisions to be made, given the possibility of margin of errors in the final forecast outcomes (see Ericsson, 2016).

4.5 **Results of Estimation**

The results of the empirical analysis are reported below. These encompass the panel unit root test, correlation matrix, Cross-Sectional Dependency, optoima lag selection and PARDL results. The study employs the P-ARDL regression estimating technique with at least six lags, and the diagnostics test, inferences and discussion of findings are presented for the five AOECs.

4.5.1 ***Panel-ARDL Unit Root Results***

The study conducts stationary tests, primarily to confirm the presence of unit roots following various tests suggested in the literature (Maddala and Wu, 1999; Choi, 2001; Hadri, 2000; Breitung 2000; Levin, Lin and Chu, 2002; Im, Pesaran and Shin, 2003). However, the results are presented in tables 4.2a and 4.2b. revealing that inflation and oil price are stationary a level I(0), while debt/GDP, interest rate, exchange rates, gross domestic products, money supply are stationary at their first differences (1) and no variable is stationary at the second difference I(2). Hence, these results are appropriate and satisfy the condition for testing and using Panel-ARDL (see Eslamloueyan and Kia (2015).

Table 4.2a: Levin et al., Im et al and Fisher-ADF unit root tests: Individual Intercept

Variables	Levin, Lin, Chu (Individual Intercept)			Im, Pesaran, Shin (Individual Intercept)			Fisher-ADF (Individual Intercept)		
	Integ Order	t-stat (t*)	Prob Value	Integ Order	t-stat (t*)	Prob Value	Integ order	t-stat (t*)	Prob Value
INF	I(0)	-3.0174	0.0013***	I(0)	-4.3311	0.0000***	I(0)	42.9048	0.0000***
INT	I(1)	-5.6617	0.0000***	I(1)	-7.7218	0.0000***	I(1)	85.0503	0.0000***
LNDBT	I(1)	-5.7884	0.0000***	I(1)	-6.1600	0.0000***	1(1)	-60.9848	0.0000***
LNEXR	I(1)	-4.5336	0.0030***	I(1)	-5.4968	0.0000***	I(1)	52.2360	0.0000***
LNGDP	I(1)	-3.89310	0.0000***	I(1)	-4.8114	0.0000***	I(1)	44.4753	0.0000***
LNMS	I(1)	-3.8835	0.0001***	I(1)	-5.8752	0.0000***	I(1)	57.5100	0.0000***
LNOP	I(1)	-9.5393	0.0000***	I(1)	-7.7662	0.0000***	I(1)	83.7026	0.0000***

"***", "**" and "*" respectively represent statistical significance @ 1 per cent, 5 per cent and 10 per cent.

Source: Author's computation (2019)

Table 4.2b: Levin et al., Im et al and Fisher-ADF unit root tests: Individual Intercept and trend

Variables	Levin, Lin, Chu (Individual Intercept and trend)			Im, Pesaran, Shin (Individual Intercept and trend)			Fisher-ADF (Individual Intercept and trend)		
	Integ Order	t-stat (t*)	Prob Value	Integ order	t-stat (t*)	Prob Value	Integ order	t-stat (t*)	Prob Value
INF	I(0)	-1.6953	0.0450**	I(0)	-3.5795	0.0002***	I(0)	32.7135	0.0002***
INT	I(1)	-5.9924	0.0000***	I(1)	-7.4489	0.0000***	I(1)	68.3329	0.0000***
LNDBT	I(1)	-6.3313	0.0000***	I(1)	-5.1745	0.0000***	I(1)	45.4085	0.0000***
LNEXR	I(1)	-5.2046	0.0000***	I(1)	-4.9707	0.0000***	I(1)	43.1834	0.0000***
LNGDP	I(1)	-4.2712	0.0000***	I(1)	-4.1879	0.0000***	I(1)	35.7055	0.0000***
LNMS	I(1)	-4.0268	0.0000***	I(1)	-5.1250	0.0000***	I(1)	45.0745	0.0000***
LNOP	I(0)	-11.0680	0.0000***	I(0)	-7.21075	0.0000***	I(0)	48.3621	0.0000***

"***", "**" and "*" respectively represent statistical significance @ 1 per cent, 5 per cent and 10 per cent.
Source: Author's computation (2019).

4.5.2 Cross-Sectional Dependency

This study is guided by Chudik and Pesaran (2013), arguing that a Panel ARDL accounts for the presence of cross-sectional dependence. Therefore, a robust standard Augmented Dickey-Fuller (ADF) test is suggested as an approach technique to eliminate cross-sectional dependence in a Panel-ARDL (see Pesaran, 2007). Regardless of procedures suggested to eliminate cross-sectional dependence, this study carries out a chow test to determine whether the series from the AOECs considered in this study could be pooled, using the benchmark hypotheses of cross-sectional dependence specified below:

$$\text{Null Hypothesis: } \delta = 1, \text{correlations of residuals or error terms do not exist}$$

$$\text{Alternate Hypothesis: } \delta \neq 1, \text{correlations of residuals or error terms exist}$$

The result from the Breusch Pagan/LM test, Pesaran Scaled LM and Pesaran CD (cross-sectional dependence) is presented in table 4.3, supporting the possibility to pool the series of these countries. This implies that, the residual of the selected AOECs are uncorrelated. This decision follows the suggested decision rule of Chudik and Pesaran (2013) that, the null hypothesis is accepted while the alternative hypothesis is rejected given that the $\text{p} - \text{value}$, being 0.0002 is less than 5% and vice versa.

