**EXCHANGE RATE FLUCTUATIONS AND ECONOMIC GROWTH IN NIGERIA**

**(1985-2018)**

**BY**

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**A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF ECONOMICS, IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF THE BACHELOR OF SCIENCE (B.Sc.) DEGREE IN ECONOMICS**

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**APRIL 2020**

**CERTIFICATION OF ORIGINALITY**

I hereby declare that this project titled “**EXCHANGE RATE FLUCTUATIONS AND ECONOMIC GROWTH IN NIGERIA (1985-2018)”** is my work and that to the best of my knowledge and belief, it contains no material previously published or written by another person nor materials which to a substantial extent have been accepted for award of any other degree or diploma of a University or other institutions of higher learning, except where due acknowledgement is made in the text.

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**SUPERVISOR ATTESTATION**

I certify that this project was carried out under my supervision, examined and found acceptable in partial fulfilment of the requirements for the award of a Bachelor of Science (B.Sc.) Degree in Economics, from the Department of Economics, Veronica Adeleke School of Social Sciences, Babcock University.

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**PROJECT APPROVAL**

**------------------------------- --------------------**

Dr Oyedele Oviku Date

Head of Department

**DEDICATION**

I dedicate this project to God Almighty who gave me the strength, favor, motivation and supernatural speed and whose grace has been more than sufficient for me throughout my project work. I also dedicate this project to my parents Dcn. and Dcns. E.C Aguzue as well as myself for not giving up at any point and for putting in all the efforts I had to put into it.

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**ABSTRACT**

*This study seeks to empirically analyze the impact of exchange rate fluctuation on the economic growth of Nigeria within the context of three profound theories: optimal currency area; purchasing power parity; and the Mundell-Fleming model. The study made use of annual time series from 1985 to 2018 sourced from Central Bank of Nigeria Statistical Bulletin (CBN). Various unit root tests like Augmented Dickey-Fuller (ADF), Phillips- Perron, Dickey- Fuller GLS (ERS) and Kwiatkowski-Phillips-Schmidt-Shin Test were conducted to test for stationarity. The result of these tests concluded that most variables in each test were stationary at levels and first difference which accounted for the reason why ADRL estimation technique was used. The Autoregressive Distributed Lag (ARDL) model was employed for this study to test for short and long run relationship among the variables. In the model, growth rate in real GDP (GRGDP) was used as the proxy for economic growth and Exchange Rate (EXR) as the target variable while Interest Rate (INT) and Inflation Rate (INF) were used as the control variable. The empirical results show that EXR had a negative relationship on economic growth in the short run while it had a positive relationship in the long run. INF had a negative relationship on economic growth in both the short and long run while INT had a positive relationship on economic growth in both the short and long run though the results were all insignificant. Based on these findings,* *it is safe to conclude however, that naira rate has great role to play in the achievement of a sustained economic growth in Nigeria because the naira rate is one of the major determinants of price level of goods and services in Nigeria especially as most consumer goods in Nigeria are imported. This study recommends that* *austere foreign exchange control policies ought to be put in place with the intention to assist in appropriate determination of the value of the exchange rate. This will in the long run help to strengthen the value of the naira.*

***Keywords:*** *Exchange rate; ARDL; Nigeria; economic growth*

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**CHAPTER ONE**

**INTRODUCTION**

**1.1 Background to the Study**

The theory of exchange rates has always been the focus point of academic research since the seventies of the 19th century. Indeed, many studies have been carried out with the aim, on one hand, of determining the main powers of control in the foreign exchange markets, which explains the sharp fluctuations in exchange rate system. (Adeniran, J.O et al 2014) asserts that rate of exchange is the value of a domestic currency in form of a different currency. It is seen as the price placed on a particular currency in relation to another currency meaning that the amount a domestic currency can buy a unit of another currency.

The exchange rate can likewise be utilized as an instrument of monetary policy. Recurrence changes in the currency’s exchange rate would adversely influence investment on account of the related vulnerability. The outcome of currency’s exchange rate on economic process varies in several countries. In Nigeria, the steady movement of exchange rate is necessary for the public as a result of the processes and direction of its fluctuation and its impact on the economy to accomplish the best productive level.

Exchange rate system remains a topical issue in developing nations, with a part of economic challenge with trade openness as being a necessity for the growth of an economy (Okoroafor et al 2013). A better exchange rate system will have great influence on other macroeconomic variables, for example, rate of interest rate, rate of inflation, import, export, output, and so forth.

These realities emphasize the significance of the rate of exchange to the economic growth of every nation considering to go into international trade. The significance of rate of exchange is obtained from the genuine reality that it attaches the value system of two liberalized countries by furnishing to accomplish worldwide trade to establish direct comparison of exchanged products. In a nutshell, it joins household prices with worldwide prices. Its effect on exports and imports is very enormous. The rate of exchange has a strong impact on a nation’s balance of payments position.

The combined result of the increase in the oil price and the instabilities in the exchange rate challenge on political economy steadiness and economic process of a country that manufactures oil like Nigeria is basically huge. When there is disequilibrium in the foreign exchange market caused by inadequate supply of foreign exchange reserve, pressure may be exerted on foreign exchange reserves (Obisesan, Ogunsanwo et al 2019). If the reserves are not adequate, this may deteriorate into balance of payments problems. This therefore signifies the need to manage a nation's foreign exchange resources so as to reduce the negative effects of foreign exchange volatility (Obaseki, 1991).

**1.2 Significance of the Study**

This study is essentially to help clarify how the insecurity in the exchange rate of an economy's currency can either influence the economic growth of that economy or not. In Nigeria, the exchange rate policy has gone through various forms of changes from the prompt post-independence period where the country kept a fixed exchange rate with the British pound, through the oil boom during the Seventies, to where there was a float in the currency in 1986.

There could not be a better time to research into this line of interest as there has never been a time

in the history of Nigeria that Naira fell to the tone of N306 to 1 dollar in the official market. Hence, this research focuses on if fluctuations in the exchange rate has an impact on economic growth.

**1.3 Statement of the Problem**

As indicated by Ozturk (2006), exchange rate volatility is described as the risk related with unexpected movement in the exchange rate. Macroeconomic variables such as the inflation rate, interest rate, money supply, and the balance of payments, which have gotten progressively unpredictable during the 1980s and early-1990s, are sources of exchange rate unpredictability.

In 2011, the exchange rate was N153.9 to $1 and the minimum wage at the time then was N18,000, which means an average worker in 2011 was living on about $116.9 monthly (N18,000÷153.9) which is equivalent to $3.9/day (N600.2) which is above the moderate poverty line of $96/month(N14,774.4) which gives us $3.2/per day(N519.3) set by the world bank. This means that an average worker then was earning twice the generally accepted daily income of $1.9/per day (N292.41) which should give us $57/month (N8,772.3).

Fast forward to 2018 the exchange rate is about N306.1 to $1 with a difference of N152.2 increase in the rate and the minimum wage then was still N18,000. Despite that fact that there was no increase, an average worker then is said to be at a disadvantage in 2018 than in 2011. With N306.1/$1 as the exchange rate an average worker is said to be living on $58.8/month which is equivalent to $1.96/per day. This shows that the standard of living in 2011 is better than that of now. This is supported by the national poverty line indicated by world bank.

Another indication of a low SOL is the increase in the inflation in 2011 from 10.3% to 18.55% in 2016 and then to 11.4% in 2018. This shows that the real income of workers now is lower than that of workers in 2011.

With this, there was need to look deeper. My interest was more on the equivalent of the purchasing power of N18,000 in 2011 to 2018. What can the N18,000 in 2011, amount to in 2018. So, I decided to assume another figure since the minimum wage was still at N18,000 but different purchasing power compared to that of 2011, why not increase this minimum wage and see. I decided to increase the minimum wage by N17,800 which is N35,800. Still with an exchange rate of N306.1/$1 an average worker was going to earn about $116.9/month which is $3.9/day. This explain that the value of N18,000 in 2011 is equivalent to N35,800 in 2018 which is almost times two of the N18,000 with a balance of N200. That means there is a difference of N17,800. The question to be asked now is what if the exchange rate in 2018 only increased by maybe N25.1 which gives us N179/$1 being more realistic because due to the Nigerian economy, there are factors that will lead to the increase in this exchange rate. So, I assume the exchange rate in 2018 would have increased to N179/$1 which is a difference of N25.1 from that of 2011. An average worker was going to earn $100.5/month giving $3.4/day which is still a much better value than that of $58.8/month and $1.96/per day with N306.1 as the exchange rate.

With this, it is indeed obvious that exchange rate plays a key role in an economy as well as the rate at which it fluctuates. In any nation, foreign exchange policy is a significant policy instrument. Before SAP, it created the impression that Nigerian’s exchange rate policy would in general invigorate over-valuation of the Naira, on the grounds that in 1985, it was about 0.89 cents in dollar to a naira (N1.00) which was it lowest for the period covered. Since then, there was a major increase in the exchange rate. It maintained a stable trend between the year 1994 to 1998 with a value of N21.88 up until 2004 when it was at N133.5 then it started to fall for a bit at a low rate and by 2008, it became N118.7. From 2014, the naira in relation to US ($) increase at a higher rate up until 2018 where it was N306.1 which is the peak for the period covered and up till date the exchange rate keeps increasing yearly and no solution has been provided as to how to work on appreciating the value of the naira in relation to the US ($). This, thus, encouraged importations, and demoralizes any export that was not oil related and this led to dependence on inputs that were imported. The rate of exchange of Nigeria since after the SAP period has been progressively unpredictable because of it over the top introduction to external shocks.

When the federal government adopted the SAP by 1986, the nation shifted from a fixed exchange rate system to a flexible exchange rate system where the rate of exchange was determined through economic processes, however rather the prevailing system is to manage float whereby financial authorities intervene occasionally within the interchange market so as to realize some strategic objectives (Mordi, 2006) Irregularity in these policies and absence of progression in rate of exchange policies brought about the unsteady nature of the Nigeria’s exchange rate (Gbosi, 2005). The period of the flexible exchange rate regime had a negative and significant impact on industrial productivity in Nigeria (Nwosa, Adeleke et al 2019). Flexible exchange rate had not significantly enhanced performance of the manufacturing firms and under the fixed exchange rate regime, performance of fiscal policy is effective and ineffective under flexible exchange rate regime (Ezenwakwelu, Okolie et al 2019).

The reason for the present world economic meltdown on Nigerian rate of exchange was because the Nigerian Naira compared to the dollar rate rose to an extreme level from 21.8861 naira to a dollar to 92.6934 naira to a dollar (about 70% increment) somewhere between the range of 1998 and 1999. This caused a sharp decline in foreign income of the government as a consequence of the relentless decline in the price of crude oil.

This increment continued although it declined at some point between 2005 to 2008 but since then kept on increasing at a high rate. The way Nigeria relies on importations and is less concerned on manufacturing domestic goods and services devalues the estimation of the naira. Benson and Victor, (2012) and Aliyu, (2009) notices that upon the efforts made by the state to achieve a steady rate of exchange, the Nigerian Naira has devalued throughout the 80’s till date.

Consistent currency devaluation has plagued many developing countries, including Nigeria. In fact, increase in the Nigerian exchange rate will make domestic goods more expensive and encourage consumers to substitute less expensive imported goods for home goods, which depresses the industrial sector of the country (Kenny S, Victoria 2019). The need for foreign exchange policy involves determining the precise rate at which foreign exchange transaction will take place (Kenny S, Victoria 2019).

The worries for achievement of a practical change price for the naira have persevered to generate an extraordinary instigation to financial authorities, due to its unarguable significance in bringing approximately financial increase. This consequently explains why it's crucial for any country to control its foreign exchange. The observation encouraged that buyers have to consider fluctuations in different macroeconomic variables so as to check wherein to direct investments for earnings maximization. There is need to have a look at similar recommendations that government and the financial authorities need to layout policies as a way to curtail the rising inflation rate thereby encouraging traders to invest in Nigeria.

**1.4 Research Questions**

1. Does the fluctuation in the Exchange rate affect economic growth?
2. How does interest rate affect economic growth?
3. What is the impact of price level change on economic growth?

**1.5 Research Objectives**

The broad objective of this study is to examine the impact of the fluctuation in exchange rate on economic growth in Nigeria. The specific objectives are;

1. To examine the impact of exchange rate fluctuation on economic growth.
2. To examine the impact of interest rate on economic growth.
3. To examine the impact of inflation rate on economic growth.

**1.6 Research Hypothesis**

H0: Exchange rate fluctuation has no significance impact on economic growth in Nigeria

H1: Exchange rate fluctuation has significance impact on economic growth in Nigeria

H0: Interest rate has no significance impact on economic growth in Nigeria

H1: Interest rate has significance impact on economic growth in Nigeria

H0: Inflation rate has no significance impact on economic growth in Nigeria

H1: Inflation rate has significance impact on economic growth in Nigeria

**1.7 Justification of the Study**

The justification of this study is based on the score that among the research works conducted on the impact of exchange rate fluctuation on economy of Nigeria and others examined, the impact of volatility of the Naira on economic growth, this work will give an in-depth knowledge on the workings in the exchange rate market and its transmission mechanism into other sectors of the economy especially its impact on growth.

This research will assist the government in designing an exchange rate policy framework that will ensure the reduction in uncertainties in the exchange rate market to enhance the flow of trade and investment most especially capital inflow to facilitate economic growth and increase the welfare of the people. Also, investors and other stakeholders in the economy such as industries that rely mostly on imported inputs will benefit from the information that will be revealed in this work so as to adopt the necessary measures and techniques to ensure stable profit margins which may be affected without proper understanding on the exchange rate market. Equally this work could set off the mark for further research into the effect of exchange rate volatility on other macroeconomic variables or on this same variable to bring to light other factors that may be in play.

Finally, the study will be useful to the government as a regulator in its quest to enhancing a stable exchange rate to impact on the exporting sector bearing in mind that the economy as whole will benefit greatly on how the exporting sector performs.

**1.8 Scope of the Study**

The economy is a huge segment with different and some of the time difficult parts; this study will just take a look at a specific piece of the economy; Exchange Rate. The empirical analysis and estimation will cover the period between 1985 and 2018.

The analysis to be made in this study will be established on time series data. Information used for this study are secondary data from Central Bank of Nigeria (CBN) publications, for example, the CBN Statistical Bulletin, CBN Annual Reports and Statements of Accounts, CBN Economic and Financial Review Bullion and National Bureau of Statistics publications. The model seeks to look into the effect of Exchange rate, Interest rate and Inflation rate on growth rate of real gross domestic product. This serves as a revert on the objectives of the study listed above. The data used is annual data. This study only focused on Nigeria. However, additional information about events that occurred in other years was added.

**1.9 Definition of Terms**

**Exchange rate:** is the value of one currency for the conversion to another foreign used to send money on international transfers. It is also the relative value between two currencies i.e. how much money you can buy with one US dollar. (%)

**Economic growth**: is an increase in the capacity of an economy to produce goods and services, compared from one period of time to another. It can be measured.

**Economic development:** development reflects social and economic progress and requires economic growth. Growth is a vital and necessary condition for development, but it is not a sufficient condition as it cannot guarantee development.

**Growth rate in real gross domestic product:** is a measure that has already been inflation-adjusted used to determine how rapid an economy is growing. (%)

**Interest rate:** itis the amount of interest due per period as a proportion of the amount lent, deposited or borrowed.

**Inflation rate:** it is annualized percentage change in a general price index, usually the consumer price index over time.

**CHAPTER TWO**

**LITERATURE REVIEW**

**2.1 Conceptual Review**

Exchange rate can be described as the price of one currency (the domestic currency) in terms of another (the foreign currency) (Oladipupo and Onotaniyohuwo 2011). It can be viewed as the rate at which one currency exchanges for the other, and it is utilized to portray the global monetary system (Iyoha, 1996). Exchange rate is a reflection of the strength of a currency when measured against another country‘s currency; usually determined in principle by the interplay of supply and demand in a free market environment. According to (Onyeizugbe and Umeagugesi 2014), no currency is allowed to float, so nation monetary authorities regulate currency between the fixed and floating exchange rate systems and other regimes, such as dual managed.

The rate of exchange can be seen as the price of the currency of a domestic country in relations to its price in the currency of a foreign country. For instance, the Nigerian currency, naira has its exchange rate against numerous different countries’ currencies. It can be expressed as the nominal exchange rate or real exchange rate. The nominal exchange rate is a monetary concept which measures the relative price of two moneys e.g. Naira in relation to dollar (N/S), while the real exchange rate is a real concept that measures the relative price or value of different countries products. Exchange rate framework can likewise be fixed or permitted to vary i.e. fluctuate. The former is a system wherein a country’s exchange rate stays steady or stays within some small margin of fluctuation around a consistent standard worth. Then again, the latter is a system with no government or central bank action to keep it stable. With floating rates, external shocks especially foreign trade shocks are less disruptive and monetary policy is more effective in influencing aggregate demand, hence economic growth is achieved (Pugel 2016).

Economic growth is an increase in an economic variable normally persisting over successive periods. The variable concerned may be real or nominal. Growth in real economic variable such as Gross Domestic Product (GDP) for brief periods or at low rate may occur by simply having similar activities conducted on a large scale. Rapid or persistent growth is probably going to include positive changes in the nature of economic activity while exchange rate fluctuation could encourage.

Interest rate is the percentage of principal charged by the lender for the use of its money. The principal is the amount of money lent, as a result, banks pay you an interest rate on deposits. They are borrowing that money from you, an individual can lend money and charge interest, but it's usually banks. They use the deposits from savings or checking accounts to fund loans, while they pay interest rates to encourage people to make deposits. Banks charge borrowers a little higher interest rate than they pay depositors so they can profit. At the same time, banks compete with each other for both depositors and borrowers. The resulting competition keeps interest rates from all banks in a narrow range of each other. Interest is therefore understood as the part of the spread between revenues and costs that cannot be competed away by entrepreneurial effort, not even in theory (Hulsmann, Pritchett et al 2005). In other words: There is, in the entire economy, a systematic spread between the total proceeds earned from the selling of products and the total expenditure paid for factors of production. This spread occurs over time, i.e. it is measured between the moment of investing and the moment of selling, and it occurs repeatedly, which is why it is sometimes considered as permanent. The part of this spread that can or could be dissolved in a process of competition is called entrepreneurial profit. The remainder is called interest.

In economics, inflation is a sustained increase in the general price level of goods and services in an economy over a period of time. When the general price level rises, each unit of currency buys fewer goods and services; consequently, inflation reflects a reduction in the purchasing power per unit of money – a loss of real value in the medium of exchange and unit of account within the economy. The opposite of inflation is deflation, a sustained decrease in the general price level of goods and services. The common measure of inflation is the inflation rate, the annualized percentage change in a general price index, usually the consumer price index, over time (Abel et al, 2005). Economists generally believe that very high rates of inflation and hyperinflation are caused by an excessive growth of the money supply. Views on which factors determine low to moderate rates of inflation are more varied. Low or moderate inflation may be attributed to fluctuations in real demand for goods and services, or changes in available supplies such as during scarcities. However, the consensus view is that a long sustained period of inflation is caused by money supply growing faster than the rate of economic growth. Inflation affects economies in various positive and negative ways. The negative effects of inflation include an increase in the opportunity cost of holding money, uncertainty over future inflation which may discourage investment and savings, and if inflation were rapid enough, shortages of goods as consumers begin hoarding out of concern that prices will increase in the future. Positive effects include reducing unemployment due to nominal wage rigidity, allowing the central bank more leeway in carrying out monetary policy, encouraging loans and investment instead of money hoarding, and avoiding the inefficiencies associated with deflation. Banchand (2000); Today, most economists favor a low and steady rate of inflation. Low (as opposed to zero or negative) inflation reduces the severity of economic recessions by enabling the labor market to adjust more quickly in a downturn, and reduces the risk that a liquidity trap prevents monetary policy from stabilizing the economy. The task of keeping the rate of inflation low and stable is usually given to monetary authorities. Generally, these monetary authorities are the central banks that control monetary policy through the setting of interest rates, through open market operations, and through the setting of banking reserve requirements (Mankiw, 2002).

Real Economic Growth Rate is the rate at which a nation's Gross Domestic product (GDP) changes/grows from one year to another. An economic growth rate is the percentage change in the value of all of the goods and services produced in a nation during a specific period of time, as compared to an earlier period. The economic growth rate is used to measure the comparative health of an economy over time. The numbers are usually compiled and reported quarterly and annually. Real Economic Growth Rate takes into account the effects of inflation. Since inflation plays a key role in the GDP of an economy, it is very important to ascertain the effects of inflation on GDP. As a result, the Real Economic Growth Rate takes into account the buying power and is inflation-adjusted. This is the reason it is considered to be a better measure of growth rate than the nominal growth rate.

**2.1.1** **Development in Exchange Rate Policy in Nigeria**

The concern with exchange rate management policy can be drawn back to 1960 when the country became politically independent despite the appearance of Central Bank of Nigeria (CBN) and the Federal Ministry of Finance 2 years earlier (Ogiogio, 1996). Management of exchange rate can be described under two divisions; the pre-Structural Adjustment period between 1960-1985 and post-Structural Adjustment period between 1986 up until date. The two divisions led to a chronicled arrangement of 5 phases:

**Phase I:** From 1960- 1967, there was a fixed equality in the exchange rate of both Nigerian (N£) and British pound (B£) until the British pound was devalued in 1967.

**Phase II:** From 1967-1974, the Nigerian pound had a fixed parity with the American dollar. Because of the international financial crisis of the early ‘70s, which caused the US President Nixon to devalue the dollar, Nigeria at this point abandoned the US dollar and re-kept its money at par with the British pound. In this phase, it was then known that pegging the Nigerian naira to a solitary currency had a downside which caused its abandonment.

**Phase III:** Between 1974-1976, there was the Independent exchange rate approach; Disregarding pegging the naira to a solitary currency of the US dollar, CBN instead decided to go for an independent management policy for exchange rate that allowed pegging of naira to the British pound sterling or the US dollar either of the two that its currency was stronger in the foreign exchange market(Ogiogio, 1996).

**Phase IV:** Between 1976-1985, there was the Pegging of naira to a basket of currencies that were import-weighted. Because of oil boom of mid ‘70s, naira was purposely devalued, and, in order to guarantee soundness and suitability in Nigeria’s naira, it then was linked to the currencies which consist of the seven countries’ currencies that Nigeria considers as major partners when it comes to trading ; the American currency (USD), the British pound sterling (GBP), the German mark (Deutsche Mark), the French franc (CFA), the Dutch guilder(Netherlands), the Swiss franc (CHF), and the Japanese yen (JPY). The 1981-1985 international economic crises prompted inaccessibility of exchange rate where the naira was terribly overestimated over the US dollar and gave the federal government of Nigeria two choices; proceed with the exaggerated naira because of the fixed exchange rate, the subsequent choice is to adopt the International Monetary Fund (IMF)-World Bank imported SAP which enclose market forces (free hands of DD and SS). The Federal Government of Nigeria (FGN) picked the subsequent choice and presented the Second-tier Foreign Exchange Market (SFEM) which changed to foreign exchange market (FEM) later on in September 1986 during IBB regime.

**Phase V:** From 1986 till date there has been existence of market determined exchange rate policy. It was during the post-SAP era that the Nigerian fifth exchange rate management commenced and it has existed till date. SFEM, the first market to be established with quick effect on the 26th of September, 1986. The Nigerian forex market was freed with the introduction of an Autonomous Foreign Exchange Market (AFEM) in 1995 and the Inter-bank Foreign Exchange Market (IFEM) in 1999. The AFEM transformed into an everyday, two-way quote IFEM, October 25, 1999. From 16 July 2002, CBN has replaced IFEM with the Dutch Auction System (DAS) which has been in operation till date.

As indicated by Mordi (2006), The requisite that encouraged the re-introduction of Dutch Auction System (DAS) in 2002 included, the external reserve position which could ensure satisfactory financing of the market by the CBN; lessen inflationary pressures; instrument autonomy of the CBN and its prompt deployment of monetary control instruments in support of the DAS as well as the bi-weekly auctions as against the previous fortnightly auctions, thus assuring a steady supply of foreign exchange. In order to further liberalize the market, narrow the arbitrage premium between the official interbank and bureau de change segments of the markets and achieve convergence, the CBN introduces the Wholesale Dutch Auction System (WDAS) on February 20, 2006. This was intended to unite the gains of the retail Dutch Auction System as well as deepen the foreign exchange market in order to evolve a realistic exchange rate of the naira. Under this arrangement, the approved vendors were allowed to bargain in foreign exchange on their own accounts for onward sale to their customers. These exchange rate systems have had some implication for economic performance.

**2.1.2 Exchange Rate and Economic Growth**

One of the primary targets of economic policy and economic decision making is economic growth. Among all the economic variables, the one that is has close relationship with the external sector and can provide growth is the real exchange rate because any fluctuation in this real exchange rate can also cause a fluctuation in the foreign trade and balance of payment of an economy. Due to the profound changes in exchange system, the exchange rate flaunts as a major factor for economic policy making more than usual (Jafari, 1999). Then again, one of the major factors in determining the exchange rate system in a developing country is the connection between real exchange rate and economic growth. Selecting exchange systems that are ineffective and exchange policies that are unsuitable has affected development of several countries. Fluctuations of real exchange rate in a flexible exchange system causes ample changes in international trade and investment, by that on economic growth as well.

**2.1.3** **Exchange Rate System and Fluctuations**

The discussion will be based on the flexible exchange rate system and the fixed exchange rate system. A primary basis supporting the choice of flexible exchange rates is the independence in monetary policy they permit when capital versatility is high. Flexibility in exchange rate enables a nation to pick its inflation rate in the long-term and liberates monetary policy that wants to achieve domestic stabilization. Moreover, exchange rate flexibility will facilitate the response of policy to external shocks by starting a programmed modification program of the domestic economy to changes in the balance of payments. At the inverse, under fixed exchange rate system, monetary policy will be redirected, partially or totally, to seek external balance. Also, where there is high capital versatility and ideal substitutability among domestic and foreign assets (Obstfeld, 1995), monetary policy turns out to be totally committed to the defense of the exchange rate equality. Without a doubt, when the nominal exchange rate is credibly fixed, interest rate equality predicts the uniformity of domestic and foreign interest rates, adjusted for any possible risk and transaction costs. Any extra cash creation will push domestic interest rate downwards and trigger an equivalent measure of capital outflow. In this manner, in a little nation, monetary policy becomes incompetent in balancing the economy when the exchange rate is pegged and the capital is exceptionally mobile. At the point when costs and nominal wages are fixed, changes in money supply modify real money balances which thusly initiate changes in real expenditure.

As stated by Dornbusch (1976) the economy acclimates to changes in money aggregates under flexible exchange rate system. Aside from monetary policy, a flexible exchange system would mellow the limitations on accessible policy instruments. Limitations forced by exchange rate fixity on monetary and fiscal policies can hinder the authorities’ capacity to impact domestic economic conditions moving the majority of the modification procedure on the real economy. In this way, one would expect, ceteris paribus, a higher unpredictability of growth under a fixed exchange rate system relative to a flexible one.

In any case, a few caveats merit referencing. The monetary framework such as inflation targeting strategy can diminish the favorable circumstances suggested by exchange rate flexibility. Exchange rate flexibility and the choice in decision making it brings will cause harm to the stability in growth if the state fails to seek after consistent policies. Fear of floating highlighted by Calvo and Reinhart (2002) and a high pass-through of exchange rate movements to domestic prices in small countries tend to reduce or overturned the advantages provided by a flexible exchange rate arrangement. It should also be noticed that the timing and the coordination of economic policies (namely monetary and fiscal policies) are critical to ensure the achievement of economic policy.

**2.2** **Theoretical Framework**

A few of these theories that are relevant to this study on the relationship between exchange rate fluctuation and economic growth are discussed here briefly;

**2.2.1** **Optimal Currency Area (OCA) Theory**

The initial and notable theoretical establishment for the decision of exchange rate system lays on Optimal Currency Area (OCA) Theory, created by Robert A. Mundell (1961) and Ronald I. McKinnon (1963). The main concern of this theory is to stabilize business cycle and trade. It is based on concepts of the symmetry of shocks, the degree of openness, and labor market mobility. As indicated by the theory, a fixed exchange rate system can increase trade and output growth by decreasing exchange rate vulnerability and encourage investment by bringing down currency premium from interest rates. It can likewise lessen trade and output growth by halting, postponing or easing back the necessary relative price adjustment process. Present day exchange rate theories depend on the monetary and asset market approaches to the balance of payments, and views the exchange rate as a purely financial phenomenon. A traditional exchange rate theory, then again, depends on trade flows and adds to the clarification of exchange rate movement over the long run. With financial flows presently overshadowing trade flow, intrigue has moved to modern exchange rate theories, however traditional theories stay significant over the long run (Salvatore, 2011).

**2.2.2** **Purchasing Power Parity (PPP)**

This theory shows the relationship between prices and exchange rate. Despite the fact that the starting points of the PPP idea is traceable to the Salamanca School, thinking back to the 16th century Spain, its advanced use as a theory of exchange rate determination started with the work of Gustav Cassel (1918), who suggested PPP as a method of amending pre–World War I exchange rates parities for nations resolved to return to the gold standard system after the contention ended. Some adjustment was important on the grounds that nations that left the gold standard in 1914 witnessed different rates of inflation during and after the war. As a standard of exchange rate determination, the easiest and powerful form of PPP (i.e. absolute PPP) depends on a worldwide multi-good edition of the law of one price. Absolute PPP imagine that the exchange rate ought to change to equate the prices of national baskets of goods and services between two nations as a result of market powers driven by exchange. PPP is the unit of a foreign currency that is required to purchase similar goods and services in the domestic market of a developing nation and its main objective is to lower the income gap between developed and developing nations. The purchasing power parity theory enunciates the determination of the rate of exchange between two inconvertible paper currencies. Although this theory can be traced back to Wheatley and Ricardo, yet the credit for developing it in a systematic way has gone to the Swedish economist Gustav Cassel.

This theory states that the equilibrium rate of exchange is determined by the equality of the purchasing power of two inconvertible paper currencies. It implies that the rate of exchange between two inconvertible paper currencies is determined by the internal price levels in two countries. Purchasing power parity (PPP) is a theory which states that exchange rates between currencies are in equilibrium when their purchasing power is the same in each of the two countries. This means that the exchange rate between two countries should equal the ratio of the two countries' price level of a fixed basket of goods and services. When a country's domestic price level is increasing (i.e., a country experiences inflation), that country's exchange rate must depreciated in order to return to PPP. The assumptions here are that there are no transportation costs for transporting a commodity from one country to another (transportation costs are zero). Also, there are no costs for converting one currency into another (currency conversion costs are zero). There are also no restrictions on the movement of commodities between countries. That is, there are no trade barriers or quotas.

**Absolute PPP Theory**

The Law of one price states that an identical product should have the same price in two countries. According to the PPP theory, the law of one price should operate for an identical commodity sold in two countries. Therefore, the price of a product in country X and the price of an identical product in country Y (in Y’s currency) should be such that, the ratio of the prices is the exchange rate between the currencies of the two countries.

**Relative PPP Theory**

According to relative PPP, price changes due to differences in inflation are the cause and exchange rate changes are the effect. But if it is the other way round— that is an undervalued currency causes price change in a country—the extent of price change is termed the ‘pass through’ effect. Since the future price of a commodity is affected by the expected inflation rate, the prices of a commodity in country X and in country Y are affected by the expected inflation rates in the two countries.

**Relevance**

Purchasing power parity constitutes a very old and fundamental theory of economics. The basic idea is that a good or service should cost about the same in one economy as in another. When this doesn't happen it means that either one currency is overvalued or another undervalued. Economists take advantage of this law to observe distortions in markets from inflation and government interference. Observing imbalances in purchasing parity helps explain trade imbalances.

Discovering the difference between purchasing power in different economies helps scholars to observe differences in the quality of life. Even if the currency of a country has become severely devalued, it may not have very wide effects on the majority of citizens as long as their purchasing power remains near parity for domestic goods. Even if the currency fluctuates in the short term, purchasing parity hopefully remains over the long term.

**2.2.3** **The Mundell-Fleming Theory**

The Mundell–Fleming model, also known as the IS-LM-BP model (or IS-LM-BP model), is an economic model first set forth (independently) by Robert Mundell and Marcus Fleming.[1][2] The model is an extension of the IS–LM model. Whereas the traditional IS-LM model deals with economy under autarky (or a closed economy), the Mundell–Fleming model describes a small open economy.

The Mundell–Fleming model portrays the short-run relationship between an economy's nominal exchange rate, interest rate, and output (in contrast to the closed-economy IS-LM model, which focuses only on the relationship between the interest rate and output). The Mundell–Fleming model has been used to argue that an economy cannot simultaneously maintain a fixed exchange rate, free capital movement, and an independent monetary policy. This principle is frequently called the "impossible trinity," "unholy trinity," "irreconcilable trinity," "inconsistent trinity," "policy trilemma," "Nahim Kouri obsession-trilemma"[3] or the "Mundell–Fleming trilemma." The assumptions here are that spot and forward exchange rates are identical, and the existing exchange rates are expected to persist indefinitely. Taxes and saving increase with income. The balance of trade depends only on income and the exchange rate. Also the demand for money depends only on income and the interest rate, and investment depends on the interest rate

**Assumptions**

The Spot and forward exchange rates are identical, and the existing exchange rates are expected to persist indefinitely. Fixed money wage rate, unemployed resources and constant returns to scale are assumed. Thus domestic price level is kept constant, and the supply of domestic output is elastic. Taxes and saving increase with income. The balance of trade depends only on income and the exchange rate. The demand for money depends only on income and the interest rate, and investment depends on the interest rate

**This model uses the following variables:**

Y is real GDP

C is real consumption

I is real physical investment, including intended inventory investment

G is real government spending (an exogenous variable)

M is the exogenous nominal money supply

P is the exogenous price level

i is the nominal interest rate

L is liquidity preference (real money demand)

T is real taxes levied

NX is real net exports

**Criticisms**

One important criticism of the model is that the assumption of perfect capital mobility might be extreme. Mundell (1963) was well aware of this limitation and recognized that the assumption should not be taken literally. Introducing imperfect capital mobility into the model implies that a fiscal expansion can play a role in affecting output under a flexible exchange rate and monetary policy can have a role under a fixed exchange rate, but the results on the relative effectiveness of the two policy instruments still hold. Several other shortcomings of the Mundell-Fleming model have also been emphasized. In particular, the model is completely static and therefore not able to address issues related to the long run, as well as to the transitional dynamics of private wealth and government finance. In order to address this limitation, Rudiger Dornbusch (1976) introduced more sophisticated, “rational” (rather than static) private agents’ expectations into the model. Furthermore, in the Mundell-Fleming model the relations between economic variables are not explicitly derived from a micro foundation of agents’ behavior. This prevents an analysis of the welfare impact of macroeconomic policies based on a utility measure.

**Relevance**

Some of the underlying assumptions and policy options of the Mundell-Fleming model, such as international capital market integration and the possibility of permitting the fluctuation of the exchange rate, were not predominant features of the world economy in the early 1960s. Restrictions to trade assets and foreign exchange were widespread, and the majority of currencies were fixed within the Bretton Woods system.

In this regard, the Mundell-Fleming model is, to a large extent, more appropriate for describing the global economy as it developed after the collapse of the Bretton Woods system, which is characterized by high financial integration and floating exchange rates, than the economic reality of the times in which the model was originally developed. This prophetic trait of the analysis, as well as the success of the theoretical predictions in matching empirical facts (such as the effects of U.S. macroeconomic policies in the 1980s), help explain the influence of the Mundell-Fleming model among both academics and policymakers.

**2.3** **Empirical Framework**

Previous researches on the effect of exchange rate fluctuation on economic growth has arrived at differentiating results. For example, various empirical confirmations show that real exchange rate fluctuation can affect growth results. Other schools of thought are of the perspectives that no significant relationship exist between exchange rate and economic growth. Edwards and Levy Yeyati (2003) discovered signs that countries with more flexible exchange rate grow faster than those without. Faster economic growth is broadly connected with real exchange rate deterioration (Hausmann, Pritchett & Rodrik, 2005).

Rodrik (2008) was of the view that real exchange rate underweening promotes economic growth, expands the benefit of the tradable sector, and prompt a growth of the portion of tradable in domestic value added. He expressed that the tradable sector in developing countries can be too small because it endures more than the non-tradable sector from institutional shortcomings and market failures. A real exchange rate undervaluation works as a second-best approach to make up for the negative impacts of this misinterpretation by enhancing the sector’s profitability. Higher profitability promotes investment in the tradable sector, which at that point extends, and promotes economic growth. Harris (2002) using the Generalized Least Square technique revealed that real exchange rate, when properly managed affect productivity and growth in both the short and long run, the result is coherent with the competitiveness hypothesis, which suggests that exchange rate devaluation support profitability and development in the short run.

Aghin et al (2006) in their study likewise found that the impact of exchange rate instabiliy, which is the consequence of how well the economy is managed on real activity is relatively small and insignificant. This is in reverberation with the findings of Dubas and Lee (2005), which both found a strong relationship between exchange rate stability and growth. Moreover, the result suggests that membership of the (South) Eastern and Central European countries in the European Monetary Union would have a positive impact on these countries’ growth rates. In the same vein, Hossain (2002) concurred that exchange rate relates the price systems of two distinct economies by guaranteeing the likelihood for international trade and it likewise impacts on the volume of imports and exports, as well as country’s balance of payments position.

Rogoffs and Reinhartl (2002) furthermore said that the choice of flexible exchange rate system make a developing country better off. Odusola and Akinlo (2003) found a mixed result on the impacts of the exchange rate deterioration on the output in Nigeria. Exchange rate depreciation is said to yield an expansionary effect on output in the medium and long run, while in the short run it is said to not expand output. This outcome confirms what Rano-Aliyu discovered making use of the Vector Error Correction Model (VECM) technique while Odusola and Akinio made use of Vector autoregression (VAR) and VECM. The distinction in their results can be justified by the different approach they both used. Rano-Aliyu (2009), in his study carried out in Nigeria discovered that exchange rate appreciation has a positive impact on real economic growth in Nigeria. It is more satisfying to appreciate currency than to depreciate it because its appreciation although will lead to loss of competitiveness and the economy lacks the ability to appropriate gain via competitiveness. This is because appreciation of currency reduces inflation because imports become less expensive and the lower costs lead to bring down inflation. It makes imports progressively alluring, causing the interest for domestic goods to fall. Local companies will need to reduce expenses and increment productivity so as to remain competitive. This will boost domestic investment, savings and the standard of living.

Aliyu (2009) agreed that the appreciation of currency will bring about an increase in import while its depreciation will increase export and debilitate import. This is going to cause a movement from foreign goods to domestic goods. This will lead to a diversion of income from importing countries to exporting countries through a movement in the terms of trade, and this will in general have impact on the economic growth of both importing and exporting countries. Asher (2012) investigated the effect of exchange rate fluctuation on the Nigerian economic growth from 1980 – 2010. His result showed a positive effect between real exchange rate and economic growth. In a related study, Akpan (2008) analyzed foreign exchange market and economic growth in a rising oil-based economy from 1970-2003 in Nigeria. He also concluded that a positive relationship existed between exchange rate and economic growth.

Obansa et al (2013) also analyzed this case from 1970–2010. He result showed a strong relationship between both variables. They established that exchange rate liberalization was good to the Nigerian economy as it promotes economic growth. Azeez, Kolapo and Ajayi (2012) investigation from 1986 – 2010 revealed that exchange rate is positive related to Gross Domestic Product. Adebiyi and Dauda (2009) with the use of error correction model disputed on the contrary, that trade liberalization promoted growth in the Nigerian industrial sector and stabilized the exchange rate market between 1970 and 2006. To them, there was a positive and significant relationship between index of industrial production and real export. A one per cent rise in real export increases the index of industrial production by 12.2 per cent. By inference, it means that the policy of deregulation influenced positively on export through exchange rate depreciation. Notwithstanding, past studies revealed no significant effect between exchange rate on economic growth.

Ubok-udom (1999) broke down the issues encompassing the implementation of SAP in Nigeria, and drew up a conclusion that the highlights of Nigerian economy constrain the adequacy of currency depreciation in producing alluring impacts. From the study of the relationship between exchange rate variation and growth of the domestic output in Nigeria; he expressed growth of domestic output as a linear function of variations in the average nominal exchange rate. In addition, he used dummy variables to capture the periods of currency depreciation. The empirical result revealed that all coefficients of the major explanatory variables have negative signs. David, Umeh and Ameh (2010) also analyzed the effect of exchange rate fluctuations on Nigerian manufacturing industry. They employed multiple regression econometric tools which showed a negative relationship between exchange rate volatility and manufacturing sector performance. The mixed or inconclusiveness of the results coupled with the emphasis placed on the impact of exchange rate fluctuation on economic growth as shown in various government policies in Nigeria is the motivation for this study.

**2.4** **Summary Of The Literature/Research Gap**

From the reviewed of previous literature, it is cleared that much research literature on relationship between exchange rate and economic growth had different opinions based on their results. Some found out that there was a positive relationship between the variables while some concluded on the fact that there is a negative relationship between the variables. While some didn’t find any relationship at all but instead, they found a significant relationship between the variables and other researchers went ahead to analyze the short run and long run relationship between the variables and found out that in the long-run there was a negative relationship between the variables and the short-run there was a positive relationship. Some other researcher didn’t even consider the relationship between exchange rate and economic growth although it was included in the variables used but instead, they looked into the relationship between other macroeconomic variable and economic growth. All these conflicting findings makes this research necessary. This study seeks to determine the level of impact of exchange rate fluctuation on economic growth using the growth rate in real GDP as the independent variable, exchange rate as the target variable and interest rate and inflation rate as the control variables Methodologically, most of the scholars used OLS and VECM estimation technique while few used ECM, ARDL and VAR. This study unlike the other literature reviewed that made use of only Augmented Dickey-Fuller (ADF) to test for stationarity in the variables tested for stationarity using four different test which are Augmented Dickey-Fuller (ADF), Phillips- Perron, Dickey- Fuller GLS (ERS) and Kwiatkowski-Phillips-Schmidt-Shin Test. Which accounted for the reason why ARDL was used for this study. The main objective of the study is to assess the impact of exchange rate fluctuation on economic growth in Nigeria between 1985 and 2018, which makes it unique from previous studies.