Table 4.3: Cross-Sectional Dependency Result

Test	Statistics	DF	P-Value
Breusch-Pagan LM	1473.107	151	0.0000
Pesaran Scaled LM	40.4164		0.0000
Pesaran CD	1.523		0.0002

Source: Author's computation

4.5.3 ***Panel ARDL optimal Lag Selection***

In consideration of selecting an appropriate optimal lag length, the study is guided by established criteria in literature that the lag with the lowest Akaike Information criterion (AIC) be considered (see Lutkepohl, 2006). This suggests that the lowest the AIC value, the better the model. To determine the appropriateness of optimal number of variable lags suitable for this study then, the study separately estimates the regressions to find the optimal lag length for each variable (see Suzuki, 2004 and Sharifi-Renani, 2010). Consequently, the order of lag is selected using the robust criteria including Schwarz Information Criterion (SC), Final Prediction Error (FPE), Hannan-Quinn information criterion (HQ) and Akaike Information Criterion (AIC) which Ali and Ali (2008), Raza et al (2015) find appropriate for panel estimating technique. As indicated in the result, the various criteria suggest lag 6 to be the most appropriate for this study.

Table 4.4: The Panel ARDL Optimum Lag Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-5290.821	NA	0.067521	14.33195	14.40665	14.36075
1	9217.645	28703.24	6.95e-19	-24.78283	-24.48402	-24.66762
2	10838.96	3181.286	9.58e-21	-29.06746	-28.54455	-28.86585
3	10883.38	86.44128	9.36e-21	-29.09022	-28.34320	-28.80220
4	10950.60	129.7061	8.61e-21	-29.17459	-28.20346	-28.80016
5	11323.55	713.6424	3.46e-21	-30.08526	-28.89002	-29.62442
6	11639.36	599.1987*	1.63e-21*	-30.84152*	-29.42218*	-30.29428*
7	11663.24	44.91999	1.68e-21	-30.80877	-29.16531	-30.17511
8	11689.78	49.47942	1.72e-21	-30.78318	-28.91562	-30.06312

Source: Author's Computation (2019)

The correlation matrix is presented in table 4.5, showing the correlation structure of the variables employed in the study. It shows that the variables display different form of relationship with one another. Specifically, we focus on the association between LNEXR and those selected independent variables (INF, INT, LNDBT, LNGDP, LNMS and LNOP) considered suitable to forecast exchange rates among the AOECs. Apart from LNDBT having negative but weak relationship with LNEXR, other variables in the model positively correlate with LNEXR. This suggests that the debt weakens the currency of the AOECs, especially where debt may not have been properly channeled to productive base or real sector of the economy.

Table 4.5: Correlation Matrix LNEXR (Dependent variable):

	LNEXR	INF	INT	LNDBT	LNGDP	LNMS	LNOP
LNEXR	1.000000	0.315113	0.451333	-0.150129	0.620047	0.788821	0.254006
INF	0.315113	1.000000	-0.203389	-0.242559	-0.209126	0.203894	0.415886
INT	0.451333	-0.203389	1.000000	0.406978	0.684554	0.227339	-0.260688
LNDBT	-0.150129	-0.242559	0.406978	1.000000	0.271157	-0.119214	-0.240088
LNGDP	0.620047	-0.209126	0.684554	0.271157	1.000000	0.463398	0.133195
LNMS	0.788821	0.203894	0.227339	-0.119214	0.463398	1.000000	0.403547
LNOP	0.254006	0.415886	-0.260688	-0.240088	0.133195	0.403547	1.000000

Source: Author's computation (2019)

4.5.4 ***Interpretation Panel ARDL Regression Model***

The estimation results of the P-ARDL are presented in Table 4.5, showing the short run and long run relationship existing among the exchange rates and the regressors.

On the long run, the result shows that all the variables are statistically significant. Though, both the INF and LNDBT are negatively related to LNEXR. This suggests that if those nations incur more debts and inflation rising simultaneously, there is high possibility that exchange rates may trigger, resulting to decline in the value of the domestic currency vis-à-vis the dollar unit they will attract. On the other hand, the result reveals that INT, LNGDP, LNMS and LNOP have positive and statistically significant relationship with LNEXR, suggesting that as these variables rise, the amount of dollar that currency of the domestic economic attracts will increase, leading to appreciation in the local currency of the oil exporting countries and vice versa. With specific focus on the oil price, a rise in the prices of oil brings about an increase in exchange rates by about 32%. This validates existing studies and in line with theory that, a rise in oil prices lead to appreciation in exchange rates. Similarly, the exchange rates of the heavily reliant economy on oil proceeds is susceptible to interruptions in oil prices, especially if the interruption is sudden. This relationship aligns with expectations, empirical evidence and economic theory (see Iwayemi, 2010, Olomola, 2011, Beneki and Yarmohammadi, 2014; Haskamp, 2017). Consequently, this may result to a fall in domestic currency when oil price plummets as result of heavy reliance of the mono-product of the economy or poor economic diversification. Other variables like LNGDP, LNMS and INT, having positive and statistically significant relationship with exchange rates, respectively have a 73%, 41% and marginally 2% variations on LNEXR. INF and LNDBT having negative and statistically significant relationship with LNEXR respectively have 55% and 16% impact on LNEXR. Beyond the fact that the result in the longrun shows that all the explanatory variables are statistically significant, it also reveals those variables which are major drivers of exchange rates in the AOECs. Buttressing this result, Appendix 4a-4e show the result of specific country with those variables influencing movement in exchange rates. Most of the variables in these specific results align with the pooled result obtained from our Panel-ARDL. Butresing this, the forecasting line shows that there is a close between the actual $(\mathrm{LNEXR})$and predicted line $(\mathrm{LNEXR_f})$ of the exchange rates.