**2.5 TABULAR PRESENTATION OF EMPIRICAL REVIEW**

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| **AUTHOR** | **TITLE** | **PERIOD** | **METHODOLOGY** | **VARIABLES** | **FINDINGS** |
| Lawal Adedoyin Isola, Atunde Ifeoluwa Oluwafunke, Ahmed Victor, Abiola John Asaleye  (2016) | Exchange rate Fluctuation and the Nigeria Economic Growth | 2003 to 2013 | ARDL | RGDP,EXR,INF,INR and MS | findings revealed that exchange rate fluctuation has no effect on economic growth in the long run though a short run relationship exist between the two. |
| Abimlech Paye Gbatu, Zhen Wang, Presley K  (2017) | Causal Effects and Dynamic Relationship between exchange rate Volatility and Economic Development in Liberia | 1980 to 2016 | unit root test, cointegration and Asymptotic Linear Tests for Granger Causality | GDP, EXR, Index Trade balance | findings show no significant relationship between ERV and Liberia’s real GDP in the short and long-run. |
| Zeyneb GUELLIL, Fatima Zohra MAROUF, and Mohammed Benbouziane  (2017) | Exchange rate Regimes and Economic Growth in Developing Countries | 1980 to 2013 | Panel Fully Modified Least Squares | GDP, Investment as a percentage of GDP, The growth rate of the MS (M2), Domestic credit to the private sector (% of GDP) (FD), Public expenditure as a percentage of GDP (GGE), The commercial opening rate, and Political Stability | there is a positive relation between exchange rate regime and economic growth with a preference for fixed exchange rate regimes in achieving the highest growth rate. |
| Nnanna Philemon Azu, Alireza Nasiri  (2015) | EXR Fluctuation and Sustainable Economic growth in Nigeria | 2004 to 2014 | VAR | Real exchange rate (RER), real GDP, real export (EXP), real import (IMP), foreign exchange reserve (FER) and foreign direct investment (FDI) | Findings revealed that RER as a dependent variable, is positively related to previous EXP and IMP but also negatively related to real GDP, FER and FDI; though these results are only significant with GDP, FER and FDI. In other words, increasing GDP will tend to appreciate the naira. |
| Nicholas Mugambi Karuraa (2017) | The Impact Of Exr Fluctuation Determinants On Ex Earnings In Kenya | 1970 to 2015 | Unit root test, cointegration, VAR, ECM and Vector Error correction model | EX earning, INR, MS, INF, Exchange rate Liberalization, External Debt Stock as a % of GNI and money supply as a % of GDP | Long run equilibrium relationship between export earnings, interest rates, money supply as a percentage of GDP, inflation rate. Additionally, inflation rate, interest rates money supply and market liberalization variables have positive long run effects on export earnings |
| Eme O. Akpan (2011) | Effects of Eexchange rate Movements on Economic Growth in Nigeria | 1986 to 2010 | Generalised Method of Moments (GMM) | INF, real GDP, nominal EXR, MS | The estimation results suggest that there is no evidence of a strong direct relationship between changes in exchange rate and output growth. Rather, Nigeria’s economic growth has been directly affected by monetary variables |
| Ade T. Ojo and Philip O. Alege (2014) | Exchange Rate Fluctuations And Macroeconomic Performance In Sub-Saharan Africa: A Dynamic Panel Cointegration Analysis | 1995 to 2007 | generalized methods of moments | RGDP, EXR, CPI, Degree of Openness, INT, Government expendiure and FDI | the findings can be seen as a contribution to the recent calls for stepping up the regional economic and financial integration efforts in Africa, particularly in the exchange rate mechanism, by identifying the main determinants |
| Gervais TWAMUGIZE, Zhang Xuegong, Abeid Ahmed Rmadhani (2017) | The Effect of Exchange rate Fluctuation on International Trade in Rwanda | 1990 to 2014 | Vector Error Correction Model, Granger causality | EX, IM, EXR, GDP, and MS | Findings show evidence that exchange rate fluctuation is the main factor that affects the level of international trade measure in terms of export and import flows in Rwanda |
| Dr. Akinmulegun Sunday O. and Falana Olajide E. (2018) | EXR Fluctuation and Industrial Output Growth in Nigeria | 1986 to 2015 | Co-Integration, Vector Error Correction model, and Granger Causality | RGDP, EXR, INF, Net export, INT | The response of industrial output to the shock from exchange rate was positive and significant; more specifically in the initial years, while response to shock from other variables was little in magnitude and not as significant as exchange rate. |
| OKORONTAH, Chikeziem F. and ODOEMENA, Ikenna Uchechukwu (2016) | Effects of EXR Fluctuations on Economic Growth of Nigeria | 1986 to 2012 | OLS, ECM, Johansson co-integration | RGDP, MS, Nominal EXR, Inflation | The result demonstrated that no strong relationship exists between the exchange rate movement and economic growth in Nigeria which contradicts many existing literature. However, we uphold our result because even the variables that are expected to have effect on the exchange rate were found to be insignificant in determining the changes in exchange rate |
| ASHER OJOCHOGU JOYCE (2012) | THE IMPACT OF EXR FLUCTUATION ON THE NIGERIA ECONOMIC GROWTH | 1980 to 2010 | Ordinary Least Square | GDP, Exchange rate, Interest rate, Inflation rat | Proper policies on exchange rate will help to curtail inflation and maintain economic growth |
| Achouak Barguellil, Ousama Ben-Salha, and Mourad Zmami (2018) | Exchange Rate Volatility and Economic Growth | 1985 to 2015 | Generalised Method of Moments (GMM) | Nominal Exchange Rate, Real Exchange rate, Financial Openness, GDP | real exchange rate volatility has a negative impact on economic growth. Also, the effect of exchange rate volatility depends on the exchange rate regimes and financial openness, that is, volatility is more harmful when countries adopt flexible exchange rate regimes and financial openness |
| Kenny S, Victoria (2019) | Exchange Rate Management and Economic Growth | 1981 to 2015 | Augmented Dickey Fuller (ADF) Unit Root Test, Co-integration test, Fully Modified Ordinary Least (FMOLS) and diagnostic tests | exchange rate, external reserve, money supply, Labour, capital input and GDP | exchange rate, external reserve, money supply and capital input have significant impact on the economic growth of Nigeria; whereas labour shows no significant impact on economic growth in the long run |
| Lawrence Ogechukwu Obokoh, Udechukwu Ojiako, James Unam Monday, and Chris Ehiobuche (2017) | The Impact of Exchange Rate Depreciation on Small and Medium Sized Enterprises Performance and Development in Nigeria | 1994 to 2009 | CHOW | Aggregate Assets, Profits, Computed ROI of 50 Sampled SMEs, Interest Rates, Inflation Rates and Exchange Rates | The results of the data analysis suggest a very high sensitivity of SMEs’ performance and cost of operations to exchange rate fluctuations. |
| Mbanasor, Christian Okechukwu (Ph.D) and Obioma, James (2017) | The Effect of Fluctuations of Exchange Rates on Nigeria’s Balance of Payment | 1987 to 2011 | Ordinary Least Square | Balance of Payment, exchange rate, export, and import | The findings indicated that exchange rate fluctuations has positive and non-significant impact on Nigeria’s balance of payment |
| Brigitta Jakob (2016) | Impact of Exchange Rate Regimes on Economic Growth | 2011 and 2012 | Descriptive statistics | inflation rate, gross capital formation (%GDP), index of government spending, exchange rate and index of human capital per person | it is found that there is a positive and significant correlation between pegged exchange rate and growth in GDP |
| MISS NAWAN LIMPAVATHANYOO (2017) | THE EFFECTS OF EXCHANGE RATE VOLATILITY ON ECONOMIC GROWTH: EVIDENCE FROM THAILAND, SINGAPORE AND MALAYSIA | 2005 to 201 | Generalized Method of Moment (GMM) | GDP, Exchange rate, Government consumption, Inflation, Gross fixed capital formation, labour, and Trade openness | finding reveals that in short-term, exchange rate volatility negatively and significantly influenced economic growth while this relationship also negative but less power to affect economic growth in long-term period |
| Iyeli and Clement Utting (2017) | Exchange Rate Volatility and Economic Growth in Nigeria | 1970 to 2011 | Cointegration, Unit root and Error correction model | GDP, exchange rate, balance of payment, oil revenue and inflation | Findings reveals that exchange rate volatility and oil revenue contributed to GDP |
| Adeyemi Paul Adeniyi and Akinbayo Olasoji Olasunkanmi (2019) | Impact of exchange rate volatility on economic growth in Nigeria | 1980 to 2016 | Unit root, cointegration and error correction mechanism | GDP, export, import, exchange rate, inflation, and money supply | The results revealed that there is existence of co integration among the variables. The study established insignificant positive relationship between exchange rate volatility and economic growth in Nigeria. |
| Nsofor Ebele Sabina, Takon Samuel Manyo, and Ugwugbe Sabastine Ugochukwu (2017) | Modeling exchange rate volatility and economic growth in Nigeria | 1981 to 2015 | Generalized Method of Moment (GMM) | Real Exchange Rate (RER), Foreign Direct Investment (FDI), Government Expenditure (GOVE), and Gross Domestic Product (GDP) | the result showed that volatility and FDI has negative and significant impact on the growth of the Nigerian economy. |
| Himani Saxema, P.K. Bansal (2019) | Relationship between economic factors and economic growth in India | 2007 to 2018 | Simple and Multiple Regression test using PASW 18 | GDP, money supply, inflation, exchange rate. | Exchange rate had negative effect on GDP but Inflation had insignificant negative relationship with GDP |
| Efi Fitriani (2019) | Analysis of Inflation and Interest rate on the economic growth in Indonesia | 2009 to 2018 | Descriptive analysis and regression analysis | GDP, interest rate and inflation rate | there is a positive influence between inflation on economic growth and a negative influence between the interest rate on economic growth |
| Sotonye Briggs, Muammad Musa (2017) | The Effect of Exchange Rate on Nigeria Economic Growth | 2006 to 2016 | OLS | RGDP, inflation rate, exchange rate, and oil price | exchange rate has a significant impact on economic growth |
| Adeniran J.O, Yusuf S.A, Adeyemi Olatoke (2014) | The Impact of exchange rate fluctuation on the Nigerian Economic growth: An empirical investigation | 1986 to 2013 | OLS | GDP, interest rate, inflation rate and exchange rate | exchange rate has positive impact but not significant, interest rate and inflation rate have negative impact on economic growth but not significant. |
| Obansa S.A.J, Okoroafor O.K, Aluko O.O, Eze Millicent (2013) | Perceived relationship between exchange rate, interest rate and economic growth in Nigeria | 1970 to 2010 | vector auto regression technique | GDP, Interest rate, exchange rate | exchange rate has a stronger impact on economic growth than interest rate. Interest rate impact was found to be positive but however declined as the time horizon increased. It has a little impact on economic growth in the period of regulation than in the deregulation era |
| Obisesan Oluwaseun Grace, Ogunsanwo Odunayo Femi, Akosile Mary Oluwayemisi (2019) | Effect of foreign exchange management on economic growth in nigeria | 1987 to 2017 | ARDL, ECM | real exchange rate, inflation, degree of openness, FDI and RGDP | real exchange rate has positive and significant effect on economic growth. Inflation revealed a negative and insignificant effect on economic growth. |
| Nwosa I. Philip, Adeleke Omolade and Kutu Adebayo (2019) | Exchange rate regimes and industrialization in Nigeria | 1960 to 2016 | unit root, co-integration and ARDL | exchange rate | exchange rate has an insignificant impact on Industrial production. The period of the flexible exchange rate regime had a negative and significant impact on Industrial productivity in Nigeria. |
| Ezenwakwelu Charity A, Okolie Patrick I, Attah Emmanuel Y, Lawal Kehinde O, Akoh Ojonugwa (2019) | Exchange rate management and performance of Nigerian manufacturing firm | 2015 to 2017 | multiple regression test | return on equity, exchange rate fluctuation, inflation rate, interest rate, trade flow, external debt | exchange rate had significant negative effect on productivity of the manufacturing firms. Flexible exchange rate had not significantly enhanced performance of the manufacturing firms. |
| Samson Ogege (2019) | Analysis of the impact of inflation, interest rate and exchange rate on economic development | 1981 to 2017 | multiple regression method | Life Expectancy Index, Education index, Consumption Per Capita, Human Development Index, Health Index, Physical quality of life index, Inflation rate, Interest Rate, Exchange rate | The estimated coefficient for INF shows the existence of a negative and statistically insignificant effect on life expectancy. the coefficient for interest rate shows a negative and insignificant effect on life expectancy. The coefficient for exchange rate (EXR) shows that there exists positive effect on the dependent variable except for education index. |
| Adekunle O. Ahmed (2018) | Re-examining the relationship between inflation, exchange rate and economic growth in Nigeria | 1981 to 2016 | ARDL | GDP, inflation rate and exchange rate | exchange rate has a significant and positive effect on GDP in the short run. Inflation rate has a negative and insignificant effect on GDP in the short run and there is long run relationship between the variables. |

*Where GDP= Gross Domestic Product, EXR=Exchange rate, INR=Interest rate, INF=Inflation rate, EX=Export, IM=Import, MS=Money Supply, FDI=Foreign Direct Investment, DRS=Diminishing Returns to Scale, TOT=Terms of Trade, CPI=Consumer Price Index, BOP=Balance of Payment, ERV=Estimated Recovery Value*

**CHAPTER THREE**

**RESEARCH METHODOLOGY**

**3.1** **Research Design**

This section highlights the methods and procedures employed in carrying out the research. It contains the procedures and techniques used for collecting and analyzing data, and more also statistical and econometric techniques used in analysis of the time series data. The A-priori expectation was also specified in relation to the stated hypothesis, estimated and evaluated the model in the making of sound statistical inference to the model.

**3.2 Data Definition and Sources**

This study is based on a thirty-four years data series from 1985-2018

|  |  |  |  |
| --- | --- | --- | --- |
| **DATA** | **VARIABLE** | **DEFINITION/DESCRIPTION** | **SOURCE** |
| GRGDP | Growth Rate in Real Gross Domestic Product | Monetary Policy Targets and Outcomes (growth rates)  Real GDP1 | Central Bank of Nigeria statistical bulletin (2019) |
| EXR | Exchange Rate | Monthly Average Official Exchange Rate of the Naira (N/US$1.00) | Central Bank of Nigeria statistical bulletin (2019) |
| INT | Interest Rate | Money Market Interest Rates (Per cent) | Central Bank of Nigeria statistical bulletin (2019) |
| INF | Inflation Rate | Monetary Policy Targets and Outcomes (growth rates)  Inflation | Central Bank of Nigeria statistical bulletin (2019) |

**3.2****.1 Sources of Data**

This research work is making use of secondary data which refers to data compiled by other sources and obtained by the researcher which was sourced from Central Bank of Nigeria (CBN) Statistical Bulletin (2020). This data sourced from the Central Bank of Nigeria Statistical Bulletin are the values of Growth Rate of Gross Domestic Product, Exchange Rate, Interest Rate and Inflation Rate of Nigerian economy. The information will be gathered for the periods between; 1985 to 2018.

**3.3 Model Specification**

The model for this study is based on the Purchasing Power Parity theory which shows the relationship between price and exchange rate. This model is formulated based on the hypotheses that were specified in the first chapter of this research. The model is specified to show the impact of Exchange Rate, Interest Rate and Inflation Rate on Economic Growth in the Nigerian economy. The proxy for economic growth is growth rate of real gross domestic product.

The functional form of the model is expressed as:

GRGDP = f (EXR, INT, INF) (1)

Where:

GRGDP = Growth Rate in Real Gross Domestic Product

EXR = Exchange Rate

INT = Interest Rate

INF = Inflation Rate

Where model(1) will be used to achieve objective i, ii and iii.

The econometric form of the model can be expressed as:

GRGDP= β0 + β1EXR + β2INT + β3INF + (2)

Where:

GRGDP = Growth Rate in Real Gross Domestic Product

EXR = Exchange Rate

INT = Interest Rate

INF = Inflation Rate

β0= intercepts of the equations

= slope coefficient of each of the independent variables in equation (2)

μt = stochastic variable.

This study adopts the Auto Regressive Distribution Lag (ARDL) cointegration technique that captures the long run and short run asymmetries between exchange rate and economic growth. The ARDL approach can be framed in equation (3)

GRGDP= 0 +1EXRt-1 + 2INTt-1 +3INFt-1 + t-1 + iEXRt-1 + iINTt-1 + t-1 + ................... (3)

Where;

In equation (3), *0* denotes the intercept, α1, α2 and α3 denotes the long run coefficient, θi, νi, and µi denotes short run coefficients.

denotes the random variable in the period *t*, denotes short run changes. Where b1, b2 and b3 are the lag orders of the variables, the rest of the variables are still defined above.

**3.4 Justification of Variables**

GDP (Gross Domestic Product) is the monetary value of all finished goods and services made within a country during a specific period. GDP provides an economic snapshot of a country, used to estimate the size of an economy and growth rate.

RGDP (Real Gross Domestic Product) is a measure that has already been inflation-adjusted that shows the values of goods and services produced by an economy in a given year that are expressed in base year prices. With the current base year given as 2011.

GRGDP (Growth Rate in Real Gross Domestic Product) is used to determine how rapid an economy is growing. Technically speaking; an economy is said to be in recession if it experiences two (2) consecutive negative quarterly GDP. This is similar to what Nigeria experienced in Q4 of year 2016 and Q1 of year 2017; and Nigerian economy was said to be in recession

A foreign exchange rate is the relative value between two currencies. The exchange rate is defined by how much money, or the amount of a foreign currency, that you can buy with one US dollar. Exchange rate also largely determines the choice of country of investment by foreign investors. Studies has shown that countries with lower exchange rate has high tendency of attracting foreign direct investment all things being equal.

Interest rate is the amount of interest due per period, as a proportion of the amount lent, deposited or borrowed (called principal sum). Studies have shown that high interest rate has a tendency of affecting exchange rate. This can be seen in developed nations with very low interest rate and a very stable exchange rate with a high value, unlike a developing economy like Nigeria whose interest rate is in double digits and a high rate of exchange.

Inflation rate is the annualized percentage change in a general price index, usually the consumer price index, over time. Previous studies have shown that exchange rate and inflation rate have an inverse relationship that is when relating the two independent variables alongside. An increase in inflation will cause a decrease in exchange rate. A hypothetical case is for a developing country like Nigeria whose increase in exchange rates, affect cost of finished goods imported thereby an increase in price; which emanates to inflation.

µ (Random Error Term) is the stochastic variable that is usually included in the model to account for the variable that affect the dependent variable but are not included in the model

**3.5 The A-Priori Expectation**

The positive (+) and negative (-) signs are the A-priori condition usually set be economic theories, and they are used to show the signs and size of the parameters of the economic relationships. They ought to comply with the A-priori expectations below. Parameters that are represented in a model are expected to have signs either positive (+) or negative (-) that comply to economic theory. Except if there is a clarification to accept that in this occasion the principles of economic theory do not hold. There is meant to be a negative relationship between exchange rate and growth rate in real gross domestic product i.e. α0 <0, there should also be a negative relationship between interest rate i.e. α2 <0, there is also meant to be a positive relationship between inflation and economic growth i.e. α3>0. These are the effects the author assumes the independent variables of the model will have on the dependent variable of the model at the end of the data estimation. This can be represented in the table below:

**Table 3.2- A-Priori Expectation**

|  |  |  |
| --- | --- | --- |
| **VARIABLE** | **EXPECTED SIGN** | **EXPECTED SIZE** |
| GDP | + | >0 |
| EXCH | - | <0 |
| INT | - | <0 |
| INF | - | <0 |

The purchasing power parity theory developed by Gustav Cassel (1918) states that the equilibrium rate of exchange is determined by the equality of the purchasing power of two inconvertible paper currencies. This theory further states that an increase in the exchange rate of a domestic country will reduce purchasing power hence a decrease in the ability to acquire capital goods that can drive the economy; hence economic growth. It can be seen here that the relationship binding exchange rate and economic growth is negative.

According to the International Fisher Effect Theory, a country with lower interest rates will see lower levels of inflation, which will translate to an increase in the real value of the country’s currency in comparison to another country’s currency, which will tend to stimulate economic growth. An apriori criteria of Interest rate negatively and inversely related to economic growth can be drawn from this.

The demand-pull inflation is a tenet of Keynesian economics that describes the effects of an imbalance in aggregate demand and supply. This theory asserts that inflation rises as real gross domestic product rises. This forms the basis of the apriori criteria above; which states that inflation has both positive and direct relationship with economic growth.

**3.6 Estimation Techniques**

This study employed the use of time series data from the period between 1985 and 2018 in Nigeria. This research is mainly quantitative and explains based on existing research studies, methodologies and procedures. The estimation began by making sure the variables in their behaviour conform with the assumptions of the model. The estimation begins with a unit root test to check for stationarity of the variables. The study tested for the stationarity level using unit root test through the application of Augmented Dickey-Fuller (ADF), Dickey- Fuller GLS (ERS), Phillips- Perron and Kwiatkowski-Phillips-Schmidt-Shin to test for stationarity, if the result of the test indicates that the variables are stationary at levels I(0), then the Ordinary Least Square estimation technique will be employed in the analysis of the data. If the variables are stationary at 1st difference I(1) , then the Johansen Cointegration technique will be employed to test for the existence of a long run equilibrium relationship. This outcome will determine if the Vector Error Correction Model (VECM) will be used to estimate the short run relationship between the variables.

However, if the variables after analysis are stationary at levels and at first difference, then the Auto regressive distributed lag Cointegration test (ARDL) will be performed to estimate both the short run and long run relationship between the variables. Post estimation tests will also be carried out are the normality test using the Jarque-Bera statistic, linearity test using the Ramsey-Reset test, autocorrelation test using the Breusch-Godfrey test and the test for heteroscedasticity using the ARCH-LM- test to confirm the robustness of the model

**3.6.1 Descriptive Statistics**

This is a summary statistic that quantitatively describes or summarizes features of a collection of information. The overall objective of this test is to provide a brief summary of the samples and the measures done on this particular study. It tells us about the natural properties of our variables. This should be done in the real form and not logged form. This data evaluation process will give an overview on information on central tendency such as the mean, median and minimum and maximum value of the observation. Measures of dispersion; such as range and standard deviation. Measures of normality such as kurtosis (measure of the degree of sharpness) and skewness (measure of the degree of symmetry). Jarque-Bera measures the difference in skewness and kurtosis of the series with those from the normal distribution. Probability is that a Jarque-Bera statistics exceeds the observed value under the null hypothesis.

Descriptive statistics help to analysis if there is evidence of significant variation in the data set as well as if the variables are positively or negatively skewed and so on.

**3.6.2 Unit Root Test**

A unit root test shows whether a time series variable is non-stationary and possesses a unit root. A time series is assumed to be stationary if a shift in time doesn’t cause a change in the shape of the distribution. This is the test of the time series data in order to validate the empirical result. It is the first step in the data estimation to test the stationarity of the data. The Augumented Dickey-Fuller (ADF) test, Philip and Peron test, Dickey- Fuller GLS (ERS) and Kwiatkowski-Phillips-Schmidt-Shin are adopted and conducted for each of of the time series variables. The Augumented Dickey Fuller approach states the null hypothesis as the series is non-stationary, against the alternative of stationary. The Phillip and Perron Test, Dickey- Fuller GLS (ERS) and Kwiatkowski-Phillips-Schmidt-Shin test was used to test the null hypothesis that the time series is integrated of order. It is an extension of the Augmented Dickey Fuller Test.

**3.6.3 Cointegration Test**

The Cointegration test is used to establish the long run relationship of the variables specifed in the model. The initial step in this test is to find the optimal lag length because of the tests’ sensitivity to lag. A high lag produces a misleading result. Akaike Information Criterion (AIC) and Schwarz Information Criterion (SC) determined the optimal lag. The information criterion according to Koehler & Murphree, (1988) is a better criterion to determine the optimal lag length.

**3.6.4 Auto Regressive Distributed Lag (ARDL)**

The data collected was carefully and appropriately analyzed using Auto Regressive Distributed Lag (ARDL) because the unit root test result shows stationarity at both levels and first difference. The study also made use of the multiple regression model using the secondary data obtained.

**3.7 Model Evaluation Techniques**

These are the test which would be used to prove the theoretical and statistical validity of the estimated parameters derived from the regression result.. The models used in evaluating this study include Coefficient of Determination (R2), F-statistic test, t-statistic, and which were used to test the statistical significance of the independent variables on the dependent variables in the model as well as the validity of the model. The result of the study was evaluated to test the hypothesis for theoretical credibility and the statistical significance using:

**3.7.1 T**-**test**

The parameters in the model usually utilizes t-test to determine its statistical significance. They are going to be tested at a 5% level of significance. The general guideline expresses that if the p-value>5% level of significance, it is expressed as being statistically insignificant, if p-value<5% level of significance, it is said to be statistically significant.

**Decision Criteria**

The decision rule was that if the probability value of the t-statistic is lesser than 0.05 level of significance, reject the null hypothesis. But if it is greater than 0.05 level of significance, do not reject the null hypothesis.

**3.7.2 Coefficient of Determination (R2)**

It expresses the percentage of variation of the dependent variable that can usually be explained by the independent variable (s) which is also known as the explanatory variable. It demonstrates the degree to which the explanatory variable (s) impacts the dependent variable. The coefficient of determination (R2) is used to evaluate the goodness of fit of the model; the value of R2 lies between 0 and 1 inclusively, the closer the R2 is to 1, the greater the proportion of the variations in the dependent variable. The coefficient of determination is equals to the square of the correlation between the two variables with a regression line.

**3.7.3 Adjusted Coefficient of Determination**

The adjusted Ṝ2 is the goodness of fit of the model after adjusting for the degrees of freedom as more explanatory values are added. It lies between zero and one and the closer it is to one the better the goodness of fit.

**3.7.4 F-Statistic**

It is used to determine whether or not the aggregate or joint effect of the independent variables on the dependent variable is statistically significant. Using 5% level of significance with a specified degree of freedom, if the probability value of the F-statistics is lesser than 0.05 level of significance, the independent variables’ parameter estimates is said to have jointly statistically significant effect on the dependent variable. If the probability value of the F-statistics is greater than 0.05 level of significance, the explanatory variables in the model have jointly statistically insignificant effect on the dependent variable.

**Decision Criteria :** The decision rule was that if the probability value of the F-statistics is lesser that 0.05 level of significance, reject the null hypothesis and do not reject the alternate hypothesis which states that there is statistical significance when testing the parameters in the model simultaneously.

**3.8 Post Estimation Techniques**

**Autocorrelation test**: For economic reliablity, this statistical test was carried out to detect the presence of autocorrelation among the variables in the model.

**3.8.1 The Durbin-Watson Statistic:** it is used to test for the presence of positive or negative autocorrelation in a model. The simple correlation matrix of the variables would be utilized as a guide in figuring out what combinations of the independent variables are answerable for multi-collinearity. It is a basic guide used to indicate the right combination of the independent variables. This test was aimed at ascertaining if the error terms are correlated. In order to achieve this, we assumed that the values of the random variables are temporarily independent by employing the Durbin Watson technique.

**3.8.2 Heteroskedasticity Test:** This test was carried out to check if the disturbance term has the same finite variance and for the presence of heteroskedasticity. The null hypotesis for the test is equal finite variance or homoskedasticity while the alternative hypothesis is unequal finite variance. The decision criteria was to not reject the alternative hypothesis if the f-statistics value is greater than 0.05 level of significance and reject the null hypothesis of homoskedasticity if the f-statistics probability is greater than 0.05 level of significance.

**3.8.3 Normality Test:** This test was carried out to check if the disturbance term follows a normal distribution. The null hypothesis of this test is normality and the alternative hypothesis is non-normality. The decision criteria was to not reject the alternative hypothesis if the f-statistics probaility value is greater thn 0.05 level of significance while we reject the null hypothesis if the f-statistics probability value is greater than 0.05 level of significance.

**3.8.4 Linearity Test:** This test was used to check if the dependent and independent variables have a linear relationship. The null hypothesis is linearity and the alternative hypothesis is non-linearity. The decision criteris was to reject the null hypothesis if the f-statistics probablity value is greater than 0.05 level of significance and do not reject the alternative hypothesis if it is less than 0.05 level of significance.

**CHAPTER 4**

**RESULTS AND DISCUSSION**

This chapter is focusing on the examining the impact of Exchange rate fluctuation on the Nigeria Economic growth using the model that were specified in chapter 3. This chapter commenced with the data presentation, a discussion of the descriptive statistics and trend analysis of the variables involved in the model and consequently proceeded to pre-test the data for unit roots using the Augmented Dickey-Fuller and Phillip Perron tests. Upon determining the order of unit root test, this study proceeded to use Auto regressive distributions lag (ARDL) to determine the short run and long run co-integrating relationship of the explanatory variables on the dependent variable. This chapter concluded with the post estimation tests.

**4.1 Data Presentation**

The variables used in this analysis are the Growth Rate of Real Gross Domestic Product (GRGDP), Exchange Rate (EXR), Interest Rate (INT), Inflation Rate (INF), for the period of 34 years between 1985 and 2018. The data was gotten from Central Bank of Nigeria (CBN) Statistical Bulletin 2018. Below is a tabular presentation of the data;

**4.2 Data Analysis**

Empirical analysis was done and was used to estimate the model and the following results were reflected in the subsequent sections.

**4.2.1 Descriptive Statistics**

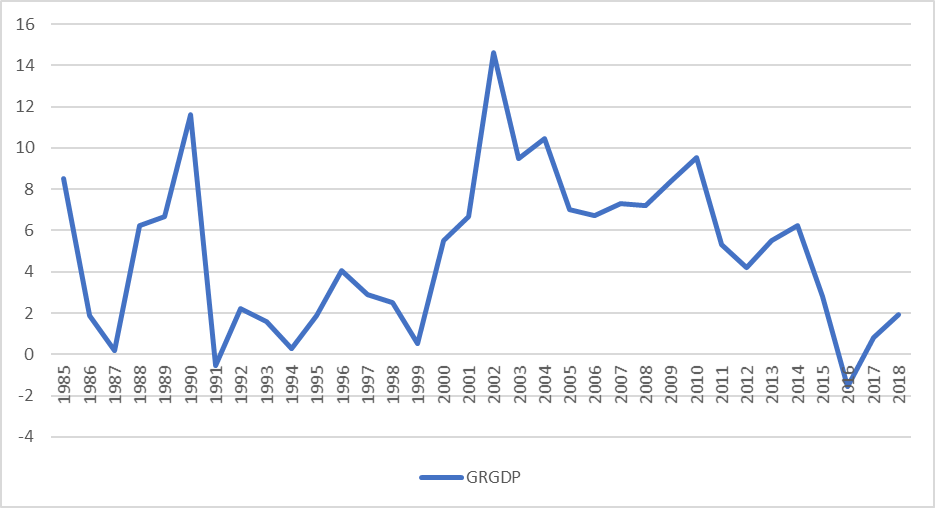
Table 4.1: Descriptive Statistics

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | GRGDP | EXR | INT | INF |
| Mean | 4.954924 | 99.01177 | 12.18281 | 19.69049 |
| Median | 5.397859 | 115.2551 | 10.85000 | 12.07481 |
| Maximum | 14.60438 | 306.0802 | 23.99000 | 76.75887 |
| Minimum | -1.583065 | 0.893750 | 4.704871 | 0.223606 |
| Std. Dev. | 3.812862 | 86.46218 | 5.038367 | 18.91575 |
| Skewness | 0.383617 | 0.683628 | 0.799975 | 1.675673 |
| Kurtosis | 2.628754 | 2.893350 | 2.934435 | 4.681582 |
| Jarque-Bera | 1.029169 | 2.664416 | 3.632529 | 19.91726 |
| Probability | 0.597749 | 0.263894 | 0.162632 | 0.000047 |
| Sum | 168.4674 | 3366.400 | 414.2156 | 669.4767 |
| Sum Sq. Dev. | 479.7512 | 246698.4 | 837.7098 | 11807.58 |
| Observations | 34 | 34 | 34 | 34 |

Source: Author’s computation using E-views (2020)

Table 4.2 shows the summary of the descriptive statistics of the variables. The median for the GRGDP, EXR, INT and INF is 5.397859, 115.2551, 10.85000 and 12.07481 respectively and this shows the average value of the variables over the period of years covered. The difference between the maximum and the minimum of all the variables indicates that there is evidence of significant variation in the data set. From the statistical distribution of the series, the results show that all the series are positively skewed. However, Inflation rate has the longest tail due to its larger values. The values of kurtosis tell you relative to the normal distribution the flatness or peakness of values on a variable over time. These values fall in the range of less than 3, greater than 3 or equal to 3 depending on the flatness of the values of the variable over time. If the kurtosis value is exactly 3 (k=3), it is mesokurtic meaning it is normally distributed. If it is less than 3(k<3), it is platykurtic which implies they are flat relative to the normal distribution. If the value is greater than 3(k>3), it is leptokurtic which implies that the variables are peaked relative to the normal distribution. The kurtosis values as shown in the descriptive statistics for GRGDP, EXR, INT and INF are 2.628754, 2.893350, 2.934435 and 4.681582 respectively and this indicates that GRGDP, EXR and INT are platykurtic which explains that they are flat relative to the normal distribution. But INF is leptokurtic which implies that this variable is peaked relative to the normal distribution. The Jacque-Bera statistics is a goodness of fit to check whether the sample data have the skewness and kurtosis matching a normal distribution. It is used to check if the variables follow a normal distribution and confirms the skewness and kurtosis value. If the probability value of Jarque- Bera is less than 5%, we reject the null hypothesis of normal distribution. From the probability of the Jarque-Bera, GRGDP, EXR, INT are normally distributed or they follow the normal distribution because they are greater than 0.05 i.e. 5%. While INF is not normally distributed because it is less than 0.05 meaning it does not follow the normal distribution.

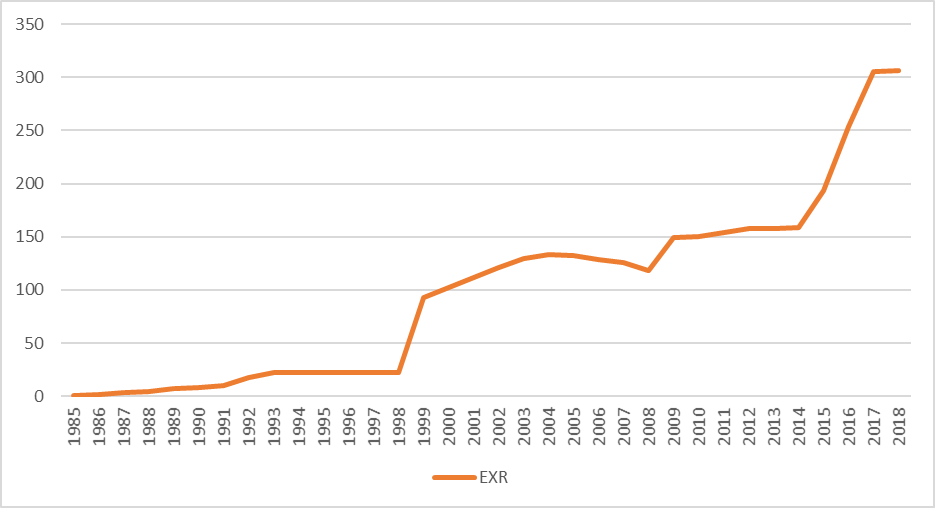
**4.2.2 Trend Analysis**



**SOURCE:** CBN Statistical Bulletin, 2020.

Figure 4.1: Trend of Growth Rate in Real Gross Domestic Product from 1985-2018

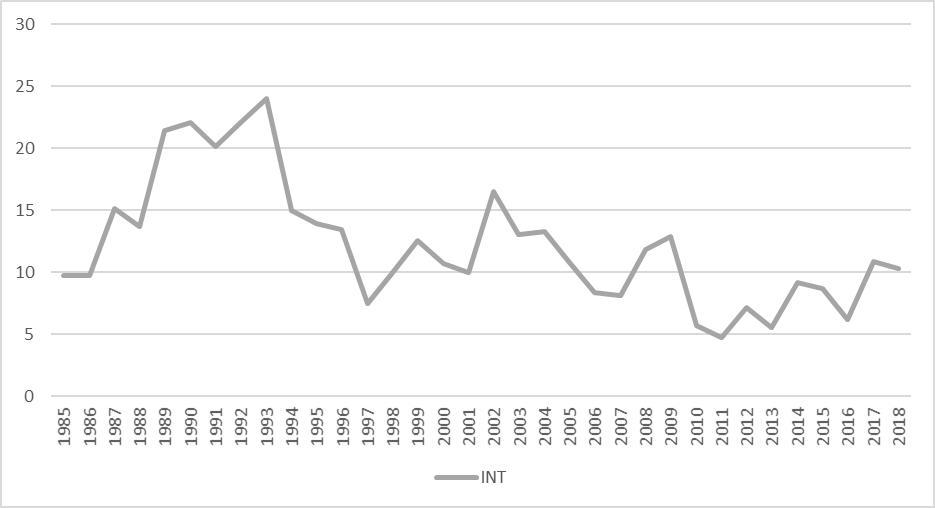
Figure 4.1 represents the trend of the Growth Rate in Real Gross Domestic Product of Nigeria. The values of growth rate of gross domestic product had an irregular trend during the period chosen for study. In the year 1985, GRGDP was 8.52%, and Nigeria continue to experience positive fluctuations until in 1991 where it then declines to -0.55% but later rose at a reduced rate until 2002 where it was at 14.6% which was the highest growth rate within the period covered and since then it continued falling at a positive rate until 2016 where it was -1.58%.Technically speaking; an economy is said to be in recession if its experiences two (2) consecutive negative quarterly GDP. This is similar to what Nigeria experienced in Q4 of year 2016 and Q1 of year 2017; and Nigerian economy was said to be in recession.



**SOURCE:** CBN Statistical Bulletin, 2020.

Figure 4.2: Trend of Exchange Rate from 1985-2018

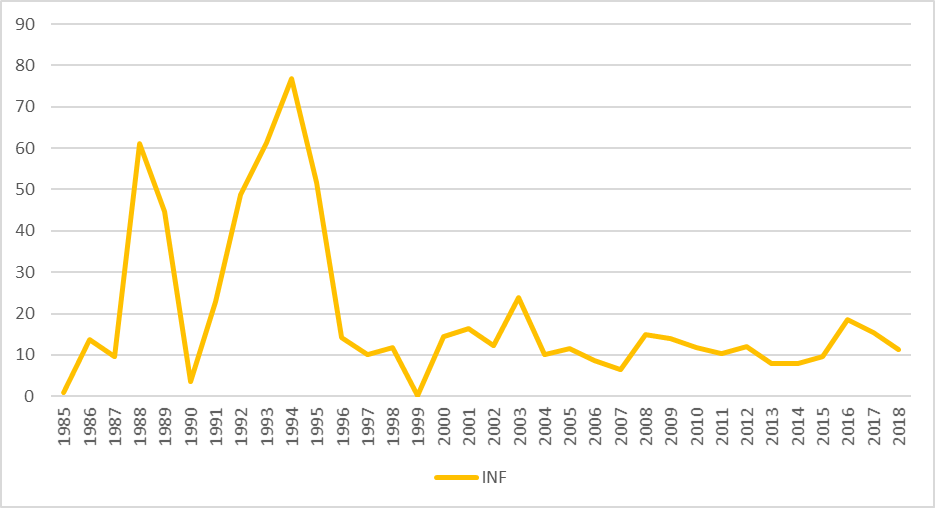
Figure 4.2 represents the trend of the Exchange Rate of Nigeria. The trend shows that over the years, the naira in relation to US ($) has been depreciating drastically and struggled to stay at a stable value. From the trend you can see clearly that exchange rate has been raising from the year 1985 where it was N0.89 which was it lowest for the period covered. Since then, there was a major increase in the exchange rate. It maintained a stable trend between the year 1994 to 1998 with a value of N21.88 up until 2004 when it was at N133.5 then it started to fall for a bit at a low rate and by 2008, it became N118.7. From 2014, the naira in relation to US ($) increase at a higher rate up until 2018 where it was N306.1 which is the peak for the period covered and up till date the exchange rate keeps increasing yearly and no solution has been provided as to how to work on appreciating the value of the naira in relation to the US ($)



**SOURCE:**  CBN Statistical Bulletin, 2020.

Figure 4.3 Trend of Interest Rate from 1985-2018

From figure 4.3, it can clearly be seen that the interest rate of Nigeria has been unstable right from 1985-2018. There has been both increase and decrease during these periods. From 1985 when it was at 9.75% to 1993 when it was at its peak of 23.99% for the period covered. It did not have any major rise again after that. It maintained minor fluctuation from 1994 up to 2011 when it had a drastic fall to 4.7% then another rise in 2012 and continued to move upward but at a low level. These fluctuations can be traced to the various changes in the monetary policies overtime.



**SOURCE:** CBN Statistical Bulletin, 2020.

Figure 4.4: Trend of Inflation Rate

From figure 4.4, we can observe that the inflation rate in the last decade is way better than that of the last two decades. The values of inflation rate had an irregular trend during the period chosen for this study. There were major fluctuations in the inflation rate of Nigeria. From 1985, where it started at 1.03%, it kept on raising and falling drastically between the period of 1986 to 1993 up to 1994 when it rose to an all-time high of 76.8% then later went to an all-time low of 0.2% in 1999. Since then, it has been raising and falling at a low rate still. It stood at 11.40% in the year 2018.



**SOURCE:** CBN Statistical Bulletin, 2020.

Figure 4.5: Trend of the Growth Rate in Real Gross Domestic Product and Exchange Rate from 1985-2018

The figure 4.5 explains the relationship that EXR has on GRGDP. From the trend, we can see that exchange rate is increasing way faster than the growth rate in RGDP. In 1990, GRGDP and EXR was at 8.5% and N0.89 respectively. The is no stable fluctuations between them. They are both increasing and decreasing at inconsistent levels. The rise in the EXR does not have a constant effect on the GRGDP because as the EXR increases, GRGDP is either increasing or decreasing so there is no regular flow in the trend. But GRGDP is for sure on a low value all through the increase. This implies that if proper policies are implanted geared towards revaluation of Nigerian Naira, it will translate into rapid economic growth



**SOURCE:** CBN Statistical Bulletin, 2020.

Figure 4.6: Trend of the Growth Rate in Real Gross Domestic Product and Interest rate from 1985-2018

Figure 4.6 explains the relationship that interest rate has on the Growth Rate in Real Gross Domestic Product. From the trend, during the period from 1985 to 1999, interest rate was mostly on the increase while the Growth Rate in Real Gross Domestic Product was relatively low and the difference between the variables was clearly in a glance. From 2000 to 2014, interest rate was not so high anymore compared to the growth rate. The difference between them got better and since interest rate decline a bit, growth rate grew by some percent although it was not for a long period of time that this lasted. But from 2015, growth rate began to decline and when growth rate was negative in 2016 due to the recession that occurred, interest rest was also low. But from then, increase rate started to increase again and the economy was still in recovery from the recession so the economy had to try to gain itself again and left that stage and started increasing at a low rate.



**SOURCE:** CBN Statistical Bulletin, 2020.

Figure 4.7: Trend of the Growth Rate in Real Gross Domestic Product and Inflation Rate from 1985-2018

The figure 4.7 above explains the relationship that inflation rate has on the Growth Rate in Real Gross Domestic Product. In 1985, INF and GRGDP was 8.5% and 1.03% respectively. Then, the inflation rate was very low which caused growth rate to increase relatively. But from 1986 when inflation started to rise, growth rate had a major decline up until 1990 when the inflation rate declined drastically, growth rate relatively increased. From 1991 to 1998, inflation rate was always on the increase which explains why growth rate during that period was on a low. From 1999 till date, the inflation rate got better although it was still on the increase and growth rate started to catch up since the economy got use to the inflation and the economy always forecast for there to be inflation in the future. The economy was doing a bit well until the recession in 2016 and the growth rate became relatively low and the economy has to recover from this trauma.



**SOURCE:** CBN Statistical Bulletin, 2020.

Figure 4.8: Trend of the Growth Rate in Real Gross Domestic Product, Exchange Rate, Interest Rate, and Inflation Rate from 1985-2018

Figure 4.8 shows how volatility in exchange rate impacts on key economic indicators like growth rate in gross domestic product, interest rate and inflation rate. From the chart, we can not really tell if there is a direct relationship between exchange rate and inflation rate or exchange rate and interest rate. The variables do not have a consistent flow, at some point it slightly increases or decreases and is never stable enough to see its effect on other variables. But the GRGDP is the variable with the least values overall even from the chart we can see that GRGDP is at the bottom of the chart and can hardly been seen from a first glance. This shows that these variables especially EXR has an impact as to why GRGDP is at this point. EXR is obviously a major factor to this cause due to the fact that exchange rate increases at a faster rate then the rest of the variables as shown by the chart.

**4.3 Pre-estimation Test**

**4.3.1 Unit root test/ Stationary Test Results**

Table 4.2- Results of the Augmented Dickey-Fuller (ADF), Phillips- Perron, Dickey- Fuller GLS (ERS) and Kwiatkowski-Phillips-Schmidt-Shin Test

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variables | ADF t-stat | PP Adj.t-stat | ERS t-stat | KPSS LM-stat |
| GRGDP  (5%) | -3.23959\*\*  (-2.954021) | -3.346334\*\*  **(**-2.954021**)** | -3.069298\*\*  **(**-1.951332**)** | 0.139253  **(**0.463000**)** |
| GRGDP  (5%) | -7.607992\*\*  **(**-2.95711) | -13.80696\*\*  **(**-2.95711**)** | -2.787103\*\*  **(**-1.952066**)** | 0.462472  **(**0.463**)** |
| EXR  (5%) | 1.385172  **(**-2.954021**)** | 1.128062  **(**-2.954021**)** | 1.660616  **(**-1.951332**)** | 0.763945\*\*  **(**0.463**)** |
| EXR  (5%) | -4.039878\*\*  **(**-2.95711**)** | -3.993589\*\*  **(**-2.95711**)** | -4.000833\*\*  **(**-1.951687**)** | 0.364627  **(**0.463000**)** |
| INT  (5%) | -2.132536  **(**-2.954021**)** | -2.240049  **(**-2.954021**)** | -2.113724\*\*  **(**-1.951332**)** | 0.455803  **(**0.463**)** |
| INT  (5%) | -6.587778\*\*  **(**-2.95711**)** | -6.615288\*\*  **(**-2.95711**)** | -6.695227\*\*  **(**-1.951687**)** | 0.101320  **(**0.463**)** |
| INF  (5%) | -1.116679  (-2.967767) | -2.981331\*\*  **(**-2.954021**)** | -1.110162  **(**-1.95291**)** | 0.345758  **(**0.463000**)** |
| INF  (5%) | -5.230523\*\*  (-2.967767) | -7.516386\*\*  **(**-2.95711**)** | -5.275987\*\*  **(**-1.951687**)** | 0.200688  **(**0.463**)** |

Source: Author’s computation using E-views (2020)

*represent the test at first difference. \*\* represent variables that are stationary at their various levels. I(0) and I(1) are the order of integration at levels and first difference respectively. The figures in () are the various test result at 5% test critical value.*

Table 4.2 shows the test that was carried out on each of the variables to determine stationarity levels. To examine the existence of stochastic non stationary in the series, the study establishes the order of integration of individual time series through the unit root test. We subjected the entire variable in the model to stationary test. Granger (1986) have demonstrated that if time series variables are non-stationary, all regression results with these time series will differ from the conventional theory of regression with stationary series. That is, the regression coefficients with non-stationary variables will be spurious and misleading.

To get over this problem, we test for stationary of the time series using Augmented Dickey Fuller (ADF) test to investigate whether the variables used in the study have unit root or not. After the ADF test, we conducted other unit root tests like Dickey- Fuller GLS (ERS), Phillips- Perron and Kwiatkowski-Phillips-Schmidt-Shin Test to compare the result of each of the tests and view the order of integration of each variable from the various tests.

Table 4.3 shows the result of each tests. Under Augmented Dickey-Fuller (ADF) test, we can see that GRGDP, EXR, INT, and INF were stationary at level, first difference, first difference, and first difference respectively although GRGDP was also stationary at first difference as well because their absolute test statistic was greater than their critical value at 5% level of critical values. The decision rule for this test states that there is unit root. If this rule is confirmed, we do not reject the null hypothesis of unit root if not, we reject the null hypothesis of unit root. Therefore, we reject the null hypothesis for these variables: GRGDP, GRGDP,EXR, INT and INF since they are seen to be stationary. We therefore do not reject the null hypothesis for these variables: EXR, INT and INF since they are not stationary. Under Phillips- Perron test, GRGDP and INF were both stationary at levels and first difference while EXR and INT were only stationary at first difference this is because their absolute test statistic was greater than their critical value at 5% level of critical values. The decision rule for Phillips- Perron test is also similar to that of Augmented Dickey-Fuller (ADF) test. Under this test, we reject the null hypothesis for these variables: GRGDP, GRGDP, EXR, INT, INF and INF since they are seen to be stationary. We therefore do not reject the null hypothesis for these variables: EXR and INT because they are not stationary. Under Dickey- Fuller GLS (ERS) test, GRGDP and INT were both stationary at levels and first difference while EXR and INF were only stationary at first difference. The decision rule for Dickey- Fuller GLS (ERS) is also similar to that of Augmented Dickey-Fuller (ADF) test. For this test, we reject the null hypothesis for these variables: GRGDP, GRGDP, EXR, INT, INTand INF because they are stationary. We therefore do not reject the null hypothesis of these variables: EXR and INF because they are not stationary. Under Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test, all the variables were not stationary at either levels or first difference except EXR that was stationary at levels. The decision rule for this test is the opposite of that of Augmented Dickey-Fuller (ADF) test stating that there is no unit root. If this rule is confirmed, we do not reject the null hypothesis of no unit root if not, we reject the null hypothesis of no unit root. Under this test, we do not reject the null hypothesis for EXR because it is the only variable that is stationary. We reject the null hypothesis for these variables: GRGDP, GRGDP, EXR, INT, INT, INF and INF because they are not stationary. From these tests, we can conclude that the variables were mostly stationary at levels and first difference. For this reason, it will be inappropriate for us to use Ordinary Least Square (O.L.S) method for estimation. Therefore, the tests to be carried out should be Auto Regressive Distribution Lag (ARDL) due to the criteria required to use this estimation technique is that the result for the unit root test should be stationary both at level and first difference. Therefore, the optimal lag length had to be determined and was shown in the next section.