Table 4.6: Panel ARDL Dynamic Regression for Short and Long run Estimates

Dependent Variable: D(LNEXR)				
Method: ARDL				
Sample: 1980Q1 2015Q4				
Maximum dependent lags: 6 (Automatic selection)				
Model selection method: Akaike info criterion (AIC)				
Dynamic regressors (6 lags, automatic): INF INT LNDBT LNGDP LNMS LNOP				
Selected Model: ARDL(6, 2, 2, 2, 2, 2, 2)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Long Run Equation				
INF	-0.553198	0.274774	-2.013280	0.0445
INT	0.022137	0.005991	3.694944	0.0002
LNDBT	-0.168439	0.086049	-1.957475	0.0050
LNGDP	0.738778	0.471877	1.565615	0.0117
LNMS	0.418593	0.278248	1.504385	0.0133
LNOP	0.328778	0.162696	2.020812	0.0437
Short Run Equation				
COINTEQ01	-0.016866	0.007635	-2.209125	0.0275
D(LNEXR(-1))	0.834821	0.013501	61.83464	0.0000
D(LNEXR(-2))	0.004877	0.002413	2.021038	0.0437
D(LNEXR(-3))	0.003865	0.002380	1.623510	0.1050
D(LNEXR(-4))	-0.410592	0.077280	-5.313055	0.0000
D(LNEXR(-5))	0.330018	0.072327	4.562834	0.0000
D(INF)	-0.420255	0.440735	-0.953532	0.0340
D(INF(-1))	0.338415	0.367176	0.921668	0.3571
D(INT)	0.028479	0.019070	1.493377	0.0135
D(INT(-1))	0.025505	0.016586	1.537796	0.0124
D(LNDBT)	-0.036030	0.025350	-1.421300	0.0155
D(LNDBT(-1))	0.032717	0.019966	1.638696	0.1018
D(LNGDP)	1.417634	0.583918	2.427797	0.0155
D(LNGDP(-1))	1.075609	0.417480	2.576434	0.0102
D(LNMS)	0.028014	0.305613	0.091665	0.0270
D(LNMS(-1))	-0.001144	0.250755	-0.004561	0.9964
D(LNOP)	0.045520	0.082243	0.553489	0.0058
D(LNOP(-1))	-0.051699	0.075290	-0.686667	0.0492
C	0.126502	0.060071	2.105865	0.0356

Source: Author's Computation (2019)

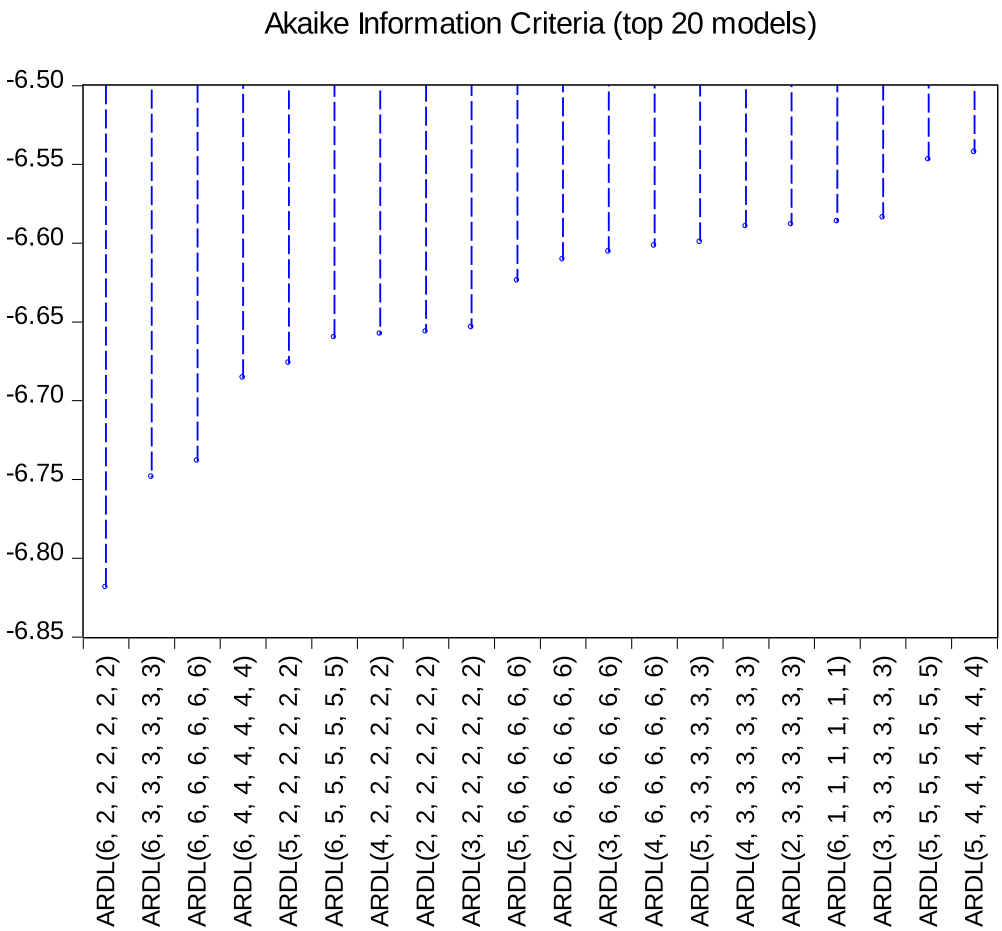
From the short run equation, the result reveals that, there is a cointegration in the model. This is evident in the cointegration coefficient -0.0168, which also is statistically significant. Quite a few of the regressors are statistically significant. The lagged values of LNEXR are only positive and statistically significant at D(LNEXR(-2)) and D(LNEXR(-3)), though marginal. This implies that the previous exchange rates influence the present value of exchange rates. Differently, D(LNEXR(-5)) reveals a strong, negative and non-statistically significant relationship with LNEXR. Similarly, INF reports a negative and non-statistically significant relationship with LNEXR. This is unlike the longrun equation where INF is statistically significant and having negative impact on LNEXR. The lagged value of inflation (i.e. D(INF(-1))) is also not statistically significant in the shortrun but it shows that a unit change in the previous has about 33% variations in LNEXR. The coefficients of D(LNDBT), -0.03603 is statistically significant and negative, suggesting that, that national debt also has negative relationship with exchange rates in the shortrun. The implication is that, as the debt rises, the domestic currency begins to decline especially where the national debts are not effectively managed to enhance the real sector. D(LNOP) reveals a positive relationship with exchange rates. It is statistically significant, suggesting that a unit variation in it will cause LNEXR to vary by 4.5%. However, this is in line with expectation and theory that a rise in price results to exchange rates appreciation, in favour of the domestic economy.