**4.3.2 Optimal Lag Length Selection**

To get the lag length, first we have to run an unrestricted VAR this is because we assume that the variables are not cointegrated. The rule of thumb is that you choose that criterion that gives you the smallest figure and this will be considered at the optimum lag length and thus be selected.

Table 4.3: Results of the Lag Length Criteria

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Lag | LogL | LR | FPE | AIC | SC | HQ |
| 0 | -497.3948 | NA | 4.78e+08 | 31.33717 | 31.52039 | 31.39790 |
| 1 | -422.7284 | 125.9995\* | 12352146 | 27.55592\* | 28.58661\* | 27.97418\* |
| 2 | -404.8946 | 25.63601 | 11602353\* | 27.67052 | 29.20487 | 28.10250 |

Source: Author’s computation using E-views (2020)

 \* indicates lag order selected by the criterion

 LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

The results from the table shows the different criterions and the lag length chosen. The sequential modified LR test statistic, Akaike information criterion, Schwarz information criterion and Hannan-Quinn information criterion all selected the lag length 1. But since Akaike information criterion gave us the smallest figure out of the other criterions, we can proceed to use 1 as our lag length.

**4.3.3 Auto Regressive Distributed Lag (ARDL)**

This estimation technique is suitable when after computing the unit root test and the order of integration are stationary both at levels I(0) and first difference I(1).

**4.3.4 Bounds Co-Integration Test**

Bound test is usually conducted in order to determine if there is a long run relationship among the variables. If the value for F-statistics is greater than the upper bounds and lower bounds of the critical values at 5%, we reject the null hypothesis that there is no cointegration and this implies they is long run relationship between the variables.

H0: There is no long run relationship among the variables

H1: There is a long run relationship among the variables

Table 4.4: Bounds Co-Integration Test Result

|  |  |  |
| --- | --- | --- |
| Test Statistic | Value | K |
| F-statistic | 3.420134 | 3 |
| Critical Value Bounds | | |
| Significance | I0 Bound | I1 Bound |
| 10% | 2.72 | 3.77 |
| 5% | 3.23 | 4.35 |
| 2.5% | 3.69 | 4.89 |
| 1% | 4.29 | 5.61 |

**Source: Author’s computed result from E-views (2020)**

From the bounds co-integration test result above, the F-statistic which is 3.420134 is greater than the lower bound (I0) test at 5% level of significance of critical value which is 3.23 but lesser than the upper bound (I1) test at 5% level of significance of critical value. This result is said to be inconclusive because the value of F-statistic is in between the upper bound and lower bound values. The long run and short run relationship will then have to be estimated using the Auto-regressive Distributed Lag model.

**4.3.5 Short Run and Long Run Model Estimation**

Table 4.5: Short Run Auto-regressive Distributed Lag (ARDL)

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | Coefficient | t-Statistic | Prob. |
| D(EXR) | -0.065807 | -1.955818 | 0.0609 |
| D(INT) | 0.217337 | 1.443336 | 0.1604 |
| D(INF) | -0.049945 | -1.260395 | 0.2183 |
| C | |  | | --- | | 0.959125 | | |  | | --- | | 0.367442 | | |  | | --- | | 0.7162 | |
| CointEq (-1) | -0.651216 | -3.820086 | |  | | --- | | 0.0007 | |

**Source: Author’s computed result done with E-views (2020)**

The estimated short run model is:

GRGDP= 3.137276-0.065807EXR+0.217337INT-0.049945INF

Table 4.5 shows that the difference of exchange rate had a negative effect on the growth rate of real gross domestic product with an elasticity of -0.065807. Hence, a one percent increase in the difference of exchange rate will lead to a decrease in the growth rate of real gross domestic product by 6.6%. However, this impact is insignificant at the 5% level of significance.

The difference of interest rate had a positive effect on the growth rate of real gross domestic product with an elasticity of 0.217337. Hence, a one percent increase in the difference of interest rate will cause the growth rate of real gross domestic product to increase by 21.7%. However, this impact is also insignificant at the 5% level of significance.

The difference of inflation rate had a negative impact on the growth rate of real gross domestic product with an elasticity of -0.049945. This simply indicates that a one percent increase in the difference of inflation rate will cause the growth rate of real gross domestic product to decrease by 4.99%. This impact too is seen as being insignificant at the 5% level of significance.

The error correction model which is usually represented as CointEq (-1) in ARDL format as expected is negative and significant and has a coefficient of -0.651216 which means that the growth rate of real gross domestic product is above the equilibrium level. Meaning if there is a displacement in the economy, it would require a speed of adjustment of 0.65 to get the variables back to the equilibrium level which is 65% and when dividing by 100 gives you about 1 year and 5 months for the economy to be able to adjust.

Table 4.6: Long Run Auto Regressive Distributed Lag (ARDL)

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | Coefficient | t-Statistic | Prob. |
| EXR | 0.017948 | 1.209271 | 0.2370 |
| INT | 0.333740 | 1.389162 | 0.1761 |
| INF | -0.076695 | -1.368447 | 0.1825 |
| C | 1.472820 | 0.381511 | 0.7058 |
| |  |  | | --- | --- | | R-squared | 0.385761 | | Adjusted R-squared | 0.272013 |  |  |  | | --- | --- | | F-statistic | 3.391368 | | Prob(F-statistic) | 0.016621 |   0   |  |  | | --- | --- | | Durbin-Watson stat | ]1.729313 | | | | |

**Source: Author’s computed result done with E-views (2020)**

The estimated long run model is:

GRGDP= 1.472820+0.017948EXR+0.333740INT-0.076695INF

From Table 4.6, exchange rate has a positive coefficient of 0.017948 which means it has a positive effect on the growth rate in real gross domestic product with an elasticity of 0.017948. Hence, a one percent increase in exchange will cause the growth rate in real gross domestic product to increase by 1.8%. This impact is insignificant at the 5% level of significance.

Interest rate has a positive coefficient of 0.333740 which also means it has a positive effect on the growth rate in real gross domestic product with an elasticity of 0.333740. Hence, a one percent increase in the interest rate will cause the growth rate in real gross domestic product to increase by 33.4%. This impact is insignificant at the 5% level of significance.

Inflation rate has a negative coefficient of -0.076695 which means it has a negative effect in the growth rate in real gross domestic product. Hence, a one percent increase in inflation rate will cause the growth rate in real gross domestic product to decrease by 7.6695%. This impact is insignificant at the 5% level of significance.

**4.3.6 Adjusted Coefficient of Determination**

The Adjusted R2 is used for this study because this study deals with multiple regression unlike R2 which is for simple regression. The regression result shows that Adjusted R2 is 0.272013. It explains that 27.2013% of the variation in the dependent variable, growth rate in real gross domestic product is explained by the independent variables (exchange rate, interest rate and inflation rate) while 72.7987% is not explained for by the independent variables which will be accounted for by the error term.

**4.3.7: T-statistic/T-test**

H0: the variable is not significant

H1: the variable is significant

The decision rule is that if the probability value of the t-statistic is lesser than 0.05 level of significance, reject the null hypothesis

Table 4.7: T-test

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variables** | **Short run**  **t- Statistic** | **Short run**  **Prob.(t-statistic)** | **Long run**  **t- Statistic** | **Long run**  **Prob.(t-statistic)** |
| EXR | -1.955818 | 0.0609 | 1.209271 | 0.2370 |
| INT | 1.443336 | 0.1604 | 1.389162 | 0.1761 |
| INF | -1.260395 | 0.2183 | -1.368447 | 0.1825 |

Source: Author’s computation using E-views (2020)

Table 4.7 shows that all the variables with their various t-statistic values and probability values are not significant because its probability value is greater than 0.05.

**4.3.8 F-test or F-statistic**

The F-statistics measures the overall statistical significance of the variables. It is used to check for the joint significance of the model.

H0: There is no statistical significance

H1: There is statistical significance

The decision rule is that if the probability value of the F-statistics is lesser that 0.05 level of significance, reject the null hypothesis

Table 4.8: F-test

|  |  |  |
| --- | --- | --- |
| Model | F-statistic | Prob. (F-stat) |
| 1 | |  | | --- | | 3.391368 | |  | | |  | | --- | | 0.016621 | |

Source: Author’s computation using E-views (2020)

The value of the F-statistic as shown in Table 4.8 is 3.391368 with the probability of F-statistic as 0.016621, this indicates that the model is significant because it is less than 5% level of significance. Hence, the independent variables (exchange rate, interest rate and inflation rate) jointly explain the changes in the dependent variable, growth rate in real gross domestic product.

**4.4 Post Estimation Tests**

Table 4.9 Results of the Post Estimation Tests

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Post Estimation Tests | Tests Conducted | F-Statistics | Probability of F-Statistics | Test Results |
| Test for Heteroskedasticity | Breusch-Pagan-Godfrey | 1.33 | 0.28 | There is no heteroskedasticity |
| Test for Linearity | Ramsey RESET Test | 0.04 | 0.84 | There is no linearity |
| Test for Normality | Jarque-Bera Normality Test | 3.77 | 0.15 | There is normality |
| Test for serial correlation | Breusch-Godfrey Serial Correlation LM Test | 1.47 | 0.25 | There is no serial correlation |

urce: Author’s computation using E-views (2020)

**4.4.1 Test for Heteroskedasticity**

The Breusch-Pagan-Godfrey heteroskedasticity test is used to test for heteroscedasticity and it is centered on the variance of the error term. This test helps to ascertain whether the variance of the error term is constant.

The hypotheses are stated below:

H0: Homoscedasticity (there is constant variance in the error term)

H1: Heteroscedasticity (there is no constant variance in the error term)

The decision rule is that if the probability of the F-statistic is greater than 0.05 level of significance, do not reject the null hypothesis of homoscedasticity

Table 4.10: Result of Heteroscedasticity Test

|  |  |  |  |
| --- | --- | --- | --- |
| F-statistic | 1.329227 | Prob. F(5,27) | 0.2818 |
| Obs\*R-squared | 6.518503 | Prob. Chi-Square(5) | 0.2590 |
| Scaled explained SS | 7.894118 | Prob. Chi-Square(5) | 0.1622 |

Source: Author’s computation using E-views (2020)

The F-statistic value is 1.33 and the probability of the F-statistic is 0.28 which is not significant at 5%, therefore do not reject null hypothesis which states that there is no heteroskedasticity. Therefore, we conclude that there is no heteroskedasticity.

**4.4.2 Test for Linearity**

The Ramsey reset test is used to test for linearity in a model. The Ramsey Reset test jointly explains whether the coefficient in the predicted squared or predicted cubed as the case may be equals to zero. The decision criteria for linearity is to reject the null hypothesis when the probability of the F-statistics is less than 0.05.

The hypothesis is stated below:

H0: Linearity

H1: No linearity

Table 4.11 Result of Ramsey Reset test

|  |  |  |  |
| --- | --- | --- | --- |
| TEST | Value | df | Probability |
| t-statistic | 0.201252 | 26 | 0.8421 |
| F-statistic | 0.040502 | (1, 26) | 0.8421 |

Source: Author’s computation using E-views (2020)

The F-statistic value is 0.04 and the probability of the F-statistic is 0.84 which is insignificant at 5%, therefore we do not reject the null hypothesis which states that there is linearity. Therefore, we conclude that there is linearity.

**4.4.3 Test for Normality**

The Jarque-Bera Normality Test was used to carry out the normality test. The hypotheses of the test are stated below:

H0: the sample data are normally distributed (Normality)

H1: the sample data are not normally distributed (Non-normality)

The decision rule is that if the probability value is lesser than 0.05 level of significance, reject the null hypothesis.



Source: Author’s computation using E-views (2020)

Figure 4.9 Normality Histogram

This test was carried out to check if there is a normal distribution among variables. The Jarque-Bera statistic value is 3.77 and the probability of the Jarque-Bera statistic is 0.15 which is not significant at 5%, therefore do not reject null hypothesis which states that there is normality. Therefore, we conclude that there is normality.

**4.4.4 Serial LM test**

This test was aimed at ascertaining if the errors are correlated. In order to achieve this, the Breusch-Godfrey Serial correlation LM test will be employed. The decision rule is that if the probability of the F-statistic is greater than 0.05 level of significance, do not reject the null hypothesis and reject the null hypothesis if the probability of the F-statistic is lesser than 0.05 level of significance.

The hypothesis is stated below:

H0: No serial correlation

H1: Serial correlation

Table 4.12-Results of Breusch-Godfrey Serial Correlation LM Test Result

|  |  |  |  |
| --- | --- | --- | --- |
| F-statistic | 1.472246 | Prob. F(2,25) | 0.2486 |
| Obs\*R-squared | 3.477188 | Prob. Chi-Square(2) | 0.1758 |

Source: Authors computation using E-views (2020)

The F-statistic value is 1.47 and the probability of the F-statistic is 0.25 which is not significant at 5%, therefore do not reject null hypothesis which states that there is no serial correlation. Therefore, we conclude that there is no serial correlation.

**4.4.5 Durbin Watson Model**

This test was performed to determine the level of auto-correlation.

H0: No Auto correlation

H1: Auto correlation

Decision Rule

1. If dU < d\* < 4 – dL, we do not reject the null hypothesis that there is no presence of autocorrelation.
2. If d\*> (4 – dL), we reject the null hypothesis and accept that there is negative autocorrelation of first order.
3. If 0< d\* < (4 - dU), we reject the null hypothesis and accept that there is positive autocorrelation.

Where; dL =lower limit

dU = upper limit

d\* = Durbin Watson calculated statistic

Table 4.13 Results of the Durbin Watson Test Results

|  |  |  |  |
| --- | --- | --- | --- |
| D\* | D-UPPER | D-LOWER | DECISION |
| 1.729313 | 1.73 | 1.21 | Positive autocorrelation |

Source: Authors computation using E-views (2020)

Table 5.7 shows that dL =1.21, dU=1.73 and d\*=1.729313. Hence, 0< d\* < (4 - dU), that is, 0 < 1.729313 < 2.27 we therefore reject the null hypothesis and accept that there is positive autocorrelation in the model.

**4.4.6 Discussion of Findings**

Exchange rate fluctuation had negative impact on economic growth in the short run and a positive impact in the long run. However, it was insignificant in both the short and long run. Thus, the fluctuation in the exchange rate has not had any significant impact on improving the economic growth of Nigeria. We do not reject the null hypothesis that exchange rate fluctuation has no significant impact on economic growth in Nigeria. The positive relationship doesn’t conform to the a-priori expectation, implying that an increase in the exchange rate will bring about an increase in the real gross domestic product. This result is consistent with the work of Abimlech, Wang et al (2017), Okorontah et al (2016), Adeyemi (2019), Adeniran (2014) and Obansa (2013) which revealed that there was no significant relationship between the variables both in the short and long run. The findings partly support the work of Zeyneb, Fatima et al (2017) who found a positive relationship between the variables although preferences were placed on fixed exchange rate regimes in achieving the highest growth rate. Also, the work of Achouak (2018) who found a negative impact between the variables concluding that the effect of exchange rate volatility depends on the exchange rate regimes i.e. volatility is more harmful when countries adapt flexible exchange rate regimes. However, this work is inconsistent with the work of Lawal, Atunde, Ahmed et al (2016) who found a positive and negative impact on the variables in the short and long run respectively. In Nawan (2017) findings, it shows that both variables were negative in both the short and the long run and the result is said to be significant as well. Also, Nnanna (2015), Kenny (2019), Clement (2017), Himani (2019) and Sontonye (2017) who found a negative a significant relationship between the variables. While Jakob (2016), Obisesan (2019) and Adekunle (2018) had a positive and significant relationship between the variables.

Interest rate had a positive impact on economic growth both in the short run and long run although they were both insignificant. We do not reject the null hypothesis that H0: Exchange rate fluctuation has no significant impact on economic growth in Nigeria interest rate has no significance impact on economic growth in Nigeria. This positive relationship does not conform to the a-priori expectation, implying that an increase in interest rate will bring about an increase in real gross domestic product. This finding was in line with the work of Nicholas (2017) in his study in Kenya found a positive long run effect among his variables. The work of Adeniran (2014) was inconsistent with the finding since his result showed a negative impact although it was insignificant as well.

Inflation rate had a negative impact on economic growth both in the short run and the long run although the result was shown to be both insignificant. We do not reject the null hypothesis that inflation rate has no significant impact on economic growth in Nigeria. This negative relationship conforms to the a-priori expectation, implying that an increase in inflation rate will lead to a decrease in the real gross domestic product. This finding went in line with that of Adeniran (2017), Obisesan (2019) and Adekunle (2018) whose results showed a negative an insignificant relationship between the variables. Although this finding was not consistent with that of Nicholas (2017) whose result showed a positive long run effect on the variables.

Different outcomes between this paper and some previous studies may be attributable to model specifications, variables definition and measurements, sample period, methodologies used in empirical works etc.

The Naira rate has no significant impact on economic growth in Nigeria. This is true owing to the fact that the Nigerian currency (Naira) has been weakening against the dollar. This could be attributable to government overdependence on loan and high rate of importation. It is a traditionally known truth that if Country A exports goods to country B more than it imports from country B, the value of Country A’s currency will be strengthening against that of Country B, and vice versa.

The empirical results as shown in the result of the ARDL estimates and Error correction model shows the exchange rate fluctuation has no effect on economic growth in the long run though a short run relationship exist between the two.

**CHAPTER FIVE**

**SUMMARY, CONCLUSION AND RECOMMENDATIONS**

**5.1 Summary of the Study**

The study examined the impact of exchange rate fluctuation on economic growth in Nigeria. The main objective of the study is to assess the impact of exchange rate fluctuation on economic growth in Nigeria between 1985 and 2018, which makes it unique from previous studies. Exchange rate, interest rate, inflation rate and growth rate of real gross domestic product were the variables used during the course of this study.

The study was structured into five chapters. Chapter one delved into the background of the study identified the problems, defined the objectives and hypotheses to guide the investigation. The chapter also provided justification for the study and described its scope. Chapter two focused on three major components namely the conceptual review, theoretical review and the empirical review. Chapter three focused on the research methodology. A model was specified in this chapter as well as the measurement and description of variables. Chapter four presented the data, analyzed it, and subjected the time series data to econometric test.

The regression result shows that Adjusted R2 is 0.272013. This implies that the independent variables (exchange rate, interest rate and inflation rate) was able to explain 27.2013% of the total variation in the dependent variable (growth rate in real gross domestic product) while 72.7987% not explained for by the independent variables was accounted for by the error term.

**5.2 Implications of Findings**

The findings of the study have implications for policymakers, researchers in the academia and industry as well as general public. The results showed that exchange rate fluctuation has a negative effect in decision making among key players in the foreign exchange market, implying that government needs to formulate policies that will stabilize her exchange rate as to increase investors’ confidence in the Naira, hence an increase in the value of foreign direct investment vis a vis economic growth.

Nigeria might need to review its exchange rate policy as it is currently not favorable to foreign investors and domestic manufacturers which relies mainly on importation for raw materials. Indigenous manufacturers often complain of continued increase in the cost of raw materials as a result of an increase in the cost of foreign exchange, while investor tend to lose the value of their investment as a result of a fall in Naira to international currency. Unfriendly exchange rate regime results to decline in foreign direct investment and the ability of local manufacturers to expand.

The implication of the result is that in the short run when economic growth is the target of policy makers, manipulating the exchange rate regime will induce an increase in GRGDP though this relationship dissolves in the long run. We do not therefore reject the null hypothesis for each of the variables showing that they have no significant impact on economic growth.

**5.3 Conclusion**

From the findings, it is safe to conclude however, that Naira rate has great role to play in the achievement of a sustained economic growth in Nigeria because the Naira rate is one of the major determinants of price level of goods and services in Nigeria especially as most consumer goods in Nigeria are imported.

**5.4 Recommendations**

The study suggests that policy makers should come up with adequate strategic policy that will stabilize the foreign exchange rate as well as other major macro-economic variable so as to achieve growth and development in the economy. Some of the policies suggested include:

1. Austere foreign exchange control policies ought to be put in place with the intention to assist in appropriate determination of the value of the exchange rate. This will in the long run help to strengthen the value of the naira

2. Interest rate needs to be maintained at its minimum in order that the purchasing power of the average Nigerian will increase.

3. High dependence on import needs to be discouraged by the impositions of stern tariffs.

4. An adequate and appropriate environment and infrastructural facility needs to be kept in place so as to attract foreign investors thereby leading to foreign direct investment. This will thereby lead to job creation, employment opportunities and at the long run improve the people’s standard of living.

5. Lastly the government needs to induce the foreign exchange rate by enacting positive economic reforms that will minimize the unfavorable effect of fluctuation of the exchange rate on the Nigerian economy with respect to trade flows and economic growth.

**5.5 Contribution of knowledge**

The study contributed to knowledge by carrying out a detailed examination of the socio-economic development sustainability through exchange rate, reasons for fluctuation in exchange rate, challenges with exchange rate policies in Nigeria, etc. The study also shed light to monetary authorities on better techniques of exchange rate management and ways to maintain a stable exchange rate.

It provides a link to the empirical results which explains that the contribution of exchange rate is insignificant to the nation’s growth rate of gross domestic product. The monetary authorities need to develop policies that clearly and purposefully eliminate impediments to achieving stable exchange.

**5.6 Limitation of the Study**

The main limitation of this study is sourcing for data and time constraint. The time allotted for the completion of this research is not adequate based on recent and contemporary happening with respect to the impact of exchange rate fluctuation on economic growth in Nigeria.

Finance is one of the elements that assist a good research. Financial constraint caused difficulties in the process of this research work; however, it did not hinder the research.

**5.7 Suggestions for Further Studies**

In order to broaden literature on exchange rate, the study suggests that further research should extend the coverage of the study to West African nations to examine the extent to which exchange rate fluctuation impacts economic output of these countries.

The relationship between crude oil price and exchange rate volatility is yet to be explored by prior studies. Thus, further studies are encouraged to assess the international price of crude and its impact on exchange rate of oil producing nations.

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**APPENDIX**

Appendix 1: Tabular presentation of data set

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| YEARS | GRGDP | EXR | INT | INF |
| 1985 | 8.52483 | 0.8938 | 9.75 | 1.03093 |
| 1986 | 1.89966 | 2.0206 | 9.75 | 13.6735 |
| 1987 | 0.17024 | 4.0179 | 15.1 | 9.69479 |
| 1988 | 6.23327 | 4.5367 | 13.7 | 61.2111 |
| 1989 | 6.65606 | 7.3916 | 21.4 | 44.6701 |
| 1990 | 11.6276 | 8.0378 | 22.1 | 3.61404 |
| 1991 | -0.552 | 9.9095 | 20.1 | 22.9597 |
| 1992 | 2.19349 | 17.2984 | 22.1 | 48.802 |
| 1993 | 1.56881 | 22.0511 | 23.99 | 61.2623 |
| 1994 | 0.25657 | 21.8861 | 15 | 76.7589 |
| 1995 | 1.87235 | 21.8861 | 13.96 | 51.5913 |
| 1996 | 4.05203 | 21.8861 | 13.43 | 14.3143 |
| 1997 | 2.88592 | 21.8861 | 7.455 | 10.2133 |
| 1998 | 2.4956 | 21.8861 | 9.98 | 11.9129 |
| 1999 | 0.52184 | 92.6934 | 12.59 | 0.22361 |
| 2000 | 5.5185 | 102.1052 | 10.67 | 14.527 |
| 2001 | 6.66685 | 111.9433 | 9.98 | 16.4949 |
| 2002 | 14.6044 | 120.9702 | 16.5 | 12.1685 |
| 2003 | 9.50261 | 129.3565 | 13.04 | 23.8114 |
| 2004 | 10.442 | 133.5004 | 13.32 | 10.0085 |
| 2005 | 7.00846 | 132.1470 | 10.82 | 11.5652 |
| 2006 | 6.72597 | 128.6516 | 8.35 | 8.54872 |
| 2007 | 7.31808 | 125.8331 | 8.1025 | 6.56395 |
| 2008 | 7.19929 | 118.5669 | 11.84390985 | 15.0556 |
| 2009 | 8.35334 | 148.8802 | 12.84833333 | 13.9296 |
| 2010 | 9.53979 | 150.2980 | 5.669765739 | 11.8 |
| 2011 | 5.30792 | 153.8616 | 4.70487117 | 10.283 |
| 2012 | 4.20589 | 157.4994 | 7.180837526 | 11.9811 |
| 2013 | 5.48779 | 157.3112 | 5.535192533 | 7.95688 |
| 2014 | 6.22294 | 158.5526 | 9.16 | 7.9783 |
| 2015 | 2.7864 | 193.2792 | 8.677635705 | 9.55 |
| 2016 | -1.5831 | 253.4923 | 6.221666667 | 18.55 |
| 2017 | 0.82399 | 305.7901 | 10.88 | 15.3716 |
| 2018 | 1.93 | 306.0802 | 10.30586615 | 11.4 |

**SOURCE:** CBN Statistical Bulletin, 2020.

Appendix 2: GRGDP (ADF)- LEVELS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: GRGDP has a unit root | | | |  |
| Exogenous: Constant | | |  |  |
| Lag Length: 0 (Automatic - based on SIC, maxlag=8) | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  | t-Statistic | Prob.\* |
|  |  |  |  |  |
|  |  |  |  |  |
| Augmented Dickey-Fuller test statistic | | | -3.239590 | 0.0265 |
| Test critical values: | 1% level |  | -3.646342 |  |
|  | 5% level |  | -2.954021 |  |
|  | 10% level |  | -2.615817 |  |
|  |  |  |  |  |
|  |  |  |  |  |
| \*MacKinnon (1996) one-sided p-values. | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Augmented Dickey-Fuller Test Equation | | | |  |
| Dependent Variable: D(GRGDP) | | |  |  |
| Method: Least Squares | | |  |  |
| Date: 02/13/20 Time: 00:10 | | |  |  |
| Sample (adjusted): 1986 2018 | | |  |  |
| Included observations: 33 after adjustments | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| GRGDP(-1) | -0.501874 | 0.154919 | -3.239590 | 0.0029 |
| C | 2.332910 | 0.976363 | 2.389389 | 0.0231 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.252921 | Mean dependent var | | -0.199843 |
| Adjusted R-squared | 0.228822 | S.D. dependent var | | 3.825833 |
| S.E. of regression | 3.359722 | Akaike info criterion | | 5.320286 |
| Sum squared resid | 349.9198 | Schwarz criterion | | 5.410983 |
| Log likelihood | -85.78471 | Hannan-Quinn criter. | | 5.350802 |
| F-statistic | 10.49495 | Durbin-Watson stat | | 1.910414 |
| Prob(F-statistic) | 0.002855 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 3: GRGDP (ADF) – 1ST DIFFERENCE

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: D(GRGDP) has a unit root | | | |  |
| Exogenous: Constant | | |  |  |
| Lag Length: 0 (Automatic - based on SIC, maxlag=8) | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  | t-Statistic | Prob.\* |
|  |  |  |  |  |
|  |  |  |  |  |
| Augmented Dickey-Fuller test statistic | | | -7.607992 | 0.0000 |
| Test critical values: | 1% level |  | -3.653730 |  |
|  | 5% level |  | -2.957110 |  |
|  | 10% level |  | -2.617434 |  |
|  |  |  |  |  |
|  |  |  |  |  |
| \*MacKinnon (1996) one-sided p-values. | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Augmented Dickey-Fuller Test Equation | | | |  |
| Dependent Variable: D(GRGDP,2) | | | |  |
| Method: Least Squares | | |  |  |
| Date: 02/12/20 Time: 15:05 | | |  |  |
| Sample (adjusted): 1987 2018 | | |  |  |
| Included observations: 32 after adjustments | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| D(GRGDP(-1)) | -1.271970 | 0.167189 | -7.607992 | 0.0000 |
| C | -0.064502 | 0.639700 | -0.100831 | 0.9204 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.658631 | Mean dependent var | | 0.241599 |
| Adjusted R-squared | 0.647252 | S.D. dependent var | | 6.080775 |
| S.E. of regression | 3.611528 | Akaike info criterion | | 5.466600 |
| Sum squared resid | 391.2939 | Schwarz criterion | | 5.558209 |
| Log likelihood | -85.46560 | Hannan-Quinn criter. | | 5.496966 |
| F-statistic | 57.88154 | Durbin-Watson stat | | 2.103100 |
| Prob(F-statistic) | 0.000000 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 4: EXR (ADF) – LEVELS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: EXR has a unit root | | | |  |
| Exogenous: Constant | | |  |  |
| Lag Length: 0 (Automatic - based on SIC, maxlag=8) | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  | t-Statistic | Prob.\* |
|  |  |  |  |  |
|  |  |  |  |  |
| Augmented Dickey-Fuller test statistic | | | 1.385172 | 0.9985 |
| Test critical values: | 1% level |  | -3.646342 |  |
|  | 5% level |  | -2.954021 |  |
|  | 10% level |  | -2.615817 |  |
|  |  |  |  |  |
|  |  |  |  |  |
| \*MacKinnon (1996) one-sided p-values. | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Augmented Dickey-Fuller Test Equation | | | |  |
| Dependent Variable: D(EXR) | | |  |  |
| Method: Least Squares | | |  |  |
| Date: 01/24/20 Time: 15:07 | | |  |  |
| Sample (adjusted): 1986 2018 | | |  |  |
| Included observations: 33 after adjustments | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| EXR(-1) | 0.056852 | 0.041043 | 1.385172 | 0.1759 |
| C | 3.975820 | 4.982491 | 0.797958 | 0.4310 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.058286 | Mean dependent var | | 9.248073 |
| Adjusted R-squared | 0.027908 | S.D. dependent var | | 18.73362 |
| S.E. of regression | 18.47036 | Akaike info criterion | | 8.728903 |
| Sum squared resid | 10575.78 | Schwarz criterion | | 8.819601 |
| Log likelihood | -142.0269 | Hannan-Quinn criter. | | 8.759420 |
| F-statistic | 1.918703 | Durbin-Watson stat | | 1.577267 |
| Prob(F-statistic) | 0.175887 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 5: EXR (ADF) – 1ST DIFFERNCE

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: D(EXR) has a unit root | | | |  |
| Exogenous: Constant | | |  |  |
| Lag Length: 0 (Automatic - based on SIC, maxlag=8) | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  | t-Statistic | Prob.\* |
|  |  |  |  |  |
|  |  |  |  |  |
| Augmented Dickey-Fuller test statistic | | | -4.039878 | 0.0038 |
| Test critical values: | 1% level |  | -3.653730 |  |
|  | 5% level |  | -2.957110 |  |
|  | 10% level |  | -2.617434 |  |
|  |  |  |  |  |
|  |  |  |  |  |
| \*MacKinnon (1996) one-sided p-values. | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Augmented Dickey-Fuller Test Equation | | | |  |
| Dependent Variable: D(EXR,2) | | |  |  |
| Method: Least Squares | | |  |  |
| Date: 01/24/20 Time: 15:09 | | |  |  |
| Sample (adjusted): 1987 2018 | | |  |  |
| Included observations: 32 after adjustments | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| D(EXR(-1)) | -0.705341 | 0.174595 | -4.039878 | 0.0003 |
| C | 6.694346 | 3.658768 | 1.829672 | 0.0773 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.352340 | Mean dependent var | | -0.026149 |
| Adjusted R-squared | 0.330752 | S.D. dependent var | | 22.53345 |
| S.E. of regression | 18.43408 | Akaike info criterion | | 8.726740 |
| Sum squared resid | 10194.45 | Schwarz criterion | | 8.818349 |
| Log likelihood | -137.6278 | Hannan-Quinn criter. | | 8.757106 |
| F-statistic | 16.32061 | Durbin-Watson stat | | 1.918430 |
| Prob(F-statistic) | 0.000342 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 6: INF (ADF) – LEVELS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: INF has a unit root | | | |  |
| Exogenous: Constant | | |  |  |
| Lag Length: 4 (Automatic - based on SIC, maxlag=8) | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  | t-Statistic | Prob.\* |
|  |  |  |  |  |
|  |  |  |  |  |
| Augmented Dickey-Fuller test statistic | | | -1.116679 | 0.6954 |
| Test critical values: | 1% level |  | -3.679322 |  |
|  | 5% level |  | -2.967767 |  |
|  | 10% level |  | -2.622989 |  |
|  |  |  |  |  |
|  |  |  |  |  |
| \*MacKinnon (1996) one-sided p-values. | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Augmented Dickey-Fuller Test Equation | | | |  |
| Dependent Variable: D(INF) | | |  |  |
| Method: Least Squares | | |  |  |
| Date: 01/24/20 Time: 15:10 | | |  |  |
| Sample (adjusted): 1990 2018 | | |  |  |
| Included observations: 29 after adjustments | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| INF(-1) | -0.179673 | 0.160899 | -1.116679 | 0.2757 |
| D(INF(-1)) | 0.325199 | 0.179584 | 1.810841 | 0.0832 |
| D(INF(-2)) | -0.438907 | 0.156930 | -2.796834 | 0.0102 |
| D(INF(-3)) | 0.140149 | 0.141262 | 0.992127 | 0.3315 |
| D(INF(-4)) | -0.350896 | 0.133295 | -2.632466 | 0.0149 |
| C | 3.151577 | 3.859648 | 0.816545 | 0.4226 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.549488 | Mean dependent var | | -1.147243 |
| Adjusted R-squared | 0.451551 | S.D. dependent var | | 14.68914 |
| S.E. of regression | 10.87839 | Akaike info criterion | | 7.793425 |
| Sum squared resid | 2721.805 | Schwarz criterion | | 8.076314 |
| Log likelihood | -107.0047 | Hannan-Quinn criter. | | 7.882022 |
| F-statistic | 5.610612 | Durbin-Watson stat | | 1.742970 |
| Prob(F-statistic) | 0.001599 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 7: INF (ADF) – 1ST DIFFERENCE

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: D(INF) has a unit root | | | |  |
| Exogenous: Constant | | |  |  |
| Lag Length: 3 (Automatic - based on SIC, maxlag=8) | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  | t-Statistic | Prob.\* |
|  |  |  |  |  |
|  |  |  |  |  |
| Augmented Dickey-Fuller test statistic | | | -5.230523 | 0.0002 |
| Test critical values: | 1% level |  | -3.679322 |  |
|  | 5% level |  | -2.967767 |  |
|  | 10% level |  | -2.622989 |  |
|  |  |  |  |  |
|  |  |  |  |  |
| \*MacKinnon (1996) one-sided p-values. | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Augmented Dickey-Fuller Test Equation | | | |  |
| Dependent Variable: D(INF,2) | | |  |  |
| Method: Least Squares | | |  |  |
| Date: 01/24/20 Time: 15:11 | | |  |  |
| Sample (adjusted): 1990 2018 | | |  |  |
| Included observations: 29 after adjustments | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| D(INF(-1)) | -1.654890 | 0.316391 | -5.230523 | 0.0000 |
| D(INF(-1),2) | 0.882225 | 0.235819 | 3.741110 | 0.0010 |
| D(INF(-2),2) | 0.332254 | 0.179824 | 1.847669 | 0.0770 |
| D(INF(-3),2) | 0.413988 | 0.121348 | 3.411577 | 0.0023 |
| C | -0.509167 | 2.047611 | -0.248664 | 0.8057 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.715498 | Mean dependent var | | 0.433430 |
| Adjusted R-squared | 0.668080 | S.D. dependent var | | 18.97891 |
| S.E. of regression | 10.93422 | Akaike info criterion | | 7.777257 |
| Sum squared resid | 2869.371 | Schwarz criterion | | 8.012998 |
| Log likelihood | -107.7702 | Hannan-Quinn criter. | | 7.851088 |
| F-statistic | 15.08945 | Durbin-Watson stat | | 1.767969 |
| Prob(F-statistic) | 0.000003 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 8: INT (ADF) – LEVELS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: INT has a unit root | | | |  |
| Exogenous: Constant | | |  |  |
| Lag Length: 0 (Automatic - based on SIC, maxlag=8) | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  | t-Statistic | Prob.\* |
|  |  |  |  |  |
|  |  |  |  |  |
| Augmented Dickey-Fuller test statistic | | | -2.132536 | 0.2339 |
| Test critical values: | 1% level |  | -3.646342 |  |
|  | 5% level |  | -2.954021 |  |
|  | 10% level |  | -2.615817 |  |
|  |  |  |  |  |
|  |  |  |  |  |
| \*MacKinnon (1996) one-sided p-values. | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Augmented Dickey-Fuller Test Equation | | | |  |
| Dependent Variable: D(INT) | | |  |  |
| Method: Least Squares | | |  |  |
| Date: 01/24/20 Time: 15:12 | | |  |  |
| Sample (adjusted): 1986 2018 | | |  |  |
| Included observations: 33 after adjustments | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| INT(-1) | -0.254377 | 0.119284 | -2.132536 | 0.0410 |
| C | 3.130338 | 1.578359 | 1.983286 | 0.0563 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.127933 | Mean dependent var | | 0.016844 |
| Adjusted R-squared | 0.099801 | S.D. dependent var | | 3.630914 |
| S.E. of regression | 3.444967 | Akaike info criterion | | 5.370398 |
| Sum squared resid | 367.9018 | Schwarz criterion | | 5.461095 |
| Log likelihood | -86.61156 | Hannan-Quinn criter. | | 5.400914 |
| F-statistic | 4.547709 | Durbin-Watson stat | | 2.096297 |
| Prob(F-statistic) | 0.040990 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 9: INT (ADF) – 1ST DIFFERENCE

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: D(INT) has a unit root | | | |  |
| Exogenous: Constant | | |  |  |
| Lag Length: 0 (Automatic - based on SIC, maxlag=8) | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  | t-Statistic | Prob.\* |
|  |  |  |  |  |
|  |  |  |  |  |
| Augmented Dickey-Fuller test statistic | | | -6.587778 | 0.0000 |
| Test critical values: | 1% level |  | -3.653730 |  |
|  | 5% level |  | -2.957110 |  |
|  | 10% level |  | -2.617434 |  |
|  |  |  |  |  |
|  |  |  |  |  |
| \*MacKinnon (1996) one-sided p-values. | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Augmented Dickey-Fuller Test Equation | | | |  |
| Dependent Variable: D(INT,2) | | |  |  |
| Method: Least Squares | | |  |  |
| Date: 01/24/20 Time: 15:12 | | |  |  |
| Sample (adjusted): 1987 2018 | | |  |  |
| Included observations: 32 after adjustments | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| D(INT(-1)) | -1.182975 | 0.179571 | -6.587778 | 0.0000 |
| C | 0.023832 | 0.651760 | 0.036566 | 0.9711 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.591274 | Mean dependent var | | -0.017942 |
| Adjusted R-squared | 0.577650 | S.D. dependent var | | 5.672907 |
| S.E. of regression | 3.686736 | Akaike info criterion | | 5.507821 |
| Sum squared resid | 407.7606 | Schwarz criterion | | 5.599430 |
| Log likelihood | -86.12514 | Hannan-Quinn criter. | | 5.538187 |
| F-statistic | 43.39882 | Durbin-Watson stat | | 1.998619 |
| Prob(F-statistic) | 0.000000 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 10: GRGDP (PPTEST) – LEVELS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: GRGDP has a unit root | | | |  |
| Exogenous: Constant | | |  |  |
| Bandwidth: 2 (Newey-West automatic) using Bartlett kernel | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  | Adj. t-Stat | Prob.\* |
|  |  |  |  |  |
|  |  |  |  |  |
| Phillips-Perron test statistic | | | -3.346334 | 0.0206 |
| Test critical values: | 1% level |  | -3.646342 |  |
|  | 5% level |  | -2.954021 |  |
|  | 10% level |  | -2.615817 |  |
|  |  |  |  |  |
|  |  |  |  |  |
| \*MacKinnon (1996) one-sided p-values. | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Residual variance (no correction) | | | | 10.60363 |
| HAC corrected variance (Bartlett kernel) | | | | 11.92963 |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Phillips-Perron Test Equation | | |  |  |
| Dependent Variable: D(GRGDP) | | |  |  |
| Method: Least Squares | | |  |  |
| Date: 02/12/20 Time: 14:19 | | |  |  |
| Sample (adjusted): 1986 2018 | | |  |  |
| Included observations: 33 after adjustments | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| GRGDP(-1) | -0.501874 | 0.154919 | -3.239590 | 0.0029 |
| C | 2.332910 | 0.976363 | 2.389389 | 0.0231 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.252921 | Mean dependent var | | -0.199843 |
| Adjusted R-squared | 0.228822 | S.D. dependent var | | 3.825833 |
| S.E. of regression | 3.359722 | Akaike info criterion | | 5.320286 |
| Sum squared resid | 349.9198 | Schwarz criterion | | 5.410983 |
| Log likelihood | -85.78471 | Hannan-Quinn criter. | | 5.350802 |
| F-statistic | 10.49495 | Durbin-Watson stat | | 1.910414 |
| Prob(F-statistic) | 0.002855 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 11: GRGDP (PPTEST) – 1ST DIFFERENCE

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: D(GRGDP) has a unit root | | | |  |
| Exogenous: Constant | | |  |  |
| Bandwidth: 31 (Newey-West automatic) using Bartlett kernel | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  | Adj. t-Stat | Prob.\* |
|  |  |  |  |  |
|  |  |  |  |  |
| Phillips-Perron test statistic | | | -13.80696 | 0.0000 |
| Test critical values: | 1% level |  | -3.653730 |  |
|  | 5% level |  | -2.957110 |  |
|  | 10% level |  | -2.617434 |  |
|  |  |  |  |  |
|  |  |  |  |  |
| \*MacKinnon (1996) one-sided p-values. | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Residual variance (no correction) | | | | 12.22794 |
| HAC corrected variance (Bartlett kernel) | | | | 1.881917 |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Phillips-Perron Test Equation | | |  |  |
| Dependent Variable: D(GRGDP,2) | | | |  |
| Method: Least Squares | | |  |  |
| Date: 02/13/20 Time: 00:32 | | |  |  |
| Sample (adjusted): 1987 2018 | | |  |  |
| Included observations: 32 after adjustments | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| D(GRGDP(-1)) | -1.271970 | 0.167189 | -7.607992 | 0.0000 |
| C | -0.064502 | 0.639700 | -0.100831 | 0.9204 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.658631 | Mean dependent var | | 0.241599 |
| Adjusted R-squared | 0.647252 | S.D. dependent var | | 6.080775 |
| S.E. of regression | 3.611528 | Akaike info criterion | | 5.466600 |
| Sum squared resid | 391.2939 | Schwarz criterion | | 5.558209 |
| Log likelihood | -85.46560 | Hannan-Quinn criter. | | 5.496966 |
| F-statistic | 57.88154 | Durbin-Watson stat | | 2.103100 |
| Prob(F-statistic) | 0.000000 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 12: EXR (PPTEST) – LEVELS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: EXR has a unit root | | | |  |
| Exogenous: Constant | | |  |  |
| Bandwidth: 2 (Newey-West automatic) using Bartlett kernel | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  | Adj. t-Stat | Prob.\* |
|  |  |  |  |  |
|  |  |  |  |  |
| Phillips-Perron test statistic | | | 1.128062 | 0.9969 |
| Test critical values: | 1% level |  | -3.646342 |  |
|  | 5% level |  | -2.954021 |  |
|  | 10% level |  | -2.615817 |  |
|  |  |  |  |  |
|  |  |  |  |  |
| \*MacKinnon (1996) one-sided p-values. | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Residual variance (no correction) | | | | 320.4781 |
| HAC corrected variance (Bartlett kernel) | | | | 389.5521 |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Phillips-Perron Test Equation | | |  |  |
| Dependent Variable: D(EXR) | | |  |  |
| Method: Least Squares | | |  |  |
| Date: 02/13/20 Time: 00:29 | | |  |  |
| Sample (adjusted): 1986 2018 | | |  |  |
| Included observations: 33 after adjustments | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| EXR(-1) | 0.056852 | 0.041043 | 1.385172 | 0.1759 |
| C | 3.975820 | 4.982491 | 0.797958 | 0.4310 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.058286 | Mean dependent var | | 9.248073 |
| Adjusted R-squared | 0.027908 | S.D. dependent var | | 18.73362 |
| S.E. of regression | 18.47036 | Akaike info criterion | | 8.728903 |
| Sum squared resid | 10575.78 | Schwarz criterion | | 8.819601 |
| Log likelihood | -142.0269 | Hannan-Quinn criter. | | 8.759420 |
| F-statistic | 1.918703 | Durbin-Watson stat | | 1.577267 |
| Prob(F-statistic) | 0.175887 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 13: EXR (PPTEST) – 1ST DIFFERENCE