The general results for the Panel ARDL permit heterogenous short run dynamics and a common longrun cointegrating vector in stirring exchange rates. This finding further confirms the appropriateness of the model and its cointegration. The default parameter estimates of the shortrun coefficient (COINTEQ01), -0.016866 is negative and statistically significant (else, cointegration seizes to exist). In addition, it suggests further that, the explanatory variables are suitable for making exchange rates forecast for the AOECs as discussed below.

4.5.5 *Measuring the Strength of the Model Selection Criteria*

In this section, the study determines and presents the strength of the AIC model selection as preferred to other models comprising the Hannan-Quinn criterion and Schwarz criterion used in the Panel ARDL regression model. This is to ascertain both the relationship of the shortrun and longrun of the Panel ARDL model. To determine the top twenty (20) Panel ARDL models, the study employs criteria graph. Following prevailing model benchmark analysis, a smaller value is suggested to behave better in every given model (see Bakar et all, 2013 and Giles, 2013). Figure 4.4 clearly shows that the ARDL criteria graph having (6, 2, 2, 2, 2, 2, 2) and -6.824 value is the most preferred, having the least value. This is followed by ARDL (6, 3, 3, 3, 3, 3, 3) having -6.750 value, and the second most preferred model.

Figure 4.4: Strength of the P-ARDL Model Selection



Source: Author's computation (2019)

4.5.6 ***Wald Test***

In this section, the study examines whether there is short run association moving from the set of the independent variables to LNEXR using the Wald test approach with a null hypothesis of no short run cointegration amongst the variables. The benchmark hypotheses of Wald test are specified below:

H_0: Shortrun cointegration does not exist among the regressors and regressand
H_1: Shortrun cointegration exists among the regressors and dependent variables

Decision rule:

Accept H_0 when P-Value is higher than 5% or Reject H_1 when P-Value is smaller than 5%

As displayed in table 4, Wald test reveals that all endogenous variables used in the model are jointly significant at each for the equation.

Table 4.7: Wald Test Result

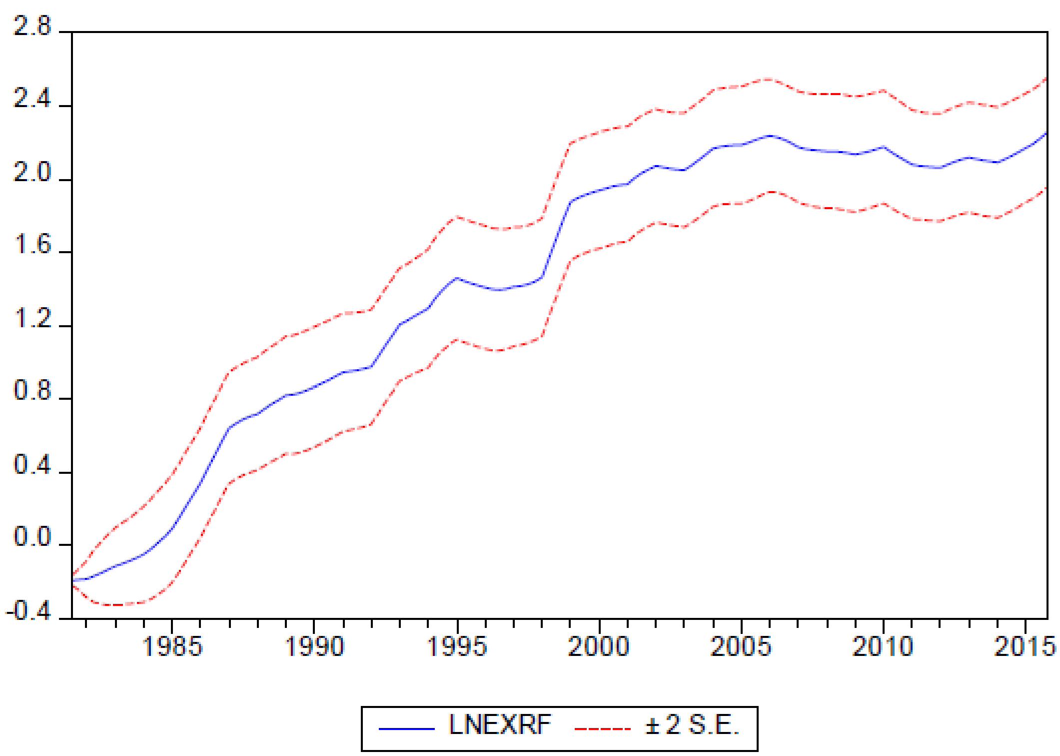
Test Statistic	Value	Df	Probability
F-statistic	48.45460	(6, 679)	0.0000
Chi-square	290.7276	6	0.0000
Null Hypothesis (H_0): C(1)=C(2)=C(3)=C(4)=C(5)=C(6)=0			
Null Hypothesis Summary:			
Normalized Restriction (=0)		Value	Std. Error
INF		0.439588	0.023097
INT		0.019202	0.005256
LNDBT		-0.180437	0.017870
LNGDP		-0.558854	0.038168
LNMS		0.493084	0.024265
LNOP		-0.408703	0.014585

Source: Author's computation (2019).

4.5.6 ***Forecasting Exchange Rates: Static and Dynamic Results***

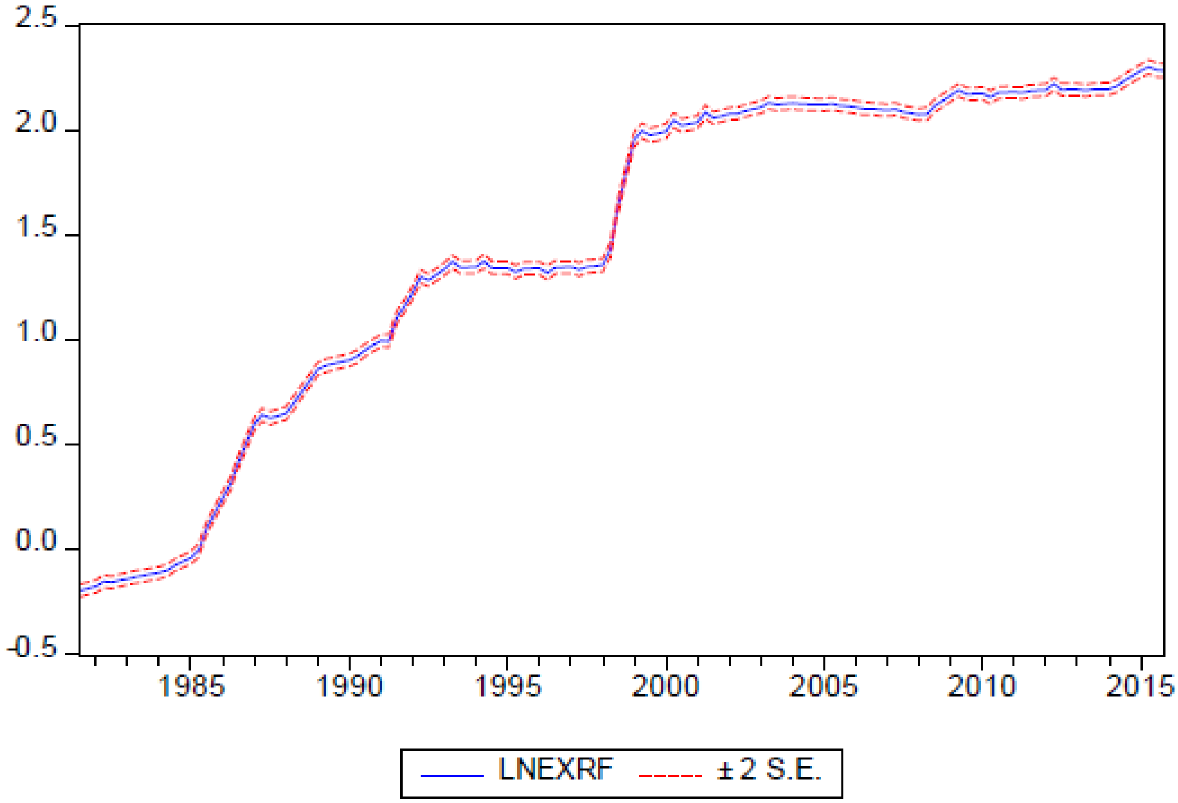
The study proceeds to forecasting exchange rates having established that the ARDL results are free from statistical errors as necessary diagnostics tests to measure the realibity and suitability of the model for forecast are carried out. However, the estimated data for exchange rates ranges from 1980:Q1 to 2018:Q4, out of which data ranging 1980:Q1 to 2015:Q4 accounts for the sample regression model for both dynamic and static forecasts showns respectively in figures 4.5 and 4.6. The outcomes of these sample regressions for dynamic and static forecast show that they are both significant at 95% confidence interval as the lines of sample pass through the two red lines, validating their appropriateness and suitability to make dynamic and static forecasts of exchange rates.

Figure 4.5: **Exchange Rates Sample Forecasting Equation:** *Dynamic*



Source: Author's computation (2019)

Figure 4.6**: Exchange Rates Sample Forecasting Equation:** *Static*



Source: Author's computation (2019)

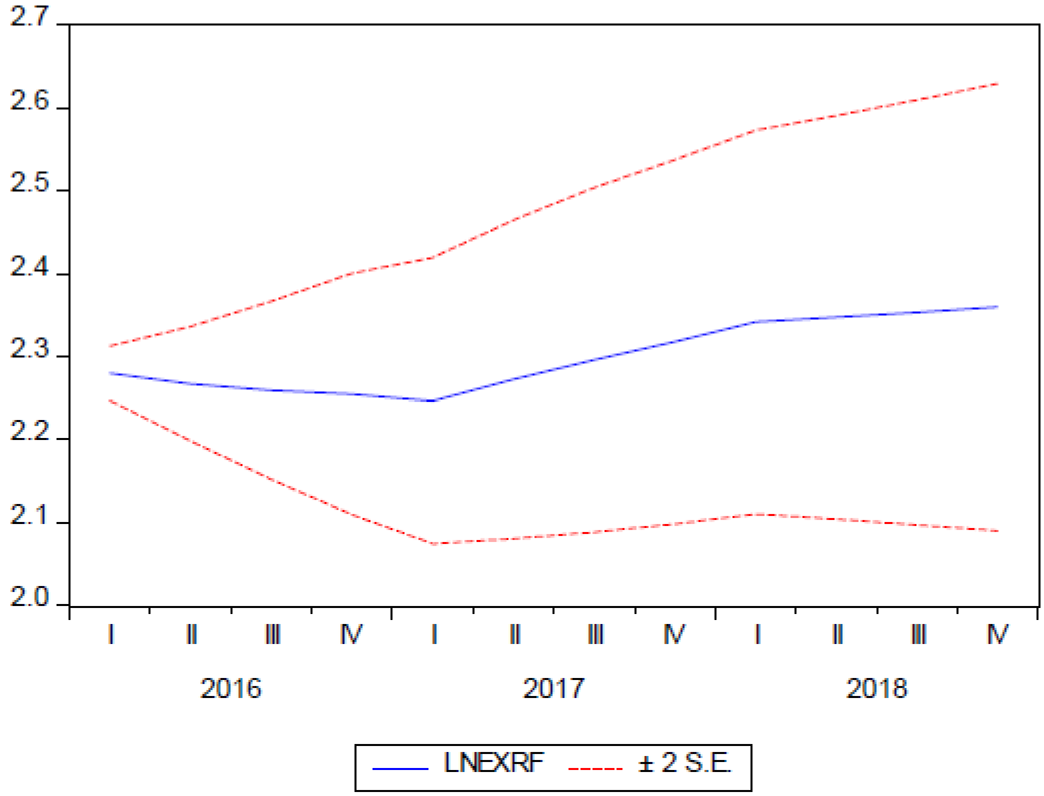
The dynamic and static forecasts are presented in figures 8 and 9. The out-of-sample forecasting horizon begins from 2016 to 2018. The the result reveals that the forecasts are significant as the two red lines confirm a 95% confidence interval within the two ($\pm$ 2) standard deviation error lines. These results support the suitability and appropriateness of the sample regression models to forecast exchange rates. Furthemore, other forecasting evaluation criterion like the RMSE, MAE and MAPE, serving as benchmark to foresting, offer support for the approproiteness of the forecasting models for both the dynamic and static forecasts (see tables and . In the forecasting equation (line) for examples, the RMSE, MAE and MAPE coefficients for the dynamic forecast is revealed as 0.006390, 0.032367 and 0.040772 nearing the zero "0" benchmark. Simlarly, the RMSE, MAE and MAPE coefficients for the static forecast is revealed as 0.013098, 0.008361 and 0.038658 also nearing the zero "0" benchmark. The Theil coefficients for the dynamic and static forecasts respectively estimated as 0.026234 and 0.003955 also validated these submissions. The movement of LNEXR within the confidence interval confirms that the forecasting model is satisfactory as this is further confirmed by the lower values of RMSE, MAE, MAPE and Theil coefficients.

Table 4.8: *Exchange Rates Sample Forecast Equations 1980Q1-2015Q4- AOECs*

	EVALUATION COEFFICIENTS			
	RMSE	MAE	MAPE	THEIL
Dynamic	0.00639	0.03236	0.04077	0.02623
Static	0.01309	0.00836	0.03865	0.00395

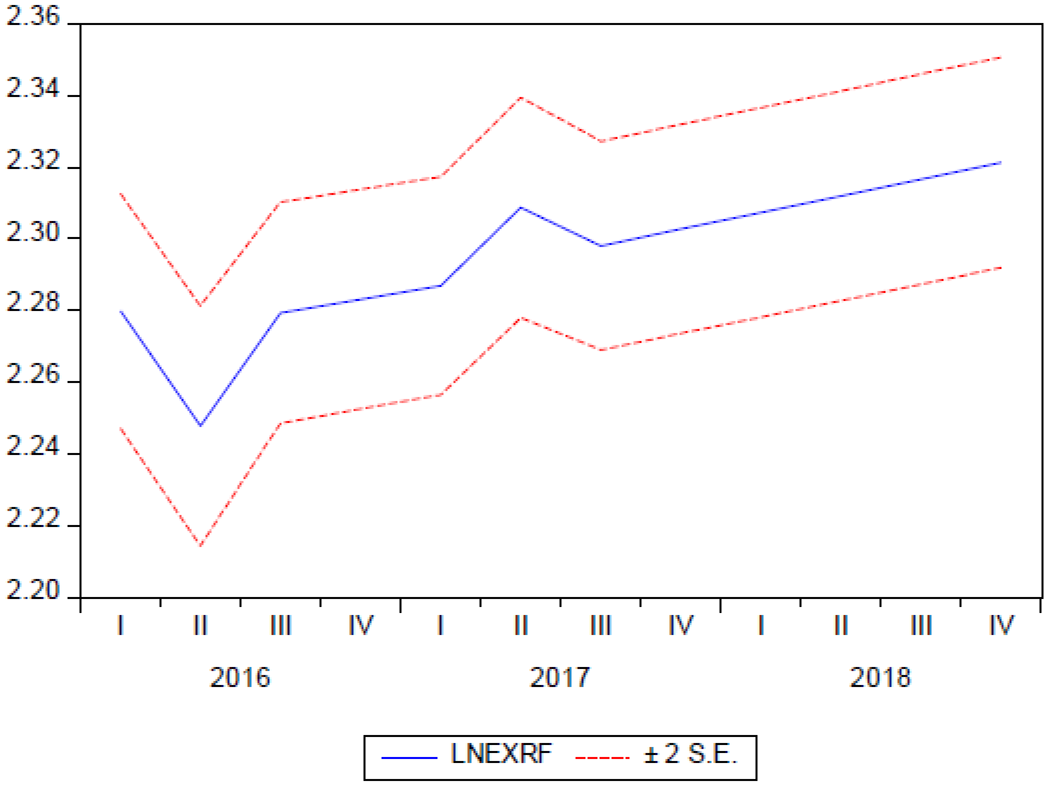
Source: Author's computation (2019).

Figure 4.7**: Exchange Rates Out-of-Sample Forecast:** *Dynamic*



Source: Author's computation (2019)

Figure 4.8: Exchange Rates Out-of-Sample Forecast: *Static*



Source: Author's computation (2019)

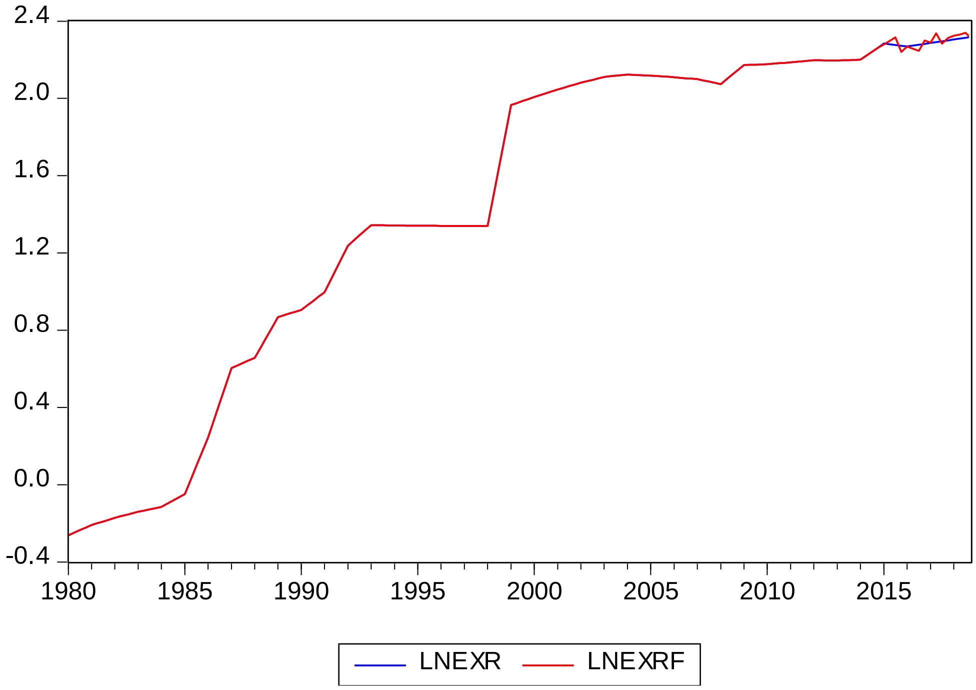
Figures 10 and 11 shows the co-movement in the actual and forecasted values of LNER for the period of forecast for the AOECs. This result displays strong co-movement in the actual and forecasted values of exchange rates. This is evident from the Theil coefficicients values, showing that the variations between the actual and forecasted values of LNEXR is low and near zero (see table 4.9). Furthermore, the dynamic forecasting graph also has a low RMSE. This is satisfactory and validating strong predictive power as displayed in figures 10 and 11.

Table 4.9: *Exchange Rates Out-of-Sample Forecast lines 1980Q1-2015Q4- AOECs*

	EVALUATION COEFFICIENTS			
	RMSE	**MAE**	**MAPE**	**THEIL**
Dynamic	0.02822	0.02459	0.06953	0.00614
Static	0.00961	0.00583	0.05548	0.00209

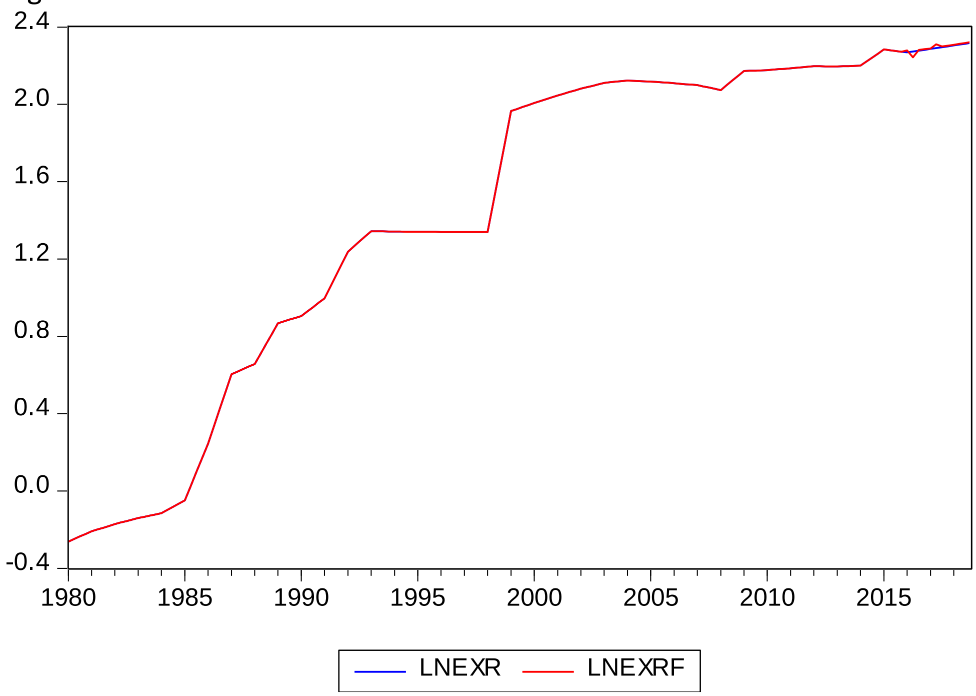
Source: Author's computation (2019).

Figure 4.9**: Dynamic forecasted: AOECs**



Source: Author's computation (2019)

Figure 4.10**: Static forecasted: AOECs**



Source: Author's computation (2019)

Buttressing the claims and offering supports to the dynamic and static sample forecasting regressions (see figures 4.5 and 4.6); dynamic and static forescating lines (see figures 4.7 and 4.8) and the co-movement in the actual and forecasted exchange rates for dynamic and static (see figures 4.9 and 4.10) displayed above, the finding reveals appropriateness in the exchange rates forecasting models.

This study also investigates the condition with individual AOECs to ascertain if there is any remarkable difference in the results obtained from the pool and country specific. The finding support the appropriateness of our model to forecast exchange rates in the AOECs. The dynamic and static forecasts for specific country in the AOECs satisfactory align with the pool (for clarification, see appendix 5a- dynamic sample forecasting equation; 5b- static sample forecasting equation; 5c- dynamic forecasting lines and 5d- static forecasting lines). The forecasting evaluation for those specific AOECs show that the coefficients of the RMSE, MAE, MAPE and the Theil are satisfactory and appropriate. Specifically, the RMSE, MAE, MAPE and the Theil coeficients for the dynamic forecasting equations are 0.0207, 0.0132, 0.0465 and 0.0071 respectively while static equation reveals 0.0079, 0.0035, 0.0458 and 0.0027 coeeficients for the RMSE, MAE, MAPE and the Theil. Similarly, for the dynamic forecasting line, the coefficients are 0.0065, 0.0050, 0.0304 and 0.0016 for the RMSE, MAE, MAPE and the Theil respectively. The evaluation coefficients for the static forecasting line are 0.0018, 0.0013, 0.0254 and 0.0004 for RMSE, MAE, MAPE and the Theil respectively. These evaluation coeeficients correspond and offer supports for our finding for the exchange rates forecasting model for the AOECs.

4.6 Discussion and Inference

Basically, this study develops and estimates a forecasting model for exchange rates for the Africa's oil exporting countries (AOECs). The exchange rates as a decision-making variable is revealed to offer satisfactory model in this study. This is obtained after necessary considerations to various forecast samples. However, among the samples considered, the study finds the sample covering 1980-2015 most suitable to forecast exchange rates. This model is quite satisfactory, following the various evaluation coefficients complementing the significance of our various tests for significance for the regressions and forecasting lines for both the dynamic and static estimates. The various evaluation coefficients comprising the RMSE, MAE, MAPE and the Theil coefficients are nearing zero "0". This is in line with the stretch of benchmark for the suitability of a forescating model. By implication, the satisfactory outcome of the sample model and significant results obtained in both the dynamic and static forecast strongly supports the claim that the selected explanatory variables are suitable to forecast exchange rates among the AOECs.

This finding aligns with Eslamloueyan and Kia (2015), Kao (1999) and Kia (2015). In addition, it is observable from the gap in the two forecasts, that is, the actual and forecasted LNEXR are often very close. While the forecast may not be entirely accurate when the movement are compared, the results suggest that the forecasted exchange rates contain very little error. Since a manageable degree of error is anticipated in forecasting exercises, then the forecastings could be considered effective and successful. Consequently, our claim that future exchange rates can be forecasted by INF, INT, LNDBT, LNEXR, LNGDP and LNMS in addition to LNOP which is reported significant and highly correlating with exchange rates is acceptable. This finding contributes to knowledge that exchange rates forecasting of the AOECs depend on these factors. Hence, the study offers an insight into what is driving exchange rates forecast and thus allow the policymakers to explore appropriate guide to regulate the exchange rates within monetary context and external shocks.

Furthermore, the forecasting ability of the model used in this study is appropriate and suitable to explain both variations in the external and domestic values of the currency (exchange rates system) as shown in figures 8 and 9. In addition, figures 10 and 11 offer satisfactory result that the actual and forecasted exchange rates closely co-move in a similar direction. Theefore, to overcome the possibility of exchange rates surge arising from oil price shocks, causing economic imbalances as noticed in Gali and Monacelli (2005) and emphasized in Dell'Ariccia (1999), which Etuk et al (2016) further conclude as major issue in the world economy, this study offers information to international economic agents who are continuously looking for opportunities to guide themselves against uncertainties and unforeseen fluctuations. In addition, stability of exchange rates among these economies and the satisfactory forecasting of this model contributes to the development of a safe macroeconomic arena, resulting to growth and investment.

Reiterating the finding of this study, forecasting of exchange rates directly impact output behaviour. In all ramification, beside the method employed in this study, the study made specific signicant contributions to knowledge through a satisfactory forecasting models for exchange rates. Furthermore, the exchange rates has not just been modelled to generate quite accurate out-of-sample forecasts but that the model could be used to generate projections of how the exchange rates forecast would deviate from the unconditional baseline forecast, conditional on alternative economic scenarios such as a surge in speculations similar to previous historical events and a resurgence of the global business cycle, or increased oil production and demand. The proposed technique allows users and policy maker to examine the risks associated with movement in oil price projections. In addition, this study offers information as guide to ascertaining the direction of foreign exchange rates market.

4.7 **Summary and Conclusion**

This study sets out to model exchange rates of the AOECs, consequent to understanding the forces involved in the fluctuations of currency values and how could behavior of exchange rates be forecasted. Finding answers to these policy issues, economists have engaged in extensive conceptual and empirical research aimed at forecasting the behavior of exchange rates. So far research efforts made by the researchers to understand the behavior of exchange rates have met with only limited success. Meanwhile policy guidelines have evolved, and lessons have been learnt from it, yet new questions arise by the experience of attempting to maintain macroeconomic stability in evolving world economy. Therefore, using a panel data of five African net oil exporting countries, (Algeria, Egypt, Gabon, Libya and Nigeria), we model exchange rates. The sample period is 1980Q1–2015Q4 and out-of-sample 2016Q1 to 2018Q4. Following Peseran et al (2001), all variables (inflation rate, interest rate, money supply, debt, GDP and oil prices) are stationary at first difference except interest rate which is stationary at level. The panel ARDL results show evidence of both long and short runs relationship between exchange rates and the explanatory variables, forecasting exchange rates. The Wald test reveals that the explanatory variables jointly and significantly accounts for the behaviour in exchange rates. This study helps to ascertain the direction of foreign exchange rates of the AOECs. To offer policy makers that would like to know what can be feasibly be done to limit fluctuation in the values of the currencies, the study forecasts the exchange rates of these countries, using the both dynamic and static forecasting. The outcomes are found satisfactory. Consistent with literature, the study shows that the monetary factors in addition to oil prices and GDP are important regressors to an extent to which exchange rates of the AOECs can be forecasted. These regressors are found significant to forecast exchange rates and also have stable relationship with exchange rates. The policy implication stemming from this analysis is that sound economic policy is important for stable exchange rates in AOECs, more so that the study offer insight to endogenous factors that could serve as catalyst to having a stable exchange rates. Sensitivity of authority to the behaviour of these factors might gurantee policy consistency and assist in curtailing the declining trend the currency of the currency of the AOECs.

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