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: D(EXR) has a unit root | | | |  |
| Exogenous: Constant | | |  |  |
| Bandwidth: 3 (Newey-West automatic) using Bartlett kernel | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  | Adj. t-Stat | Prob.\* |
|  |  |  |  |  |
|  |  |  |  |  |
| Phillips-Perron test statistic | | | -3.993589 | 0.0043 |
| Test critical values: | 1% level |  | -3.653730 |  |
|  | 5% level |  | -2.957110 |  |
|  | 10% level |  | -2.617434 |  |
|  |  |  |  |  |
|  |  |  |  |  |
| \*MacKinnon (1996) one-sided p-values. | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Residual variance (no correction) | | | | 318.5767 |
| HAC corrected variance (Bartlett kernel) | | | | 296.6458 |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Phillips-Perron Test Equation | | |  |  |
| Dependent Variable: D(EXR,2) | | |  |  |
| Method: Least Squares | | |  |  |
| Date: 02/12/20 Time: 14:18 | | |  |  |
| Sample (adjusted): 1987 2018 | | |  |  |
| Included observations: 32 after adjustments | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| D(EXR(-1)) | -0.705341 | 0.174595 | -4.039878 | 0.0003 |
| C | 6.694346 | 3.658768 | 1.829672 | 0.0773 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.352340 | Mean dependent var | | -0.026149 |
| Adjusted R-squared | 0.330752 | S.D. dependent var | | 22.53345 |
| S.E. of regression | 18.43408 | Akaike info criterion | | 8.726740 |
| Sum squared resid | 10194.45 | Schwarz criterion | | 8.818349 |
| Log likelihood | -137.6278 | Hannan-Quinn criter. | | 8.757106 |
| F-statistic | 16.32061 | Durbin-Watson stat | | 1.918430 |
| Prob(F-statistic) | 0.000342 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 14: INF (PPTEST) – LEVELS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: INF has a unit root | | | |  |
| Exogenous: Constant | | |  |  |
| Bandwidth: 1 (Newey-West automatic) using Bartlett kernel | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  | Adj. t-Stat | Prob.\* |
|  |  |  |  |  |
|  |  |  |  |  |
| Phillips-Perron test statistic | | | -2.981331 | 0.0471 |
| Test critical values: | 1% level |  | -3.646342 |  |
|  | 5% level |  | -2.954021 |  |
|  | 10% level |  | -2.615817 |  |
|  |  |  |  |  |
|  |  |  |  |  |
| \*MacKinnon (1996) one-sided p-values. | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Residual variance (no correction) | | | | 220.3154 |
| HAC corrected variance (Bartlett kernel) | | | | 254.5717 |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Phillips-Perron Test Equation | | |  |  |
| Dependent Variable: D(INF) | | |  |  |
| Method: Least Squares | | |  |  |
| Date: 02/12/20 Time: 14:19 | | |  |  |
| Sample (adjusted): 1986 2018 | | |  |  |
| Included observations: 33 after adjustments | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| INF(-1) | -0.403332 | 0.141359 | -2.853237 | 0.0076 |
| C | 8.357339 | 3.879872 | 2.154024 | 0.0391 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.207991 | Mean dependent var | | 0.314214 |
| Adjusted R-squared | 0.182442 | S.D. dependent var | | 16.93711 |
| S.E. of regression | 15.31435 | Akaike info criterion | | 8.354149 |
| Sum squared resid | 7270.407 | Schwarz criterion | | 8.444847 |
| Log likelihood | -135.8435 | Hannan-Quinn criter. | | 8.384666 |
| F-statistic | 8.140964 | Durbin-Watson stat | | 1.680818 |
| Prob(F-statistic) | 0.007643 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 15: INF (PPTEST) – 1ST DIFFERENCE

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: D(INF) has a unit root | | | |  |
| Exogenous: Constant | | |  |  |
| Bandwidth: 15 (Newey-West automatic) using Bartlett kernel | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  | Adj. t-Stat | Prob.\* |
|  |  |  |  |  |
|  |  |  |  |  |
| Phillips-Perron test statistic | | | -7.516386 | 0.0000 |
| Test critical values: | 1% level |  | -3.653730 |  |
|  | 5% level |  | -2.957110 |  |
|  | 10% level |  | -2.617434 |  |
|  |  |  |  |  |
|  |  |  |  |  |
| \*MacKinnon (1996) one-sided p-values. | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Residual variance (no correction) | | | | 281.9566 |
| HAC corrected variance (Bartlett kernel) | | | | 50.47799 |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Phillips-Perron Test Equation | | |  |  |
| Dependent Variable: D(INF,2) | | |  |  |
| Method: Least Squares | | |  |  |
| Date: 02/13/20 Time: 00:33 | | |  |  |
| Sample (adjusted): 1987 2018 | | |  |  |
| Included observations: 32 after adjustments | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| D(INF(-1)) | -0.993802 | 0.181192 | -5.484792 | 0.0000 |
| C | -0.073823 | 3.066781 | -0.024072 | 0.9810 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.500690 | Mean dependent var | | -0.519192 |
| Adjusted R-squared | 0.484047 | S.D. dependent var | | 24.14350 |
| S.E. of regression | 17.34225 | Akaike info criterion | | 8.604630 |
| Sum squared resid | 9022.612 | Schwarz criterion | | 8.696239 |
| Log likelihood | -135.6741 | Hannan-Quinn criter. | | 8.634996 |
| F-statistic | 30.08295 | Durbin-Watson stat | | 1.981301 |
| Prob(F-statistic) | 0.000006 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 16: INT (PPTEST) – LEVELS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: INT has a unit root | | | |  |
| Exogenous: Constant | | |  |  |
| Bandwidth: 4 (Newey-West automatic) using Bartlett kernel | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  | Adj. t-Stat | Prob.\* |
|  |  |  |  |  |
|  |  |  |  |  |
| Phillips-Perron test statistic | | | -2.240049 | 0.1967 |
| Test critical values: | 1% level |  | -3.646342 |  |
|  | 5% level |  | -2.954021 |  |
|  | 10% level |  | -2.615817 |  |
|  |  |  |  |  |
|  |  |  |  |  |
| \*MacKinnon (1996) one-sided p-values. | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Residual variance (no correction) | | | | 11.14854 |
| HAC corrected variance (Bartlett kernel) | | | | 12.60672 |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Phillips-Perron Test Equation | | |  |  |
| Dependent Variable: D(INT) | | |  |  |
| Method: Least Squares | | |  |  |
| Date: 02/13/20 Time: 00:33 | | |  |  |
| Sample (adjusted): 1986 2018 | | |  |  |
| Included observations: 33 after adjustments | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| INT(-1) | -0.254377 | 0.119284 | -2.132536 | 0.0410 |
| C | 3.130338 | 1.578359 | 1.983286 | 0.0563 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.127933 | Mean dependent var | | 0.016844 |
| Adjusted R-squared | 0.099801 | S.D. dependent var | | 3.630914 |
| S.E. of regression | 3.444967 | Akaike info criterion | | 5.370398 |
| Sum squared resid | 367.9018 | Schwarz criterion | | 5.461095 |
| Log likelihood | -86.61156 | Hannan-Quinn criter. | | 5.400914 |
| F-statistic | 4.547709 | Durbin-Watson stat | | 2.096297 |
| Prob(F-statistic) | 0.040990 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 17: INT (PPTEST) – 1ST DIFFERENCE

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: D(INT) has a unit root | | | |  |
| Exogenous: Constant | | |  |  |
| Bandwidth: 3 (Newey-West automatic) using Bartlett kernel | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  | Adj. t-Stat | Prob.\* |
|  |  |  |  |  |
|  |  |  |  |  |
| Phillips-Perron test statistic | | | -6.615288 | 0.0000 |
| Test critical values: | 1% level |  | -3.653730 |  |
|  | 5% level |  | -2.957110 |  |
|  | 10% level |  | -2.617434 |  |
|  |  |  |  |  |
|  |  |  |  |  |
| \*MacKinnon (1996) one-sided p-values. | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Residual variance (no correction) | | | | 12.74252 |
| HAC corrected variance (Bartlett kernel) | | | | 12.12413 |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Phillips-Perron Test Equation | | |  |  |
| Dependent Variable: D(INT,2) | | |  |  |
| Method: Least Squares | | |  |  |
| Date: 02/12/20 Time: 14:20 | | |  |  |
| Sample (adjusted): 1987 2018 | | |  |  |
| Included observations: 32 after adjustments | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| D(INT(-1)) | -1.182975 | 0.179571 | -6.587778 | 0.0000 |
| C | 0.023832 | 0.651760 | 0.036566 | 0.9711 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.591274 | Mean dependent var | | -0.017942 |
| Adjusted R-squared | 0.577650 | S.D. dependent var | | 5.672907 |
| S.E. of regression | 3.686736 | Akaike info criterion | | 5.507821 |
| Sum squared resid | 407.7606 | Schwarz criterion | | 5.599430 |
| Log likelihood | -86.12514 | Hannan-Quinn criter. | | 5.538187 |
| F-statistic | 43.39882 | Durbin-Watson stat | | 1.998619 |
| Prob(F-statistic) | 0.000000 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 18: GRGDP (ERS TEST) – LEVELS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: GRGDP has a unit root | | | |  |
| Exogenous: Constant | | |  |  |
| Lag Length: 0 (Automatic - based on SIC, maxlag=8) | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  | t-Statistic |
|  |  |  |  |  |
|  |  |  |  |  |
| Elliott-Rothenberg-Stock DF-GLS test statistic | | | | -3.069298 |
| Test critical values: | 1% level |  |  | -2.636901 |
|  | 5% level |  |  | -1.951332 |
|  | 10% level |  |  | -1.610747 |
|  |  |  |  |  |
|  |  |  |  |  |
| \*MacKinnon (1996) | | |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| DF-GLS Test Equation on GLS Detrended Residuals | | | | |
| Dependent Variable: D(GLSRESID) | | | |  |
| Method: Least Squares | | |  |  |
| Date: 02/12/20 Time: 14:26 | | |  |  |
| Sample (adjusted): 1986 2018 | | |  |  |
| Included observations: 33 after adjustments | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| GLSRESID(-1) | -0.464037 | 0.151187 | -3.069298 | 0.0043 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.225264 | Mean dependent var | | -0.199843 |
| Adjusted R-squared | 0.225264 | S.D. dependent var | | 3.825833 |
| S.E. of regression | 3.367464 | Akaike info criterion | | 5.296032 |
| Sum squared resid | 362.8741 | Schwarz criterion | | 5.341380 |
| Log likelihood | -86.38452 | Hannan-Quinn criter. | | 5.311290 |
| Durbin-Watson stat | 1.919195 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 19: GRGDP (ERS TEST) – 1ST DIFFERENCE

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: D(GRGDP) has a unit root | | | |  |
| Exogenous: Constant | | |  |  |
| Lag Length: 1 (Automatic - based on SIC, maxlag=8) | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  | t-Statistic |
|  |  |  |  |  |
|  |  |  |  |  |
| Elliott-Rothenberg-Stock DF-GLS test statistic | | | | -2.787103 |
| Test critical values: | 1% level |  |  | -2.641672 |
|  | 5% level |  |  | -1.952066 |
|  | 10% level |  |  | -1.610400 |
|  |  |  |  |  |
|  |  |  |  |  |
| \*MacKinnon (1996) | | |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| DF-GLS Test Equation on GLS Detrended Residuals | | | | |
| Dependent Variable: D(GLSRESID) | | | |  |
| Method: Least Squares | | |  |  |
| Date: 02/12/20 Time: 15:01 | | |  |  |
| Sample (adjusted): 1988 2018 | | |  |  |
| Included observations: 31 after adjustments | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| GLSRESID(-1) | -0.718043 | 0.257630 | -2.787103 | 0.0093 |
| D(GLSRESID(-1)) | -0.259576 | 0.181329 | -1.431519 | 0.1630 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.519387 | Mean dependent var | | 0.091466 |
| Adjusted R-squared | 0.502814 | S.D. dependent var | | 6.120704 |
| S.E. of regression | 4.315797 | Akaike info criterion | | 5.824782 |
| Sum squared resid | 540.1570 | Schwarz criterion | | 5.917297 |
| Log likelihood | -88.28412 | Hannan-Quinn criter. | | 5.854940 |
| Durbin-Watson stat | 1.799425 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 20: EXR (ERS TEST) – LEVELS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: EXR has a unit root | | | |  |
| Exogenous: Constant | | |  |  |
| Lag Length: 0 (Automatic - based on SIC, maxlag=8) | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  | t-Statistic |
|  |  |  |  |  |
|  |  |  |  |  |
| Elliott-Rothenberg-Stock DF-GLS test statistic | | | | 1.660616 |
| Test critical values: | 1% level |  |  | -2.636901 |
|  | 5% level |  |  | -1.951332 |
|  | 10% level |  |  | -1.610747 |
|  |  |  |  |  |
|  |  |  |  |  |
| \*MacKinnon (1996) | | |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| DF-GLS Test Equation on GLS Detrended Residuals | | | | |
| Dependent Variable: D(GLSRESID) | | | |  |
| Method: Least Squares | | |  |  |
| Date: 02/12/20 Time: 14:59 | | |  |  |
| Sample (adjusted): 1986 2018 | | |  |  |
| Included observations: 33 after adjustments | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| GLSRESID(-1) | 0.073329 | 0.044158 | 1.660616 | 0.1066 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | -0.152039 | Mean dependent var | | 9.248073 |
| Adjusted R-squared | -0.152039 | S.D. dependent var | | 18.73362 |
| S.E. of regression | 20.10737 | Akaike info criterion | | 8.869884 |
| Sum squared resid | 12937.80 | Schwarz criterion | | 8.915233 |
| Log likelihood | -145.3531 | Hannan-Quinn criter. | | 8.885143 |
| Durbin-Watson stat | 1.311687 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 21: EXR (ERS TEST) – 1ST DIFFERENCE

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: D(EXR) has a unit root | | | |  |
| Exogenous: Constant | | |  |  |
| Lag Length: 0 (Automatic - based on SIC, maxlag=8) | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  | t-Statistic |
|  |  |  |  |  |
|  |  |  |  |  |
| Elliott-Rothenberg-Stock DF-GLS test statistic | | | | -4.000833 |
| Test critical values: | 1% level |  |  | -2.639210 |
|  | 5% level |  |  | -1.951687 |
|  | 10% level |  |  | -1.610579 |
|  |  |  |  |  |
|  |  |  |  |  |
| \*MacKinnon (1996) | | |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| DF-GLS Test Equation on GLS Detrended Residuals | | | | |
| Dependent Variable: D(GLSRESID) | | | |  |
| Method: Least Squares | | |  |  |
| Date: 02/12/20 Time: 14:25 | | |  |  |
| Sample (adjusted): 1987 2018 | | |  |  |
| Included observations: 32 after adjustments | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| GLSRESID(-1) | -0.681422 | 0.170320 | -4.000833 | 0.0004 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.340518 | Mean dependent var | | -0.026149 |
| Adjusted R-squared | 0.340518 | S.D. dependent var | | 22.53345 |
| S.E. of regression | 18.29907 | Akaike info criterion | | 8.682329 |
| Sum squared resid | 10380.54 | Schwarz criterion | | 8.728134 |
| Log likelihood | -137.9173 | Hannan-Quinn criter. | | 8.697512 |
| Durbin-Watson stat | 1.923462 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 22: INF (ERS TEST) – LEVELS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: INF has a unit root | | | |  |
| Exogenous: Constant | | |  |  |
| Lag Length: 4 (Automatic - based on SIC, maxlag=8) | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  | t-Statistic |
|  |  |  |  |  |
|  |  |  |  |  |
| Elliott-Rothenberg-Stock DF-GLS test statistic | | | | -1.110162 |
| Test critical values: | 1% level |  |  | -2.647120 |
|  | 5% level |  |  | -1.952910 |
|  | 10% level |  |  | -1.610011 |
|  |  |  |  |  |
|  |  |  |  |  |
| \*MacKinnon (1996) | | |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| DF-GLS Test Equation on GLS Detrended Residuals | | | | |
| Dependent Variable: D(GLSRESID) | | | |  |
| Method: Least Squares | | |  |  |
| Date: 02/12/20 Time: 15:02 | | |  |  |
| Sample (adjusted): 1990 2018 | | |  |  |
| Included observations: 29 after adjustments | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| GLSRESID(-1) | -0.151231 | 0.136225 | -1.110162 | 0.2779 |
| D(GLSRESID(-1)) | 0.303744 | 0.165643 | 1.833721 | 0.0791 |
| D(GLSRESID(-2)) | -0.455463 | 0.146842 | -3.101720 | 0.0049 |
| D(GLSRESID(-3)) | 0.128219 | 0.134541 | 0.953004 | 0.3501 |
| D(GLSRESID(-4)) | -0.360313 | 0.128132 | -2.812046 | 0.0097 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.547097 | Mean dependent var | | -1.147243 |
| Adjusted R-squared | 0.471614 | S.D. dependent var | | 14.68914 |
| S.E. of regression | 10.67757 | Akaike info criterion | | 7.729753 |
| Sum squared resid | 2736.251 | Schwarz criterion | | 7.965493 |
| Log likelihood | -107.0814 | Hannan-Quinn criter. | | 7.803584 |
| Durbin-Watson stat | 1.738991 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 23: INF (ERS TEST) – 1ST DIFFERENCE

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: D(INF) has a unit root | | | |  |
| Exogenous: Constant | | |  |  |
| Lag Length: 0 (Automatic - based on SIC, maxlag=8) | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  | t-Statistic |
|  |  |  |  |  |
|  |  |  |  |  |
| Elliott-Rothenberg-Stock DF-GLS test statistic | | | | -5.275987 |
| Test critical values: | 1% level |  |  | -2.639210 |
|  | 5% level |  |  | -1.951687 |
|  | 10% level |  |  | -1.610579 |
|  |  |  |  |  |
|  |  |  |  |  |
| \*MacKinnon (1996) | | |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| DF-GLS Test Equation on GLS Detrended Residuals | | | | |
| Dependent Variable: D(GLSRESID) | | | |  |
| Method: Least Squares | | |  |  |
| Date: 02/12/20 Time: 14:27 | | |  |  |
| Sample (adjusted): 1987 2018 | | |  |  |
| Included observations: 32 after adjustments | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| GLSRESID(-1) | -0.945644 | 0.179235 | -5.275987 | 0.0000 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.472861 | Mean dependent var | | -0.519192 |
| Adjusted R-squared | 0.472861 | S.D. dependent var | | 24.14350 |
| S.E. of regression | 17.52924 | Akaike info criterion | | 8.596369 |
| Sum squared resid | 9525.499 | Schwarz criterion | | 8.642173 |
| Log likelihood | -136.5419 | Hannan-Quinn criter. | | 8.611552 |
| Durbin-Watson stat | 1.942012 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 24: INT (ERS TEST) – LEVELS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: INT has a unit root | | | |  |
| Exogenous: Constant | | |  |  |
| Lag Length: 0 (Automatic - based on SIC, maxlag=8) | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  | t-Statistic |
|  |  |  |  |  |
|  |  |  |  |  |
| Elliott-Rothenberg-Stock DF-GLS test statistic | | | | -2.113724 |
| Test critical values: | 1% level |  |  | -2.636901 |
|  | 5% level |  |  | -1.951332 |
|  | 10% level |  |  | -1.610747 |
|  |  |  |  |  |
|  |  |  |  |  |
| \*MacKinnon (1996) | | |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| DF-GLS Test Equation on GLS Detrended Residuals | | | | |
| Dependent Variable: D(GLSRESID) | | | |  |
| Method: Least Squares | | |  |  |
| Date: 02/12/20 Time: 14:27 | | |  |  |
| Sample (adjusted): 1986 2018 | | |  |  |
| Included observations: 33 after adjustments | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| GLSRESID(-1) | -0.244242 | 0.115551 | -2.113724 | 0.0424 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.122495 | Mean dependent var | | 0.016844 |
| Adjusted R-squared | 0.122495 | S.D. dependent var | | 3.630914 |
| S.E. of regression | 3.401267 | Akaike info criterion | | 5.316008 |
| Sum squared resid | 370.1958 | Schwarz criterion | | 5.361356 |
| Log likelihood | -86.71413 | Hannan-Quinn criter. | | 5.331266 |
| Durbin-Watson stat | 2.104855 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 25: INT (ERS TEST) – 1ST DIFFERENCE

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: D(INT) has a unit root | | | |  |
| Exogenous: Constant | | |  |  |
| Lag Length: 0 (Automatic - based on SIC, maxlag=8) | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  | t-Statistic |
|  |  |  |  |  |
|  |  |  |  |  |
| Elliott-Rothenberg-Stock DF-GLS test statistic | | | | -6.695227 |
| Test critical values: | 1% level |  |  | -2.639210 |
|  | 5% level |  |  | -1.951687 |
|  | 10% level |  |  | -1.610579 |
|  |  |  |  |  |
|  |  |  |  |  |
| \*MacKinnon (1996) | | |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| DF-GLS Test Equation on GLS Detrended Residuals | | | | |
| Dependent Variable: D(GLSRESID) | | | |  |
| Method: Least Squares | | |  |  |
| Date: 02/12/20 Time: 15:03 | | |  |  |
| Sample (adjusted): 1987 2018 | | |  |  |
| Included observations: 32 after adjustments | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| GLSRESID(-1) | -1.182690 | 0.176647 | -6.695227 | 0.0000 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.591165 | Mean dependent var | | -0.017942 |
| Adjusted R-squared | 0.591165 | S.D. dependent var | | 5.672907 |
| S.E. of regression | 3.627267 | Akaike info criterion | | 5.445587 |
| Sum squared resid | 407.8691 | Schwarz criterion | | 5.491392 |
| Log likelihood | -86.12940 | Hannan-Quinn criter. | | 5.460770 |
| Durbin-Watson stat | 1.998551 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 26: GRGDP (KPSS TEST) – LEVELS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: GRGDP is stationary | | | |  |
| Exogenous: Constant | | |  |  |
| Bandwidth: 3 (Newey-West automatic) using Bartlett kernel | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  | LM-Stat. |
|  |  |  |  |  |
|  |  |  |  |  |
| Kwiatkowski-Phillips-Schmidt-Shin test statistic | | | | 0.139253 |
| Asymptotic critical values\*: | | 1% level |  | 0.739000 |
|  |  | 5% level |  | 0.463000 |
|  |  | 10% level |  | 0.347000 |
|  |  |  |  |  |
|  |  |  |  |  |
| \*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1) | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Residual variance (no correction) | | | | 14.11033 |
| HAC corrected variance (Bartlett kernel) | | | | 28.68633 |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| KPSS Test Equation | | |  |  |
| Dependent Variable: GRGDP | | |  |  |
| Method: Least Squares | | |  |  |
| Date: 02/12/20 Time: 14:39 | | |  |  |
| Sample: 1985 2018 | | |  |  |
| Included observations: 34 | | |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| C | 4.954924 | 0.653900 | 7.577490 | 0.0000 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.000000 | Mean dependent var | | 4.954924 |
| Adjusted R-squared | 0.000000 | S.D. dependent var | | 3.812862 |
| S.E. of regression | 3.812862 | Akaike info criterion | | 5.543608 |
| Sum squared resid | 479.7512 | Schwarz criterion | | 5.588501 |
| Log likelihood | -93.24133 | Hannan-Quinn criter. | | 5.558917 |
| Durbin-Watson stat | 0.979053 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 27: GRGDP (KPSS TEST) – 1ST DIFFERENCE

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: D(GRGDP) is stationary | | | |  |
| Exogenous: Constant | | |  |  |
| Bandwidth: 28 (Newey-West automatic) using Bartlett kernel | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  | LM-Stat. |
|  |  |  |  |  |
|  |  |  |  |  |
| Kwiatkowski-Phillips-Schmidt-Shin test statistic | | | | 0.462472 |
| Asymptotic critical values\*: | | 1% level |  | 0.739000 |
|  |  | 5% level |  | 0.463000 |
|  |  | 10% level |  | 0.347000 |
|  |  |  |  |  |
|  |  |  |  |  |
| \*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1) | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Residual variance (no correction) | | | | 14.19345 |
| HAC corrected variance (Bartlett kernel) | | | | 1.260723 |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| KPSS Test Equation | | |  |  |
| Dependent Variable: D(GRGDP) | | |  |  |
| Method: Least Squares | | |  |  |
| Date: 02/12/20 Time: 14:40 | | |  |  |
| Sample (adjusted): 1986 2018 | | |  |  |
| Included observations: 33 after adjustments | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| C | -0.199843 | 0.665992 | -0.300068 | 0.7661 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.000000 | Mean dependent var | | -0.199843 |
| Adjusted R-squared | 0.000000 | S.D. dependent var | | 3.825833 |
| S.E. of regression | 3.825833 | Akaike info criterion | | 5.551264 |
| Sum squared resid | 468.3839 | Schwarz criterion | | 5.596613 |
| Log likelihood | -90.59585 | Hannan-Quinn criter. | | 5.566522 |
| Durbin-Watson stat | 2.451233 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 28: EXR (KPSS TEST) – LEVELS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: EXR is stationary | | | |  |
| Exogenous: Constant | | |  |  |
| Bandwidth: 4 (Newey-West automatic) using Bartlett kernel | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  | LM-Stat. |
|  |  |  |  |  |
|  |  |  |  |  |
| Kwiatkowski-Phillips-Schmidt-Shin test statistic | | | | 0.763945 |
| Asymptotic critical values\*: | | 1% level |  | 0.739000 |
|  |  | 5% level |  | 0.463000 |
|  |  | 10% level |  | 0.347000 |
|  |  |  |  |  |
|  |  |  |  |  |
| \*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1) | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Residual variance (no correction) | | | | 7255.834 |
| HAC corrected variance (Bartlett kernel) | | | | 28262.85 |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| KPSS Test Equation | | |  |  |
| Dependent Variable: EXR | | |  |  |
| Method: Least Squares | | |  |  |
| Date: 02/12/20 Time: 14:31 | | |  |  |
| Sample: 1985 2018 | | |  |  |
| Included observations: 34 | | |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| C | 99.01177 | 14.82814 | 6.677288 | 0.0000 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.000000 | Mean dependent var | | 99.01177 |
| Adjusted R-squared | 0.000000 | S.D. dependent var | | 86.46218 |
| S.E. of regression | 86.46218 | Akaike info criterion | | 11.78626 |
| Sum squared resid | 246698.4 | Schwarz criterion | | 11.83115 |
| Log likelihood | -199.3664 | Hannan-Quinn criter. | | 11.80157 |
| Durbin-Watson stat | 0.056963 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 29: EXR (KPSS TEST) – 1ST DIFFERENCE

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: D(EXR) is stationary | | | |  |
| Exogenous: Constant | | |  |  |
| Bandwidth: 0 (Newey-West automatic) using Bartlett kernel | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  | LM-Stat. |
|  |  |  |  |  |
|  |  |  |  |  |
| Kwiatkowski-Phillips-Schmidt-Shin test statistic | | | | 0.364627 |
| Asymptotic critical values\*: | | 1% level |  | 0.739000 |
|  |  | 5% level |  | 0.463000 |
|  |  | 10% level |  | 0.347000 |
|  |  |  |  |  |
|  |  |  |  |  |
| \*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1) | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Residual variance (no correction) | | | | 340.3136 |
| HAC corrected variance (Bartlett kernel) | | | | 340.3136 |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| KPSS Test Equation | | |  |  |
| Dependent Variable: D(EXR) | | |  |  |
| Method: Least Squares | | |  |  |
| Date: 02/12/20 Time: 14:38 | | |  |  |
| Sample (adjusted): 1986 2018 | | |  |  |
| Included observations: 33 after adjustments | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| C | 9.248073 | 3.261104 | 2.835872 | 0.0079 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.000000 | Mean dependent var | | 9.248073 |
| Adjusted R-squared | 0.000000 | S.D. dependent var | | 18.73362 |
| S.E. of regression | 18.73362 | Akaike info criterion | | 8.728351 |
| Sum squared resid | 11230.35 | Schwarz criterion | | 8.773700 |
| Log likelihood | -143.0178 | Hannan-Quinn criter. | | 8.743609 |
| Durbin-Watson stat | 1.401601 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 30: INF (KPSS TEST) – LEVELS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: INF is stationary | | | |  |
| Exogenous: Constant | | |  |  |
| Bandwidth: 3 (Newey-West automatic) using Bartlett kernel | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  | LM-Stat. |
|  |  |  |  |  |
|  |  |  |  |  |
| Kwiatkowski-Phillips-Schmidt-Shin test statistic | | | | 0.345758 |
| Asymptotic critical values\*: | | 1% level |  | 0.739000 |
|  |  | 5% level |  | 0.463000 |
|  |  | 10% level |  | 0.347000 |
|  |  |  |  |  |
|  |  |  |  |  |
| \*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1) | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Residual variance (no correction) | | | | 347.2818 |
| HAC corrected variance (Bartlett kernel) | | | | 738.4111 |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| KPSS Test Equation | | |  |  |
| Dependent Variable: INF | | |  |  |
| Method: Least Squares | | |  |  |
| Date: 02/12/20 Time: 14:41 | | |  |  |
| Sample: 1985 2018 | | |  |  |
| Included observations: 34 | | |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| C | 19.69049 | 3.244024 | 6.069774 | 0.0000 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.000000 | Mean dependent var | | 19.69049 |
| Adjusted R-squared | 0.000000 | S.D. dependent var | | 18.91575 |
| S.E. of regression | 18.91575 | Akaike info criterion | | 8.746837 |
| Sum squared resid | 11807.58 | Schwarz criterion | | 8.791730 |
| Log likelihood | -147.6962 | Hannan-Quinn criter. | | 8.762147 |
| Durbin-Watson stat | 0.777717 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 31: INF (KPSS TEST) – 1ST DIFFERENCE

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: D(INF) is stationary | | | |  |
| Exogenous: Constant | | |  |  |
| Bandwidth: 11 (Newey-West automatic) using Bartlett kernel | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  | LM-Stat. |
|  |  |  |  |  |
|  |  |  |  |  |
| Kwiatkowski-Phillips-Schmidt-Shin test statistic | | | | 0.200688 |
| Asymptotic critical values\*: | | 1% level |  | 0.739000 |
|  |  | 5% level |  | 0.463000 |
|  |  | 10% level |  | 0.347000 |
|  |  |  |  |  |
|  |  |  |  |  |
| \*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1) | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Residual variance (no correction) | | | | 278.1728 |
| HAC corrected variance (Bartlett kernel) | | | | 90.67125 |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| KPSS Test Equation | | |  |  |
| Dependent Variable: D(INF) | | |  |  |
| Method: Least Squares | | |  |  |
| Date: 02/12/20 Time: 14:41 | | |  |  |
| Sample (adjusted): 1986 2018 | | |  |  |
| Included observations: 33 after adjustments | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| C | 0.314214 | 2.948372 | 0.106572 | 0.9158 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.000000 | Mean dependent var | | 0.314214 |
| Adjusted R-squared | 0.000000 | S.D. dependent var | | 16.93711 |
| S.E. of regression | 16.93711 | Akaike info criterion | | 8.526725 |
| Sum squared resid | 9179.701 | Schwarz criterion | | 8.572074 |
| Log likelihood | -139.6910 | Hannan-Quinn criter. | | 8.541984 |
| Durbin-Watson stat | 1.969432 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 32: INT (KPSS TEST) – LEVELS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: INT is stationary | | | |  |
| Exogenous: Constant | | |  |  |
| Bandwidth: 4 (Newey-West automatic) using Bartlett kernel | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  | LM-Stat. |
|  |  |  |  |  |
|  |  |  |  |  |
| Kwiatkowski-Phillips-Schmidt-Shin test statistic | | | | 0.455803 |
| Asymptotic critical values\*: | | 1% level |  | 0.739000 |
|  |  | 5% level |  | 0.463000 |
|  |  | 10% level |  | 0.347000 |
|  |  |  |  |  |
|  |  |  |  |  |
| \*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1) | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Residual variance (no correction) | | | | 24.63852 |
| HAC corrected variance (Bartlett kernel) | | | | 83.30753 |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| KPSS Test Equation | | |  |  |
| Dependent Variable: INT | | |  |  |
| Method: Least Squares | | |  |  |
| Date: 02/12/20 Time: 14:42 | | |  |  |
| Sample: 1985 2018 | | |  |  |
| Included observations: 34 | | |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| C | 12.18281 | 0.864073 | 14.09929 | 0.0000 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.000000 | Mean dependent var | | 12.18281 |
| Adjusted R-squared | 0.000000 | S.D. dependent var | | 5.038367 |
| S.E. of regression | 5.038367 | Akaike info criterion | | 6.101012 |
| Sum squared resid | 837.7098 | Schwarz criterion | | 6.145905 |
| Log likelihood | -102.7172 | Hannan-Quinn criter. | | 6.116322 |
| Durbin-Watson stat | 0.503614 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 33: INT (KPSS TEST) – 1ST DIFFERENCE

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Null Hypothesis: D(INT) is stationary | | | |  |
| Exogenous: Constant | | |  |  |
| Bandwidth: 3 (Newey-West automatic) using Bartlett kernel | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  | LM-Stat. |
|  |  |  |  |  |
|  |  |  |  |  |
| Kwiatkowski-Phillips-Schmidt-Shin test statistic | | | | 0.101320 |
| Asymptotic critical values\*: | | 1% level |  | 0.739000 |
|  |  | 5% level |  | 0.463000 |
|  |  | 10% level |  | 0.347000 |
|  |  |  |  |  |
|  |  |  |  |  |
| \*Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1) | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Residual variance (no correction) | | | | 12.78403 |
| HAC corrected variance (Bartlett kernel) | | | | 9.341050 |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| KPSS Test Equation | | |  |  |
| Dependent Variable: D(INT) | | |  |  |
| Method: Least Squares | | |  |  |
| Date: 02/12/20 Time: 14:57 | | |  |  |
| Sample (adjusted): 1986 2018 | | |  |  |
| Included observations: 33 after adjustments | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| C | 0.016844 | 0.632061 | 0.026650 | 0.9789 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.000000 | Mean dependent var | | 0.016844 |
| Adjusted R-squared | 0.000000 | S.D. dependent var | | 3.630914 |
| S.E. of regression | 3.630914 | Akaike info criterion | | 5.446680 |
| Sum squared resid | 421.8731 | Schwarz criterion | | 5.492029 |
| Log likelihood | -88.87022 | Hannan-Quinn criter. | | 5.461938 |
| Durbin-Watson stat | 2.364807 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 34: OPTIMAL LAG

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| VAR Lag Order Selection Criteria | | |  |  |  |  |
| Endogenous variables: GRGDP EXR INT INF | | | |  |  |  |
| Exogenous variables: C | | |  |  |  |  |
| Date: 02/01/20 Time: 08:56 | | |  |  |  |  |
| Sample: 1985 2018 | |  |  |  |  |  |
| Included observations: 32 | | |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| Lag | LogL | LR | FPE | AIC | SC | HQ |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| 0 | -497.3948 | NA | 4.78e+08 | 31.33717 | 31.52039 | 31.39790 |
| 1 | -422.7284 | 125.9995\* | 12352146 | 27.55592\* | 28.58661\* | 27.97418\* |
| 2 | -404.8946 | 25.63601 | 11602353\* | 27.67052 | 29.20487 | 28.10250 |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| \* indicates lag order selected by the criterion | | | |  |  |  |
| LR: sequential modified LR test statistic (each test at 5% level) | | | | |  |  |
| FPE: Final prediction error | | |  |  |  |  |
| AIC: Akaike information criterion | | |  |  |  |  |
| SC: Schwarz information criterion | | |  |  |  |  |
| HQ: Hannan-Quinn information criterion | | | |  |  |  |
|  |  |  |  |  |  |  |

Appendix 35: ARDL TEST

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Dependent Variable: GRGDP | |  | |  | |
| Method: ARDL | | |  | |  | |  |
| Date: 02/01/20 Time: 15:04 | | | | |  | |  |
| Sample (adjusted): 1986 2018 | | | | |  | |  |
| Included observations: 33 after adjustments | | | | | | |  |
| Maximum dependent lags: 1 (Automatic selection) | | | | | | | |
| Model selection method: Akaike info criterion (AIC) | | | | | | | |
| Dynamic regressors (1 lag, automatic): EXR INT INF | | | | | | | |
| Fixed regressors: C | | | | |  | |  |
| Number of models evalulated: 8 | | | | | | |  |
| Selected Model: ARDL(1, 1, 0, 0) | | | | | | |  |
|  |  | |  | |  | |  |
|  |  | |  | |  | |  |
| Variable | Coefficient | | Std. Error | | t-Statistic | | Prob.\* |
|  |  | |  | |  | |  |
|  |  | |  | |  | |  |
| GRGDP(-1) | 0.348784 | | 0.170472 | | 2.045991 | | 0.0506 |
| EXR | -0.065807 | | 0.033647 | | -1.955818 | | 0.0609 |
| EXR(-1) | 0.077495 | | 0.036547 | | 2.120445 | | 0.0433 |
| INT | 0.217337 | | 0.150580 | | 1.443336 | | 0.1604 |
| INF | -0.049945 | | 0.039627 | | -1.260395 | | 0.2183 |
| C | 0.959125 | | 2.610278 | | 0.367442 | | 0.7162 |
|  |  | |  | |  | |  |
|  |  | |  | |  | |  |
| R-squared | 0.385761 | | Mean dependent var | | | | 4.846745 |
| Adjusted R-squared | 0.272013 | | S.D. dependent var | | | | 3.818625 |
| S.E. of regression | 3.258133 | | Akaike info criterion | | | | 5.363151 |
| Sum squared resid | 286.6166 | | Schwarz criterion | | | | 5.635244 |
| Log likelihood | -82.49200 | | Hannan-Quinn criter. | | | | 5.454702 |
| F-statistic | 3.391368 | | Durbin-Watson stat | | | | 1.729313 |
| Prob(F-statistic) | 0.016621 | |  | |  | |  |
|  |  | |  | |  | |  |
|  |  | |  | |  | |  |
| \*Note: p-values and any subsequent tests do not account for model | | | | | | | |
| selection. | | | | |  | |  |

Appendix 36: BOUNDS TEST

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ARDL Bounds Test | | |  |  |
| Date: 02/01/20 Time: 15:08 | | |  |  |
| Sample: 1986 2018 | | |  |  |
| Included observations: 33 | | |  |  |
| Null Hypothesis: No long-run relationships exist | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
| Test Statistic | Value | k |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| F-statistic | 3.420134 | 3 |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Critical Value Bounds | | |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Significance | I0 Bound | I1 Bound |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| 10% | 2.72 | 3.77 |  |  |
| 5% | 3.23 | 4.35 |  |  |
| 2.5% | 3.69 | 4.89 |  |  |
| 1% | 4.29 | 5.61 |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Test Equation: | |  |  |  |
| Dependent Variable: D(GRGDP) | | |  |  |
| Method: Least Squares | | |  |  |
| Date: 02/01/20 Time: 15:08 | | |  |  |
| Sample: 1986 2018 | | |  |  |
| Included observations: 33 | | |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| D(EXR) | -0.061545 | 0.034725 | -1.772359 | 0.0876 |
| C | 3.137276 | 2.532407 | 1.238852 | 0.2261 |
| EXR(-1) | 0.006518 | 0.009227 | 0.706350 | 0.4860 |
| INT(-1) | 0.051095 | 0.174941 | 0.292072 | 0.7725 |
| INF | -0.036360 | 0.046879 | -0.775602 | 0.4447 |
| GRGDP(-1) | -0.646232 | 0.183958 | -3.512923 | 0.0016 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.342935 | Mean dependent var | | -0.199843 |
| Adjusted R-squared | 0.221257 | S.D. dependent var | | 3.825833 |
| S.E. of regression | 3.376161 | Akaike info criterion | | 5.434321 |
| Sum squared resid | 307.7585 | Schwarz criterion | | 5.706414 |
| Log likelihood | -83.66630 | Hannan-Quinn criter. | | 5.525872 |
| F-statistic | 2.818369 | Durbin-Watson stat | | 1.758344 |
| Prob(F-statistic) | 0.035699 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 37: COINTEGRATION AND LONG RUN FORM

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ARDL Cointegrating And Long Run Form | | | |  |
| Dependent Variable: GRGDP | | |  |  |
| Selected Model: ARDL(1, 1, 0, 0) | | | |  |
| Date: 02/01/20 Time: 15:09 | | |  |  |
| Sample: 1985 2018 | | |  |  |
| Included observations: 33 | | |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Cointegrating Form | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| D(EXR) | -0.065807 | 0.033647 | -1.955818 | 0.0609 |
| D(INT) | 0.217337 | 0.150580 | 1.443336 | 0.1604 |
| D(INF) | -0.049945 | 0.039627 | -1.260395 | 0.2183 |
| CointEq(-1) | -0.651216 | 0.170472 | -3.820086 | 0.0007 |
|  |  |  |  |  |
|  |  |  |  |  |
| Cointeq = GRGDP - (0.0179\*EXR + 0.3337\*INT -0.0767\*INF + 1.4728 ) | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Long Run Coefficients | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| EXR | 0.017948 | 0.014842 | 1.209271 | 0.2370 |
| INT | 0.333740 | 0.240246 | 1.389162 | 0.1761 |
| INF | -0.076695 | 0.056045 | -1.368447 | 0.1825 |
| C | 1.472820 | 3.860494 | 0.381511 | 0.7058 |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 38: SERIAL CORRELATION

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Breusch-Godfrey Serial Correlation LM Test: | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
| F-statistic | 4.044488 | Prob. F(2,28) | | 0.0286 |
| Obs\*R-squared | 7.620754 | Prob. Chi-Square(2) | | 0.0221 |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Test Equation: | |  |  |  |
| Dependent Variable: RESID | | |  |  |
| Method: Least Squares | | |  |  |
| Date: 01/31/20 Time: 12:18 | | |  |  |
| Sample: 1985 2018 | | |  |  |
| Included observations: 34 | | |  |  |
| Presample missing value lagged residuals set to zero. | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| EXR | 0.001806 | 0.008268 | 0.218390 | 0.8287 |
| INT | -0.019692 | 0.153791 | -0.128047 | 0.8990 |
| INF | 0.033479 | 0.040676 | 0.823063 | 0.4174 |
| C | -0.653905 | 2.348872 | -0.278391 | 0.7828 |
| RESID(-1) | 0.474992 | 0.188763 | 2.516346 | 0.0179 |
| RESID(-2) | 0.061586 | 0.202145 | 0.304662 | 0.7629 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.224140 | Mean dependent var | | -7.84E-16 |
| Adjusted R-squared | 0.085593 | S.D. dependent var | | 3.583806 |
| S.E. of regression | 3.427000 | Akaike info criterion | | 5.460033 |
| Sum squared resid | 328.8413 | Schwarz criterion | | 5.729391 |
| Log likelihood | -86.82056 | Hannan-Quinn criter. | | 5.551892 |
| F-statistic | 1.617795 | Durbin-Watson stat | | 1.962998 |
| Prob(F-statistic) | 0.187899 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 39: HETEROSKEDACITY TEST

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Heteroskedasticity Test: Breusch-Pagan-Godfrey | | | | |
|  |  |  |  |  |
|  |  |  |  |  |
| F-statistic | 2.059757 | Prob. F(3,30) | | 0.1266 |
| Obs\*R-squared | 5.807061 | Prob. Chi-Square(3) | | 0.1214 |
| Scaled explained SS | 3.548485 | Prob. Chi-Square(3) | | 0.3145 |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Test Equation: | |  |  |  |
| Dependent Variable: RESID^2 | | |  |  |
| Method: Least Squares | | |  |  |
| Date: 01/31/20 Time: 12:09 | | |  |  |
| Sample: 1985 2018 | | |  |  |
| Included observations: 34 | | |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| C | -3.043909 | 10.24614 | -0.297079 | 0.7685 |
| EXR | 0.026354 | 0.036381 | 0.724382 | 0.4744 |
| INT | 1.548840 | 0.678765 | 2.281850 | 0.0298 |
| INF | -0.303079 | 0.165278 | -1.833753 | 0.0766 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.170796 | Mean dependent var | | 12.46591 |
| Adjusted R-squared | 0.087876 | S.D. dependent var | | 15.85340 |
| S.E. of regression | 15.14082 | Akaike info criterion | | 8.382797 |
| Sum squared resid | 6877.334 | Schwarz criterion | | 8.562369 |
| Log likelihood | -138.5076 | Hannan-Quinn criter. | | 8.444036 |
| F-statistic | 2.059757 | Durbin-Watson stat | | 1.967160 |
| Prob(F-statistic) | 0.126627 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Appendix 40: LINEARITY TEST

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Ramsey RESET Test | | |  |  |
| Equation: UNTITLED | | |  |  |
| Specification: GRGDP EXR INT INF C | | | |  |
| Omitted Variables: Squares of fitted values | | | |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  | Value | df | Probability |  |
| t-statistic | 0.516678 | 29 | 0.6093 |  |
| F-statistic | 0.266956 | (1, 29) | 0.6093 |  |
| Likelihood ratio | 0.311552 | 1 | 0.5767 |  |
|  |  |  |  |  |
|  |  |  |  |  |
| F-test summary: | | |  |  |
|  | Sum of Sq. | df | Mean Squares |  |
| Test SSR | 3.866035 | 1 | 3.866035 |  |
| Restricted SSR | 423.8409 | 30 | 14.12803 |  |
| Unrestricted SSR | 419.9748 | 29 | 14.48189 |  |
|  |  |  |  |  |
|  |  |  |  |  |
| LR test summary: | | |  |  |
|  | Value | df |  |  |
| Restricted LogL | -91.13487 | 30 |  |  |
| Unrestricted LogL | -90.97909 | 29 |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Unrestricted Test Equation: | | |  |  |
| Dependent Variable: GRGDP | | |  |  |
| Method: Least Squares | | |  |  |
| Date: 01/31/20 Time: 12:09 | | |  |  |
| Sample: 1985 2018 | | |  |  |
| Included observations: 34 | | |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| EXR | 0.001495 | 0.011019 | 0.135680 | 0.8930 |
| INT | -0.034437 | 0.391516 | -0.087958 | 0.9305 |
| INF | 0.008720 | 0.179307 | 0.048634 | 0.9615 |
| C | 1.691770 | 6.769273 | 0.249919 | 0.8044 |
| FITTED^2 | 0.128400 | 0.248510 | 0.516678 | 0.6093 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.124265 | Mean dependent var | | 4.955294 |
| Adjusted R-squared | 0.003474 | S.D. dependent var | | 3.812136 |
| S.E. of regression | 3.805508 | Akaike info criterion | | 5.645829 |
| Sum squared resid | 419.9748 | Schwarz criterion | | 5.870294 |
| Log likelihood | -90.97909 | Hannan-Quinn criter. | | 5.722378 |
| F-statistic | 1.028764 | Durbin-Watson stat | | 1.017567 |
| Prob(F-statistic) | 0.409115 |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |