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**THE EXCHANGE RATE PASS-THROUGH TO
INFLATION, INFLATION PERSISTENCE, AND
THRESHOLD INFLATION RATE OF WEST AFRICAN
COMMONWEALTH COUNTRIES**



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UUM
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**THE EXCHANGE RATE PASS-THROUGH TO INFLATION, INFLATION
PERSISTENCE, AND THRESHOLD INFLATION RATE OF WEST
AFRICAN COMMONWEALTH COUNTRIES**



**Thesis Submitted to
School of Economics, Finance and Banking,
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In Fulfillment of the Requirement for the Degree of Doctor of Philosophy**



Kolej Perniagaan
(College of Business)
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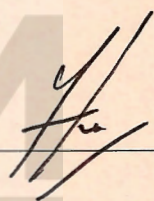
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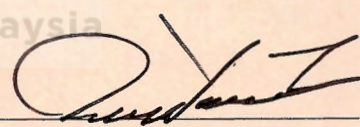
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ABSTRACT

High inflation rate and currency devaluation prevailed to be among the everyday challenges of West African Commonwealth Countries (WACCs). Additionally, the majority of the WACCs are unable to curtail and maintain inflation rate at single digit, for registering meaningful economic growth and development. This study aims to analyze the exchange rate pass-through (*ERPT*) to inflation of WACCs during 1980 – 2016, examine the inflation persistence of WACCs, and establish a threshold-inflation rate by which it is inimical to the economic growth of WACCs during 1970 – 2016. Data were analyzed using Autoregressive Distributed Lag Model (ARDL), Autoregressive (AR) Model, and the Conventional Threshold Model of regime-switching. The ARDL results show that during the short-run, the existence of immediate and complete *ERPT* is discovered in Ghana, the Gambia and Sierra Leone, whereas no *ERPT* in Nigeria. The long-run results reveal the existence of complete and positive *ERPT* in all countries. The AR result shows that high persistence inflation is associated with the first-year lag inflation rate in all the countries in addition to the second year-lag inflation of the Gambia alone. Meanwhile, in Nigeria, the second-year lag inflation is associated with low inflation persistence. It is the third-year lag inflation rate that has an association with low inflation persistence in the Gambia. The results of the threshold model indicate that the lower threshold inflation rates of WACCs are single-digit in all the WACCs except Nigeria, which has double-digit, while the upper threshold inflation rates are double-digit in Nigeria and Ghana and single-digit in the Gambia and Sierra Leone. This study suggests import substitutions and export promotions programs to stabilize exchange rate. Targeted inflation rates are achievable if the inflation-targeting policy is strengthened.

Keyword: exchange rate, inflation, inflation persistence, threshold inflation rate, West African Commonwealth Countries

ABSTRAK

Kadar inflasi dan penurunan nilai mata wang yang tinggi adalah antara cabaran harian Negara-negara Komanwel Afrika Barat (WACCs). Majoriti WACCs tidak mampu mengurangkan kadar inflasi apatah lagi mengekalkan kadar inflasi satu digit bagi mencatatkan pertumbuhan dan perkembangan ekonomi yang bermakna. Kajian ini bertujuan untuk menganalisis *Exchange Rate Pass-Through (ERPT)* inflasi WACCs bagi tempoh 1980 - 2016, meneliti keterusan inflasi WACCs, dan mengenalpasti kadar inflasi ambang yang boleh memudaratkan pertumbuhan ekonomi WACCs bagi tahun 1970 – 2016. Data dianalisis menggunakan Model Lat Tertabur Autoregresif (ARDL), Model *Autoregressive (AR)*, dan Model Ambang Konvensional Penukaran Rejim digunakan dalam analisis kajian ini. Keputusan ARDL menunjukkan bahawa dalam jangka pendek, kewujudan *ERPT* yang serta-merta dan lengkap ditemui di negara Ghana, Gambia dan Sierra Leone, sedangkan tiada *ERPT* di Nigeria. Hasil jangka panjang mendedahkan kewujudan *ERPT* yang lengkap dan positif di semua negara. Keputusan AR pula menunjukkan bahawa keterusan inflasi yang tinggi dikaitkan dengan kadar inflasi lag tahun pertama di semua negara sebagai tambahan kepada inflasi lag tahun kedua bagi negara Gambia sahaja. Sementara itu, di Nigeria, inflasi lag tahun kedua dikaitkan dengan ketegaran inflasi yang rendah. Kadar inflasi pada tahun ketiga mempunyai hubungan dengan keputusan inflasi yang rendah di Gambia. Keputusan model ambang menunjukkan bahawa kadar inflasi ambang bawah bagi semua WACCs adalah satu digit kecuali Nigeria yang mencatatkan dua angka, manakala negara kadar inflasi ambang atas adalah dua digit di Nigeria dan Ghana, dan satu digit di Gambia dan Sierra Leone. Kajian ini mencadangkan supaya penggantian import dan promosi eksport diberikan perhatian serius bagi menstabilkan kadar pertukaran. Kadar inflasi yang disasarkan akan dapat dicapai jika dasar penyasaran-inflasi diperkukuhkan.

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Kata kunci: kadar pertukaran, inflasi, ketegaran inflasi, kadar inflasi ambang, Negara-negara Komanwel Afrika Barat

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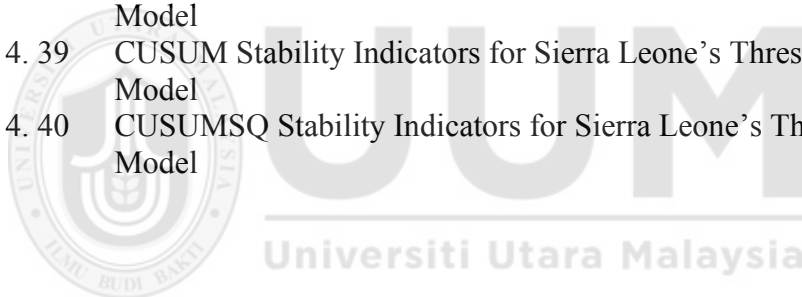
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LIST OF ABBREVIATIONS

ADF	Augmented Dickey-Fuller
AIC	Akaike Information Criterion
AR	Autoregressive Model
ARDL	Autoregressive Distributed Lag Model
CPI	Consumer Price Index
CUSUM	Cumulative Sum of Recursive Residuals
CUSUMSQ	Cumulative Sum of Recursive Residuals Squares
DSGE	Dynamic Stochastic General Equilibrium
ECT	Error Correction Term
ERPT	Exchange Rate Pass-Through
GDP	Gross Domestic Products
GMM	Generalized Method of Moment
HQC	Hannan-Quinn Information Criterion
IMF	International Monetary Fund
IRF	Impulse Response Function
IT	Inflation Targeting
LSTP	Logistic Smooth Transition Pass-Through
OLS	Ordinary Least Squares
SAP	Structural Adjustment Program
SIC	Schwarz's Information Criterion
USD	United State Dollars
VAR	Vector Autoregressive Model
VD	Variance Decomposition
VECM	Vector Error Correction Model
VIF	Variance Inflation Factor
WACCs	West African Commonwealth Countries
WACs	West African Countries
WAFCs	West African French-speaking Countries
WDIs	World Development Indicators

CHAPTER ONE

INTRODUCTION

This chapter presents the general introduction of the research. Background of the study is highlighted in Section 1.2, and statement of the problem is discussed in Section 1.3. Research question and research objectives are discussed in Section 1.4 and Section 1.5, respectively. Meanwhile, the significance of the study is discussed in Section 1.6. The scope of the study is discussed in Section 1.7. Finally, an organization of the study is highlighted in Section 1.8.

1.1 Background of the Study

Nigeria, Ghana, Gambia, and Sierra Leone are known as West African Commonwealth Countries (WACCs). They are located in West Africa and colonized by Great Britain. The countries are developing economies and are always trying to make and implement policies that will elevate their economies to the path of sustainable growth and development. Achieving long-term economic growth is one of the macroeconomic objectives of every country, which is only possible if the prices of goods and services are relatively stable. Sustainable price stability not only attempts to provide but also to promote long-term economic growth. The primary concern of every country is to have price stability and to maintain it, which is foremost to both short-run and long-run growth and development (Nguyen, 2014; Bawa & Abdullahi, 2012; Odusanya & Atanda, 2010). The main reason behind this assertion is the variation of inflation rate, which has been proven to have adverse social and economic implications on any economy. High inflation rate has been

considered prejudicial to the performance of an economy in a given country (Sek, Teo & Wong, 2015).

The source of inflation in WACCs has been decomposed and classified into internal and external sources (Shamsul-Alam & Kamath, 1986). The internal sources comprise of the countries having multiple-channels of monetary expansion coupled with sluggish economic growth in addition to having low supply over demand and excess demand above the supply of goods and services within the WACCs. The external sources have been attributed to exchange rate volatility and increase in prices of commodities worldwide. For example, Nigeria, virtually, imports almost everything, several times the country implements currency devaluation which depreciates its legal tender in respect of foreign currencies of its trading associates such as United States Dollars (USD), which translate into inflation (Oriavwote & Eshenake, 2012). This could be attributed to the fact that Nigeria is a mono-cultural economy because its export of crude oil accounts for; 80 to 90 percent of its GDP and price of oil has been fluctuating. For example, in early 2008, it was around USD147 per barrel and later fell to about USD38 per barrel in the same year. Hence, crude oil being the major source of foreign exchange to the country, this will definitely affect the exchange rate of the country, and this effect will be passed to the prices of goods and services (Oriakhi & Osaze, 2013; Wilson, David, Inyiana & Beatrice, 2014).

1.2 Inflation in West African Commonwealth Countries

Sustainable price stability is a mandatory condition for economic growth and development. The perpetual price level changes, specifically, persistence increase in

price level, signifies the presence of inflation in an economy. The high rate of inflation in WACCs could be attributed to the excessive devaluation of their local currencies (changes, especially, increase in the exchange rate) (Oriakhi & Osaze, 2013; Wilson, David, Inyama & Beatrice, 2014). Meanwhile, Ahmad and Stavey-O'Carrol (2017), Cogley, Primeceri and Sargent (2010) and Coleman (2010) attributed the high rate of inflation, in WACCs to high expectations resulted from high persistent of the inflation rate. Usually, the inflation rate is harmful to economic growth when it is above the threshold rate (Khan & Senhadji, 2000; Gylfason & Herbertson, 2001; Bawa & Abdullahi, 2012; Baglan & Yoldas, 2014).

1.2.1 The Change in Exchange Rate

Each country has a unique legal tender that is being used for payments of goods and services within its territorial boundaries. When it comes to transactions across international borders (international trade), most countries change their local currency to an internationally accepted pair of currency, usually, USD at a specific rate which is termed as an exchange rate. The exchange rate is determined by demand and supply of the foreign exchange. An increase in the exchange rate reflects a devaluation of the local currency of the country concern, whereas, a decrease in the exchange rate reflects a revaluation of the local currency of the concerned country. In most cases, exchange rates determine the value of the legal tender of various countries, as the legal tenders are generally accepted as a means of payments within the territorial boundaries of the countries that created it. Exchange rate demand and supply are being influenced by the volume of countries' exports, the volume of imports, the nature, and elasticity of demand for both exports and imports as well as the source and availability of foreign exchange.

One of the consequences of currency devaluation is inflation that occurs through exchange rate pass-through (*ERPT*), which simply signifies an increase in general price level resulted from currency devaluations and the impact of the changes in exchange rate on inflation (Lafleche, 1996). Having knowledge of the nature of *ERPT* to inflation aids the decisionmaking process on exchange rate fluctuations of any nation.

Understanding the nature of *ERPT* requires studying the trend of exchanges rates and their changes. Therefore, the trend of exchange rates for all the WACCs are observed, and their patterns are similar in all the countries. The changes in exchange rate in WACCs started in the early 1980s due to balance of payment deficits accrued to the countries resulted from fixed exchange rate policy that was completely abolished in 1986 which marked the beginning of the period of floating exchange rates, adopted after the abolishing of Bretton Woods System as depicted in the various figures: Figure 1.1, Figure 1.2, Figure 1.3 and Figure 1.4.

The local currencies in the region started losing value from the early 1980s and continued onward; strengthen by the 1986 floating exchange rate policy, which marked the end of the fixed exchange rate regime. The exchange rate continues to trend up with the passage of time, indicating depreciation of local currencies of WACCs. While, the change in exchange rate, usually, stays above zero in all the countries which show continuing devaluations of the local currency that could result in the high inflation rate.

The trend of the exchange rate and its changes as well as the trend of inflation rate for Nigeria is observed in Figure 1.1. The figure shows an upward trend of the exchange rate, which signifies perpetual currency devaluation, and this is confirmed by the trend of the changes in exchange rate that mostly stays above zero. This could be one of the reasons why the rates of inflation in most of the times are above 10 percent

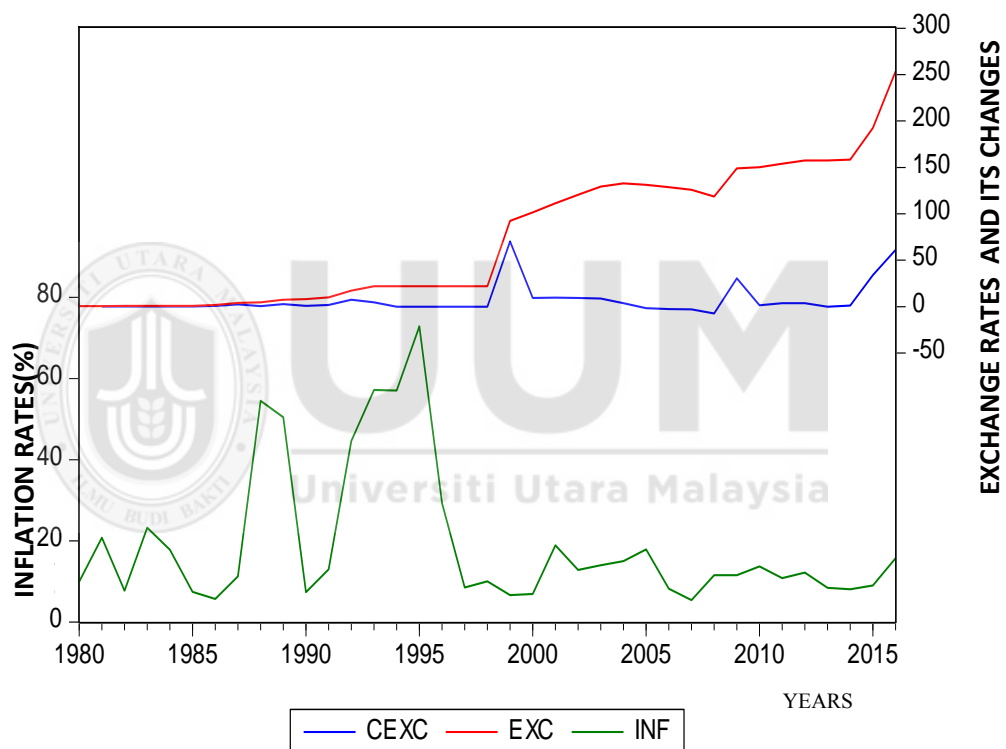


Figure 1. 1
*Nigeria's Inflation Rate, Exchange Rate and Change in Exchange Rate
 1980 – 2016*
 Source: World Development Indicators, 2017

Similarly, in Ghana, the trend of exchange rate, and its changes are much similar to that of Nigeria, though the rates of inflation are higher in Ghana, as indicated in Figure 1.2. This could imply that the currency devaluation, in the region, could be

one of the major sources of a high inflation rate that make the countries unable to make and retain their rates of inflation single digit.

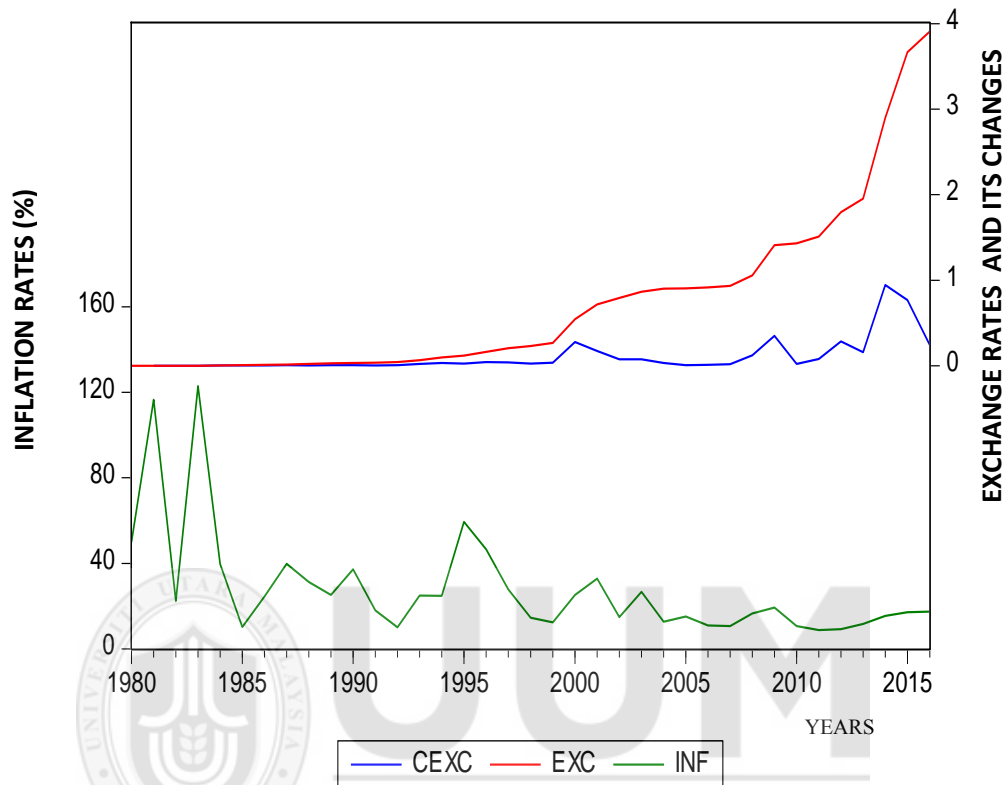


Figure 1. 2
Ghana's Inflation Rate, Exchange Rate and Change in Exchange Rate
1980 – 2016

Source: World Development Indicators, 2017

Also, Figure 1.3 shows a similar situation in the case of the Gambia. The exchange rate has been trending upward, showing evidence of currency devaluation, which is confirmed by the positive values of the change in exchange rate. Though despite that inflation rates are high in the country, it has lower values in the Gambia compared to that of Nigeria and Ghana. Hence, there is a need to investigate the evidence of *ERPT* in WACCs.

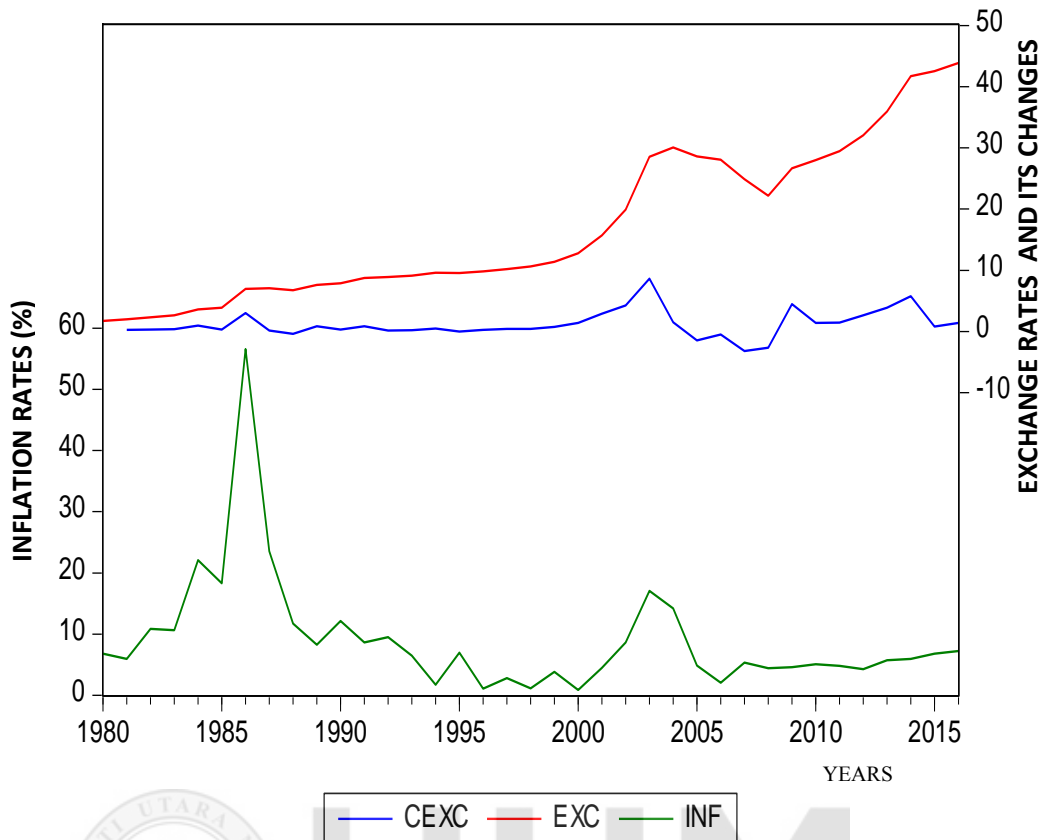


Figure 1.3
The Gambia's Inflation Rate, Exchange Rate and Change in Exchange Rate 1980 – 2016
 Source: World Development Indicators, 2017

Meanwhile, Figure 1.4 shows no difference in terms of the trend of exchange rate, and it changes as well as the trend of inflation rate in Sierra Leone. The figure clearly shows an upward trend of the exchange rate throughout the period and the corresponding positive values of the changes in exchange rate, similar to Nigeria, Ghana, and the Gambia. The rates of inflation are mostly double-digit in Sierra Leone, and it is higher than the rest of the WACCs

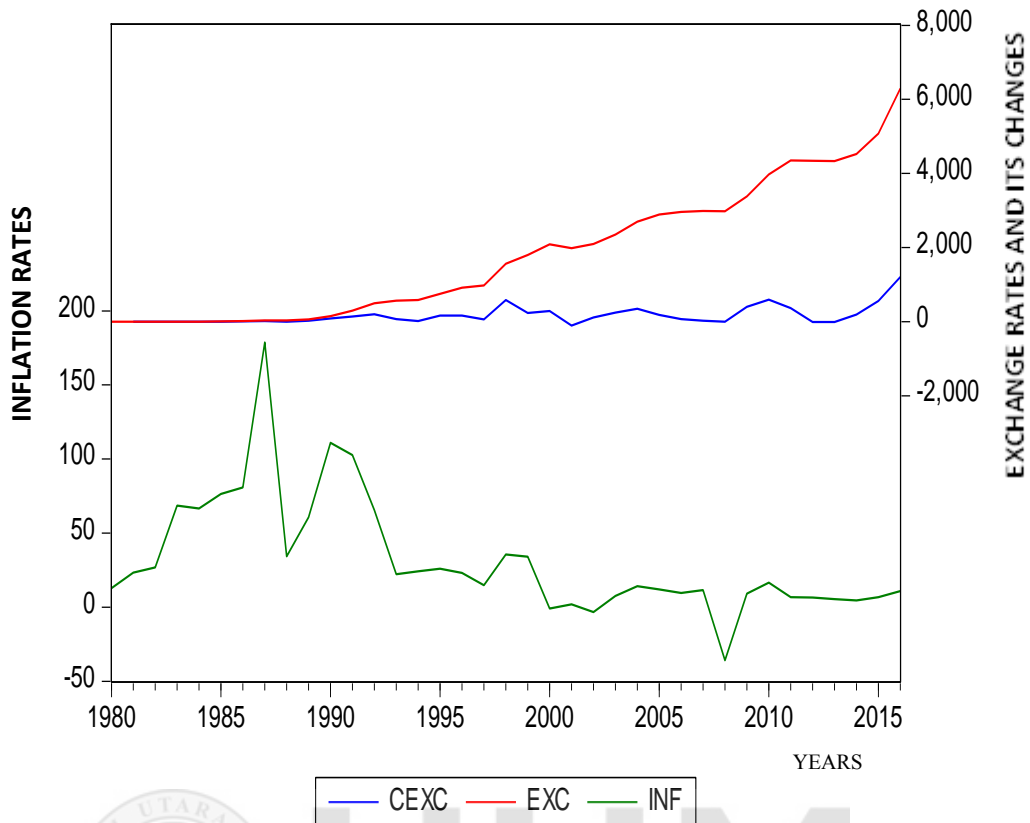


Figure 1. 4
*Sierra Leone's Inflation Rate, Exchange Rate and Change in Exchange Rate
 1980 – 2016*
 Source: World Development Indicators, 2017

1.2.2 Persistence of Inflation

The trends of inflation in WACCs for a period 1970 – 2016 are observed, and high degrees of persistence are recorded. In most cases, increases in the rates are followed by a further increase in addition to being double-digit in most of the periods. In the case of Nigeria, in a decade after independence, from 1970 to 1979, two years of single-digit inflation rates were recorded in 1972 and 1973, four years of single-digit inflation rate were recorded during 1980 – 1989 and 1990 – 1990. Also, three years were recorded for a single digit inflation rate, from 2000 – 2009 and 2010 – 2016, as depicted in Figure 1.5. Note that fluctuations of inflation rate are not much during the period of fixed exchange rate 1970 to 1986. The floating exchange rate was introduced towards the end of 1986 and immediately the following year inflation rate

jumped up, by 1988 it reached nearly 60 percent, though it came down to less than 10 percent 1990. The inflation rate in Nigeria reached its peak in 1994 above 70 percent as a result of a transition from a quasi-socialist (mixed) economy to a market economy (Mbutor, 2014).

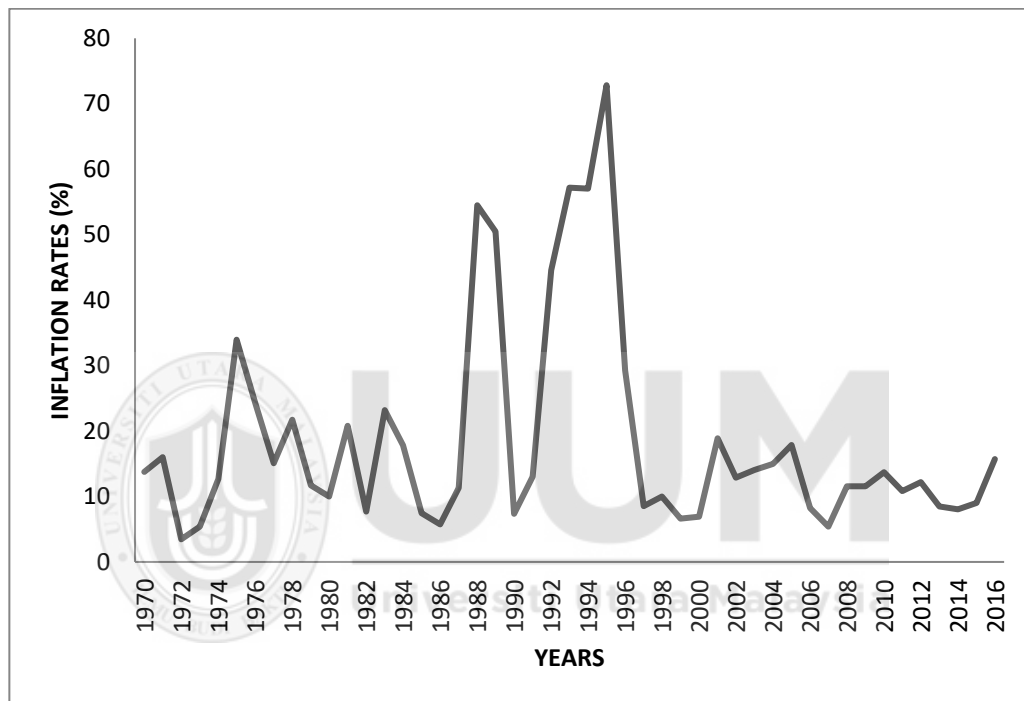


Figure 1. 5
Nigerian Annual Inflation Rates, 1970 – 2016
 Source: World Development Indicators, 2017

Furthermore, as observed in Figure 1.6, Ghanaian inflation rates were single digits in 1970, 1971, 2011 and 2012. The rest of the years, inflation rates were double-digit, in addition to high fluctuations of the inflation rates. From 1975 to 1985, the rates of inflation were highly volatile as a result of the high balance of payment deficit accrued due to the over-value of the local currency resulted from fixed exchange rate regime which was abolished in 1986 (Garber, 1993).

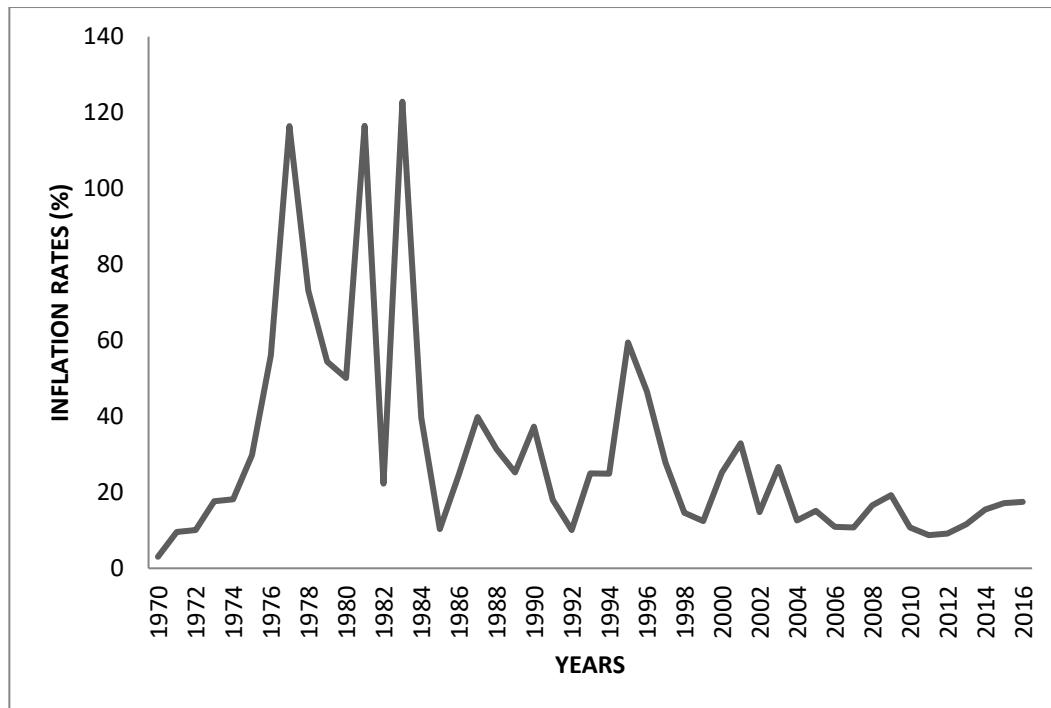


Figure 1. 6
 Ghanaian Annual Inflation Rates, 1970 – 2016
 Source: World Development Indicators, 2017

Meanwhile, Figure 1.7 displays the pattern of the inflation rate in the Gambia; the inflation rate fluctuation was a little bit better, as more than 70 percent of the period (1970 – 2016) the rates were single-digits. While below 30 percent of the period the rates reached double-digits, but the country experienced high volatile rates of inflation, the fluctuations of inflation is much. As it is in other countries, Gambia abolished fixed exchange rate regime in 1986, immediately after that inflation started rising and reached nearly 60 percent in 1987, though it was normalized to single digit in 1989.

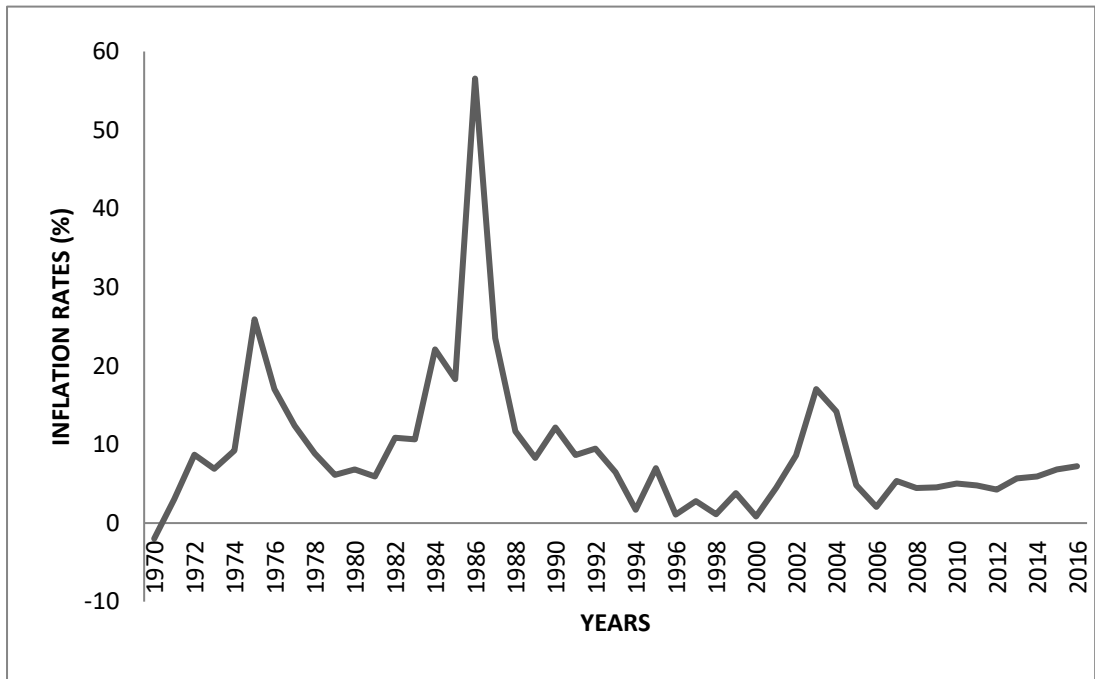


Figure 1. 7
Gambian Annual Inflation Rates, 1970 – 2016
 Source: World Development Indicators, 2017

In Sierra Leone, the situation is not better, out of 47 years (1970 – 2016) period, 10 years of single-digits inflation rates were recorded in 1970, 1972, 1973, 1977, 2001, 2003, 2006, 2009, 2014 and 2015. Four years of deflation were also recorded, and they are 1971, 2000, 2002, and 2008. The rest of the years were of high inflation rates. The rate of inflation started rising around 1983 to more than 20 percent due to the high balance of payment deficit accrued to the country as a result of the overvalue of local currency due to fixed exchange rate regime that was abolished in 1986. The country did not restructure its economy like others such as Nigeria and Ghana, the rate of inflation in 1987 increased to almost 180 percent. The economic restructure popularly known as Structural Adjustment Program (SAP) was later implemented in 1993 by Sierra Leone. This can be seen in Figure 1.8.

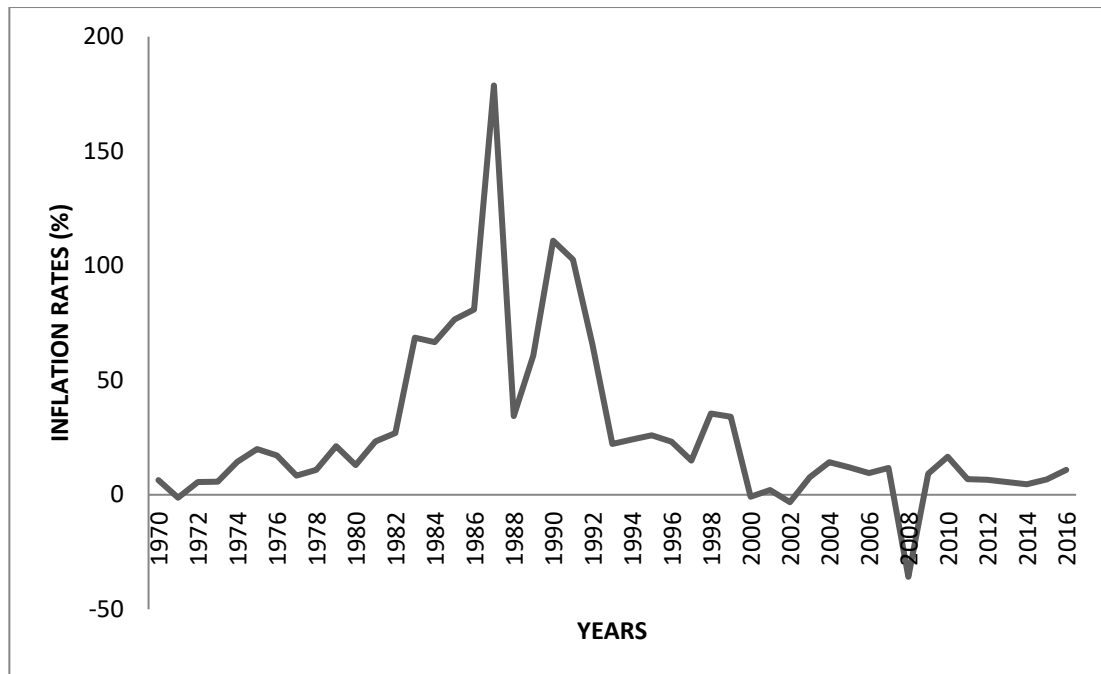


Figure 1. 8
Sierra Leone Annual Inflation Rates, 1970 – 2016
 Source: World Development Indicators, 2017

Many countries, including Nigeria, Ghana, Gambia, and Sierra Leone, experienced changes in their macroeconomic variables in the mid of 80s as a result of the collapse of the Bretton Wood System of the fixed exchange rate (Garber, 1993). This can be seen in all the figures of all the four countries presented; there were overshoots in the rates on inflation around 1986 in all the countries as a result of fixed exchange rate abolishing and adoption of flexible exchange rates. In addition to that, developing countries started adopting and implementing SAP in order to structure their economies and to adjust the balance payment disequilibrium or balance of payment deficit accrued to them.

The theoretical accounts of inflation in developing countries can be categorized into two points of views; the Monetarists and the Structuralists (Shamsul-Alam &

Kamath, 1986).¹ Inflation is perceived as a monetary phenomenon by Monetarists; only the rate of money supply growth determines the rate of inflation solely.² On the other hand, Structuralists maintained that inflation is caused by structural rigidities or existence of bottlenecks and lack of free hand in the developing economies; like minimum wage regulations, fixed exchange rate regime and other administered prices. Variables under structural rigidities may affect or influence inflation either directly such as fixed exchange rate regime or indirectly like the effects of an increase in government revenue which increases the money supply in both the short run and long run (Musa, Usman & Zoramawa, 2014) and such money supply will influence inflation.

1.2.3 The Threshold Inflation Rate

Presence of high inflation is harmful to the economy, likewise zero inflation rate. Low inflation rates are needed for economic growth enhancement (Aydin, Essen & Bayrak, 2016; Doguwa, 2012; Thanh, 2015). It is when the inflation rate exceeds a certain rate or a threshold that it becomes inimical to economic growth. The threshold inflation points out a specific rate of inflation, at which from it, inflation is inimical to economic growth and below it, inflation has no harmful effects on the economy. Turbulent inflation is a major challenge to WACCs, and not only to the rest of the developing economies but also to developed ones. The rates of inflation, in most of the WACCs, are above 10 percent despite the measures they have been putting and the recommendations by analysts and researchers to retain the said rate at

¹Structuralist is one of the strands of thoughts in economics, whom maintained a belief in the arguments that existence of constraints and structural imbalances as the major sources of problems of developing countries.

²Monetarist is the strand of thought or group of economists whose hold an intense belief that changes in money supply is almost the sole determinant of economic performance. Members of this group are called Monetarists.

single-digit which is from one to nine percent, for meaningful progress in economic growth and economic development to be registered by the countries concerned (Babalola, Danladi, Akomolafe & Ajiboye, 2015; Anwar & Islam, 2013; Phiri, 2012; Risso & Sanchez-Carrera, 2009). Their arguments automatically pegged the threshold inflation rate in all developing economies at 10 percent. Any rate of inflation from 10 percent and above is considered harmful to economic growth, and rates below 10 percent are considered safe for the economy.

The trend of inflation rate and that of GDP growth rate for WACCs are observed and presented in Figure 1.9, Figure 1.10, Figure 1.11 and Figure 1.12., for the period 1970 – 2016. Starting with Nigeria, in most of the periods, an inverse movement between inflation rate and GDP growth rate are observed while in some few periods, there is no such co-movement. This could imply an existence of non-linear relationships and existence threshold that might be empirically investigated between inflation rate and GDP growth in the country

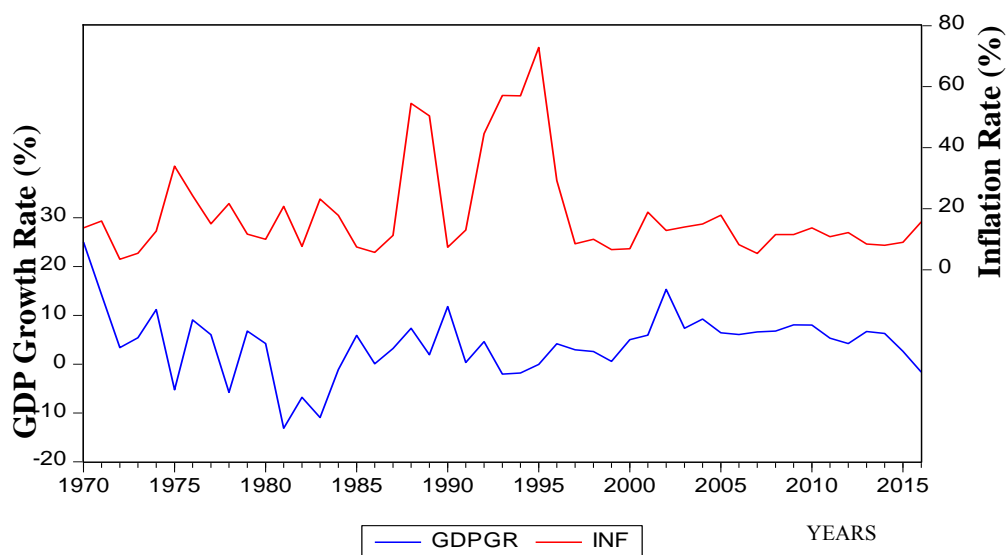


Figure 1. 9
Nigerian GDP Growth Rate and Inflation Rate 1970 – 2016
 Source: World Development Indicators, 2017

Furthermore, Figure 1.10 for Ghana indicates a similar scenario with that of Nigeria, having the trend of inflation and that of GDP growth rate moving in the opposite direction throughout the period

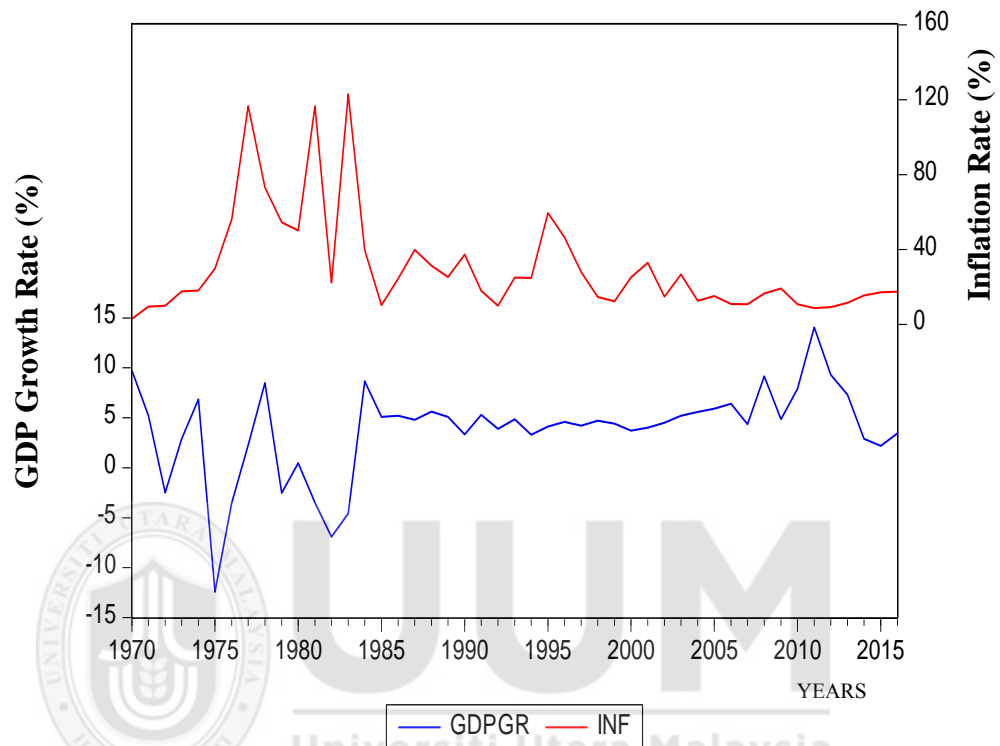


Figure 1. 10
Ghanaian GDP Growth Rate and Inflation Rate 1970 – 2016
 Source: World Development Indicators, 2017

Nevertheless, in the case of the Gambia, there is no significant disparity that is observed on the co-movement of the inflation rate and GDP growth rate based on what Figure 1.11 displayed. It is similar to that of Nigeria and Ghana in the sense that it inverse co-movements of the growth rate of GDP and inflation rate are observed in most of the periods which could reflect a threshold or non-linear relationships among between them.

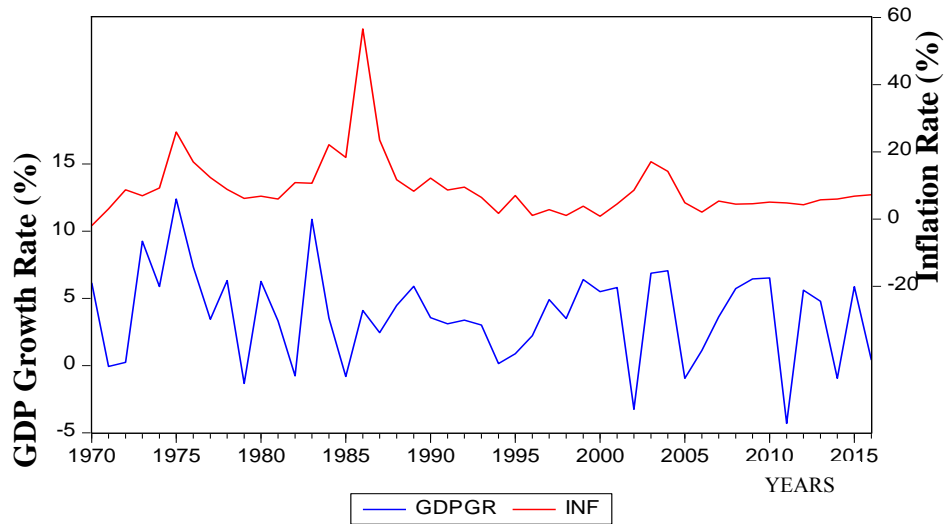


Figure 1. 11
The Gambian GDP Growth Rate and Inflation Rate 1970 – 2016
 Source: World Development Indicators, 2017

Moreover, in Sierra Leone, Figure 1.12 displays a similar nature of trend movement, between GDP growth rate and inflation rate, with that of the rest of WACCs, which implies non-linear and threshold relationships between them.

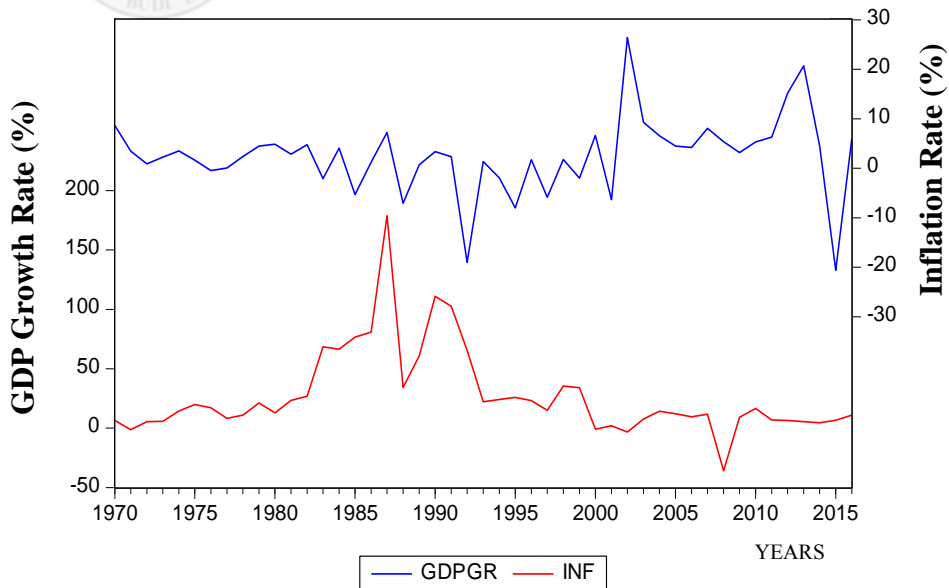


Figure 1. 12
The Gambian GDP Growth Rate and Inflation Rate 1970 – 2016
 Source: World Development Indicators, 2017

1.3 Problem Statement

Over the years, price instability has been the major issue of concern to WACCs, as they are among the developing countries with high rates of inflation around the globe; it has been above the desired limit. The strategies and measures that are being taken, by various authorities of the countries, to halt the rate at single-digit proved abortive — the existence of multiple channels of monetary expansion and overdependence on imported commodities; (which deteriorates the purchasing power of their legal tender). Coupled with a low level of economic growth could be the main hindrance to the ability of the policies developed by WACCs to hold the inflation rate at the desired level. As observed from the trends of inflation, the rates of are not static, they do change in different periods, and at most times, the rates stay above 10 percent. WACCs are among those economies whose pursue policies that intend to reduce the pressures of inflation and elevate their respective economies to the path of growth and development. The problem of ineffective monetary management, the sluggish rate of economic growth, high level of poverty, and frequent devaluation of local currencies by WACCs might have a strong connection with the high rate of persistent inflation in the region. In a nutshell, with the present level of the high persistent inflation rate, significant welfare improvements, and meaningful economic growth achievements are hardly realized.

The inability of the policymakers of WACCs to implement policies for the purpose of achieving all the macroeconomic objectives simultaneously posed serious challenges to the process and stages of their economic growth and the level of their economic development. The WACCs policymakers in most times, increase the rate of exchange of their currencies for the purpose of discouraging imports and

encouraging exports to boost their economies without taking into cognizance that increase in the exchange rate could pass-through into inflation. Having observed the trends of the exchange; which clearly show upward trending immediately in the early 1980s and after abolishing of exchange rate regime and such could be a source of the high inflation rate of WACCs. The upward trend of the WACCs exchange rate continues even in the last five years. These necessitated the need to empirically investigate not only the impact of the changes of exchange rate on inflation in both the short run and the long run of WACCs but also how fast it passes through to inflation for the policymakers to witness, empirically, the impact of the exchange rate to inflation.

Persistency of high inflation rate has been considered as the major hindrance to the main aim of achieving sustainable economic growth in WACCs. Having observed the trends of inflation of WACCs, which show the visible persistence of the high rate of the variable (10 percent and above), this reveals the need to empirically investigate and verify the extent of such persistence in WACCs to aid in making policies regarding inflation in the region. Coleman (2010) pointed out that most of the studies on inflation persistence are conducted in developed countries even though their inflation rate is low while no much studies on inflation persistence in developing countries even though they have high inflation rate. Prices of commodities hardly comedown after rising especially, in developing economies, reductions or falling in the rate of inflation does not mean prices are falling but rather it exhibits reductions in terms of the rate at which they are rising. In WACCs in particular and most of developing economies in general, high rate of inflation is being experienced majorly in most time. The longer the high rate of inflation persists

the more harm it causes the economy. Assessing empirically, how long changes in inflation in WACCs persist is necessary considering the harmful effect of high rate of inflation. Pursuing and maintaining price stability become essential as the persistence of the high inflation rate is known to have a lot of hostile consequences on any economy.

The policymakers of WACCs are facing the major challenge of macroeconomic policies of controlling high inflation rate and at the same time monitoring and controlling the economy from falling into depression. It is a known fact that the WACCs have low economic growth and high rates of inflation, compared with developed nations. Having a high rate of inflation could be one of the reasons for the low rate of economic growth. Though, some scholars asserted that not all rates of inflation are harmful as some inflation rates are needed to ginger economic growth (Aydin, Essen & Bayrak, 2016; Phiri, 2012; Risso & Sanchez-Carrera, 2009; Khan & Senhadji, 2000). Knowing the threshold inflation rate of WACCs will aid the countries to take corrective measures for remedying harmful rates of inflation and reinforcing performance while having the needed inflation rates.

1.4 Questions of the Study

This study is designed to attempt answering the following questions concerning inflation in WACCs

- i. Do the impacts of exchange rate pass-through to inflation matter in WACCs?
- ii. Does the WACCs inflation rate persist over time?
- iii. What is the threshold level of an inflation rate of WACCs by which is inimical to economic growth?

1.5 Objectives of the Study

The general objective of this research is to study the exchange rate pass-through to inflation rates of WACCs, inflation persistence of WACCs, and study the threshold inflation rate of WACCs. The specific objectives are;

- i. to analyze the exchange rate pass-through to inflation rate of WACCs,
- ii. to examine the inflation persistence of WACCs, and
- iii. to establish a threshold inflation rate by which is inimical to the economic growth of WACCs.

1.6 Significance of the Study

Having ascertained that inflation could be featured in both microeconomics and macroeconomics elements that affect countries' economic stability. Taking the world's economic recessions into consideration, nations and researchers continue to deliberate for the purpose of getting an accurate prediction of inflation rates which is not an easy task as it is very uncertain and complex as well as have no unique model of its estimation or prediction (Thakur, Bhattacharyya & Mondal, 2016). Hence, the study of inflation in WACCs is of paramount importance.

The study provides adequate and updated information about the trend and dynamics of inflation to the policymakers of the WACCs using ARDL, threshold model, and the AR model. Hence, the study becomes a guide for making policies on macroeconomic issues and monetary policy in particular, and the countries' economy in general. Mordi et al., (2007), stressed the need and importance of deep comprehension, and understanding of trends of inflation to developing countries and economies (like Nigeria in particular and the rest of African countries in general).

Especially, those economies that depict notable or remarkable structural disparities and uncertainties for making efficient policies that will adjust the determinants of the concerned factor or variable on the right and the needed way.

In the same vein, the study provides updated information about the pass-through of exchange rate into inflation, especially, to policymakers in the region. It enlightens the policymakers about the need of having exchange rate stability that might lead to not only sustainable price stability but also lead to a gain or at least prevent a loss from the sides of investors that hold financial positions in the local currencies in the region which could have been a loss due to currency devaluation.

Many countries have experienced the dynamics of inflation with regards to its average rates, steadfastness and its fluctuations as well as inflation persistence more especially, in European economies after the introduction of the union unanimous currency 'Euro' (Kanellopoulos & Kuotroulis, 2016). This highlights a demarcation between countries with low economic growth as well as experiencing high inflation rates and those with low inflation rates that are also running into deflation. Hence, this stressed the need for understanding the trend of inflation, the high rate at which it will adversely affect economic growth and the lowest rate at which below it countries will be running into economic deflation. This aids the policymakers on issues regarding monetary policy as it could be a guide in choosing the optimal inflation target.

Moreover, the study could elaborate the understanding of the persistence of inflation and could help in guiding policymakers in understanding the current trend of

inflation as it relates to the expected inflation in the future, on whether to take corrective measures when needed and reinforce performance where appropriate.

Furthermore, the study is valuable to the researcher's knowledge in analyzing and understanding the trends and dynamics of inflation and inflation's trends in WACCs. Also, the study is first for its kind in WACCs; it has opened a new leaf of research for other studies to be conducted using the same cluster or community (WACCs) in different fields and areas of studies. Therefore, the study has contributed significantly to the existing knowledge as it could serve as a material of reference for further researches on inflation, exchange rate pass-through to inflation, inflation persistence and threshold rate of inflation that may be carried out in the relevant area.

Nevertheless, the research is conducted using time series of four different countries, namely Nigeria, Ghana, the Gambia, and Sierra Leone. It might enlighten the countries to team up, in taking unanimous decision to boost their respective economies and to synergize in tackling the inflationary pressure that has been disturbing their economies.

1.7 Scope of the Study

This study is carried out on WACCs namely; Nigeria, Ghana, Gambia, and Sierra Leone, even though, there are 16 countries in West Africa, only four are members of the Commonwealth of Nations. These Commonwealth countries share some similar features as they were colonized by the same country; Great Britain, and their official language is English. They are located in the same region (of West Africa), they

become independent in almost the same period, and they were practicing a fixed exchange rate regime before SAP implementation. After the implementation of SAP, they adopted a floating exchange rate regime (SAP implementation indicated that there are some similarities regarding the decision-making process of the WACCs).

The study is entirely on the inflation rate of WACCs. A variable like inflation is being studied by either how it is affected by another variable or how the previous shocks of the same variable affect the current shock or how the variable affects another variable. This research involves all the three categories as it consists of studying the *ERPT* to inflation (how currency devaluation affects inflation), how the previous shocks of inflation affects the current shock (inflation persistence) and threshold inflation rate by which from it inflation is inimical to economic growth (the effect of inflation of economic growth). The major variables of the study include inflation rate, exchange rate, and economic growth.

Having ascertained that high inflation rates of WACCs are attributed to both external and internal sources while at the same time many scholars such as; Shamsul-Alam and Kamath (1986), Risso & Sanchez-Carrera (2009), and Phiri (2012) have given more weight to the external sources. Therefore, it is important to note that studying *ERPT* to inflation is also motivated by deepening the investigation of the external source of inflation in WACCs by this study. Bada et al. (2016) also stressed that *ERPT* has an extreme implication to the policies on macroeconomic activities in a country. Similarly, Aliyu et al. (2009) highlighted that *ERPT* is a significant tool in scheming monetary policy in tackling the fluctuations of prices due to exchange rate shocks.

The study uses annual time series data from 1980 to 2016 for *ERPT* to inflation and data from for the period 1970 to 2016 for the rest of the objectives. The disparity of the study period aroused as a result of the fixed exchange rate regime that makes the exchange rates of the WACCs fixed before 1980. Therefore, the data, before then, are mostly unavailable as there are no changes in the exchange rate. Also, the data are sourced from World Bank Open Data popularly known as World Development Indicators.

1.8 Organization of the Study

The study is on the analysis of the exchange rate pass-through to inflation, inflation persistence and threshold inflation rate of WACCs, to carry out the research successfully; the work is divided into five chapters. Chapter One, being an introduction, introduces the topic of the research, it contains a statement of the research problem, research questions, objectives of the study, significance of the study, the scope of the research and organization of the study. Chapter Two reviews the related literature on the subject of the study, including theoretical literature and empirical studies on inflation. Chapter Three is the research methodology, and it comprises of the theoretical framework, model specifications, and justifications of the variables as well as the methods of analysis of the study. Chapter Four deals with the presentation and analysis of data as well as the interpretation of the results; and finally, Chapter Five is the summary, conclusion, and recommendations.

1.9 Conclusion

Being an introduction, the chapter denotes the assimilations and understanding of the study. It covers the overview of WACCs, and their possible sources of inflation,

followed by stating the problems of the study where issues and problems on inflation in WACCs; which is possibly caused by increase in exchange rate (currency devaluations), and high inflation rate of the previous years that might have exceeded the presumed threshold inflation rate of the region, are discussed. Whereupon, questions, and objectives of the study are categorically raised and stated, after that, the chapter states the significance of the study to both the researcher, the future researchers for future researches and to the policymakers, and the chapter states the scope of the research. Organization of the research is also highlighted in the chapter. Finally, the chapter is closed with the conclusion.



CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter deals with the review of previous theoretical and empirical studies. It consists of theoretical reviews of; inflation, exchange rate pass-through, inflation persistence, and threshold inflation rate, whereupon, review of empirical studies, and analysis of the literature gap are presented. Finally, the chapter is closed by the conclusion.

2.2 Theoretical Review of Inflation

This section presents a theoretical review of the concept of inflation and the magnitude of inflation as they related to the study.

2.2.1 Concept of Inflation

There are many definitions of the term inflation by different analysts and scholars; such definitions are, basically, pointing towards the same thing or making the same point. When prices of commodities (goods and services) are persistently increasing or rising within a defined territory in a particular period, such vicinity will be said to have been experiencing inflation. Inflation occurs when too much money is chasing a few goods. Some perceived inflation in terms of multiplications of the velocity of money in circulation which results in an increase in the quantity of money in circulation (through the way commercial banks create money) thus results to increases in the general price level (Haberler, 1960; Hazlitt, 1960; Melberg, 1992; Hamilton, 2001). High inflation rate is a plague of the contemporary economy, which if not suppress will sabotage and destroy decades of witnessed economic

blooming and growth; it redistributes income unfairly by making some rich at the expense of others (Fielding, 2008).

Neo-classical economists perceived inflation as a speedy or what they called a galloping rise in the general price level, which is being caused by the imprudent and rampant expansion of the quantity of money. Their perception on inflation is that the term is a wrecking disease came up as a consequence of the absence of strong monetary control which injures business rules, creates widespread destructions in markets and financial decay as well as creates total uncertainty of the future. To Keynesians, money supply expansion in a state of underemployment economy will increase aggregate demand, total output, and level of employment. In a period of depression, expansion of money supply will lead to a proportionate increase in output, aggregate demand and employment levels but when diminishing return starts, bottleneck appears the prices will start rising, the process will continue until the economy reached full employment level. To Keynesians, this rise in prices is perceived to be semi-inflation or bottleneck inflation (Keynes, 1936; Jhingan, 2011).

2.2.2 Types of Inflation

It is highly imperative to comprehend that persisted increase in general price levels are of various magnitude with different determinants, causes, consequences, and different policy implications as well as different applicable remedies, depending on their strength, extremity, and persistence (Cagan, 1956; Frisch, 1983; McCallum, 1990; Modi et al., 2007; Jhingan, 2011). Mostly, when the rate of inflation is one to two percent, i.e., a slow rise in price, it is being considered as creeping or low inflation (McCallum, 1990). Also, when the annual percentage of increase in the

prices level is less than 10 percent, i.e., specifically, from three percent to nine percent, it is being considered as walking or trotting inflation, and it is also termed as moderate inflation (Cagan, 1956; Mordi et al., 2007). High inflation or running inflation is when the annual rate of increase in the general price level is 10 – 20 percent or 25 percent in a few cases, and it is approaching the unneeded hyperinflation (Jhingan, 2011). When the general price level is rising very high above 25 percent or to some when it is just double-digit, it is referred to us hyperinflation (Frisch, 1983; Modi et al., 2007; Jhingan, 2011).

2.3 Theoretical Review of Exchange Rate Pass-Through

In this section, the concept of the exchange rate and the Exchange Rate Pass-Through are reviewed as they relate to the inflation rate. Also, the review of *ERPT* theory is presented.

2.3.1 The Concept of Exchange Rate

The exchange rate is the rate at which local currency, of a particular country, is being exchanged with international currency usually USD, for the purpose of conducting transactions across international borders (World Bank, 2016). It is being determined by the forces of demand and supply for foreign exchange of the concerned country. Increase in the exchange rate implies a depreciation of the local currencies whereas, a decrease in exchange rate signifies appreciations of the local currencies (Amuedo-Dorantes & Polo, 2004; Pan, Fox & Liu, 2007; Ponties & Rajan, 2011).

Many scholars including Yanamandra (2015) and Karagoz, Demirel and Bozdag (2016) highlighted that; changes in the exchange rate derived from the exchange rate

fluctuations mostly, devaluations of currencies by developing countries, either as a loan requirement or condition given by multinationals organization (World Bank and International Monetary Fund – IMF) or as import promotion strategy, have an impact on the general price level changes, majorly, inflation of the concerned country.

2.3.2 The Concept of Exchange Rate Pass-Through

The concept of Exchange Rate Pass-Through (*ERPT*) consists of the definitions of the *ERPT*. Amoah and Aziakpono (2018) defined *ERPT* as the movement of exchange rate changes into domestic prices. Similarly, Choudhri and Hakura (2006), An and Wang (2012), Bangura, Caulker and Pessima (2012), and Jobarteh (2016) defined *ERPT* as the extent to which the changes in the exchange rate of a country move into the general prices of goods and services in the concerned country. Basically, all the definitions stress on the extent of the movement of the changes in exchange rate into the prices of goods and services, that is to say, an increase in exchange rate results to increase in the domestic prices of goods and services.

Lafleche (1996) and Jiang and Kim (2013) maintained that the theoretical expositions of *ERPT* to inflation consist of a direct link by which devaluation of the currency leads to an increase in import prices. The indirect link by which the devaluation of the local currency leads to an increase in the aggregate demand of the locally manufactured goods, and hence general inflation in the entire economy. Therefore, to them the major source of inflation, in developing economies, is the excessive devaluation of their local currencies caused by excessive demand for foreign exchange, or as a means of implementing one program or another; for

example, SAP, or even as a condition of loan and aid collections from IMF, World Bank and Paris club.

2.3.3 The Exchange Rate Pass-Through Theory

The theoretical explanation of *ERPT* can best be understood using the model developed by Campa and Goldberg (2005) on the basis of combined *ERPT* theory and markup inflation theory. The theory is built based on the believe that the major sources of inflation, especially in developing economies, is the excessive devaluation of their local currency caused by high demand for foreign exchange necessitated by overdependence on imported goods. The theoretical explanation of *ERPT* is divided into two; the first is when the exchange rate devaluation pass-through to import prices, while the second is when the exchange rate devaluation pass-through to inflation.

The proponent of the markup theory, such as Duesenberry (1950), Ackley (1959), and Bronfenbrenner and Holzman (1963) maintained that in most countries, commodities are categorized into two bases depending on the way their prices are being set. The first category; are those commodities whose prices are being set through a competitive bid, and the goods are being sold to the highest bidder. The second category; are those commodities by which one of the parties; either the seller or the buyer (in some cases, marketing boards) announce the price of the commodity (after taking consideration the average cost of the commodity) and the other party accept it. The announced price is usually calculated at cost plus margin, the margin added is the profit to the seller, and hence, the set price is termed as markup price

(Hagger, 1977). To this model, inflation is the continuous increase in some index of markup prices.

The theoretical accounts of the effects of the changes in exchange on import prices could be traced to the *ERPT* theory built on the basis of markup theory (Menon, 1996). Meanwhile, Campa and Goldberg (2005) asserted that in trading between two countries; importing and exporting countries, exchange rate changes can be passed to the price of the trading commodity to either of the nations. Depending on the nature of the price elasticity of demand of the trading commodities; the differences in terms of price elasticities and elasticities of income for commodities were elaborated by Frisch (1983). The positive *ERPT* to import price is associated with the highly inelastic commodities, whereas, the *ERPT* that reduces the profit margin of the supplying countries is associated with the trading commodities that are highly elastic (Campa & Goldberg, 2005; Atkeson & Burstein, 2008; Yanamandra, 2015; Feenstra, 2015).

The theoretical explanation of *ERPT* theory to inflation is that; inflation in developing economy is majorly caused by the excessive devaluation of their local currencies. The strategies of import substitutions and export promotions, which are being frequently implemented by developing countries require excessive local currency devaluations (more inputs are in the theoretical framework). The elaboration of the theoretical account of *ERPT* to inflation is that combination of both the direct link and indirect effect of the consequences of the changes in exchange rate to the general increase of the prices of goods and service (inflation)

(Lafleche, 1996; Gagnon & Ihrig, 2004; Jiang & Kim, 2013; Tandrayen-Ragoobur & Chicooree, 2013).

The direct consequence of currency devaluation is through the increase in the prices of the importing commodities, whereas, the indirect consequences are through the increase in the demand of the domestic goods by both internal and external consumers. This could result in the increase in the demand for labor and wages, consequent to the general increase in the price of goods and services (Lafleche, 1996; Gagnon & Ihrig, 2004; Jiang & Kim, 2013; Tandrayen-Ragoobur & Chicooree, 2013). Hence, the *ERPT* to inflation comprises both the *ERPT* to import prices (which is the direct effect of exchange rate devaluation) and the demand-pull inflation caused by the increase in the demand of the locally produced commodities by both internal and external consumers (which is the indirect effect of the exchange rate devaluation).

2.4 Theoretical Review of Inflation Persistence

In this section, the concept of inflation persistence is reviewed. Moreover, the expectation theory, which explains the possibility of inflation to persist, is also reviewed.

2.4.1 Concept of Inflation Persistence

The persistence of inflation rate can be viewed as the sustenance of increase in the rate of inflation over some period of times – more than one period or in a sequence of periods of time which results in the dynamics of inflation. It has been considered to be related to the period held by the rate of inflation before returning to its initial

base after a shock (Zhang & Clovis, 2010). Persistent in a series of a variable (such as inflation) that displays no recurrence and no repetition in two or more successive or succeeding periods of time (months or years) can be termed as dynamics. Also, Fuhrer (2011) defined the persistence of inflation as the resistance of its rates to change its direction of speed downward after reaching a specific rate that is considered high unless external-force intervene. Whereas, Cogley, Primeceri and Sargent (2010) perceived inflation persistence as when current inflation is being affected or influenced by the shocks of the past or previous inflation rates. Given the definitions of inflation persistence, its estimation requires the use of dynamic modeling as analyzing inflation persistence is unanimous with dynamic analysis of inflation (Fuhrer, 2011).

Dynamics is defined as a circumstance that shapes, produces, and decorates time-changing patterns, nature, and characteristics of the pattern in a particular period being interrelated with another period (Luenberger, 1979). Mostly, in econometric analysis, when lagged value or lagged series of a dependent variable is used as a regressor or as one of the independent variables in a model, such models are usually termed as dynamics (Garrett, 2017; Schalck, 2014; Blackburne & Frank, 2007; F, 2005; Weinhold, 1999; Ahn & Schmidt, 1995; Anderson & Hsiao, 1982).

The word dynamics also implies the absence of monotony (non-static) or variable series of occurrences of events, records of data and other occasions as the word reflects in various write-ups (Gonçalves & Machado, 2015; Rodrigues, 2013; Paothong & Ladde, 2013; Ahn & Schmidt, 1995). Furthermore, in econometric analysis, when a short run analysis is conducted using the first difference of a data

series of both the dependent and the independent variables, it is also termed as dynamic analysis (Shang, 2017; Chiarella, He & Nikitopoulos, 2014).

The theoretical explanations of the linkages between the previous inflation rate and its current values to measure the inflation persistence are provided by expectations theories (Ahn & Schmidt, 1995; Fuhrer, 2011). Studies conducted on persistency include Amano (2007), Noriega and Ramos-Francia (2009), Coleman (2010), and Cogley, Primeceri and Sargent (2010).

2.4.2 The Expectation Theory

The expectation theory of inflation is developed on the basis of the dynamics of inflation. It is built based on commodities with markup pricing system (Hagger, 1977). Work on expectations was first sighted in the work of Hicks (1946), who analyzed the concept in relation to the dynamic and stability of the general equilibrium with regards to expectations in prices changes. To him, the stability or dynamics of the general equilibrium is entirely attributed to how expectations changes resulted from a shock that causes the disequilibrium. He used the concept of elasticity of expectations to simplify his analysis, which simply, shows that the percentage changes in the expected value of a variable in relation to the percentage change in its actual value.

Many scholars, for example, Lucas Jr (1972), Muth (1961) as well as Sargent and Wallace (1975, 1976), and more recently Galbac (2015) further developed the concept of expectation theory of inflation, and this leads to the emergence of classifying the theory into adaptive expectations and rational expectations. Rational

expectations believe that if variables behave in a proper way by being affected only by the variables presumed and explained by economic theory (Sargent & Wallace, 1973).

The concept of the adaptive expectations theory of inflation suggested and pointed out that expectations are not directly observable. Therefore, expectations in term of inflation are linked to the past values of the variable (Frisch, 1983). The central idea behind this is that inflation that will be experienced in the future depends on current and past inflation just like the current inflation which is also being influenced by the previous inflation rates (Hagger, 1977). The expected inflation is equivalent to previous inflation added to the forecast error, which is the proportion of the difference between the previous actual and forecasted inflation.

2.5 Theoretical Review of Threshold Inflation Rate

The section provides reviews on the explanations of the concepts of the threshold inflation rate, and it links to the theories of the research.

2.5.1 The Concept of Threshold Inflation Rate

The threshold inflation rate is the rate of inflation that is considered high and harmful to the rate of economic growth. It is the rate of inflation at which from it (from the rate and above it), inflation is inimical to economic growth (Aydin, Essen & Bayrak, 2016; Vinayagathan, 2013; Bawa & Abdullahi, 2012; Hansen, 2000; Khan & Senhadji, 2000). This implies that there is no unanimous effect of inflation on the economy. There could be desirable rates of inflation that have different effects

on the economy compared to the high rates of inflation with a harmful effect of the countries' economy.

Having considered one of the factors afflicting the growth of an economy as high inflation rate, Sek, Teo and Wong (2015) asserted that the high inflation rate is highly detrimental to the performance of any economy. On the other hand, a reasonable rate of inflation is needed to foster economic growth (Aydin, Essen & Bayrak, 2016). Accordingly, having an idea of the threshold inflation rate by any country aids its policymakers in making policies about the economies of their respective countries. Knowing the threshold rate will encourage them to take corrective measures where needed and re-enforce performance where appropriate. Studies regarding the threshold inflation rate include that of Aydin, Essen and Bayrak (2016), Thanh (2015), Bawa and Abdullahi (2012), and Doguwa (2012).

2.5.2 Threshold Inflation and Its Link to Inflation Theories

All inflation theories; including the theory of *ERPT*, and expectation theory believe that high inflation rate (rate of inflation after a certain range or threshold) is inimical to economies. This is one of the reasons why the theories made presumptions and explanations on what causes inflation based on their tests and believed. That is to say, all the theories of inflation (including the theories utilized by this research) believe in the existence of the threshold inflation rate, though it can best be understood by neo-Keynesian theory. The existence of threshold inflation rate has been confirmed by many empirical studies such as Aydin, Esen and Bayrak (2016), Than (2015), Bawa and Abdullahi (2012), Gylfason and Herbertsson (2001), and Khan and Senhadji (2001).

2.5.3 Neo-Keynesian Theory of Inflation

The Neo-Keynesian hypothetical explanation on inflation theory in-cooperated aggregate supply and aggregate demand together, as they did not totally reject the classical and monetarist perception on inflation, but modified it and presumed that it is only workable in the long-run while Keynes' perceptions were classified by them as short-run. Classicists and Monetarists believed that inflation everywhere is caused by money supply expansion or increase, whereas, Keynes believed that expansion of money supply does not always feed directly into inflation as argued by Classicists. He maintained that before the money supply affects prices, certain conditions must be fulfilled. At the level before unemployment, an increase in the quantity of money will lead to an increase in the level of employment that is by decreasing the level of unemployment and also increase the level of output. In such times, prices will not be increased by the increase in the quantity of money in circulation. It is when the quantity of money increase at the level of full-employment that will feed into inflation as it will increase the price level because there is no tendency to increase the level of employment and the level of output (the economy is at full employment level) (Keynes, 1936; Mordi et al., 2007, 2012; Jhingan, 2011).

To Neo-Keynesians, increase in money supply is unanimous with the increase in government expenditure in the short-run, such increase in money supply will have no effect on inflation, it will increase both levels of employment and output during the short, but it is inflationary in the long run. Also, to them, diminishing return is being identified by a decrease in the level of productivity; this leads to diminishing return to scale, and hence induces as well as persuades inflationary pressures; (this implies that many things can induce inflation at the level of diminishing return to scale

because, at this stage, the economy has developed structural rigidities that hinders the full interaction of market forces especially in developing economies). The concept of natural output or potential output was developed by Neo-Keynesian theorists, to them, it is in accord with Natural-Rate of unemployment which inflation is highly depended on; but the challenge is that over time, such natural-rate of unemployment becomes very volatile and hence its exact rate is unknown (Mordi et al. 2007, 2012).

Classical economists maintained that at full employment level, level of employment is not expected to increase or decrease so as economic growth and rate of interest. At such time, if money supply increased it will definitely feed into price level proportionately. Neo-Keynesian economists proposed this perception with some modification to be their long run stand. They added that any short-run action (increase in government spending, currency devaluations and so on, in the short run) would, in the long-run, lead to increase in money supply and hence translate into inflation either directly or indirectly. Neo-Keynesian further changes the nature of relationship of interest rate with inflation rate from inverse to direct as witnessed in their support of fiscal policy over monetary policy, although, they maintained the nature of relationship between inflation rate and economic growth which they all agreed to be inverse.

In the short run, Neo-Keynesian economists stressed their stand of Keynes, as they argued that increase in the money supply would not affect price level as long as the economy is at below full employment level. Prices may be changed (inflation may

arise) as a result of changes in the other factors or variables rather than price level (Mordi et al., 2012).

Majorly, inflation theories are enacted for the purpose of fishing out the best remedy to inflation based on the belief that inflation after a certain threshold has an adverse effect on the economy. The threshold inflation rate investigation in this research is backed by the Neo-Keynesian inflation theory even though it is supported by all the theories of the study.

2.6 The Review of Empirical Studies

In this section, empirical reviews of inflation are discussed. Studies regarding *ERPT* to inflation, studies on inflation persistence, and studies on threshold inflation rate are reviewed and critically discussed.

2.6.1 The Exchange Rate Pass-Through Studies

A number of studies were conducted to empirically measure the extent of exchange rate pass-through with different and inconclusive findings that is not possible to make use of them for generalization purposes. Most of these studies were conducted to investigate the existence of *ERPT*, on one hand, Adeyemi and Samuel (2013) in Nigeria, Campa, Goldberg and Gonzalez-Minguez (2005) based on their studies in Euro area, then, comparative studies among Asia-pacific, South America and Turkish economies by Karagoz, Demirel and Bozdog (2016). Studies by Leigh and Rossi (2002) in Turkey and studies on industrialized economies by McCarthy (2007) confirmed the existence of *ERPT* in their respective studies. On the other hand, in

their research on Nigeria, Adelowokan (2012) and Omisakin (2009) indicated in the findings of their studies that there is no evidence of *ERPT*.

In terms of size and location, Karagoz, Demirel and Bozdog (2016) investigated the effect of *ERPT* in Asia, Latin America, and Turkey and confirmed its existence. Though, the effect of *ERPT* in Asia is lower than those of Latin America and Turkey. Yanamandra (2015) maintained that the *ERPT* in India is about -1.16. It truly exists, and it is negative. Savoie-Chabot and Khan (2015) confirmed the existence of positive *ERPT* in Canada, which is between 0.5 and 0.7 percentage points in a rate of inflation ranged from 0.9 to 1.1 percentage points. Leigh and Rossi (2002) confirmed the existence of positive *ERPT* in Turkey using monthly data. They showed that the level of pass-through is high during the first four months and therefore, its effects are seeing mostly in the short-run.

Furthermore, some studies indicated that the *ERPT* is positive while it is negative in some studies in some areas. For instant, Leigh and Rossi (2002), Campa, Goldberg and Gonzalez-Minguez (2005), Oyinlola and Babatunde (2009), Adeyemi and Samuel (2013), Savoie-Chabot and Khan (2015), Karagoz, Demirel and Bozdog (2016), and Mawajje and Lwanga (2016), as well as Usman (2018) discovered and reported positive *ERPT* in their findings. This signifies that the rapid increase in exchange rate changes depreciates local currencies and fuels the flame of inflation. In contrary, negative *ERPT* is reported in the findings of McCarthy (2007), Aliyu, Yakubu, Sanni and Duke (2009), and Yanamandra (2015).

Nevertheless, another source of controversy in the findings of the previous studies is on whether the *ERPT* discovered and reported, is complete or incomplete as well as high *ERPT* or low *ERPT*. On this basis, Aliyu, Yakubu, Sanni and Duke (2009), Oyinlola and Egwaikhide (2011), An and Wang (2012), Razafimahefa (2012), Jiang and Kim (2013), Zubair, Okorie and Sanusi (2013), Choudhri and Hakura (2015), and Bada et al., (2016) discovered and reported incomplete *ERPT* in their respective studies. Similarly, Faruqee (2006) and Rodriguez-lopez (2011) discovered low *ERPT* in their studies, whereas, high and complete *ERPT* are discovered and reported in their various studies by Shambaugh (2008), Ogundipe and Samuel (2013), Cheikh and Louhichi (2015), Helali and Kalai (2015), Yanamandra (2015), and Communale and Simola (2018).

In another view, the extent of *ERPT* is associated with the inflation regime of the concerned importing country; high inflation associated with high *ERPT* while low inflation rate is unanimous with low *ERPT* (Cheik & Louhichi, 2016; Juntila & Korhonen, 2012; Razafimahefa, 2012; Choudhri & Hakura, 2006; Taylor, 2000). Similarly, the extent of *ERPT* is associated with the nature of the exchange rate volatility; a high volatile exchange rate change is associated with the high *ERPT* while a low volatile exchange rate change is associated with low *ERPT* (Amoah & Aziakpono, 2018; Kilic, 2016; Razafimahefa, 2012; Campa & Goldberg, 2005). Meanwhile, in his view, Lafleche (1996) highlighted that the extent of *ERPT* is being determined by the channels of some components (exports and imports) either directly or indirectly.

Similarly, McCarthy (2007) examined and established the existence of *ERPT* to inflation in industrialized economies. The result implies that the pass-through is modest but has disinflationary effects. Adeyemi and Samuel (2013) investigated the level of *ERPT* to consumer price in Nigeria and confirmed its existence. To them, the level of pass-through is large and can explain the inflationary situations of the country than does the money supply. Campa, Goldberg and Gonzalez-Minguez (2005) also confirmed the existence of *ERPT* in the euro area. The result shows that the pass-through is high in the short-run, even though it is incomplete and not unique across countries and industries. It is higher and close to unity (close to completeness) during the long run.

Aliyu et al. (2009) investigated the *ERPT* in Nigeria and confirmed its existence. They reported positive *ERPT* to import prices and negative *ERPT* to consumer price. On the other hand, Bada et al., (2016) based on Johansen cointegration and VECM reported incomplete *ERPT* in Nigeria. Ocran (2010) reported and confirmed in his study, the existence of positive *ERPT* in South Africa, while Omisakin (2009) found no evidence of *ERPT* in his study in Nigeria. On the other hand, Oyinlola and Egwaikhide (2011) reported the existence of positive *ERPT* in the long-run of Nigeria and reported that there is no evidence of it in the short-run. Nevertheless, Taylor (2000) concluded that high inflation persistence is associated with high and complete *ERPT*, whereas, low inflation persistence is associated with low and incomplete *ERPT*. Zubair, Okorie and Sanusi (2013) reported an incomplete *ERPT*, low and slow during the period of their study in Nigeria.

Meanwhile, Mawajje and Lwanga (2016) analyzed the level of *ERPT* in Uganda and affirmed its existence in a multi-stage analysis. At the level of the external sector, the pass-through is positive with a one percent increase in exchange rate resulting in a 0.91 percent increase in the consumer price index. On the other hand, in their final (general) result (what they termed as single equation model), it has been reported that one percent increase in the exchange rate will increase the inflation by 0.15 percent after three periods (three lags). Usman and Musa (2018) discovered positive *ERPT* in both the short run and the long run of Nigeria based on 1960 – 2015 data.

Moreover, in terms of the methodology used on *ERPT* investigation, most of the studies used Vector Autoregressive (VAR) Model, Vector Error Correction Model (VECM), Impulse Response Function (IRF) and Variance Decomposition (VD), approaches. Among them include; Adeyemi and Samuel (2013) find positive *ERPT*, Aliyu et al., (2009) reported negative *ERPT*, An and Wong (2012) reported incomplete *ERPT*.

Using the same method of analysis, Cheikh and Louhichi (2015) and Choudhri and Hakura (2015) shows the association of high inflation and high *ERPT* while low inflation and low *ERPT*, Faruqee (2006) reported low *ERPT*, Helali and Kalai (2015) reported complete *ERPT*, while Jiang and Kim (2013) reported incomplete *ERPT*, Usman and Musa (2018), Karagoz, Demirel and Bozdog (2016), Mawajje and Lwanga (2016), Shambaugh (2008) and Leigh and Rossi (2002), all confirmed the existence of *ERPT* in their studies.

Meanwhile, the few studies that utilized different methods of econometric analysis include; Saiki (2015) whose applied Generalized Method of Moment (GMM), whereas, logistic smooth transition pass-through (LSTP) was developed as used to measure non-linear *ERPT* by Kilic (2016) and reported that *ERPT* is determined by the nature of exchange rate volatility in a country.

2.6.2 Studies on the Inflation Persistence

Having ascertained that the existence of high inflation rate could have been due to the high inflation rate in the previous years that made it persists to the current year (Amano, 2007; Coleman, 2010). There are few studies regarding inflation persistence in developing countries despite the existence of a high inflation rate in those countries. Most of the studies, in this respects, are conducted on the experience and data of the developed nations due to its significance of checking the effectiveness of their respective stabilization policies, especially, monetary policy. Moreover, similar studies in the same area provide inconsistent results and findings, for example, Pivetta and Reis (2007) presented different results when compared with that of Noriega and Ramos-Francia (2009) as well as compared with the results reported by Cogley, Primiceri and Sargent (2010).

Meanwhile, Ahmad and Staveley-O'Carrol (2017) investigated the existence and level of the persistence of inflation by applying the dynamic stochastic general equilibrium (DSGE) model for 135 countries comprise both developed and developing countries. They reported a result of low persistence of inflation in developed countries and those countries with the low inflation rate. High persistence of inflation has been reported in developing countries and those countries with a high

inflation rate. Amano (2007) analyzed the effectiveness of monetary policy when inflation persistence is uncertain. The result reveals that the strategy that is being adopted during the implementation of monetary policy in such periods is usually underestimating the degree of inflation persistence, which normally limits the effectiveness of the policy.

In the same vein, Antonakakis, Cunado, Gil-Alana and Gupta (2016) used online price index and official price index to examine the persistence of inflation in the US, the UK, South Africa, Japan, Germany, China, Brazil and Argentina. The result shows that the degree of inflation persistence is smaller in the US, the UK, China, Brazil, and Argentina when online price indexes are used which, to them, is more accurate than the official Consumer Price Index (CPI) usage.

In their effort to investigate the existence of changes in the US inflation persistence, Cogley, Primeceri and Sargent (2010) applied VAR to measure inflation persistence in short-term and medium-term. The results show that the persistence of inflation is higher during the great inflation period, but it reduced during the Volcker period of disinflation. This result is in accord with the findings of research conducted by Noriega and Ramos-Francia (2009) though it is contrary to the findings of Pivetta and Reis (2007).

Coleman (2010) investigated the existence of inflation persistence in 12 West African French-speaking countries (WAFC) using a fractionally integrated method on food and non-food inflation. The result reveals the existence of inflation persistence in both food and non-food inflation in Cote d'Ivoire, Chad, and Niger.

While, in Burkina Faso, Chad, Cote d'Ivoire, Gabon, Niger and Senegal, the existence of long memory of persistence of inflation in the non-food sector was recorded. Inconclusive results were reported in the food sector of the Central African Republic and Togo.

Furthermore, Giannellis and Koukouritakis (2013) studied inflation persistence in some Latin American countries such as Venezuela, Uruguay, Mexico, and Brazil in relation to exchange rates of the respective countries. The result reveals that inflation was persistent in a period of high currency depreciation experienced by the countries compared to the period of slower local currency depreciation. Levin and Piger (2004) assessed the inflation persistence of 12 industrial economies using four price indices: – CPI, the core CPI-exclude food and energy, price deflator of GDP and personal consumption price deflator, for a period 1984 – 2003. The study was conducted on 10 industrialized countries, such as the US, the UK, Switzerland, New Zealand, Japan, Italy, Germany, France, Canada, and Austria. After taking care of breaks, the results show that there exists relatively low inflation persistence in these countries. Therefore, industrial economies have no features of high persistent inflation countries.

Nevertheless, Zhang (2011) highlighted that inflationary expectations play a significant role towards high persistent inflation in China. In a study conducted for a period, 1979 – 2009, the use of monetary policy to avert inflationary expectations has been helpful in terms of breaking the high inflation persistence in China. In a similar study, Zhang and Clovis (2010) analyzed the existence of changes in inflation persistence in China. The results confirmed a significant reduction in the

persistence of inflation towards the late 1990s in the country. This was attributed to the usage of a change in the systematic monetary policy of the country.

Moreover, Alexova (2012) investigated inflation persistence in some selected European Union countries such as; Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia, and Romania, with the major focus on the determinants of inflation for the period 1996 – 2011. The study employed a structured vector error correction model as the econometric tool of analysis. The study reported that cost-push inflation, in the long-run, constituted the source of the persistence of inflation in Bulgaria, Czech Republic, Hungary, Poland, and Slovakia, whereas, demand-side factors are the cause, in Estonia, Lithuania, Latvia, Slovenia, and Romania.

Hojjat and Barnhorst (2013) examined the inflation persistence for a group of seven Islamic economies and its relation to money supply and economic growth, for the period 1980 – 2009. The study discovered that there is a link between money supply and inflation persistence in the countries during the period of study.

In his contribution, Kar (2010) investigated the superiority of using unobserved component model (UCMs) as a measure of inflation persistence, - specifically, to measure core inflation, - over the structured vector autoregression (SVAR) method. The study maintained that the UCMs is superior to SVAR in terms of wholesale price index (WPI) inflation forecasts. Also, Kozamernik and Zumer (2011) attempted to study inflation persistence in Slovenia with an emphasis on the sources of the disinflationary process of the country. The study discovered inflation to be

highly persistent and maintained that changes in interest rate through inflation targeting after the year 2000, fall in oil price and expectations on inflation are the major sources of disinflation in the country.

Similarly, Phiri (2017) analyzed inflation persistence within the period of inflation target (IT) of South Africa, using quarterly data from 2003 – 2014. The study used a three-regime threshold autoregressive (TAR) model based on Hansen (2000). The study discovered that the IT of 3 – 6 percent set by South African Reserve Bank (SARB) is in the high persistent inflation range. Therefore, the study recommends IT to be redesigned by SARB to accommodate higher inflation rates or the IT to be abandoned completely. In their contribution to inflation persistence, Lolic and Sori (2014) conducted their study in Croatia. They attempted to measure the effect of inflation expectation and the possibility of an asymmetric effect in the inflation generating process in the country. The study employed smooth transition regression (STR), and the results reveal that high expectations, significantly, intensify inflation and its expectation.

2.6.3 Studies on Threshold Inflation Rate

It is based on the confirmation that inflation is a necessary evil; despite that some rates are needed for economics, beyond a certain limit or threshold it becomes harmful to the economy (Khan & Senhadji, 2000; Ndoricimpa, 2017). Some empirical studies have been conducted to investigate the level or rate of inflation at which it becomes inimical to the economic growth of various economies. Also, the findings of the numerous studies are inconclusive as different figures and values emerged, which make generalizations impossible. Some studies, such as Baglan and

Yoldas (2014), Eggoh and Khan (2014), Bawa and Abdullahi (2012), Doguwa (2012), and Gylfason and Herbertsson (2001) reported double-digit threshold inflation rate (10 percent and above). Whereas, studies like that of; Aydin, Esen and Bayrak (2016), Thanh (2015), Tung and Thanh (2015) Kremer, Bick and Nautz (2013), Salami and Kelikume (2010), and Sarel (1996), are among the studies that reported single-digit threshold inflation rate (1 - 9 percent).

Furthermore, on the basis of country-specific studies, Bawa and Abdullahi (2012), Doguwa (2012), Salami and Kelikume (2010), and Fabayo and Ajilore (2006) reported different threshold, by which inflation is inimical to economic growth as 13 percent, 10.5 - 12 percent, nine percent, and eight percent, respectively for their studies conducted in Nigeria. Nevertheless, inflation rate threshold on the economic growth of Pakistan is established to be nine percent by both Hussain and Malik (2011) and Mubarik (2005). On the other hand, Frimpong and Oteng-Abayie (2010) established a threshold inflation rate of 11 percent for Ghana which is above the nine percent that is established by Risso and Sanchez-Carrera (2009) for Mexico.

Also, Munir, Mansur and Faruoka (2009) established a threshold inflation rate of 3.89 percent for Malaysia, while Fakhri (2011) indicated that the threshold inflation rate by which it becomes inimical to the economic growth of Azerbaijan is 13 percent. Moreover, Tung and Thanh (2015) reported the established threshold inflation rate on the economic growth of Vietnam to be seven percent. In the same vein, Ahmed and Mortaza (2005) reported in their study, a threshold of six percent by which inflation is inimical to the economic growth of Bangladesh. Similarly,

Dammak and Helali (2017) reported in their findings, 3.4 percent threshold inflation rate by which is inimical to the economic growth of Tunisia.

Nevertheless, on the basis of country-groupings and panel data studies, Aydin, Esen and Bayrak (2016) reported inflation rate threshold of 7.97 percent for five Turkic republics – Turkmenistan, Uzbekistan, Kyrgyzstan, Kazakhstan, and Azerbaijan. Similarly, Thanh (2015) established an inflation threshold rate of 7.84 percent for five ASEAN countries. Moreover, a threshold inflation rate of 12 percent is established by Baglan and Yoldas (2014), for 92 developing countries, which is above the 5.43 percent threshold inflation that is established for 32 Asian countries by Vinayagathan (2013). A threshold inflation rate of eight percent is established by Sarel (1996) for the sample of 87 countries used in his studies which is lower than the 10 – 20 percent threshold inflation rate for the sample of 170 countries used by Gylfason and Herbertsson (2001).

Meanwhile, on the basis of sub-countries grouping and classifications – panel studies, Khan and Senhadji (2000) established a threshold inflation rate of one to three percent for the industrialized countries and seven to 11 percent for the non-industrialized countries as well as eight to 12 percent for the global or combined industrialized and non-industrialized countries together. Similarly, Eggoh and Khan (2014) reported having established threshold inflation rates of 19.5 percent for lower-income countries while lower-middle-income countries have a threshold inflation rate of 12.9 percent over the 10 percent rate that is reported for the upper-middle-income countries. The threshold inflation rate for higher-income countries is

established to be 3.4 percent, while for all countries combined as the global threshold inflation rate is established to be 10.5 percent.

Kremer, Bick and Nautz (2013), in a study of 124 countries, reported threshold inflation rates of two percent for industrialized nations and 17 percent for the non-industrialized nations. In the same vein, Ndoricimpa (2017) investigated the threshold inflation rate by which inflation is inimical to the economic growth of some selected African countries by which the presented results reveal that the threshold inflation rate for the low-income countries sub-sample is nine percent as against 6.5 percent threshold inflation rate for the middle-income countries sub-sample. Meanwhile, 6.7 percent threshold inflation rate is established for the whole sample.

2.7 Analysis of the Literature Gap

The review discloses inconsistent results or findings on the nature of the influence of the variables such as a change in exchange rate (*ERPT*) and previous rates of inflation on the current inflation rate. Also, studies on exchange rate pass-through and the threshold level of inflation showed that pass-through and the thresholds differ from one country or area to another, for example, McCarthy (2007) and Yanamandra (2015) reported negative *ERPT* while Savoie-Chabot and Khan (2015), and Leigh and Rossi (2002) reported positive *ERPT* in their respective studies. The existence of inconsistencies in the findings and conclusions of the previous studies revealed that the study in one area, country, or cluster of study could not be generalized in another cluster or area of study. Hence, this called for a need to

investigate the threshold level, the effects of the selected identified variables on - and pass-through to - inflation rates in WACCs.

In addition to the inconsistencies of findings, the majority of the *ERPT* studies used few econometric methods of analysis such as; VAR, VECM, and their likes, in their research. Also, most of *ERPT* measures the pass-through of the change rate to import prices, very limited studies measured the pass-through to inflation. It has been discovered that majority of *ERPT* studies concentrated on two variables; inflation and exchange rate, therefore, neglecting other variables like government expenditure and trade balance that aid in the process of *ERPT* especially, in developing economies, based on theoretical arguments.

Furthermore, the review of the studies on threshold inflation rates to economic growth disclosed that, apart from inconsistencies in the findings of the studies, the studies such as Bawa and Abdullahi (2012), Doguwa (2012) and Vinayagathan (2013) concentrated on finding the threshold rate. Less emphasis was given to the investigation of the rates of inflation that can foster economic growth or at least the rates of inflation that are not harmful to economic growth.

Moreover, different theories explain the different cause of inflation and also assigned different nature of the relationship between the inflation rate and some variables. Taking, for example, *ERPT* concludes that it is the devaluations of currencies that cause inflation in developing countries whereas; neo-Keynesian theory belied that existence of excess demand over supply as the major source of inflation as against

money supply. Moreover, expectation theory believed the high expectations caused by a high previous inflation rate that generates high inflation in the future.

In terms of the nature of the differences of the theoretical explanation of the effects of some variables on the inflation rate, taking, for example, the effect of money supply on inflation has been considered significantly positive by most theories and insignificant by another theory. Classical and Monetarist economists believed that the increase in money supply beyond what is required by the economy would automatically be transmitted into inflation.

On the other hand, Keynes and Neo-Keynesian economists maintained that full employment level is rare to achieve in real life and an increase in money supply at a level below full-employment will only increase aggregate demand and output. To them, it is only when the money supply is increased when there is no room for employment and aggregate demand to increase, that it will impact on the price level. Thus, the nature of effects of money supply on inflation rate (significantly direct or insignificant) may differ from one country or economy to another, and such nature of the relationship may give a clue to an economy on which of the stabilization policies should be adopted in the events of inflation. Hence such needs to be investigated for WACCs being among the developing economies where resources are not fully utilized (operate below full employment).

Nevertheless, the majority of the studies on the persistence of inflation are conducted in developed countries using their data even though they have low inflation rates. Lesser studies, on the persistence of inflation, are conducted in developing

economies using their data even though, the majority of them are experiencing high inflation rates. Therefore, there is a need for more studies on the persistence of inflation, especially in developing economies.

In the same vein, studies in WACCs are profoundly lacking; hence, there is a need for some studies to be conducted using this cluster of study.

2.8 Conclusion

In this chapter, both the related theoretical and empirical reviews of inflation are carried-out, and a summary of the identified gaps are highlighted on the basis of the reviewed. This disclosed that new methodology to measure *ERPT* to inflation and to investigate inflation persistence in developing economies, especially WACCs as well as empirical estimations of the countries' threshold inflation rate by which from it, inflation is inimical to economic growth, would add to the existing knowledge. Finally, in the chapter, the theoretical and empirical literature, are also reviewed as well as the gaps identified, on the basis of the cluster of study, are highlighted.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

The focus of this chapter is to account for the methodology employed in the study. The theoretical framework is presented in Section 3.2. Section 3.3 presents the model specification. Meanwhile, Section 3.4 provides operation justifications of the variables. Explanations of data sources and sampling method are in Section 3.5. Meanwhile, Section 3.6 provides justifications for the data period divergence. The methods used for data analysis are highlighted in Section 3.7. Finally, Section 3.8 offers the conclusion of the chapter.

3.2 Theoretical Framework

This section presents the theoretical framework of the study. The theoretical approach of the link among the variables in a study is what theoretical frameworks elaborate (Maxwell, 2005). The underpinning theories used in this study consist of exchange rate pass-through theory, expectations theory, and Neo-Keynesian theory. The research's conceptual framework is presented in Figure 3.1. It summarizes the theoretical presumptions and arguments on the effects of the variables of the study on inflation.

On the basis of the *ERPT* theory, developing countries usually devalue their local currencies to improve their trade balance through discouraging import and encouraging export, but the end result is inflation. On the other hand, expectation theory reveals that the current rate of inflation is high because of high expectation

resulted by the high rate of inflation of the previous years. Even though all the theories believe that inflation, after a certain range, is inimical to economic growth (threshold inflation rate), the threshold inflation rate specification is based on the arguments of the Neo-Keynesian theory.

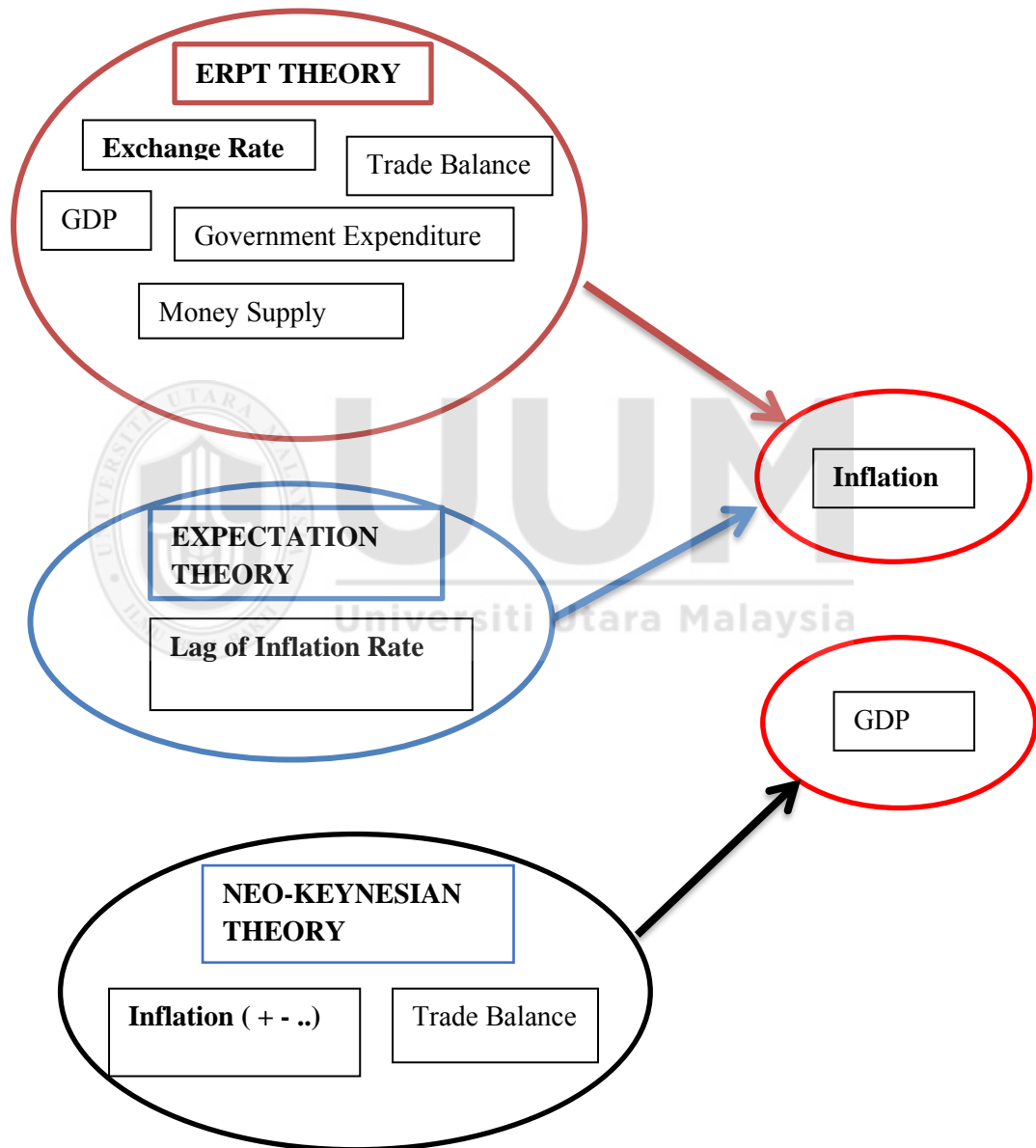


Figure 3. 1
Conceptual Framework of ERPT, Expectation, and Neo-Keynesian Theories

3.2.1 The Exchange Rate Pass-Through Theory

As mentioned in the second chapter, the theoretical explanation of *ERPT* is divided into two; the first is when the exchange rate devaluation pass-through to import prices, while the second is when the exchange rate devaluation pass-through to inflation. Duesenberry (1950), Ackley (1959), and Bronfenbrenner and Holzman (1963) maintained that in most countries, those commodities by which their prices are being set by either the sellers or the buyer or even, in some cases, the marketing boards that announce the price of the commodity (after taking consideration the average cost of the commodity) and the other party accept it. The announced price is usually calculated at cost plus margin, the margin added is the profit to the seller, and hence, the set price is termed as the mark-up price (Hagger, 1977). In most cases, persistence increases in the prices of this category of goods are as a result of the continuous increase in some index of markup prices in one hand and devaluation of currencies, in case the commodity is traded internationally, on the other hand.

3.2.1.1 The Exchange Rate Pass-Through to Import Prices

On the basis of markup model, Campa and Goldberg (2005) asserted that in trading between two countries; importing and exporting countries, exchange rate changes can be passed to the price of the trading commodity to either of the nations, consider Equation [3.1]:

$$I_p = E_c \cdot E_p \quad [3.1]$$

where I_p is import price, E_c is the exchange rate, and E_p is the export price.

After taking the log of both sides, Equation [3.1] is transformed into Equation [3.2]

$$\log I_p = \log E_c + \log E_p \quad [3.2]$$

The export price (E_p) consists of marginal cost ' MC ' and profit margin usually known as the mark up ' ϕ ' from the exporting country, and it is a certain percentage of the cost which is;

$$E_p = MC(1 + \phi) \text{ or } \log E_p = \log MC + \log \phi \quad [3.3]$$

Hence import price is:

$$\log I_p = \log E_c + \log MC + \log \phi \quad [3.4]$$

The markup (profit margin) ' ϕ ' also depends on the effect of the sector ' λ_0 ', amount or volume of import of the importing country (nature of the demand of the commodity in the importing country ' MT ') and exchange rate (E_c), accordingly, mark-up ($\log \phi$) can be presented in Equation [3.5].

$$\log \phi = \lambda_0 + \alpha_1 \log MT + \lambda_1 \log E_c \quad [3.5]$$

where λ_0 is the effect of the sector, MT is the amount of import of the importing country, E_c is the exchange rate and $\lambda_1 \log E_c$ is the level of adjustment of the import price to exchange rate. The total import price is presented in Equation [3.6] and Equation [3.7].

$$\log I_p = \log E_c + \log MC + \lambda_0 + \alpha_1 \log MT + \lambda_1 \log E_c \quad [3.6]$$

and

$$\log I_p = \lambda_0 + (1 + \lambda_1) \log E_c + \log MC + \alpha_1 \log MT \quad [3.7]$$

In Equation [3.7], $(1 + \lambda_1)$ is the coefficient of the exchange rate and it represents the total pass-through of the exchange rate to import price. The size of the pass-through depends on the size of the λ , having $\lambda \geq 0$, implies the existence of complete pass-through of the exchange rate to importer's price. On the other hand, having the value of $\lambda = -1$, signifies that $(1 + \lambda) = 0$ and there is no pass-through, the exporter exhausts the exchange rate changes. This model has been used to measure *ERPT* by many studies, include Campa and Goldberg (2005) and Yanamandra (2015).

I_p can be changed with the change in any of the independent variables or both (E_c and MT), consequently; $\frac{\partial I_p}{\partial E_c} = \alpha_2$, $\frac{\partial I_p}{\partial MT} = \alpha_1$ by setting $1 + \lambda_1 = \alpha_2$. Frisch (1983) highlighted the existence of differences in terms of price elasticities and elasticities of income for commodities. If the commodity of import is highly inelastic, the pass-through and the coefficient of import and export value will be positive, and both will be negative if the commodity is highly elastic.

3.2.1.2 The Exchange Rate Pass-Through to Inflation

The theoretical explanation of *ERPT* theory to inflation is that; inflation in developing economies is majorly caused by the excessive devaluation of their local currencies. The strategies of import substitutions and export promotions, which are being frequently implemented by developing countries require excessive local

currency devaluations (more inputs are in the theoretical framework). Lafleche (1996) simplifies the process of *ERPT* to inflation, and it is presented in Figure 3.2.

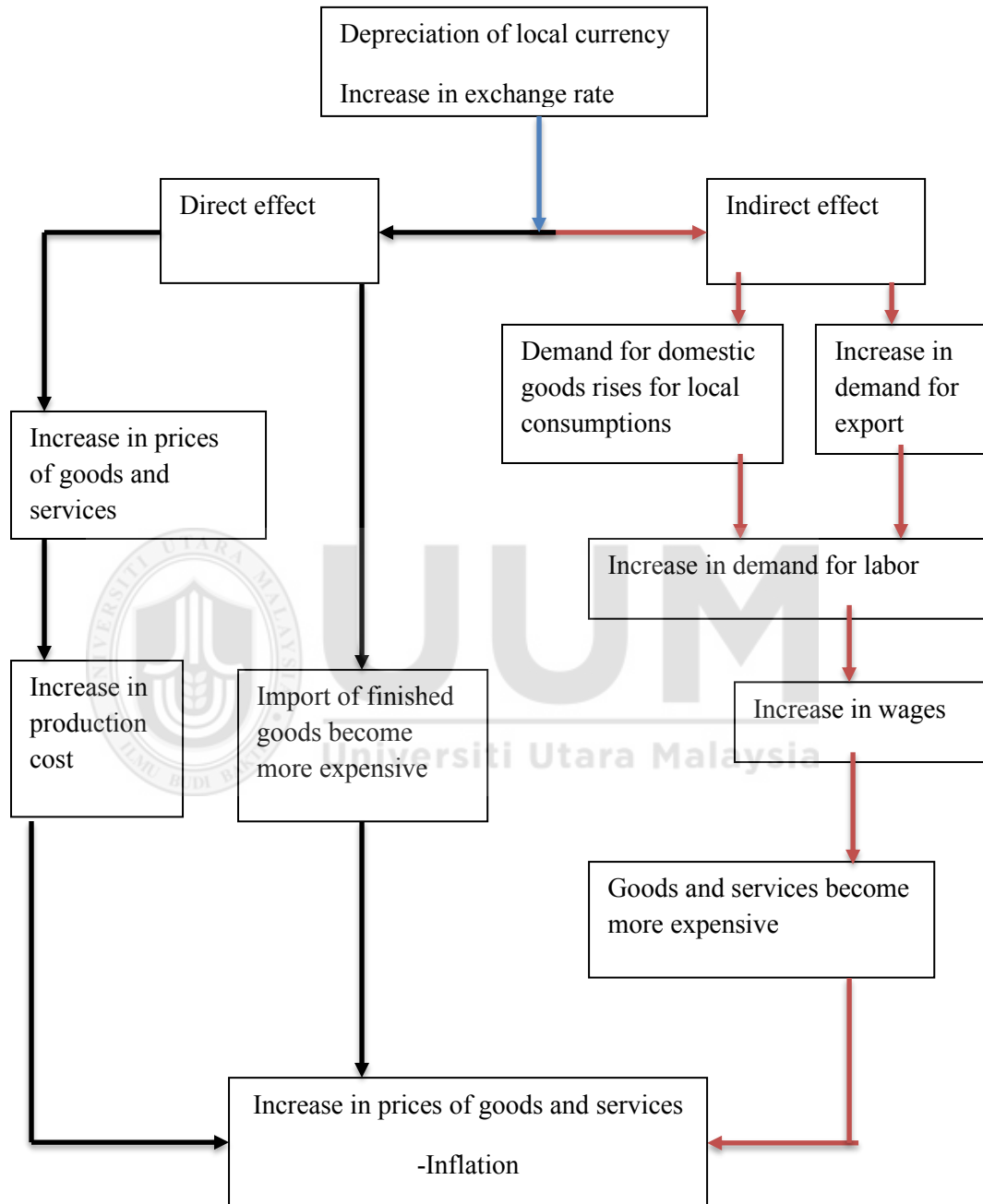


Figure 3. 2
The Process of Exchange Rate Pass-Through to Inflation
 Source: Lafleche, 1996.

The figure stressed that devaluation of local currencies in any country has double consequences; direct and indirect. The direct effect involved the increase in the cost and price of the importing commodity. While the indirect consequences through general, both cost-push and demand-pull inflation. The cost-push inflation arises when the demand of domestic products increases to substitute the high priced imported goods due to the devaluation of local currencies, and therefore, more laborers are employed to produce it hence, result in the increase in the demand for wages by the labor which pushes the cost of production upward. In addition to this, some machinery for productions of the local goods needs to be imported and therefore, directly affected by the devaluation of the local currencies.

On the other hand, the demand-pull inflation arises in quest and rise of the locally manufactured goods to substitute those that are being imported due to the increase in the prices of the imported commodities arises from the devaluations of the local currencies. Therefore, the final result of local currency devaluation is inflation in general, due to the rise in prices of both imported goods and locally manufactured commodities (Lafleche, 1996; Gagnon & Ihrig, 2004; Jiang & Kim, 2013; Tandrayen-Ragoobur & Chicooree, 2013).

3.2.2 Expectation Theory

The expectation theory of inflation is developed on the basis of the dynamics of inflation. It is built based on commodities with markup pricing system (Hagger, 1977). Work on expectations was first sighted in the work of Hicks (1946), who analyzed the concept in relation to the dynamic and stability of the general equilibrium with regards to expectations in prices changes. To him, the stability or

dynamics of the general equilibrium is entirely attributed to how expectations changes resulted from a shock that causes the disequilibrium. He used the concept of elasticity of expectations to simplify his analysis, which, simply, shows that the percentage changes in the expected value of a variable in relation to the percentage change in its actual value. Applying this concept to inflation and price changes, taking P_e as the expected price in the future while P as the actual price in the future, Hicks' elasticity of expectation ϵ_{Pe} is presented in Equation [3.8]

$$\epsilon_{Pe} = \frac{\partial P_e / P_e}{\partial P / P} \quad [3.8]$$

If $\epsilon_{Pe} = 1$, increases in current price leads to the same proportion increase in prices in the future. If the current price increases by five percent, the future price is expected to increase by five percent in the future. If $\epsilon_{Pe} > 1$, a small change in price presently will lead to a greater percentage of increase in the future prices (higher expectations).

Many scholars further developed the concept of expectation theory of inflation, and this leads to the emergence of classifying the theory into adaptive expectations and rational expectations. Rational expectations believed that if variables behave in a proper way by being affected only by the variables presumed and explained by economic theory (Sargent & Wallace, 1973). The concept of adaptive expectations theory of inflation suggested and pointed out that expectations are not directly observable. Therefore, expectations in term of inflation are linked to the past values of the variable (Frisch, 1983). The central idea behind this is that inflation that will be experienced in the future depends on current and past inflation just like the

current inflation which is also being influenced by the previous inflation rates (Hagger, 1977). Their simple model is presented in Equation [3.9];

$$P^e = P_{t-1}^e + \alpha(P_{t-1} - P_{t-1}^e) \quad [3.9]$$

where P^e is expected inflation, P_{t-1}^e is previous expected inflation, P_{t-1} is previous years actual inflation and α is constant lying between zero and one.

The expected inflation is equivalent to previous expected inflation added to the forecast error, which is the proportion of the difference between the previous actual and forecasted inflation.

3.2.3 The Neo-Keynesian Theory

The focal point behind the argument of this theory is that inflation is generally caused by excess demand over supply and (demand-pull inflation). The theory believes that inflation, after a certain range, is inimical to economic growth. This implies that there are certain rates that are not harmful to the rate of growth of the economy that should be maintained and retained by the concerned country (Hansen, 1999, 2000; Khan & Senhadji, 2000).

The theory highlighted that the source of inflation, especially in developing economies like WACCs, is not the increase in money supply as there is always room for improving the level of employment and the level of out. In such type of economy, an increase in money supply can only increase the level of output, income, and the level of employment; hence, it does not affect inflation. It is only when there

is no room for employment or output increments that increase in money supply will feed into the price level of an economy, and that economy could have been in full employment level which is out of the reach for most developing nations (Mordi et al., 2007, 2012).

The nature of the effect of inflation on economic growth is not unanimous, and it is of different regimes. At the rate below the threshold, the rates of inflation are believed to either have a positive effect on the economy or no effect on the economy at all. On the other hand, the rates of inflation are having an adverse effect on the economy from the threshold rate onward (Iqbal & Nawaz, 2009; Khan & Senhadji, 2000).

3.3 Model Specification

This section presents the specifications of the three models of the three objectives designed to achieve in the research.

3.3.1 The Model of Exchange Rate Pass-Through to Inflation

This model deals with research objective one, which analyzes the exchange rate pass-through to inflation rate of WACCs. Adapting Amoah and Aziyakpono (2018), de-Mendonca and Tiberto (2017), Elahi, Salami and Masoomzadeh (2016), Adu and Marbuah (2011) and Faruqee (2006), the *ERPT* function for this study is expressed in Equation [3.10]

$$INF = f(CEXC, BRAG, GDP, TB, GOV) \quad [3.10]$$

where INF is inflation rate, $CEXC$ is the change in exchange rate, $BRAG$ is broad money supply, GDP is gross domestic products, TB is trade balance, and GOV is government expenditure, the variables are in logarithm form.

The estimated empirical specification is presented in Equation [3.11]

$$INF_t = \alpha_0 + \alpha_1 CEXC_t + \alpha_2 BRAG + \alpha_3 GDP_t + \alpha_4 TB_t + \alpha_5 GOV_t + \varepsilon_t \quad [3.11]$$

where $\alpha_0, \alpha_1, \dots, \alpha_5$ are coefficients, $t = 1, \dots, 47$, and ε is the error term with its usual properties of independently and identically distributed with zero mean and constant variance; $\varepsilon_t \sim iid(0, \delta_t^2)$.

3.3.2 Model of the Persistence of Inflation Rate

This model is designed to address the second objective of the research which examines the persistence of inflation rate in WACCs. The functional form of is designed based on Ahn and Schmidt (1995), Leven and Piger (2004), Pivetta and Reis (2007), and Altissimo, Mojon and Zaffarano (2009), which is given in Equation [3.12]:

$$INF_t = \rho_0 + \sum_{k=1}^n \rho_k INF_{t-k} + \varepsilon_t \quad [3.12]$$

where INF_t is the current inflation rate, INF_{t-k} is the lagged inflation rate, ρ_0 is the intercept, ρ_k is coefficient, ε is error term, k is the lag length and n is the number of observations.

3.3.3 Threshold Inflation Rate Model

This model deals with the third objective of the research. That is, it establishes a threshold by which inflation is inimical to the economic growth of WACCs. The threshold model is specified in line with Hansen (1999, 2000) and Iqbal and Nawaz (2009), that were developed based on Bai and Perron (1998). This has been used by several studies including Aydin, Esen and Bayrak (2016), Thanh (2015), Baglan and Yoldas (2014), Doguwa (2012), and Salami and Kelikume (2010). The function of the model is given in Equation [3.13].

$$GDP=f(INF, D*\pi_i, TB) \quad [3.13]$$

where GDP is gross domestic products, and INF is the inflation rate, $D*\pi$ is the threshold variable, which consists of; D is dummy variable, π is the threshold rate which is the rate of inflation that has different effect from the previous rate (regime switching rate), ‘*’ is multiplication sign, and TB is trade balance which is just the difference between export and import as control variable,

Empirically, the estimated model takes the following form:

$$\Delta LGDP_t = \alpha_0 + \alpha_1(\Delta LINF_t) * D(LINF_t < \pi_1) + \alpha_2(\Delta LINF_t) * D(\pi_1 \leq LINF_t \leq \pi_2) + \alpha_3(\Delta LINF_t) * D(LINF_t > \pi_2) + \alpha_4 \Delta LTB_t + \varepsilon_t \quad [3.14]$$

where Δ is the difference operator, α_i ($i=1, 2, 3, 4$) are parameters, D is dummy variable with value 0 and 1, it takes the value of one (1) if the statements in the

parenthesis are true otherwise it takes zero (0), π_1 is the lower threshold and π_2 is the upper threshold inflation rates.

3.4 Justification of the Variables

In this section, the brief descriptions or definition, measurements, and postulates of the operational rationalizations of the variables on the basis of the theoretical and empirical reviews are provided.

3.4.1 Inflation Rate

Inflation (*INF*) refers to the persistence rise in the general price level. It is measured in percentage based on the retail price. It is being calculated using Laspeyres formula, and it reflects a terminal usually annual percentage change in the price to the average consumer of acquiring a basket of goods and services that may be changed or fixed at specified intervals, such as yearly (World Bank, 2016; Kumar & Kattookaran, 2016). The rate of inflation is used as a dependent variable in this study in *ERPT* model, and the model of inflation persistence. Although, past or lagged values of the variable is used, where appropriate, as independent variables in some models; especially, inflation persistence model and the study hypothesized positive linkage between the lagged values of inflation rates to its current values. It has been used in many studies like; Cheng and Tan (2002), Phiri (2012), and Asongu (2013).

The variable is used as an independent variable in a threshold model as used in Khan and Senhadji (2000), Iqbal and Nawaz (2009), Bawa and Abdullahi (2012), Thanh (2015), and Aydin, Esen and Bayrak (2016). It is hypothesized to have an inverse influence on the level of economic growth from the threshold rate onward.

3.4.2 The Change in Exchange Rate

The change in exchange rate (*CEXC*) is the value of increase or decrease (change) of exchange rate from one period to another. The difference between the current year exchange rate and last year exchange is termed as a change in exchange rate. It is being used to measure *ERPT* to import price and inflation. The exchange rate is usually, being perceived as the rate at which local currency is being exchanged with international currencies usually USD for international transactions. For example, Malaysian Ringgit (RM) to a USD is approximately 4:1, i.e., RM4 is being exchanged to USD1. The exchange rate of currencies is being determined by the legal sectioned exchange market on the basis of demand and supply of the foreign exchange (World Bank, 2016). It is being calculated based on the monthly average to get the annual rate. The variable is used as an independent variable, and *CEXC* is used to measure *ERPT*, and it is used in many studies such as Campa and Goldberg (2005), Yanamandra (2015) and Karagoz, Demirel and Bozdog (2016). The *ERPT* is hypothesized to have a positive sign, as an increase in *CEXC* is expected to depreciate legal tender and increase the prices of goods and services.

3.4.3 Money Supply

Broad money (*BRAG*) is used as a proxy for money supply. *BRAG* is the total stock of money in an economy which comprised total money in circulation, in addition to net time deposit and certificates of deposits other than those of the central government (World Bank, 2016). The variable serves as an independent variable in this study as used in many studies such as in Adu and Marbuah (2011) and Mawajje and Lwanga (2016) with a significant and positive influence on inflation. The money supply is considered to be the sole cause of inflation by some theorist. In fact, based

on the monetarist theory of inflation arguments, the money supply is the sole determinants of all economic activities and inflation is solely caused by the increase in money supply beyond what is required by the economy. It is hypothesized in this study that increases in money supply will arise inflationary pressures and induces inflationary trends (positive effects on inflation).

3.4.4 Economic Growth

Economic growth refers to the level at which the whole economy of a country is growing. It is the indicator by which countries, are identified and categorized as either developed or developing country. It is normally being measured using the Gross Domestic Product (*GDP*) of a country which is the sum total of goods and services produced in a country at a particular period of time, usually a year. The World Bank measures *GDP* as the sum of gross value added by all resident producers in an economy in addition to product tax, less subsidies that are not included in the value of the products (World Bank, 2016). *GDP* is used as an independent variable in the model of *ERPT*. This variable is used in similar studies such as Darrat (1985), Cheng and Tan (2002), Adu and Marbuah (2011) and Bashi et al. (2011). This study expected *GDP* to have an inverse influence on inflation.

Also, in the threshold model, *GDP* is the dependent variable as applied by many studies such as Khan and Senhadji (2000), Iqbal and Nawaz (2009), Salami and Kelikume (2010), Bawa and Abdullahi, (2012), Baglan and Yoldas (2014), Aydin, Thanh (2015), and Esen and Bayrak (2016).

3.4.5 Trade Balance

Trade balance (*TB*) is referred to as commercial balance, and it is also termed as net export. It is the difference, in monetary value, between the amount received as a payment for the export of goods and services (*EXP*), and the amount paid out as a payment for the import of goods and services (*IMP*) over a defined period usually one year. It is the means of assessment of the proceeds of capital transfer through trade across the international borders of two or more countries (Elahi, Salami & Masoomzadeh, 2016). It is being calculated by subtracting the total value of *IMP* from the total value of export *EXP*. This variable has been used by a number of studies including Baglan and Yoldas (2014), Thanh (2015), Ahmad and Civelli (2016), Aydin, Essen and Bayrak (2016), and Mawajje and Lwanga (2016). Its hypothesis depends on the size of the *TB* as it is being determined by *IMP* and *EXP*. When the *EXP* is higher than the *IMP* surplus trade balance emerged, conversely, when *EXP* is less than *IMP*, deficit trade balance emerged. The hypothesized effect of the surplus trade balance is positive and whiles its effects in negative when the *TB* is a deficit.

3.4.6 Government Expenditure

Government expenditure (*GOV*) is referred to as the general and final consumption expenditure and also know as general government consumption. It is the total expenses (expenditure) by the government during a specific period, usually a year (World Bank, 2016). It includes all purchases, by the government, of goods and services as well as compensations of employees in addition to defense and security expenses apart from military expenses which are in government capital formation (World Bank, 2016). It has been used in a number of studies such as Lozano and

Rodriguez (2011), Ocran (2011), Mallik and Choudhuri (2002) and Chen and Tan (2002), Darrat (1985). The variable serves as an independent variable in the study. It is hypothesized to have an inflationary effect, i.e., a positive influence on inflation.

3.4.7 Threshold Variable

The threshold variable (π_t) is designed to measure the effects of a series of a variable on another series of a variable, when the former is expected to behave in a different way affecting the latter, after exceeding a certain value. It is a regime switching value by which from it the nature of effect of the independent variable on the dependent variable changes. In the case of the threshold inflation rate on economic growth, the threshold consists of increasing values or series as ($\lambda_1 < \lambda_2 \dots < \lambda_t$), are in regime ‘j’ such that:

$$\lambda_j \leq \pi < \lambda_{j+1} \tag{3.15}$$

where: λ_t is inflation rate, π threshold value, j is the period or regime.

This implies that inflation has a different effect of economic growth at a regime below the threshold rate, and the nature of effect changed after the threshold rate. The threshold variable is expected to have an inverse effect on economic growth from the threshold rate onward, as used by the previous studies, includes; Baglan and Yoldas (2014), Bawa and Abdullahi (2012) and Khan and Senhadji (2000).

3.5 Data and Sampling Method

Annual data on the inflation rate, exchange rate, broad money, *GDP*, trade balance, and government expenditure for the period 1980 – 2016 for the first objective, and 1970 – 2016 for the second and third objectives are the range of data used for the analysis. All the data are obtained and sourced from World Development Indicators (WDIs) of the World Bank.

The study, purposively, involved four members of WACCs for the period of 1980 – 2016 and 1970 – 2016 for time series. This indicates that the data are of a secondary source. The explored countries in this study involved Nigeria, Ghana, Gambia, and Sierra Leone. They are chosen based on their membership in commonwealth located in West Africa; the countries are unable to make their rate of inflation single-digit. Also, the persistence of high rate of inflation has been noticeably featured in the countries and at the same time experiencing high and volatile inflation rate. The countries share some similarities, such as having the same official language (which is English), and in most cases, they make and implement similar economic policies such as SAP.

3.6 Justification for Data Period Divergence

The WACCs are purposively chosen to be studied among the developing nations. The countries are among the developing nations, and the majority of them have high rates of inflation in addition to its being persistent, coupled with the frequent devaluation of their local currencies as witnessed in the background of the study. It is the aim of the study to investigate *ERPT* to inflation for the period 1980 – 2016

while inflation persistence and threshold inflation rate investigations are for the period 1970 – 2016.

The reasons behind this divergence of the study period are because prior to 1980 WAACs are using fixed exchange rate regime and hence there were no exchange rate fluctuations, and therefore, inflation rate changes then are unaccounted for by *ERPT*. The exchange rate fluctuations are started in the early '80s in WACCs, and full floating exchange rate regime was implemented in 1986 (Garber, 1993; Edward & Santaella, 1993). In addition to this, some important control variables such as government expenditure of the *ERPT* to inflation model is only available, for some WACCs from 1980 (World Bank, 2016).

The time period for the remaining objectives covers 1970 -2016 given the fact that it has been maintained and argued that including more time period in an estimation regarding inflation persistence and threshold inflation rate produce more accurate and efficient results, hence the more the period the better the models (Hansen, 1999, 2000; Khan & Senhadji, 2000; Gylfason & Herbertson, 2001; Iqbal & Nawaz, 2009; Coleman, 2010; Fuhrer, 2011).

3.7 Method of Analysis

Generally, this study applies time series data analysis, using annual data that is employed to analyze the *ERPT* to inflation, which is the first objective of the study. Specifically, Autoregressive Distributed Lag model (ARDL) is used for this purpose. Also, in the study, the univariate method of analysis is used to check the persistence of inflation rate in WACCs, which is the second objective. Meanwhile, Hansen

(1999, 2000) and Iqbal and Nawaz (2009) threshold model of regime switching is used for checking a threshold inflation rate of WACCs, which is the third objective.

3.7.1 Autoregressive Distributed Lag Model

The ARDL method was proposed by Pesaran, Shin and Smith (1999, 2001). The ARDL model and its co-integration process are superior to other models of co-integration analysis in the sense that the variables are not necessarily restricted to be integrated in the same order as it is in the other techniques. ARDL can be applied, provided that the variables are stationary at level, $I(0)$ at first difference, $I(1)$ or mixed stationary (including order zero, $I(0)$ and one, $I(1)$) but excluding $I(2)$ the second order). The test is valid even with small samples, and it is robust to bias estimation with the inclusion and treating some variables as endogenous (Jalil, Tariq & Bibi, 2013; Narayan & Narayan, 2005; Pesaran, Shin & Smith, 2001).

ARDL is being started with ascertaining that none of the variables is integrated in the second order, $I(2)$, because the critical values of the bound test for long-run relationship accommodate only stationary at level, $I(0)$ and stationary at first difference, $I(1)$. This can easily be done through the unit root test, though it is not a requirement or part of ARDL, it is being done to ascertain the level of integrations of the series, and to make sure that second difference series $I(2)$ are not part of the model. This is followed by the test weak exogeneity and selection of lag length, which is a determination of the appropriate lag-length for the model. The estimated model should be optimal (postestimation diagnostic check). This is followed by general ARDL modeling which involved the formulation of unrestricted error correction model (ECM), and the next stage is performing a Bound test to check for

the existence of the long run relationship. This is followed by the estimation of a long run and the short run coefficients separately, after establishing the existence of the relationship using Bound test.

3.7.1.1 Unit Root Test

Estimation using time series data requires that series should be stationary. Estimation with non-stationary time series data affects the regression results, which could be spurious (Granger & Newbold, 1974; Dickey & Fuller, 1979; Baumohl & Lyocsa, 2009). Several tests that determine stationary of variables exist in different kinds of literature. Each test has its peculiar strengths and weakness in a peculiar situation as enumerated in several kinds of literature (Maddala & Kim, 1998).

The level of integration or stationary of variables is tested in this research using the famous Augmented Dickey-Fuller test (ADF) test developed by Dickey and Fuller (1979, 1981). ADF is a necessary extension of Dickey-Fuller (DF) test, developed to correct the bias of the DF test towards a unit root and to wipe out the problem of autocorrelation attributed to DF test (Gujarati & Porter, 2009). ADF tests are of three forms represented by three different equations. Equation [3.16] represents the test with drift or intercept, Equation [3.17] has time trend in addition to the intercept, and Equation [3.18] represents the ADF test without intercept and time trend.

$$\Delta Y_t = \beta_0 + \theta Y_{t-1} + \sum_{i=1}^n \alpha \Delta Y_{t-k} + \varepsilon_t \quad [3.16]$$

$$\Delta Y_t = \beta_0 + \beta_1 t + \theta Y_{t-1} + \sum_{i=1}^n \alpha \Delta Y_{t-k} + \varepsilon_t \quad [3.17]$$

$$\Delta Y_t = \theta Y_{t-1} + \sum_{i=1}^n \alpha \Delta Y_{t-i} + \varepsilon_t \quad [3.18]$$

where Δ is the difference operator, Y_t is the series of the variable to be tested (*LINF*, *CLEXC*, *LBRAG*, *LGDP*, *LTB*, and *LGOV*), β_0 is the intercept or drift, t is the time trend, Y_{t-1} is the lag variable under consideration, n denotes the number of observations, k is the lag length, and ε is the error term with white noise identities, such as $\varepsilon_t \sim iid(0, \delta^2)$.

3.7.1.2 Test for Weak Exogeneity

In most of the econometrics modeling, independent variables are supposed to be determined outside the model, except in VAR by which variables are treated as endogenous. In a model where variables are not supposed to be affected by anything or any variable in such a model, the variables are classified and referred to as exogenous variables or existence of exogeneity. When an independent variable is affected by either of the dependent variable or any of the independent variable, weak exogeneity is detected in the model or the variables are said to be endogeneous (Green, 2003; Gujarati & Porter, 2009). Although it has been maintained that endogeneity has no disturbance effects on ARDL estimations, hence it is no longer a problem in ARDL modeling (Banerjee et al., 1993; Laurenceson & Chai, 2003; Jalil, Tariq & Bibi, 2014). Therefore, ARDL can accommodate all variables, whether endogenous or exogenous.

Econometric modeling like ordinary least squares (OLS) required variables to be purely exogenous, while models like VAR required variables of the system

equations to be either endogenous or to be treated as such. On the other hand, ARDL techniques accommodate endogeneity in the short run and robust it in the long run (Banerjee et al., 1993; Pesaran, Shin & Smith, 1999; Laurenceson & Chai, 2003; Jalil, Tariq & Bibi, 2014) hence, ARDL accommodates variables that are either endogenous, exogenous or even mixed variables.

The test of weak exogeneity has been conducted to provide more justifications for using ARDL modeling and to confirm the level and strength of the exogeneity of the variables using the Toda-Yamamoto causality approach that was proposed by Toda and Yamamoto (1995). The test is selected due to its superiority and advantages over other tests. There is no need for the variables to be integrated in the same order; it can be conducted even if the variables are $I(0)$ or $I(1)$ or even mixed stationary variables. The test is valid even if variables are co-integrated or not (Toda & Yamamoto, 1995).

The Toda-Yamamoto weak exogeneity test is in the form of a modified Wald test (Toda & Yamamoto, 1995; Guru-Gharana, 2012; Umar & Dahalan, 2015). It involves two stages; the first stage requires the estimation of Augmented Vector Autoregression. The second stage involves the estimations of causality by which the results of both causality and that of modified Wald test for weak exogeneity are produced (Toda & Yamamoto, 1995; Umar & Dahalan, 2015).

The test for weak exogeneity is built based on the fact that if a past or lag series of a variable does not have explanatory power on another variable in the designed system, then such variable is weakly exogenous (Greene, 2003). Thus, the Toda-

Yamamoto test is based on the aggregate and combined effects of the entire variables in the system. The VAR specifications of the test are presented in Equation [3.19] and Equation [3.20].

$$\begin{aligned}
 LINF_t = & \phi_0 + \sum_{k=1}^n \phi_1 LINF_{t-k} + \sum_{j=n+1}^{dmax} \phi_2 LINF_{t-j} + \sum_{k=1}^n \phi_3 X_{t-k} + \sum_{j=n+1}^{dmax} \phi_4 X_{t-j} \\
 & + \varepsilon_t
 \end{aligned} \tag{3.19}$$

$$\begin{aligned}
 X_t = & \varpi_0 + \sum_{k=1}^n \varpi_1 LINF_{t-k} + \sum_{j=n+1}^{dmax} \varpi_2 LINF_{t-j} + \sum_{k=1}^n \varpi_3 X_{t-k} + \sum_{j=n+1}^{dmax} \varpi_4 X_{t-j} \\
 & + \varepsilon_t
 \end{aligned} \tag{3.20}$$

where X_{ts} are *CLEXC*, *LBRAG*, *LGDP*, *LTB*, and *LGOV*, while X_{t-js} are their respective lags, ε_t is the error term with its usual properties, ϕ and ϖ are coefficients.

The final stage of the Toda-Yamamoto weak exogeneity test is based on the modified Wald test, by which restrictions are imposed on the estimated coefficient for testing a null hypothesis of $H_0: \phi_{is} = 0$ and $H_0: \varpi_{is} = 0$ against the alternative hypothesis of $H_1: \phi_{is} \neq 0$ and $H_1: \varpi_{is} \neq 0$. The condition is that H_0 must be rejected where *LINF* is the dependent variable based on Equation [3.19]. Non-rejection of the null hypotheses implies that the variables are weakly exogenous.

3.7.1.3 Selection of Lag Length

How many lags to be included in any model, is always among the fundamental questions, in any estimation. This is being solved by using any of the lag selection criteria including but not limited to Akaike Information Criterion (AIC), Schwarz's

Information Criterion (SIC), and Hannan-Quinn Information Criterion (HQC). The condition of lag selection is based on minimum AIC, SIC, and minimum HQC. The general model is $ARDL(p, q_1, q_2, q_3, q_4, q_5, q_6)$, where p is the selected lag of the dependent variable and q_i ($i = 1, 2, 3, 4, 5, 6$) are the chosen lag of the independent variables or the orders of ARDL model.

3.7.1.4 The Optimal Model

This involves conducting the postestimation diagnostics checks and presentation of the results of the test. An optimal model should be free from serial correlation based on the Breusch-Godfrey³ test developed by Breusch (1978) and Godfrey (1978), and error term of the model should be normally distributed using Jarque-Bera statistics. Similarly, the variance of the error term should be constant, which is homoskedastic; this can easily be checked using Breuch-Pagan⁴ test developed by Breusch and Pagan (1979). Lastly, an optimal model should be dynamically stable which can be tested by Cumulative Sum of Recursive Residuals (CUSUM) or Cumulative Sum of Recursive Residuals Squares (CUSUMSQ)⁵ proposed by Brown, Durbin and Evans (1975).

3.7.1.5 The General Modeling

Following the result of unit root test and ascertaining that none of the series is integrated to the second order and having established the required optimal lag lengths, next stage is the formulation of an unrestricted error correction model

³Breusch-Godfrey test is a test of serial correlation among the error term, testing whether error term of one period affects that of another period, they are supposed to be independent of one another in different periods.

⁴Breusch-Pagan test is testing the whether the variance of the error term in the model is constant. It is based on regressing the squared residuals on the independent variables.

⁵CUSUM and CUSUMSQ are used to monitor the existence of changes or otherwise in the series of data and hence it is used to check the stability of the model.

(ECM) that is used in the ARDL estimation which is subsequently used for Bound test of cointegration. The Bound test for cointegration is used to establish the existence of a long run relationship among the variables in the model (Jalil, Tariq & Bibi, 2014; Pesaran & Shin, 1998). The formulated unrestricted ECM equation is presented in Equation [3.21] for the *ERPT* to inflation model:

The unrestricted ECM for the *ERPT* to inflation model:

$$\begin{aligned}
 \Delta LINF_t = & \alpha_0 + \sum_{k=1}^p \alpha_1 \Delta LINF_{t-k} + \sum_{k=0}^{q_1} \alpha_2 \Delta CLEX_{t-k} + \sum_{k=0}^{q_2} \alpha_3 \Delta LBRAG_{t-k} \\
 & + \sum_{k=0}^{q_3} \alpha_4 \Delta GDPL_{t-k} + \sum_{k=0}^{q_4} \alpha_5 \Delta LTB_{t-k} + \sum_{k=0}^{q_5} \alpha_6 \Delta LINR_{t-k} \\
 & + \sum_{k=0}^{q_6} \alpha_7 \Delta LGOV_{t-k} + \phi_1 LINF_{t-1} + \phi_2 CLEX_{t-1} + \phi_3 LBRAG_{t-1} \\
 & + \phi_4 LGDP_{t-1} + \phi_5 LTB_{t-1} + \phi_6 LINR_{t-1} + \phi_7 LGOV_{t-1} + \varepsilon_t \quad [3.21]
 \end{aligned}$$

where α_i and ϕ_i ($i=1, 2, \dots, 7$) are the short run and the long run parameters, respectively.

The rest of the items and variables are as defined in the previous equations.

3.7.1.6 Bound Test for Cointegration

The Bound test approach to cointegration is utilized to check the existence of the long run associations as specified in the first objective, which intends to analyze the *ERPT* to inflation. Given Equation [3.21] for *ERPT* to inflation, the long run association encompasses the inflation rate in one hand and exchange rate, money supply, *GDP*, trade balance, and government expenditure. In this study, the long run relationship is investigated using the ARDL bounds testing method constructed by

Pesaran, Shin and Smith (1999, 2001). The ARDL bounds test approach used in this study is through applying Pesaran, Shin and Smith (1999, 2001) ARDL modeling specification. Many studies such as Sek, Teo and Wong (2015) and Jalil, Tariq and Bibi (2013) applied the same method.

The methods of Bounds tests are on the bases of joint F -statistics to investigate the existence of the long run cointegration or not. Therefore, the null hypothesis (H_0) of no cointegration of Equation [3.21] is $H_0: \alpha_i = 0; \phi_i = 0$ ($i = 1, 2, 3, 4, 5, 6, 7$) is set against the alternative hypothesis (H_1) of the existence of long-run cointegration, which is $H_1: \alpha_i \neq 0; \phi_i \neq 0$. The decision rule mandated that the calculated F -statistic to be greater than the critical upper bounds values ($I(1)$) calculated and provided by Pesaran Shin and Smith (2001), for the null hypothesis to be reject. Also, the null hypothesis should not be rejected if the calculated F -statistic is lower than the critical lower bounds values ($I(0)$). Finally, the result is inconclusive if the calculated F -statistic fall in between the critical lower and upper bounds values.

3.7.1.7 Estimation of the Long Run Coefficients

Once the long run relationship is established next is an estimation of the long run coefficient. The long-run equation is presented in Equation [3.22] for *ERPT* to inflation model.

$$\begin{aligned}
LINF_t = & \delta_0 + \sum_{k=1}^p \delta_1 LINF_{t-k} + \sum_{k=0}^{q_1} \delta_2 CLEXC_{t-k} + \sum_{k=0}^{q_2} \delta_3 LBRAG_{t-k} \\
& + \sum_{k=0}^{q_3} \delta_4 GDPL_{t-k} + \sum_{k=0}^{q_4} \delta_5 LTB_{t-k} + \sum_{k=0}^{q_5} \delta_6 LINR_{t-k} \\
& + \sum_{k=0}^{q_6} \delta_7 LGOV_{t-k} + \varepsilon_t
\end{aligned} \tag{3.22}$$

where $\delta_0, \delta_1, \dots, \delta_3$ are coefficients of the long run for the *ERPT* to inflation model.

3.7.1.8 Estimation of the Short Run Coefficients

The short run coefficients estimation follows the long run coefficients estimation.

The short-run equation is presented in Equation [3.23].

Equation [3.23] for the short run of *ERPT* to inflation model:

$$\begin{aligned}
\Delta LINF_t = & \alpha_0 + \sum_{k=1}^p \alpha_1 \Delta LINF_{t-k} + \sum_{k=0}^{q_1} \alpha_2 \Delta CLEXC_{t-k} + \sum_{k=0}^{q_2} \alpha_3 \Delta LBRAG_{t-k} \\
& + \sum_{k=0}^{q_3} \alpha_4 \Delta GDPL_{t-k} + \sum_{k=0}^{q_4} \alpha_5 \Delta LTB_{t-k} + \sum_{k=0}^{q_5} \alpha_6 \Delta LINR_{t-k} \\
& + \sum_{k=0}^{q_6} \alpha_7 \Delta LGOV_{t-k} + v_0 ECT_{t-1} + \varepsilon_t
\end{aligned} \tag{3.23}$$

where v_0 is the speed of adjustment for *ERPT* to inflation estimation, *ECT* is the error correction term; the rest as defined in the previous equations.

3.7.2 Univariate Analysis for the Persistency Estimation

Investigating the persistence of a variable involves regressing the current series of a variable, on its lag series which is Autoregressive (AR) process. (Fuhrer, 2011; Box & Jenkins, 1970). The AR process is specifically designed for analyzing single variable in a regression, more especially, when the lagged value of the dependent variable is used as an independent variable (Biorn, 2017; Canova & Ciccarelli, 2013).

Modeling and estimations of relationships for forecasting and persistency estimations – effects of a lag of the dependent variable on its current values is popularly known as the AR process in an econometric circle. Friedlander and Porat (1984) asserted that the AR process was, initially, introduced by Yule (1927) and Walker (1931). The univariate method of analysis is finalized by Box and Jenkins (1970), after completing the derivations of the likelihood function that makes the estimations of the parameters possible, through maximum likelihood.

The univariate analysis is important for forecasting purposes (Hassan & Othman, 2018), and it is also used for checking the persistence of a variable Fuhrer (2011). This process involves four stages; starting with checking the level of stationarity of the variable through the unit root test. This is followed by the model lag selection. The next stage is the model estimation. The last part is the model diagnostic checking.

3.7.2.1 Root Test

Examining the level of integration and stationary of a series is necessary for the purpose of avoiding spurious regression. Investigating the level of stationary of data series is always the priority to the examination of their long run co-integration (Hassan, Abu-Bakar & Abdullah, 2004). The first stage of univariate analysis is determining the level of stationary of the variable through the unit root test. The procedures are the same as the specification made in section 3.7.1.1.

3.7.2.2 The Model Lag Selection

Once the level of stationarity of the variable ascertained, the next stage is the model lag identification and selection of optimal lag length for the model, which is also known as the order of the model. The lag selection criteria used in this research is specified in Equation [3.24], Equation [3.25] and Equation [3.26] for AIC that is proposed by Akaike (1974), SIC which is proposed by Schwarz (1978), and HQC proposed by Hannan and Quinn (1979), respectively.

$$AIC = (e^{2k/n}) \frac{\sum \hat{\varepsilon}_i^2}{n} \quad [3.24]$$

where e is the exponential constant (2.718), k is the number of regressors, n is the number of observation, and ε is the error term.

$$SIC = (n^{k/n}) \frac{\sum \hat{\varepsilon}_i^2}{n} \quad [3.25]$$

and

$$HQC = -2L_{max} + 2k \ln(\ln(n)) \quad [3.26]$$

where L_{max} is the log-likelihood, \ln is natural logarithm.

3.7.2.3 Model Estimation

The model of inflation persistence in WACCs is designed based on Fuhrer (2011). The method has been used in many studies including Antonakakis, Cunado, Fills and Gracia (2017), Attinasi and Metelli (2017), Galariotus, Makrichoriti and Spyrou (2016), Canova and Ciccarelli (2013), and Altissimo, Mojon and Zaffaroni (2009). The model is presented in Equation [3.27].

$$LINF_t = \rho_0 + \sum_{k=1}^n \rho_k LINF_{t-k} + \varepsilon_t \quad [3.27]$$

where: k is the lag length, and n is the number of observations

3.7.2.4 Magnitude of Inflation Persistence

The magnitude of inflation persistence determines if there is a need for policymakers' intervention to break such persistence. Coleman (2010) highlighted that inflation persistence is of two magnitudes, and they are high inflation persistence and low inflation persistence. The high inflation persistence requires the policymakers' intervention for it to be broken due to its adverse effect on the economy. Whereas, the low inflation persistence requires no policymakers' intervention, as it has no adverse consequences on the economic activities of the concerned country. Therefore, identifying the magnitude of inflation persistence is very crucial. Hence, Fuhrer (2011) maintained that if the coefficient of the estimated

AR model is positive, 0.4 or 40 percent and above, then the rate of inflation is of high persistence otherwise it is of low inflation persistence.

3.7.2.5 Diagnostic Checking of the Univariate Analysis

The best univariate model estimated should have a normally distributed error term, which requires the model to have the probability of more than five percent after estimating Jarque-Bera statistics, though it is not a necessary condition. In addition to this, the variance of the error term, from the estimated model, should be constant based on Breuch-Pagan test, and finally, the model should be dynamically stable based Brown, Durbin and Evans (1975) CUSUM and CUSUMSQ.

3.7.3 Threshold Model

This section presents the stages and methods of threshold inflation rate estimation, which is the third and final objective of the study. It starts by stating explaining the threshold identity, followed by the methods of estimation and closed by stating the necessary postestimation diagnostic checks.

3.7.3.1 Threshold Identity

The combinations of variables in the threshold model determine the nature of the threshold estimation. Having the lagged values of the dependent variable as the threshold variable in addition to other controlled variables is termed as a self-exciting (SE) threshold model (Hansen, 2011; Tsay, 1989). When the model has no other control variable, and it contains only lagged values of the dependent variables as the independent variables and the threshold variable it is called self-exciting autoregression (SETAR) threshold model (Tong & Lim, 1980; Hansen, 2011).

In a model where there are no lagged values of the dependent variables as a threshold or controlled variables, such model is considered as conventional threshold model (Hansen, 1999, 2000; Potter, 1999). This study utilized conventional threshold model to investigate the existence of threshold or otherwise on the effect of the rates of inflation on the economic growth of WACCs suggested by Hansen (1999, 2000) and based on conditional threshold model of regime switching popularized by Iqbal and Nawaz (2009).

3.7.3.2 Threshold Model Estimation

Having a threshold on the relationship between inflation and economic growth implies an existing of a non-linear relationship between the variables. The threshold or non-linear relationship gives birth to the existence of multiple regimes (Hansen, 1999, 2000, 2011; Bai & Perron 1998, 2003). The threshold model in this research utilizes the model designed by Hansen (1999, 2000) and Iqbal and Nawaz (2009) based on threshold model of regime switching. It is the model that is designed to check the existence of a threshold by which from it, inflation is inimical to economic growth and to check the rates of inflation that are not harmful to economic growth. The model also checks whether the relationship between inflation and economic growth is not linear. This model has been used by several studies including Baglan and Yoldas (2014), Doguwa (2012), Hussain and Malik (2011), Fakhri (2011), Salami and Kelikume (2010), and Mubarik, (2005). The model is presented in Equation [3.28].

$$\Delta LGDP_t = \alpha_0 + \alpha_1(\Delta LINF_t) * D(LINF_t < \pi_1) + \alpha_2(\Delta LINF_t) * D(\pi_1 \leq LINF_t \leq \pi_2) + \alpha_3(\Delta LINF_t) * D(LINF_t > \pi_2) + \alpha_4 \Delta LTB_t + \varepsilon_t \quad [3.28]$$

where Δ is the difference operator, α_i ($i=1, 2, 3, 4$) are parameters, D is dummy variable with value 0 and 1, it takes the value of one (1) if the statements in the parenthesis are true otherwise it takes zero (0), π_1 is the lower threshold and π_2 is the upper threshold inflation rates.

Iqbal and Nawaz (2009) and Khan and Senhadji (2000) affirm that the rates of inflation below the lower threshold rate have no significant effect on the economic growth of the concern countries and therefore they should be the rates of inflation to be targeted. Also, the rates of inflation, from the upper threshold onward, are highly inimical to economic growth, and therefore they should be avoided as the harmful effect of the inflationary pressures outweigh the rates of economic growth. Finally, the rates of inflation that are in between the lower and upper threshold rates are also inimical to economic growth, but rates of growth of the economy outweigh their harmful effect.

3.7.3.2 Diagnostic Checking of the Threshold Model

The estimated threshold model is valid if it is free from serial correlation, based on the Breusch-Godfrey test for autocorrelation. It should also be free from heteroskedasticity based on the Breusch-Pagan test, and at the same time, it should be dynamically stable based on CUSUM and CUSUMSQ. The estimated coefficients should not be perfectly correlated (absence of multicollinearity). The threshold model is a non-linear model, and therefore, the normality of the error term is desirable but not necessary.

3.8 Conclusion

Being the third chapter of the study, it arrays the procedures and methods utilized in the study. It started by explaining the theories (theoretical framework) by which the work is based and upon which the research models are built. Whereupon, model specification, operational rational of the variables and sources of data are prescribed. The chapter further expatiates the econometric methodology used in the research, which comprised only the time series data techniques, which involves unit root tests using ADF as well as a Bound test using ARDL. It also comprises the estimation of inflation persistence using univariate analysis, and threshold model based on conventional threshold model of regime switching to estimate the threshold inflation rates of the WACCs.



CHAPTER FOUR

DISCUSSION OF RESULTS

4.1 Introduction

This chapter deals with the discussions of the findings of the study. Descriptive statistics, correlation analysis, ARDL results of *ERPT* of different countries, results of the persistence of inflation, and results of threshold inflation rates of the WACCs are discussed.

4.2 Descriptive Statistics

The summary of the descriptive statistics of the variables of this study are presented in Table 4.1 to Table 4.4 for the individual countries based on the time series data used for the analysis.

The descriptive statistics of the individual countries are presented in Table 4.1 for Nigeria, Table 4.2, Table 4.3, and Table 4.4 for Ghana, Gambia, and Sierra Leone, respectively. In Nigeria, the standard deviation, of all the variables, is less than their corresponding average values except the change in exchange rate. This implies that the distributions of the variables are closer to their respective means, except the change in exchange rate. Also, the variable with a standard deviation value of less than unity, in Nigeria, include inflation, exchange rate, and trade balance, while the rest of the variables have various standard deviation value of more than unity.

Table 4. 1
Descriptive Statistics for Nigeria

Variables	Mean	Standard Deviation	Minimum	Maximum
<i>LINF</i>	2.67	0.71	1.68	4.29
<i>CLEXC</i>	0.17	0.30	-0.06	1.44
<i>LBRAG</i>	27.04	2.53	23.39	30.67
<i>LGDP</i>	24.96	1.12	23.48	27.07
<i>LTB</i>	0.38	0.30	-0.21	0.99
<i>LGOV</i>	22.52	1.11	20.76	24.36

On the other hand, in Ghana, the mean values of all the variables are higher than their respective standard deviation except that of the trade balance. This implies that the variables are normally distributed with the exception of the series of the trade balance. Also, in terms of volatility, all the variables have standard deviation values of less than unity, which could imply that they are less volatile, except money supply, as stipulated in Table 4.2.

Table 4. 2
Descriptive Statistics for Ghana

Variables	Mean	Standard Deviation	Minimum	Maximum
<i>LINF</i>	3.08	0.66	2.17	4.81
<i>CLEXC</i>	0.27	0.30	0.00	1.40
<i>LBRAG</i>	19.61	3.41	13.59	24.78
<i>LGDP</i>	23.01	0.85	22.12	24.59
<i>LTB</i>	-0.32	0.15	-0.59	0.11
<i>LGOV</i>	20.71	0.87	19.29	22.42

Similarly, the descriptive statistics of the variables for the Gambia is highlighted in Table 4.3. The table shows most of the variables are less volatile as they have a standard deviation value of less than unity except money supply. Furthermore, most

the variables have a mean value higher than the corresponding standard deviation of the variable, which implies that the distribution centered around mean except exchange which has a mean value lower than its corresponding standard deviation, and trade balance that has a mean value of -0.29 with a corresponding standard deviation of 0.13.

Table 4. 3
Descriptive Statistics for the Gambia

Variables	Mean	Standard Deviation	Minimum	Maximum
<i>LINF</i>	1.84	0.87	-0.17	4.04
<i>CLEXC</i>	0.09	0.13	-0.12	0.58
<i>LBRAG</i>	21.11	1.65	18.32	23.69
<i>LGDP</i>	20.11	0.59	18.99	20.69
<i>LTB</i>	-0.29	0.13	-0.59	-0.10
<i>LGOV</i>	18.09	0.35	17.35	18.54

The characteristics of the variables in Sierra Leone are highlighted in Table 4.4. The table shows that most of the variables are normally distributed; this is because the standard deviation values of the variables are lower than their respective mean values except that of the exchange rate with the 0.24 as its mean value and 0.30 as its standard deviation value.

Table 4. 4
Descriptive Statistics for Sierra Leone

Variables	Mean	Standard Deviation	Minimum	Maximum
<i>LINF</i>	3.06	1.05	0.74	5.19
<i>CLEXC</i>	0.24	0.30	-0.05	1.15
<i>LBRAG</i>	25.20	3.10	19.38	29.44
<i>LGDP</i>	21.00	0.64	20.01	22.34
<i>LTB</i>	-0.44	0.44	-1.38	0.69
<i>LGOV</i>	18.64	0.70	17.25	19.91

4.3 Correlation Analysis

The existence of relationships between two variables can be established using correlation analysis. Correlation analysis could also be used in detecting some elements of multicollinearity, especially among the independent variable (Gujarati & Porter, 2009). The correlation matrixes for the *ERPT* models of the various countries are presented in Table 4.5 to Table 4.8., and the correlation matrixes for the threshold model are displayed in Table 4.9 to Table 4.12.

The correlation matrix of the inflation model of *ERPT* for Nigeria is presented in Table 4.6. It shows that correlation between inflation and all the variables is weak as they are less than 70 percent, though mostly, insignificant except the correlation between inflation and money supply (*LBRAB*) in one hand and inflation and *GDP*, as well as inflation and government expenditure in the other hand. Correlation among variables is considered weak if it is below 70 percent and strong from 70 percent and above (Koutsoyiannis, 1977). Also, the correlation between inflation and the change in exchange rate is negative, weak and insignificant

Table 4. 5

Variables Correlation Matrix: ERPT Model for Nigeria

Variables	<i>LINF</i>	<i>CLEXC</i>	<i>LBRAG</i>	<i>LGDP</i>	<i>LTB</i>	<i>LGOV</i>
<i>LINF</i>	1.00 -----					
<i>CLEXC</i>	-0.08 (0.63)	1.00 -----				
<i>LBRAG</i>	-0.29 (0.09)*	-0.30 (0.08)*	1.00 -----			
<i>LGDP</i>	-0.42 (0.01)**	-0.34 (0.04)**	0.85 (0.00)***	1.00 -----		
<i>LTB</i>	0.10 (0.57)	0.13 (0.45)	-0.06 (0.72)	-0.09 (0.60)	1.00 -----	
<i>LGOV</i>	-0.42 (0.01)**	-0.41 (0.01)**	0.76 (0.00)***	0.94 (0.00)***	-0.24 (0.17)	1.00 -----

Note: '***' '**' '*' implies significant at one, five and ten percent, respectively.

Figures in the parenthesis represent probability

The correlation matrix of the inflation model of *ERPT* for Ghana is presented in Table 4.6. The correlation between inflation and the individual variables are all significant, though they are mostly weak below 70 percent. The correlation between inflation and the change in exchange rate, in Ghana, is positive and significant, though it is weak with value, less than 70 percent. Also, there is a significant correlation between inflation and money supply, and inflation and government expenditure, though, the correlations between them are negative.

Table 4. 6

Variables Correlation Matrix: ERPT Model for Ghana

Variables	<i>LINF</i>	<i>CLEXC</i>	<i>LBRAG</i>	<i>LGDP</i>	<i>LTB</i>	<i>LGOV</i>
<i>LINF</i>	1.00 -----					
<i>CLEXC</i>	0.48 (0.00)***	1.00 -----				
<i>LBRAG</i>	-0.61 (0.00)***	-0.45 (0.01)**	1.00 -----			
<i>LGDP</i>	-0.59 (0.00)***	-0.39 (0.02)**	0.88 (0.00)***	1.00 -----		
<i>LTB</i>	0.39 (0.02)**	0.22 (0.19)	-0.33 (0.05)	-0.17 (0.34)	1.00 -----	
<i>LGOV</i>	-0.63 (0.00)***	-0.45 (0.01)**	0.90 (0.00)***	0.97 (0.00)***	-0.27 (0.11)	1.00 -----

Note: '***' '**' '*' implies significant at one, five and ten percent, respectively.
 Figures in the parenthesis represent probability

The correlation matrix of the inflation model for *ERPT* of the Gambia is presented in Table 4.7. It is similar to that of Nigeria and Ghana in the sense that a weak correlation exists between inflation and the rest of the variables. The correlation between inflation and change in exchange rate is positive significant but weak. Most of the correlation between inflation and the rest of the independent variables are significant except the correlation between inflation and trade balance.

Table 4. 7

Variables Correlation Matrix: ERPT Model of the Gambia

Variables	<i>LINF</i>	<i>CLEXC</i>	<i>LBRAG</i>	<i>LGDP</i>	<i>LTB</i>	<i>LGOV</i>
<i>LINF</i>	1.00 -----					
<i>CLEXC</i>	0.47 (0.01)**	1.00 -----				
<i>LBRAG</i>	-0.36 (0.03)**	-0.23 (0.18)	1.00 -----			
<i>LGDP</i>	-0.69 (0.00)***	-0.42 (0.01)**	0.79 (0.00)***	1.00 -----		
<i>LTB</i>	0.13 (0.45)	0.29 (0.10)	-0.51 (0.00)***	-0.34 (0.05)*	1.00 -----	
<i>LGOV</i>	-0.53 (0.00)***	-0.22 (0.20)	0.10 (0.58)	0.49 (0.00)****	-0.23 (0.18)	1.00 -----

Note: '***' '**' '*' implies significant at one, five and ten percent, respectively.
Figures in the parenthesis represent probability

The correlation matrix of the inflation model for *ERPT* of Sierra Leone is summarized in Table 4.8. The table shows the existence of a strong correlation between inflation and some independent variables. For instant, inflation is strongly correlated with the change in exchange rate, and it is significant as well as positive. While the correlation between inflation and money supply, even though it is strong and significant, it is negative. The correlation between inflation and GDP is strong, significant, and negative as expected. The correlation between inflation and trade balance is also significant, positive, and strong. Meanwhile, the correlation between inflation and government expenditure is negative, strong, and significant. The correlations between inflation and most of the independent variables are all significant.

Table 4. 8

Variables Correlation Matrix: ERPT Model for Sierra Leone

Variables	<i>LINF</i>	<i>CLEXC</i>	<i>LBRAG</i>	<i>LGDP</i>	<i>LTB</i>	<i>LGOV</i>
<i>LINF</i>	1.00 -----					
<i>CLEXC</i>	0.79 (0.00)*	1.00 -----				
<i>LBRAG</i>	-0.75 (0.00)*	-0.49 (0.00)*	1.00 -----			
<i>LGDP</i>	-0.74 (0.00)*	-0.60 (0.00)*	0.70 (0.00)*	1.00 -----		
<i>LTB</i>	0.72 (0.00)*	0.42 (0.02)*	-0.50 (0.00)*	-0.55 (0.00)*	1.00 -----	
<i>LGOV</i>	-0.81 (0.00)*	-0.66 (0.00)*	0.78 (0.00)*	0.97 (0.00)*	-0.64 (0.00)*	1.00 -----

Note: '****' '**' '*' implies significant at one, five and ten percent, respectively.

Figures in the parenthesis represent probability

Table 4.9 presents the correlation matrix of the threshold model for Nigeria. The table reveals that the correlation between *GDP* and inflation is weak but significant and negative as expected. Whereas Table 4.10, presents the correlation matrix of the threshold model for Ghana, which shows that the correlation between *GDP* and inflation rate in Ghana, even though, it is weak like that of Nigeria, it is statistically significant with negative effect as expected. Meanwhile, Table 4.11 presents the correlation matrix of the threshold model for the Gambia, and it shows that the correlation between *GDP* and inflation in the Gambia is negative, weak, and significant. While Table 4.12 highlighted the correlation matrix of the threshold model for Sierra Leone, it shows that there is an existence of a weak, negative and significant correlation between *GDP* and inflation rate Sierra Leone, similar to the rest of WACCs.

Table 4. 9
Nigerian Threshold Model Correlation Matrix

Variables	LGDP	LINF	LTB
LGDP	1.00 -----		
LINF	-0.27 (0.07)*	1.00 -----	
LTB	0.18 (0.24)	0.05 (0.75)	1.00 -----

Note: '****' '**' '*' implies significant at one, five and ten percent, respectively.
 Figures in the parenthesis represent probability

Table 4. 10
Ghanaian Threshold Model Correlation Matrix

Variable	LGDP	LINF	LTB
LGDP	1.00 -----		
LINF	-0.36 (0.01)**	1.00 -----	
LTB	-0.48 (0.00)***	0.21 (0.15)	1.00 -----

Note: '****' '**' '*' implies significant at one, five and ten percent, respectively.
 Figures in the parenthesis represent probability

Table 4. 11
The Gambian Threshold Model Correlation Matrix

Variables	LGDP	LINF	LTB
LGDP	1.00 -----		
LINF	-0.33 (0.02)**	1.00 -----	
LTB	-0.38 (0.01)**	0.10 (0.51)	1.00 -----

Note: '****' '**' '*' implies significant at one, five and ten percent, respectively.
 Figures in the parenthesis represent probability

Table 4. 12

Sierra Leone Threshold Model Correlation Matrix

Variables	LGDP	LINF	LTB
LGDP	1.00 -----		
LINF	-0.27 (0.07)*	1.00 -----	
LTB	-0.56 (0.00)***	0.53 (0.00)***	1.00 -----

Note: ‘***’ ‘**’ ‘*’ implies significant at one, five and ten percent, respectively. Figures in the parenthesis represent probability

4.4 Estimations of the Exchange Rate Pass-Through to Inflation Model

This section presents the results obtained for the estimation of the *ERPT* to inflation for each of the WACCs using ARDL, based on time series data. It is started by presenting the results of the unit root test, followed by the weak exogeneity test, lag selection, and selection of the optimal model, whereupon, general ARDL modeling of the *ERPT* to inflation is presented followed by the bound test for co-integration and presentation of long-run results and that of the short run results.

4.4.1 Unit Root Tests for the Exchange Rate Pass-Through to Inflation Model

The results of the unit root test of the *ERPT* to inflation are presented in Table 4.13. The table shows that the variables are mixed stationary; some are stationary at level while some are stationary at first difference. Inflation, being the dependent variable, is stationary at first difference in all the countries. Meanwhile, the change in exchange rate (*CLEXC*) is stationary at level in all the countries. Also, Money Supply (*LBRAG*) is stationary at first difference in all the countries. Similarly, *GDP* is unanimously, stationary at first difference in all the countries. On the other hand, the trade balance (*LTB*) is stationary at level in Nigeria and Ghana while it is stationary at first difference in the Gambia and Sierra Leone. Finally, government

expenditure (*LGOV*) is stationary at first difference in all the WACCs except in the Gambia where it is stationary at level.

Table 4. 13
The Result of Unit Root Test of the ERPT

Variable	Nigeria		Ghana		The Gambia		Sierra Leone	
	ADF Level	ADF 1 st Difference	ADF Level	ADF 1 st Difference	ADF Level	ADF 1 st Difference	ADF Level	ADF 1 st Difference
<i>LINF</i>	-1.95 (0.30)	-3.58 (0.01)**	-2.04 (0.27)	-5.99 (0.00)***	-1.95 (0.31)	-3.08 (0.04)**	-1.82 (0.37)	-6.56 (0.00)***
<i>CLEXC</i>	-5.09 (0.00)***	-9.08 (0.00)***	-3.53 (0.01)**	-9.04 (0.00)***	-4.69 (0.00)***	-9.60 (0.00)***	-6.56 (0.00)***	-6.25 (0.00)***
<i>LBRAG</i>	-2.18 (0.49)	-3.45 (0.06)*	0.34 (1.00)	-5.42 (0.00)***	-2.38 (0.38)	-6.33 (0.00)***	-0.55 (0.98)	-4.93 (0.00)***
<i>LGDP</i>	-2.52 (0.31)	-5.81 (0.00)***	-1.58 (0.78)	-4.79 (0.00)***	-1.43 (0.83)	-5.50 (0.00)***	-2.02 (0.57)	-5.39 (0.00)***
<i>LTB</i>	-4.37 (0.00)***	-6.39 (0.00)***	-2.75 (0.08)*	-7.96 (0.00)***	-1.58 (0.48)	-4.36 (0.00)***	-2.19 (0.21)	-7.01 (0.00)***
<i>LGOV</i>	-0.57 (0.86)	-6.00 (0.00)***	-2.58 (0.29)	-4.84 (0.00)***	-4.10 (0.00)***	-5.77 (0.00)***	-2.93 (0.17)	-8.09 (0.00)***

Note: ‘***’ ‘**’ ‘*’ implies significant at one, five and ten percent, respectively. Figures in the parenthesis represent probability

4.4.2 The Exogeneity Test of the Variables

Tests of weak exogeneity have been conducted, and the results of the tests of the *ERPT* to inflation model are presented in Table 4.14. The table shows that null hypotheses of weak exogeneity are all rejected where inflation (*LINF*) is the dependent variable in all the WACCs, as the corresponding probabilities of the estimations are below ten percent. The requirement is that for the model to hold, the null hypothesis must be rejected where *LINF* is the dependent variable in the tests as it is the dependent variable of the model. Hence, all the variables are considered and retained for further analysis.

Table 4. 14

Results of Weak Exogeneity Test for the ERPT

Country	Dependent Variable	Chi-square (χ^2)	Probability	Decision
Nigeria	LINF	17.65	0.06*	Reject H₀
	CLEXC	9.07	0.53	Do not reject H ₀
	LBRAG	10.19	0.42	Do not reject H ₀
	LGDP	5.13	0.88	Do not reject H ₀
	LTB	15.22	0.12	Do not reject H ₀
	LGOV	6.17	0.80	Do not reject H ₀
Ghana	LINF	20.88	0.00***	Reject H₀
	CLEXC	5.36	0.37	Do not reject H ₀
	LBRAG	3.26	0.66	Do not reject H ₀
	LGDP	0.52	0.99	Do not reject H ₀
	LTB	1.88	0.86	Do not reject H ₀
	LGOV	2.87	0.72	Do not reject H ₀
The Gambia	LINF	19.91	0.03**	Reject H₀
	CLEXC	36.26	0.00***	Reject H ₀
	LBRAG	46.21	0.00***	Reject H ₀
	LGDP	10.29	0.42	Do not reject H ₀
	LTB	7.37	0.69	Do not reject H ₀
	LGOV	34.44	0.00***	Reject H ₀
Sierra Leone	LINF	69.17	0.00***	Reject H₀
	CLEXC	98.56	0.00***	Reject H ₀
	LBRAG	12.70	0.24	Do not reject H ₀
	LGDP	14.07	0.17	Do not reject H ₀
	LTB	58.15	0.00***	Reject H ₀
	LGOV	9.10	0.52	Do not reject H ₀

Note: '*****' '***' '*' implies significant at one, five and ten percent, respectively.
H₀: implies variables are weakly exogenous

4.4.3 Selection of Lag Length

On the basis of AIC, ARDL (6, 2, 0, 2, 1, 2), ARDL (1, 1, 2, 1, 2, 2), ARDL (2, 1, 0, 1, 1, 0) and ARDL (1, 0, 1, 0, 0, 0) are selected for Nigeria, Ghana, the Gambia and Sierra Leone, respectively. Figure 4.1 to Figure 4.4 present the AIC for the top 20 models for the selected countries. The chosen lags differ from one country to another as a result of the divergence of different minimum values of the AIC for each country. The chosen lags are always the one with the minimum AIC values (Akaike, 1974).

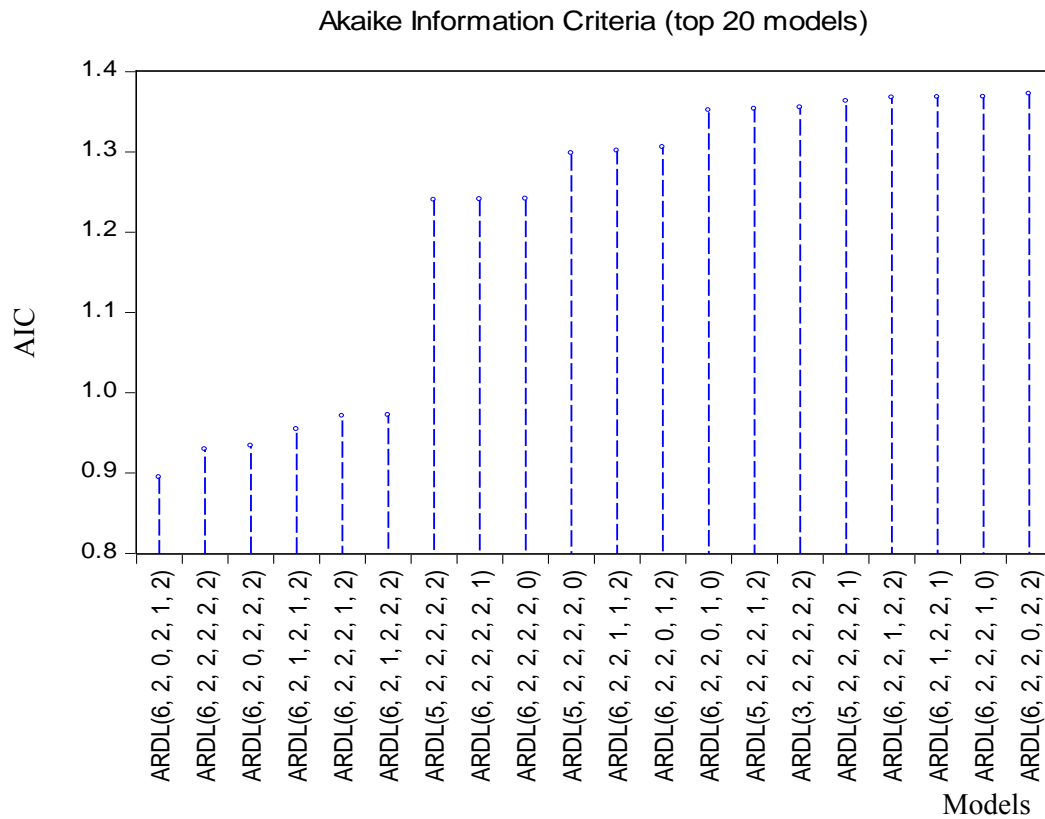


Figure 4. 1
ERPT to Inflation Model Lag Selection for Nigeria

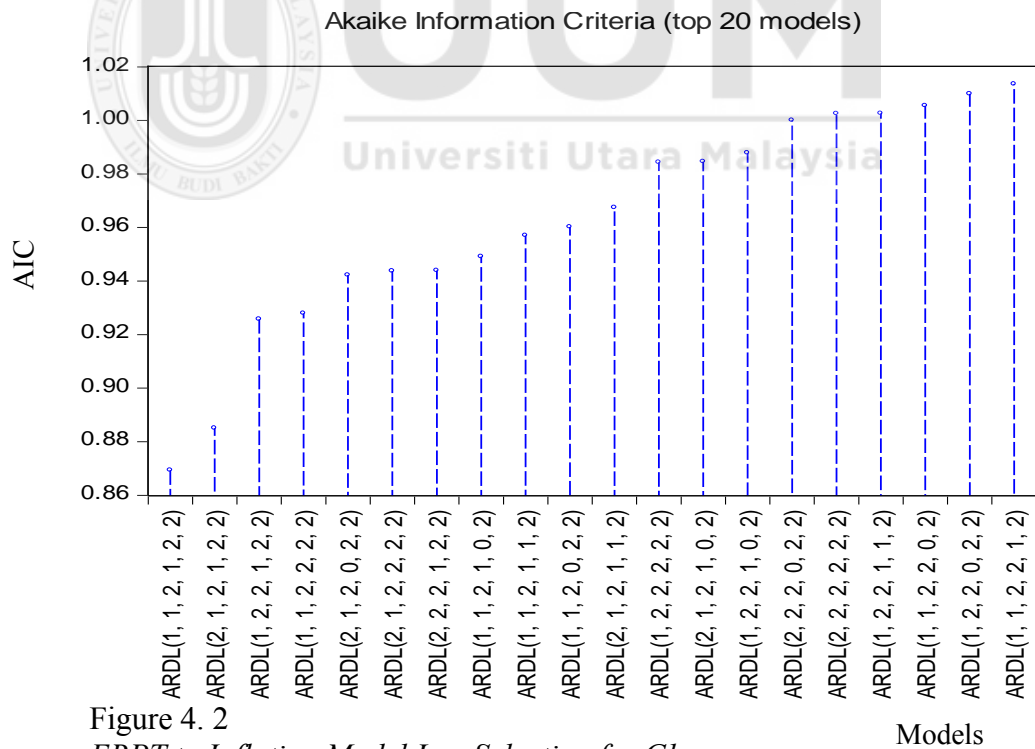


Figure 4. 2
ERPT to Inflation Model Lag Selection for Ghana

Akaike Information Criteria (top 20 models)

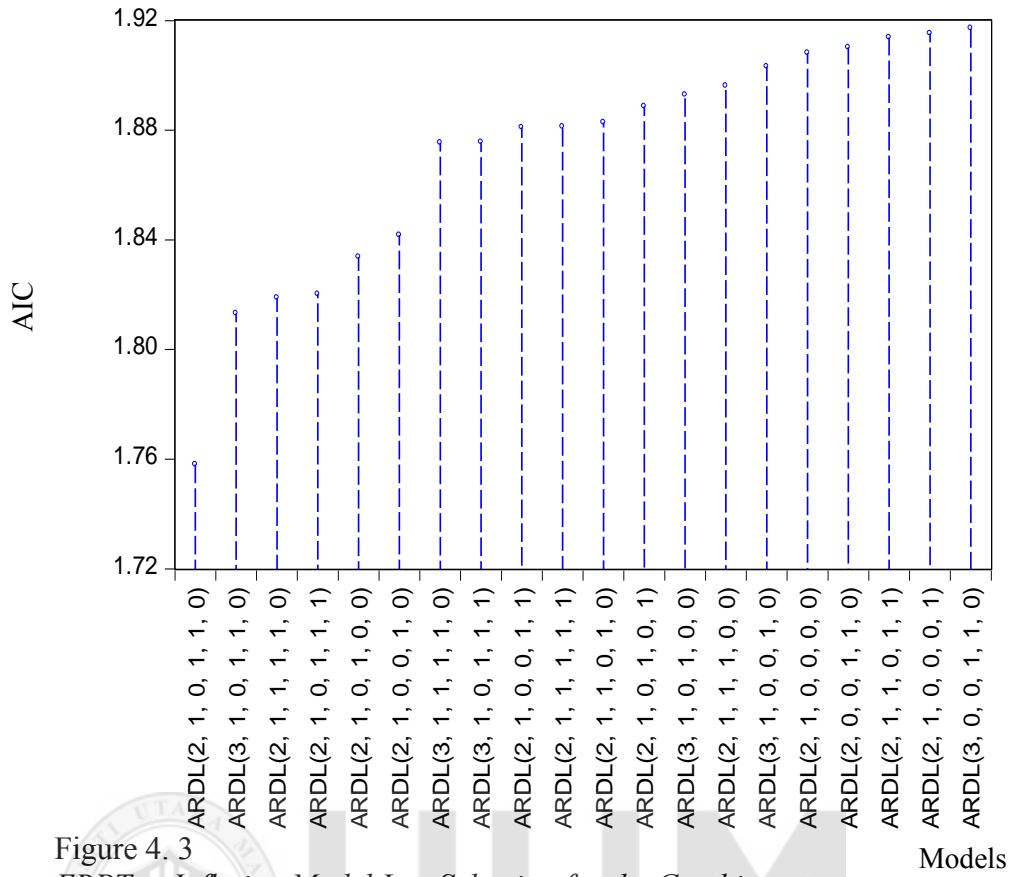


Figure 4. 3
ERPT to Inflation Model Lag Selection for the Gambia

Akaike Information Criteria (top 20 models)

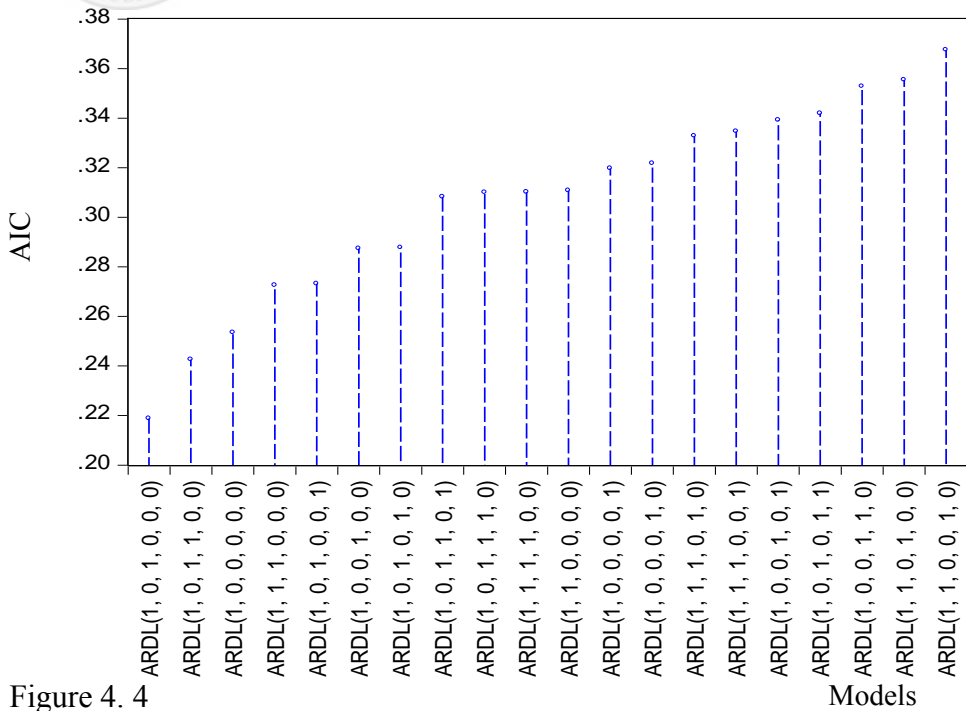


Figure 4. 4
ERPT to Inflation Model Lag Selection for Sierra Leone

4.4.4 The Optimal Model

Table 4.15 presents the results of the postestimation diagnostic checks of the *ERPT* to inflation model. The results reveal that the estimated models, in all the countries, are free from serial correlation and the estimated error terms are white noise. Similarly, Ramsey reset test results show that all the models are correctly specified, having the value of more than five percent of the corresponding probabilities in all the tests.

Table 4. 15
Results of Post-estimation Diagnostic Checks of the ERPT to Inflation Model

Countries	Normality: Jarque-Bera	Serial Correlation	Heteroskedasticity	Ramsey Reset Test
Nigeria	1.38 (0.50)	0.96 (0.51)	0.24 (0.99)	2.21 (0.17)
Ghana	1.07 (0.59)	0.10 (0.91)	0.36 (0.97)	1.50 (0.24)
The Gambia	1.44 (0.49)	1.09 (0.31)	1.00 (0.48)	0.20 (0.66)
Sierra Leone	0.07 (0.96)	0.54 (0.47)	0.33 (0.93)	0.22 (0.65)

Note: The parenthesis represents probability

Also, Table 4.16 indicates that multicollinearity is not severe in the estimated *ERPT* to inflation models, with the coefficients of the Variance Inflation Factor (VIF) that are less than five. It is when the values of the coefficients of the VIF are up to five that implies the detection of some element of multicollinearity, and when it reaches 10 and above, it implies severe multicollinearity, respectively.

Table 4. 16

VIF Test Results for Multicollinearity for the ERPT to Inflation Models

Nigeria		Ghana		The Gambia		Sierra Leone	
Variable	Coefficient Variance	Variable	Coefficient Variance	Variable	Coefficient Variance	Variable	Coefficient Variance
LINF(-1)	0.02	LINF(-1)	0.02	LINF(-1)	0.03	LINF(-1)	0.01
LINF(-2)	0.04	CLEXC	0.11	LINF(-2)	0.02	CLEXC	0.06
LINF(-3)	0.05	CLEXC(-1)	0.08	CLEXC	0.81	LBRAG	0.22
LINF(-4)	0.04	LBRAG	0.80	CLEXC(-1)	0.69	LBRAG(-1)	0.21
LINF(-5)	0.03	LBRAG(-1)	1.35	LBRAG	0.02	LGDP	0.11
LINF(-6)	0.03	LBRAG(-2)	0.69	LGDP	0.52	LTB	0.03
CLEXC	0.22	LGDP	0.25	LGDP(-1)	0.48	LGOV	0.14
CLEXC(-1)	0.24	LGDP(-1)	0.30	LTB	1.93	C	--
CLEXC(-2)	0.14	LTB	0.37	LTB(-1)	1.64		
LBRAG	0.02	LTB(-1)	0.45	LGOV	0.19		
LGDP	0.27	LTB(-2)	0.51	C	--		
LGDP(-1)	0.35	LGOV	0.17				
LGDP(-2)	0.14	LGOV(-1)	0.18				
LTB	0.15	LGOV(-2)	0.09				
LTB(-1)	0.13	C	--				
LGOV	0.16						
LGOV(-1)	0.15						
LGOV(-2)	0.13						
C	--						

Accordingly, Figure 4.5 to Figure 4.8 confirms that the error terms of the estimated models are normally distributed, given the respective probability values of more than five percent for each of the models as presented in the figures.

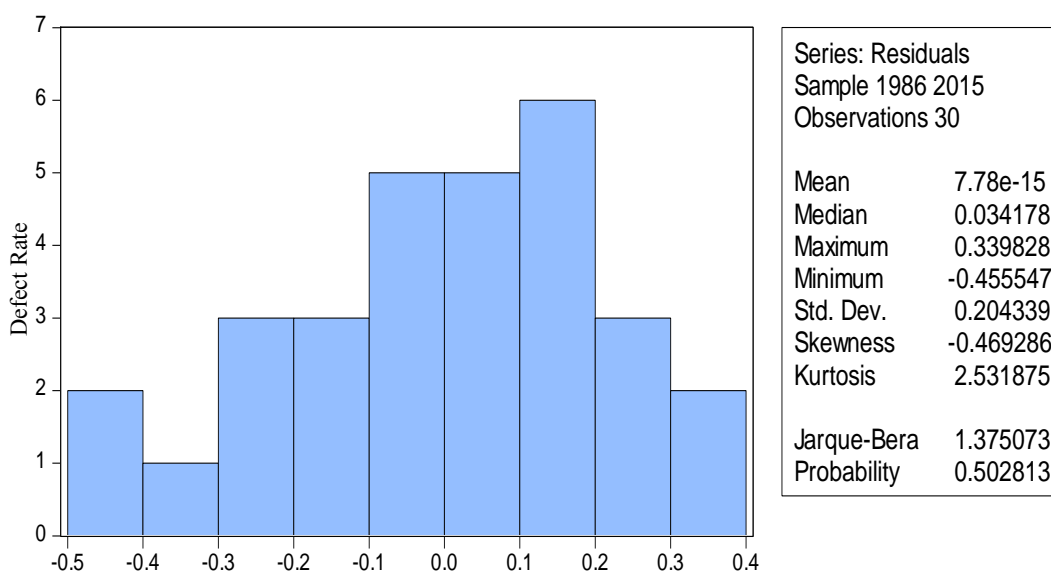


Figure 4. 5

Normality of the Nigerian ERPT to Inflation Model

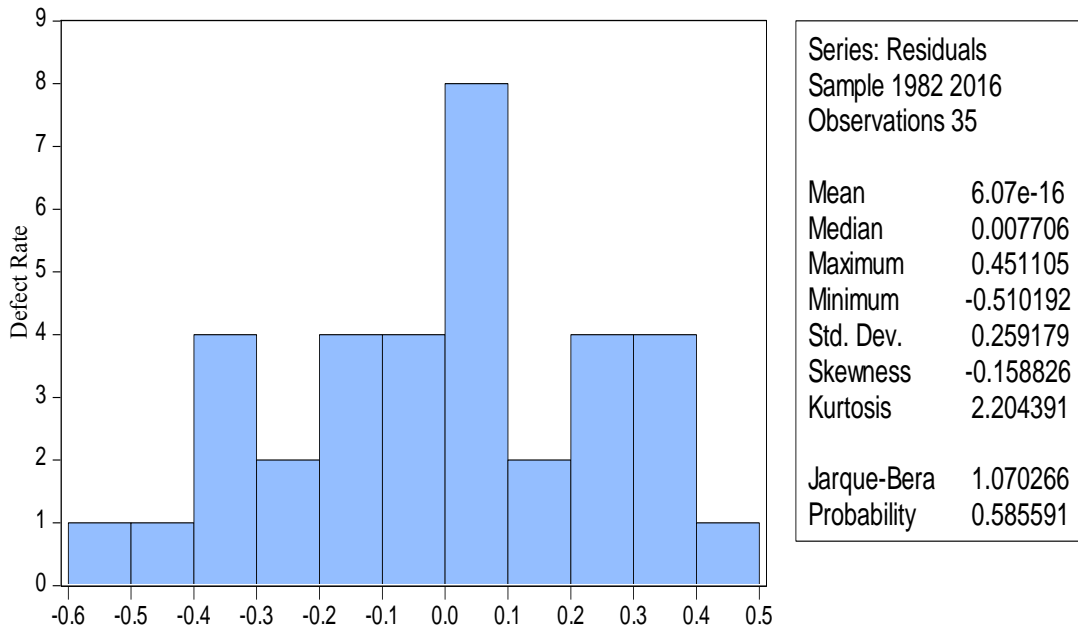


Figure 4. 6
Normality of the Ghanaian ERPT to Inflation Model

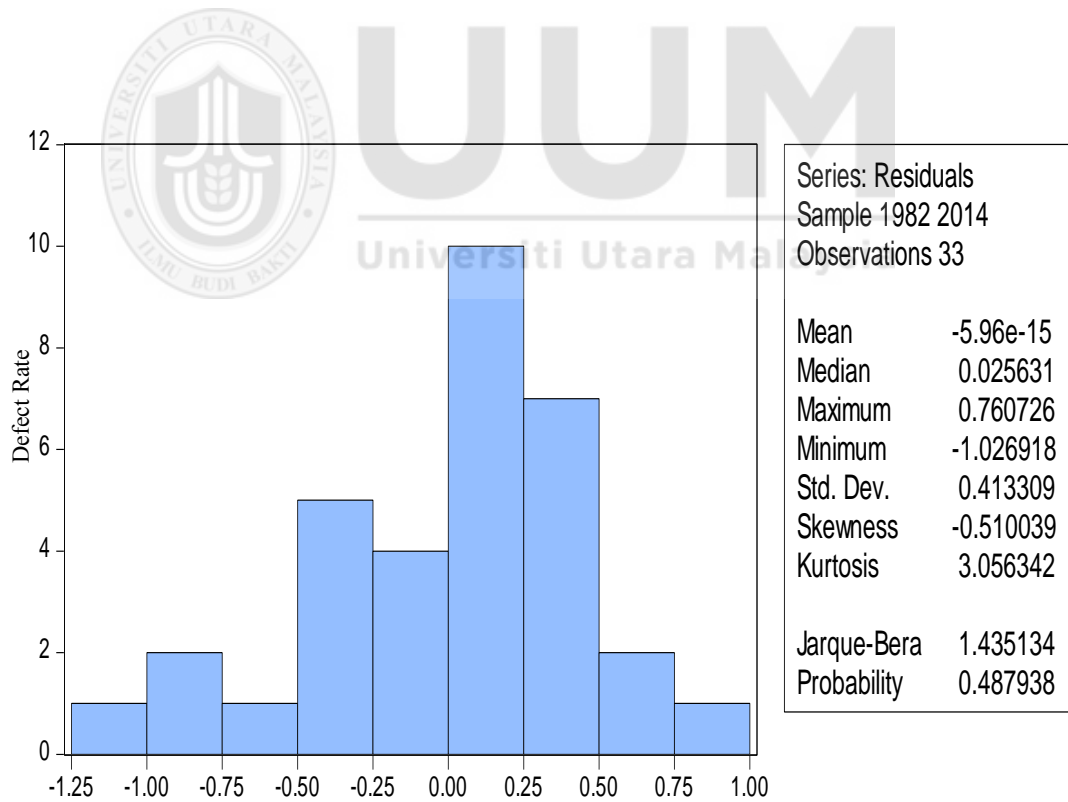


Figure 4. 7
Normality of the Gambian ERPT to Inflation Model

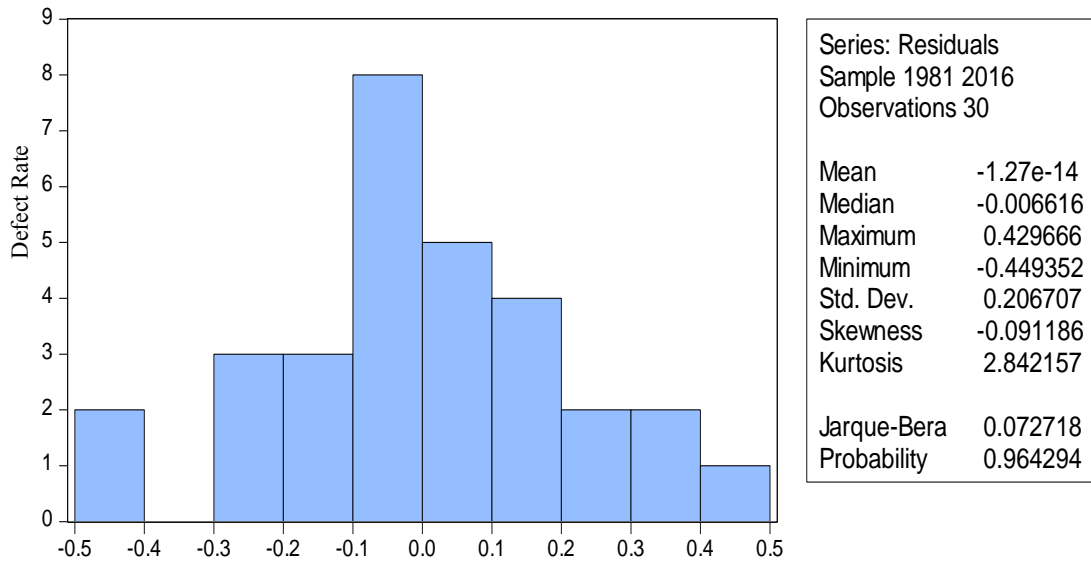


Figure 4. 8
Normality of Sierra Leone's ERPT to Inflation Model

Similarly, Figure 4.9 to Figure 4.16 show that the estimated *ERPT* to inflation models are dynamically stable in either of CUSUM or CUSUM of square or combination of the two, as the estimated model is between the upper and lower ridge lines.

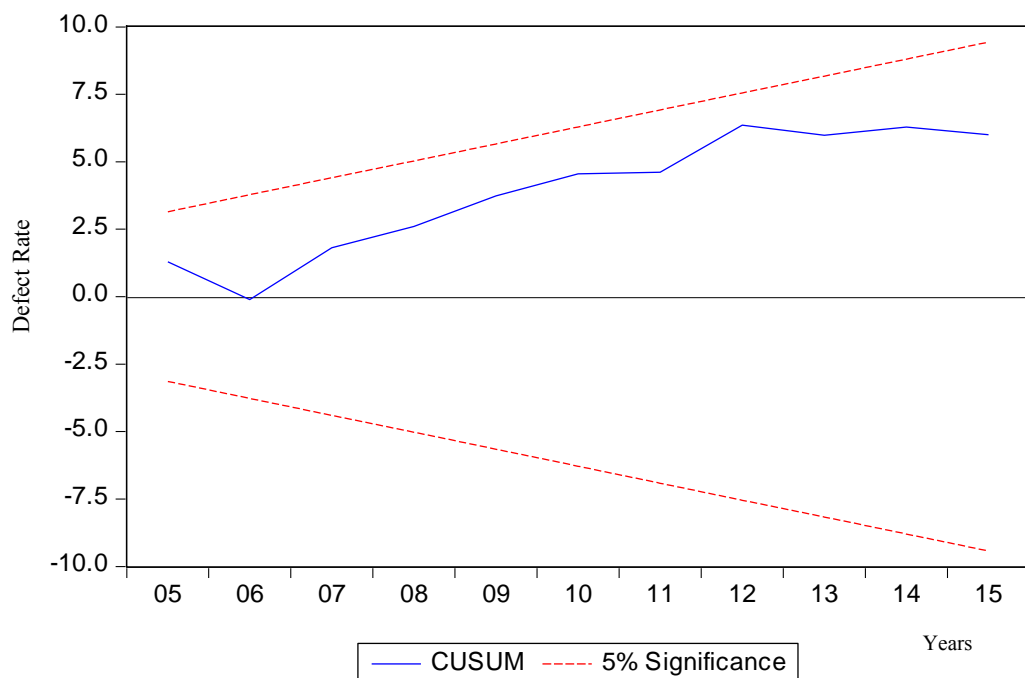


Figure 4. 9
CUSUM for the ERPT to Inflation Model, Nigeria

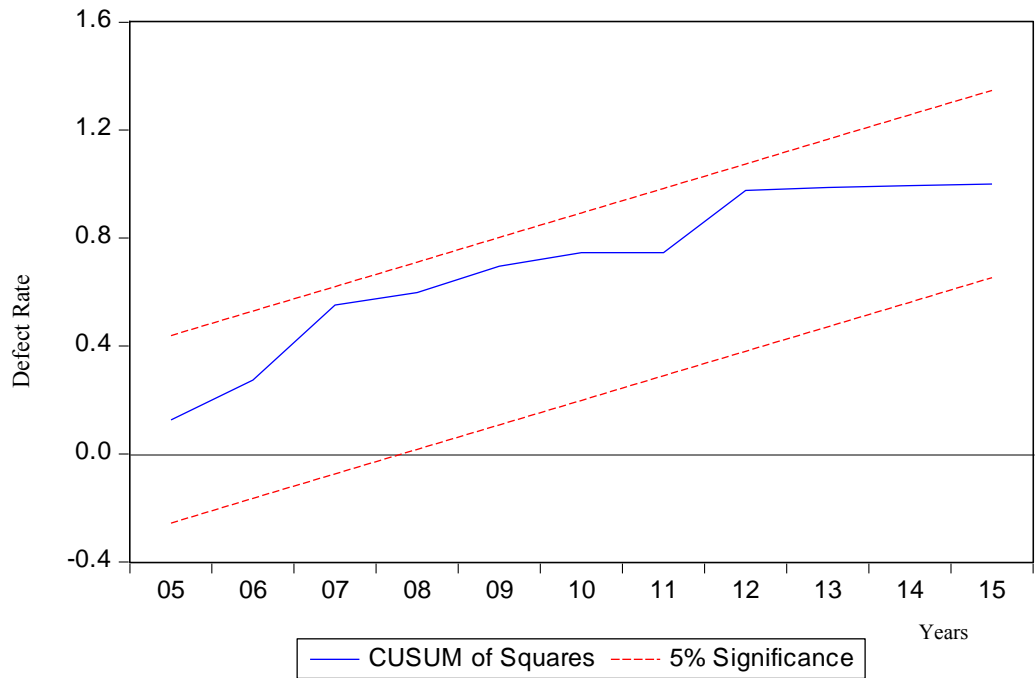


Figure 4. 10
CUSUMSQ for the ERPT to Inflation Model, Nigeria

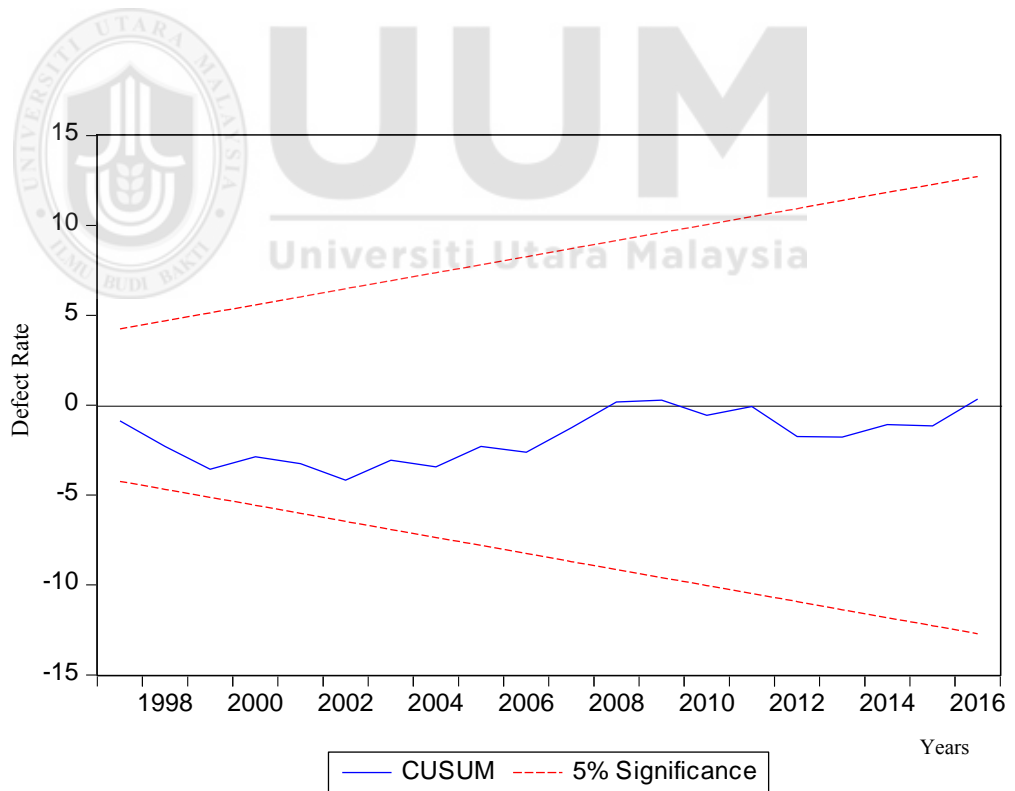


Figure 4. 11
CUSUM for the ERPT to Inflation Model, Ghana

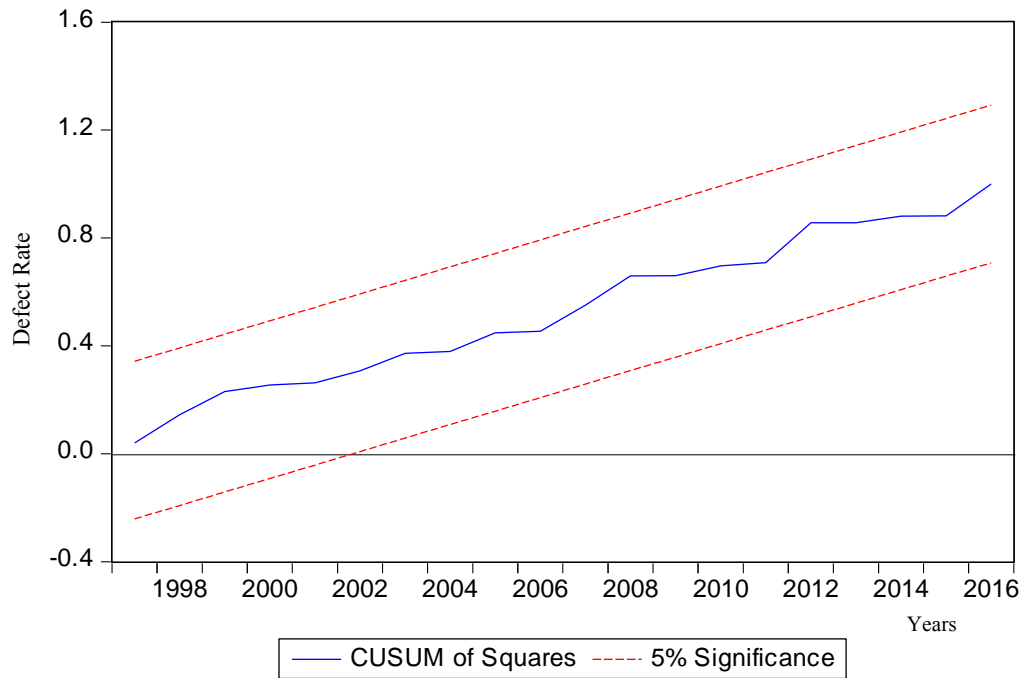


Figure 4. 12
CUSUMSQ for the ERPT to Inflation Model, Ghana

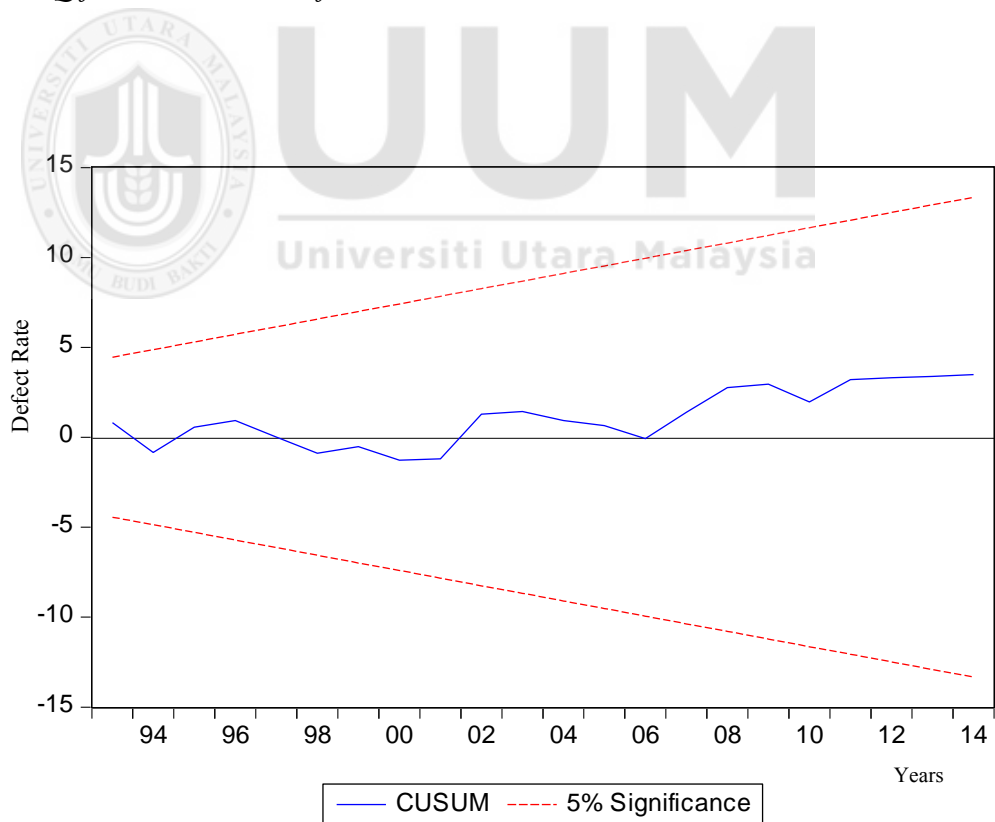


Figure 4. 13
CUSUM for the ERPT to Inflation Model, the Gambia

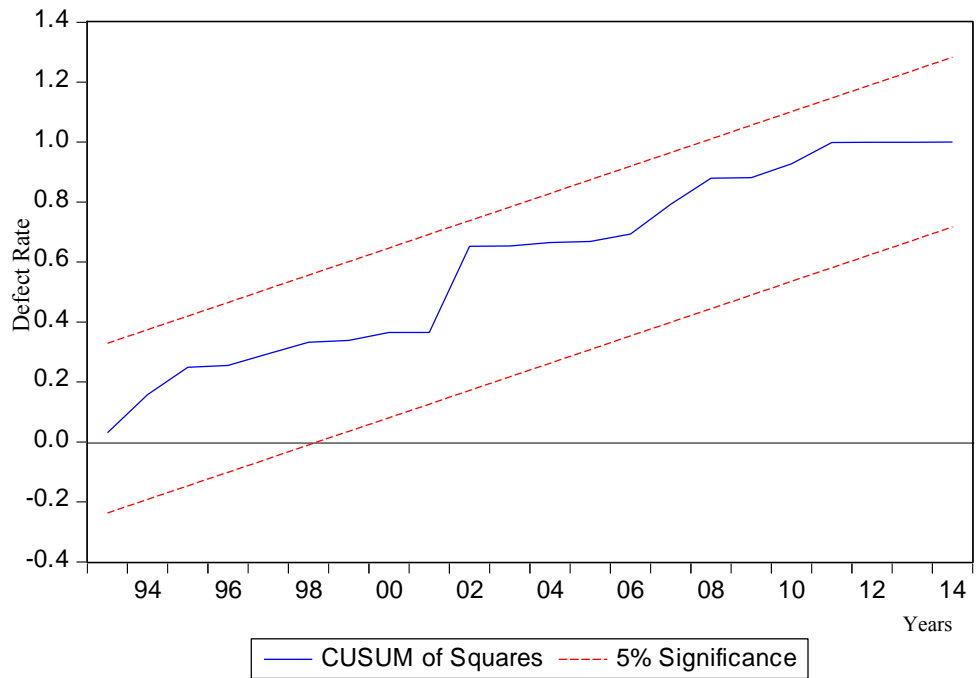


Figure 4. 14
CUSUMSQ for the ERPT to Inflation Model, the Gambia

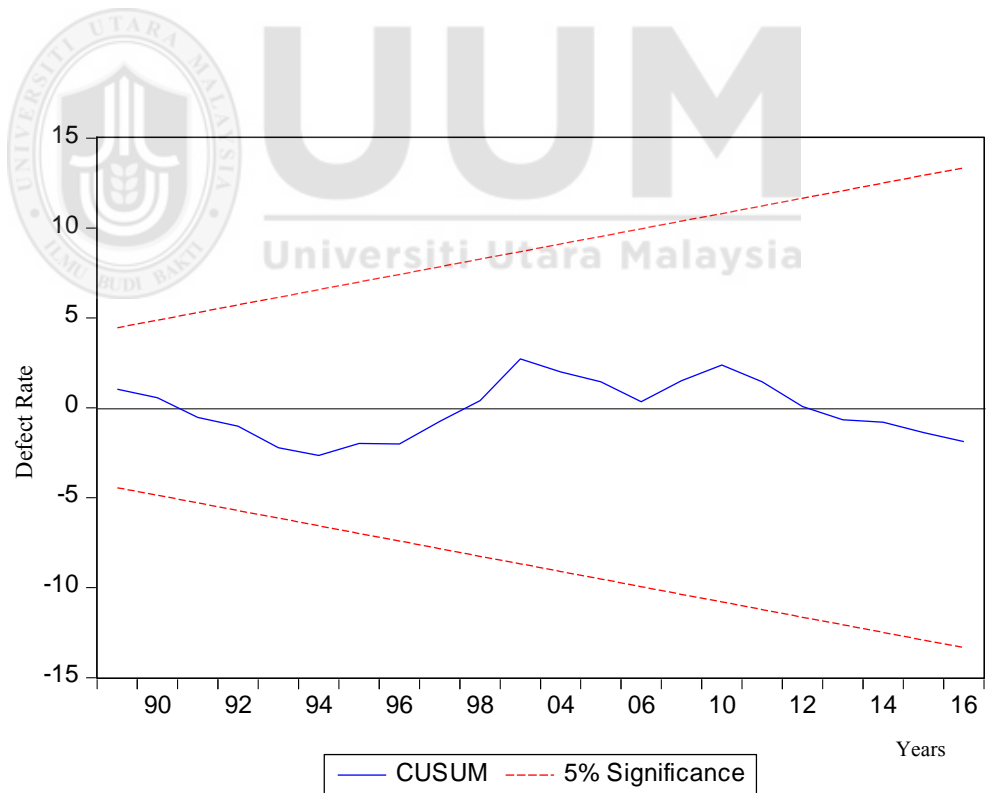


Figure 4. 15
CUSUM for the ERPT to Inflation Model, Sierra Leone

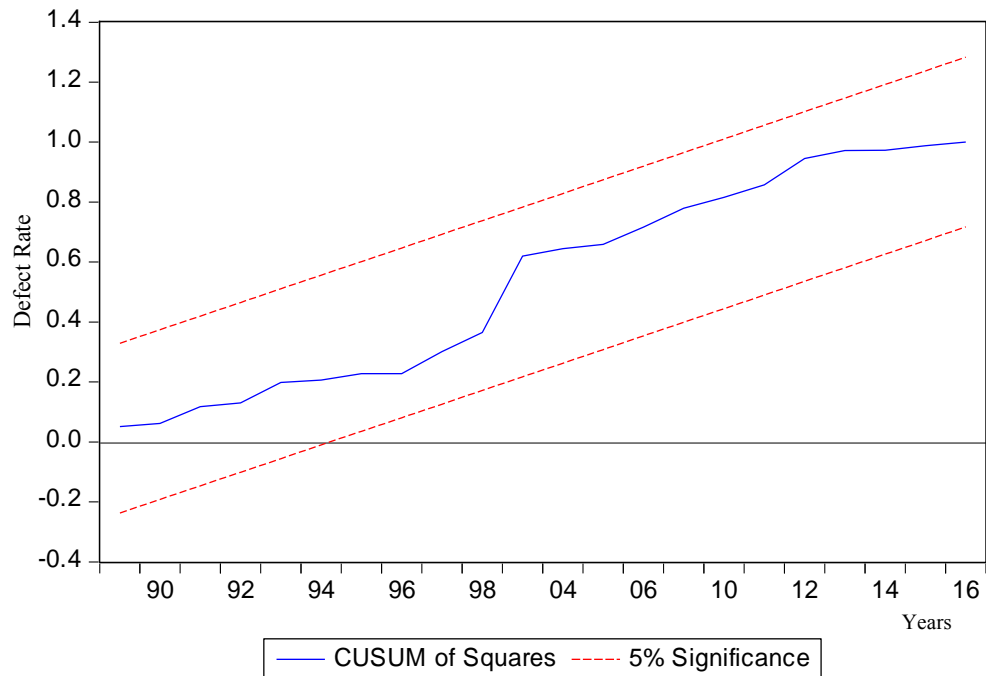


Figure 4. 16
CUSUMSQ for the ERPT to Inflation Model, Sierra Leone

4.4.5 General Modeling of the Exchange Rate Pass-Through to Inflation

Given the selected lag lengths and the confirmation that the estimated *ERPT* models are optimal, this section presents the general modeling of the ARDL for the *ERPT* of WACCs, and the result is presented in Table 4.17. The result is subsequently used for bound test for cointegration to ascertain the existence of a long-run relationship among the variables of the model, which is the main reason behind the general modeling estimation.

Table 4. 17

General Modelling of the ARDL for ERPT to Inflation of WACCs

Countries: -	Nigeria	Ghana	The Gambia	Sierra Leone
Variables	Coefficient (Probability)	Coefficient (Probability)	Coefficient (Probability)	Coefficient (Probability)
<i>LINF(-1)</i>	0.84 (0.00)***	0.14 (0.36)	-0.19 (0.25)	0.23 (0.03)**
<i>LINF(-2)</i>	-0.37 (0.09)*	--	0.40 (0.01)**	--
<i>LINF(-3)</i>	0.34 (0.16)	--	--	--
<i>LINF(-4)</i>	0.01 (0.97)	--	--	--
<i>LINF(-5)</i>	-0.20 (0.25)	--	--	--
<i>LINF(-6)</i>	-0.47 (0.01)**	--	--	--
<i>CLEXC</i>	0.11 (0.82)	1.59 (0.00)***	2.92 (0.00)***	1.77 (0.00)***
<i>CLEXC(-1)</i>	1.77 (0.00)***	-0.52 (0.08)*	1.93 (0.03)**	--
<i>CLEXC(-2)</i>	1.91 (0.00)***	--	--	--
<i>LBRAG</i>	-0.03 (0.87)	-0.98 (0.29)	0.21 (0.18)	-0.80 (0.10)
<i>LBRAG(-1)</i>	--	2.70 (0.03)**	--	0.65 (0.17)
<i>LBRAG(-2)</i>	--	-1.73 (0.05)*	--	--
<i>LGDP</i>	-0.33 (0.54)	0.12 (0.81)	0.10 (0.89)	-1.44 (0.00)***
<i>LGDP(-1)</i>	-0.56 (0.36)	-1.12 (0.05)*	-0.26 (0.76)	--
<i>LGDP(-2)</i>	1.09 (0.02)**	--	-1.30 (0.08)*	--
<i>LTB</i>	-0.66 (0.12)	0.15 (0.81)	-3.13 (0.03)**	0.54 (0.00)***
<i>LTB(-1)</i>	-1.33 (0.00)***	1.12 (0.11)	2.43 (0.07)*	--
<i>LTB(-2)</i>	-1.35 (0.00)***	-1.35 (0.07)*	--	--
<i>LGOV</i>	-0.51 (0.23)	0.14 (0.73)	0.37 (0.40)	1.48 (0.00)***
<i>LGOV(-1)</i>	0.64 (0.13)	0.07 (0.88)	--	--
<i>LGOV(-2)</i>	-1.19 (0.01)**	0.70 (0.03)**	--	--
<i>C</i>	-0.96 (0.83)	6.76 (0.07)*	13.80 (0.09)*	8.666 (0.00)***
R ²	0.93	0.81	0.85	0.96
Adjusted R ²	0.81	0.67	0.75	0.94

Note: '***' '**' '*' implies significant at one, five and ten percent, respectively.

Figures in the parenthesis represent probability

4.4.6 The Bound Test for Co-integration

The results presented in Table 4.18 are for Bound tests conducted on the *ERPT* to inflation models. The results indicated that there exist long-run relationships among the variables in all the countries.

Table 4. 18
Results of Bound Tests for Co-integration of the ERPT to Inflation Model

Country	Variables	F-stat	K	Sig. Level	Critical Values	
					I(0)	I(1)
Nigeria	$F_{INF}[INF/CEXC, BRAG, GDP, TB, GOV]$	5.68***	5	10%	2.26	3.35
	$F_{CEXC}[CEXC/ BRAG, GDP, TB, GOV, INF]$	6.23***	5	5%	2.62	3.79
	$F_{BRAG}[BRAG/CEXC, GDP, TB, GOV, INF]$	9.97***	5	2.5%	2.96	4.18
	$F_{GDP}[GDP/CEXC, BRAG, TB, GOV, INF]$	6.02***	5	1%	3.41	4.68
	$F_{TB}[TB/CEXC, BRAG, GDP, GOV, INF]$	10.13***	5			
	$F_{GOV}[GOV/CEXC, BRAG, GDP, TB, INF]$	5.27***	5			
Ghana	$F_{INF}[INF/CEXC, BRAG, GDP, TB, GOV]$	9.83***	5	10%	2.26	3.35
	$F_{CEXC}[CEXC/ BRAG, GDP, TB, GOV, INF]$	9.82***	5	5%	2.62	3.79
	$F_{BRAG}[BRAG/CEXC, GDP, TB, GOV, INF]$	4.38**	5	2.5%	2.96	4.18
	$F_{GDP}[GDP/CEXC, BRAG, TB, GOV, INF]$	1.15	5	1%	3.41	4.68
	$F_{TB}[TB/CEXC, BRAG, GDP, GOV, INF]$	6.80***	5			
	$F_{GOV}[GOV/CEXC, BRAG, GDP, TB, INF]$	2.62	5			
The Gambia	$F_{INF}[INF/CEXC, BRAG, GDP, TB, GOV]$	6.39***	5	10%	2.26	3.35
	$F_{CEXC}[CEXC/ BRAG, GDP, TB, GOV, INF]$	5.62***	5	5%	2.62	3.79
	$F_{BRAG}[BRAG/CEXC, GDP, TB, GOV, INF]$	0.47	5	2.5%	2.96	4.18
	$F_{GDP}[GDP/CEXC, BRAG, TB, GOV, INF]$	0.57	5	1%	3.41	4.68
	$F_{TB}[TB/CEXC, BRAG, GDP, GOV, INF]$	3.40*	5			
	$F_{GOV}[GOV/CEXC, BRAG, GDP, TB, INF]$	3.50*	5			
Sierra Leone	$F_{INF}[INF/CEXC, BRAG, GDP, TB, GOV]$	5.32***	5	10%	2.26	3.35
	$F_{CEXC}[CEXC/ BRAG, GDP, TB, GOV, INF]$	6.85***	5	5%	2.62	3.79
	$F_{BRAG}[BRAG/CEXC, GDP, TB, GOV, INF]$	6.53***	5	2.5%	2.96	4.18
	$F_{GDP}[GDP/CEXC, BRAG, TB, GOV, INF]$	2.08	5	1%	3.41	4.68
	$F_{TB}[TB/CEXC, BRAG, GDP, GOV, INF]$	2.36	5			
	$F_{GOV}[GOV/CEXC, BRAG, GDP, TB, INF]$	6.64***	5			

Note: '****' '**' '*' implies significant at one, five and ten percent, respectively.
K is the number of independent variables in the model

The results of the Bound tests indicate the existence of a long run relationship in all the country. The *F*-statistics is higher the respective critical values in all the countries. The *F*-statistics values of 5.68 and 9.83 for Nigeria and Ghana, respectively, are higher than the corresponding critical value of I(0) 3.41 and I(1) 4.68 at one percent level. Also, the *F*-statistics values of 6.39 and 5.32 for the

Gambia and Sierra Leone, respectively, are higher than the corresponding critical values of $I(0)$ 3.41 and $I(1)$ 4.68 at one percent level.

4.4.7 The Long Run Estimation Results

The long-run result of the *EPRT* to inflation model is presented in Table 4.19. The table reveals that all coefficients of the exchange rate (*CLEXC*) for all the countries are statistically significant mostly at five percent level of significance in Nigeria, Ghana and the Gambia while that of Sierra Leone it is statistically significant at one percent level. It means that a change in exchange rate is positively affecting inflation in all the countries. For instant, a one percent change in exchange rate causes a 4.43 percent change in the inflation rate in the same direction, in Nigeria. This is in accord with findings of Ogundipe and Samuel (2013) and Usman and Musa (2018) studies from Nigeria.

Similarly, in Ghana, a one percent change in exchange rate leads to a change in the inflation rate, in the same direction, by 1.24 percent. This result is in accord with the findings of Adu and Marbuah (2011) in Ghana and the result of asymmetry, of Amoah and Aziakpono (2018) though, contrary to their findings on non-asymmetry in the same country. Moreover, in the Gambia, a one percent change in exchange rate causes a 6.14 percent change in the inflation rate, in the same direction. This result is similar to that of Mawajje and Lwanga (2016) in Uganda and Jobarteh (2016) in the Gambia. Also, a one percent change in the exchange rate in Sierra Leone, leads to a 2.29 percent change in inflation, in the same direction in the country. This result is in accord with the findings of Campa, Goldberg and

Gonzalez-Minguez (2005) in the Euro area and the finding of Bangura, Caulker and Pessima (2016) in Sierra Leone.

This implies that the exchange rate pass-through to inflation during the long run of WACCs is complete having a coefficient value of more than one (100 percent). The *ERPT* is higher in the Gambia which having the biggest coefficient, followed by Nigeria, then Sierra Leone, Ghana has the least *ERPT* among the WACCs. The completeness of the WACCs *ERPT* to inflation could be as a result of the fact that WACCs and other developing African nations are highly depended on the importation of most of the goods and service for consumptions and daily usage.

Table 4. 19
The ERPT to Inflation Model Long Run Results

Countries: -	Nigeria	Ghana	The Gambia	Sierra Leone
Variables	Coefficient (Probability)	Coefficient (Probability)	Coefficient (Probability)	Coefficient (Probability)
<i>CLEXC</i>	4.43 (0.04)**	1.24 (0.02)**	6.14 (0.01)**	2.29 (0.00)***
<i>LBRAG</i>	-0.03 (0.88)	-0.02 (0.78)	0.26 (0.19)	-0.19 (0.00)***
<i>LGDP</i>	0.23 (0.72)	-1.17 (0.03)**	-1.51 (0.01)**	-1.86 (0.00)***
<i>LTB</i>	-2.35 (0.05)*	-0.09 (0.91)	-0.89 (0.52)	0.70 (0.00)***
<i>LGOV</i>	-0.04 (0.91)	1.05 (0.09)*	0.46 (0.43)	1.92 (0.00)***
<i>C</i>	-1.12 (0.84)	7.84 (0.05)*	17.46 (0.03)**	11.23 (0.00)***

Note: '***' '**' '*' implies significant at one, five and ten percent, respectively.
Figures in the parenthesis represent probability

Furthermore, the money supply is insignificant in all the countries except in Sierra Leone, where, surprisingly, it has a disinflationary effect. Nevertheless, GDP is significant, with an anticipated disinflationary effect, in explaining the change in inflation in all the countries except Nigeria. Whereas, the trade balance is insignificant in explaining the changes in the inflation rate in Ghana and the Gambia

and it is statistically significant in Nigeria and Sierra Leone, but in Nigeria, it has a disinflationary effect while in Sierra Leone it has an inflationary effect. Finally, government expenditure is significant in explaining inflation rate fluctuations in all the countries except in Nigeria.

The findings of the study are also in accord with the theoretical arguments of *ERPT* theory, as the theory postulated that rise in general prices, especially, in developing countries is majorly caused by the excessive devaluation of local currencies in such countries. That is to say, an increase in exchange rate (devaluation of local currencies in WACCs) depreciates their legal tender and leads to the increase in prices of imported goods and more pressure of the demand of the locally produced goods, consequent to increase in the general prices of goods and services (inflation).

4.4.8 The Short Run Estimation Results

The short-run result of the *EPRT* to inflation model is presented in Table 4.20. The table reveals that during the short run, the coefficients of the *CLEXC* are statistically significant at one percent level, in all the countries except Nigeria, where the coefficient is statistically insignificant. It means that the exchange rate is positively affecting the inflation rate in Ghana, the Gambia, and Sierra Leone, whereas, it has no significant effect in Nigeria. For instant, a one percent increase in exchange in Ghana during the short run, leads to a 1.59 percent change in the inflation rate, in the same direction. Similarly, a one percent change in the exchange rate in the Gambia and Sierra Leone results in a 2.92 and 1.77 percent change in their inflation rate, respectively, in the same direction.

The result also reveals that the speeds of adjustments towards long-run equilibrium (ECT) are statistically significant in all the countries. The *ECT* is significant at five percent in Nigeria, and it is significant at one percent in the rest of the countries. It means that the speed at which short-run changes or adjust toward long-run equilibriums are 86 percent, for Nigeria and Ghana, and 79 percent and 77 percent for the Gambia, and Sierra Leone, respectively. The speeds of adjustments, towards the long-run equilibriums in all the countries, are relatively fast. It is faster in Nigeria and Ghana, followed by the Gambia, then Sierra Leone.

Table 4. 20
Short run Results of the ERPT to Inflation Estimations

Countries: -	Nigeria	Ghana	The Gambia	Sierra Leone
Variables	Coefficient (Probability)	Coefficient (Probability)	Coefficient (Probability)	Coefficient (Probability)
<i>D(LINF(-1))</i>	0.69 (0.01)**	--	-0.40 (0.01)**	--
<i>D(LINF(-2))</i>	0.33 (0.24)	--	--	--
<i>D(LINF(-3))</i>	0.67 (0.03)**	--	--	--
<i>D(LINF(-4))</i>	0.68 (0.01)**	--	--	--
<i>D(LINF(-5))</i>	0.47 (0.01)**	--	--	--
<i>D(CLEXC)</i>	0.11 (0.82)	1.59 (0.00)***	2.92 (0.00)***	1.77 (0.00)***
<i>D(CLEXC(-1))</i>	-1.91 (0.00)***	--	--	--
<i>D(LBRAG)</i>	-0.03 (0.88)	-0.98 (0.29)	0.21 (0.18)	-0.80 (0.10)
<i>D(LBRAG(-1))</i>	--	1.73 (0.05)*	--	--
<i>D(LGDP)</i>	-0.33 (0.54)	0.12 (0.81)	0.10 (0.89)	-1.44 (0.00)***
<i>D(LGDP(-1))</i>	-1.09 (0.02)**	--	1.21 (0.10)	--
<i>D(LTB)</i>	-0.66 (0.12)	0.15 (0.81)	-3.13 (0.03)**	0.54 (0.00)***
<i>D(LTB(-1))</i>	--	1.35 (0.07)*	--	--
<i>D(LGOV)</i>	0.51 (0.23)	0.14 (0.73)	0.37 (0.40)	1.48 (0.00)***
<i>D(LGOV(-1))</i>	1.19 (0.01)**	-0.70 (0.03)**	--	--
<i>ECT(-1)</i>	-0.86 (0.01)**	-0.86 (0.00)***	-0.79 (0.00)***	-0.77 (0.00)***

Note: '***' '**' '*' implies significant at one, five and ten percent, respectively.
Figures in the parenthesis represent probability

4.4.9 Robustness of the Estimated ERPT Models

In order to check for the robustness of the estimated models, the controlled variables are dropped, and the models are re-estimated using only the dependent variable which is inflation rate (*LINF*) and the concerned variable the change in exchange rate (*CLEXC*) using the same method of analysis ARDL. This is because the dependent variable *-LINF* is stationary at first difference while the independent variable *-CLEXC* is stationary at level. The result is presented in Table 4.21, which reveals similarities and confirms the findings of the previous estimations. Just like the previous results, it shows the existence of *ERPT* to inflation in all the countries during the long-run with the Gambia having the highest *ERPT* followed by Nigeria, then Sierra Leone and Ghana has the lest *ERPT*. It is only the size or magnitude of the *ERPT* that differs from the previous models.

Table 4. 21
Robust Estimation of the ERPT Models

Variable/Countries	Nigeria: Coefficients	Ghana: Coefficients	The Gambia: Coefficients	Sierra Leone: Coefficients
Short Run				
D(LINF(-1))	--	--	-0.46 (0.00)***	--
D(CLEXC)	-0.04 (0.90)	1.27 (0.00)***	2.60 (0.00)***	1.40 (0.00)***
D(CLEXC(-1))	-0.96 (0.01)**	--	--	--
D(@TREND)	--	--	--	-0.03 (0.00)***
CointEq(-1)	-0.50 (0.00)***	-0.68 (0.00)***	-0.42 (0.00)***	-0.72 (0.00)***
Long Run				
CLEXC	2.32 (0.07)*	1.03 (0.02)**	11.40 (0.00)***	1.94 (0.00)***
C	2.33 (0.00)***	2.70 (0.00)***	0.82 (0.04)**	3.54 (0.00)***
@TREND	--	--	--	-0.05 (0.00)***

Note: '***' '**' '*' implies significant at one, five and ten percent, respectively.
Figures in the parenthesis represent probability

Similarly, from the upper part of the same table, the short-run results indicate replica findings with that of the previous estimation as there is no evidence of ERPT in Nigeria while complete, positive and significant *ERPT exist* in the rest of the countries.

4.5 Analysis of Inflation Persistence

This section presents the result of the univariate analysis of inflation persistence, which is the second objective of the research. The section starts with a unit root test follows by the model lag selection, then model estimation, and the section is closed by the model postestimation diagnostic checking.

4.5.1 Unit Root Tests Results

The result of inflation ADF unit root test presented in Table 4.22 indicates that the variable is stationary at level in all the countries, with the value of τ -Statistics approximately -3.89 for Nigeria, -4.01 for Ghana, -2.64 for the Gambia, and -2.94 for Sierra Leone. The rate of inflation in Nigeria and Ghana are stationary at one percent level of significance while the rates are stationary at a ten percent level of significance in the Gambia and Sierra Leone.

Table 4. 22
The Unit Root Test Result for Univariate Analysis

Test Type: Augmented Dickey-Fuller (ADF), Variable: Inflation Rate			
Countries	τ -Statistics	Probability	Status
Nigeria	-3.89	0.00***	Stationary at Level
Ghana	-4.01	0.00***	Stationary at Level
The Gambia	-2.64	0.09*	Stationary at Level
Sierra Leone	-2.94	0.05*	Stationary at Level

Note: ‘*’ ‘**’ ‘***’ implies significant at one, five and ten percent, respectively.

4.5.2 The Model Optimal Lag Length Selection

The lag selection criteria unanimously chose the second lag to measure the persistence of inflation in WACCs. The result of the lag selection is presented in Table 4.23 for Nigeria, Table 4.24 for Ghana, Table 4.25 and Table 4.26 for the Gambia, and Sierra Leone, respectively.

Table 4.23 shows that both AIC, SC, and HQ unanimously chose the second lags for estimating inflation persistence in Nigeria, whereas, Table 4.24 indicates that all the lag selection criteria have unanimously chosen one lag for the estimation of inflation persistence in Ghana. On the other hand, Table 4.25 point out that three lags are optimal for estimating the inflation persistence in the Gambia, and lastly, Table 4.26 highlights that one lag is chosen by all the three criteria for the estimation of inflation persistence in Sierra Leone.

Table 4. 23
Nigerian Inflation Persistence Lag Selection

Lag	AIC	SC	HQ
0	0.45	0.49	0.47
1	0.18	0.26	0.21
2	0.12*	0.24*	0.17*
3	0.16	0.32	0.22

Note: ‘*’ indicates the selected lag length.

Table 4. 24
Ghanaian Inflation Persistence Lag Selection

Lag	AIC	SC	HQ
0	0.49	0.53	0.51
1	0.15*	0.23*	0.18*
2	0.17	0.29	0.22
3	0.21	0.38	0.27

Note: ‘*’ indicates the selected lag length.

Table 4. 25

The Gambian Inflation Persistence Lag Selection

Lag	AIC	SC	HQ
0	0.86	0.90	0.88
1	0.47	0.55	0.50
2	0.41	0.54	0.46
3	0.37*	0.53*	0.43*

Note: ‘*’ indicates the selected lag length.

Table 4. 26

Sierra Leone’s Inflation Persistence Lag Selection

Lag	AIC	SC	HQ
0	1.60	1.64	1.61
1	1.00*	1.08*	1.03*
2	1.03	1.16	1.08
3	1.08	1.24	1.14

Note: ‘*’ indicates the selected lag length.

4.5.3 Estimated Models of the Inflation Persistence

The results of inflation persistence estimations are presented in Table 4.27. The table indicates that in all the countries, one-year lag inflation rates have a positive and significant effect on the current rate inflation. It means that the one-year lag inflation rate or a positive shock last year has a positive effect in the current year in all the countries. For instant, one percent change in inflation rate last year lead to 0.63 percent change in the current rate of inflation in the same direction in Nigeria while it leads to 0.55 percent, 0.49 percent, and 0.68 percent change in the current rate of inflation, in the same direction in Ghana, the Gambia and Sierra Leone, respectively.

Furthermore, one percent change in the inflation rate two years ago has a significant effect of causing changes in the current rate of inflation; by 0.43 percent in the same direction in the Gambia and by 0.29 percent in an inverse direction in Nigeria. Finally, one percent change in the rate of inflation, after three years, has a significant effect in affecting the current rate of inflation to change in an inverse direction by 0.27 percent in the Gambia.

While in terms of the severity of magnitude of the inflation persistence, Fuhrer (2011) perceived that inflation persistence is high once the coefficient is above 0.40 percent and above. On the basis of this, it can be said that high inflation persistence is associated with a one-year lag inflation rate in all the countries and two years lag inflation rate in the Gambia alone. Taking into cognizance, only the first year it can be said that Sierra Leone has the highest inflation persistence with the largest coefficient (0.68), followed Nigeria and Ghana (0.63 and 0.55), respectively, the least is the Gambia (0.49). Meanwhile, Gambia has high inflation persistence for two consecutive years (the first-year which is 0.49, and the second-year which 0.43) which makes the country having the highest inflation persistence when the consequences are sum up together. The high inflation persistence of WACCs could be as a result of high inflation expectations, due to experience from inflation of the previous years, on inflation of the current years.

This result corresponds to the findings of Ahmad and Staveley-O'Carrol (2017) on inflation persistence in developing economies which is above 0.40 percent for developing countries but not their findings on developed economies which is below 0.40 percent. It is also in accord with the findings of Coleman (2010) on inflation persistence in WAFCs, which is also high (above 0.40 percent). It also corresponds to the findings of Giannellis and Kouritakis (2013) on high inflation persistence in Latin America during currency devaluation periods

Table 4. 27

Results of Inflation Persistence Estimations

Countries	Variable	Coefficient	St error	t-stat	Prob
Nigeria	INFL _{t-1}	0.63***	0.15	4.25	0.00
	INFL _{t-2}	-0.29*	0.15	-1.93	0.06
	C	0.76***	0.18	4.28	0.00
Ghana	INFL _{t-1}	0.55***	0.11	4.98	0.00
	C	0.62***	0.15	4.00	0.00
The Gambia	INFL _{t-1}	0.49***	0.15	3.32	0.00
	INFL _{t-2}	0.43**	0.15	2.80	0.01
	INFL _{t-3}	-0.27*	0.14	-1.98	0.06
	C	0.29**	0.12	2.45	0.02
S. Leone	INFL _{t-1}	0.68***	0.11	6.12	0.00
	C	0.38*	0.14	2.69	0.01

Note: ‘*’ ‘**’ ‘***’ implies significant at one, five and ten percent, respectively.

4.5.4 Diagnostic Checking

Table 4.28 presents the postestimation diagnostic checks of the inflation persistence estimation of WACCs. The table indicates the absence of the problem of heteroskedasticity; it shows that error terms of the estimated models are normally distributed and there is no serial correlation in the estimated models having the values of probability of more than five percent on each of the tests conducted in all the models across countries.

Table 4. 28

Diagnostic Check for Inflation Persistence Models

Countries	Normality:	Serial Correlation:		Heteroskedasticity:
	Jarque-Bera	Breusch-Pagan Multiplier	Lagrange	ARCH Effect
Nigeria	0.06	0.39	0.78	0.00
	(0.97)	(0.68)	(0.38)	(0.97)
Ghana	2.77	0.29	0.58	1.18
	(0.25)	(0.75)	(0.45)	(0.28)
The Gambia	0.60	0.21	0.20	0.06
	(0.74)	(0.81)	(0.66)	(0.80)
Sierra Leone	2.77	0.69	1.23	0.08
	(0.25)	(0.51)	(0.27)	(0.77)

Note: Figures in the parenthesis represent probability

Similarly, the estimated models are dynamically stable as indicated by either CUSUM or CUSUM of Squares, as the estimated models lie between the upper and lower ridge line, as shown in Figure 4.17 to Figure 4.24.

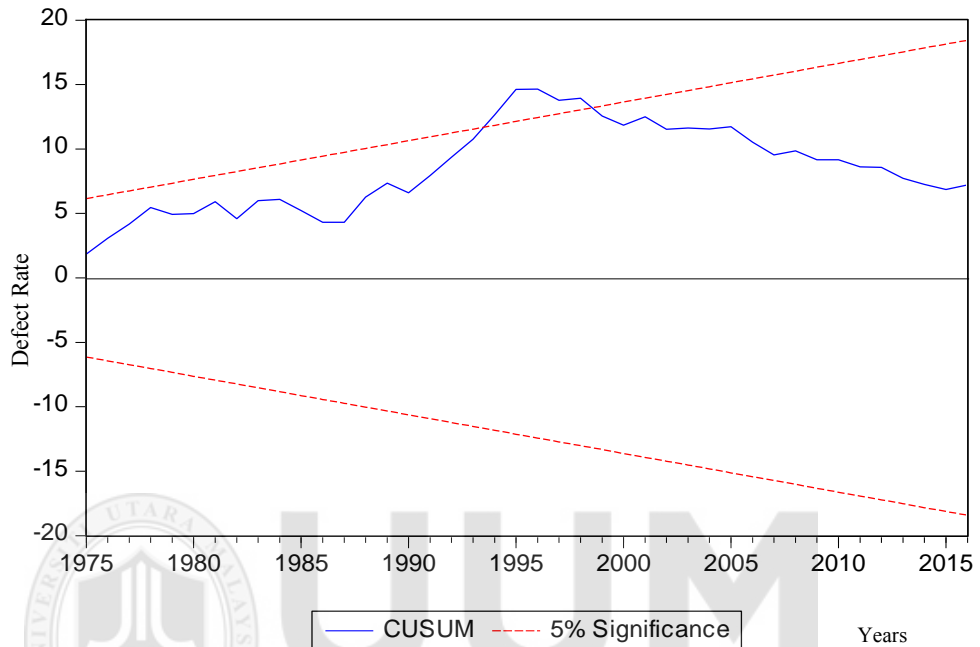


Figure 4. 17
CUSUM Stability Indicators for Nigerian Inflation Persistence Model

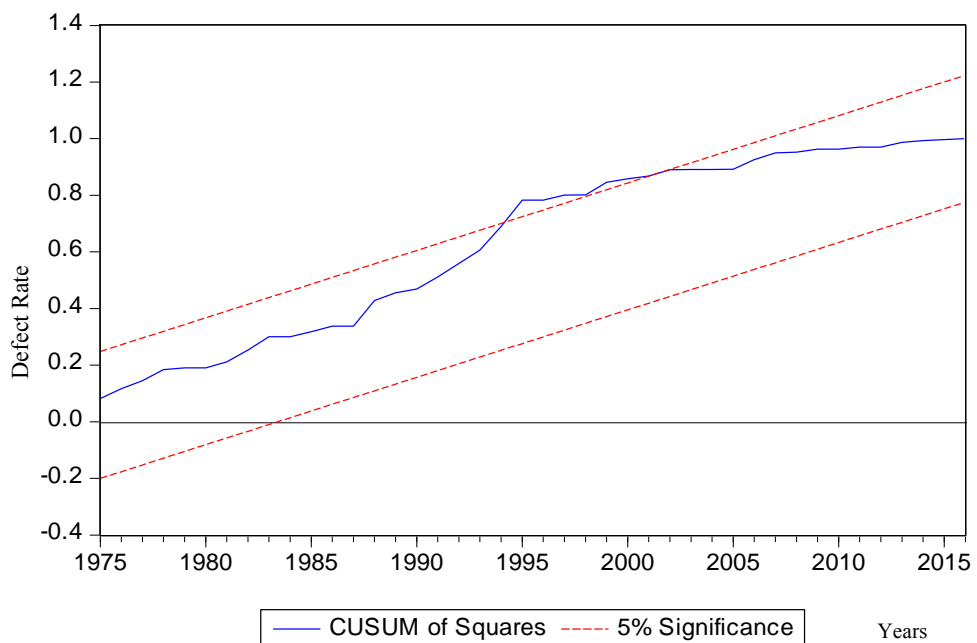


Figure 4. 18
CUSUMSQ Stability Indicators for Nigerian Inflation Persistence Model

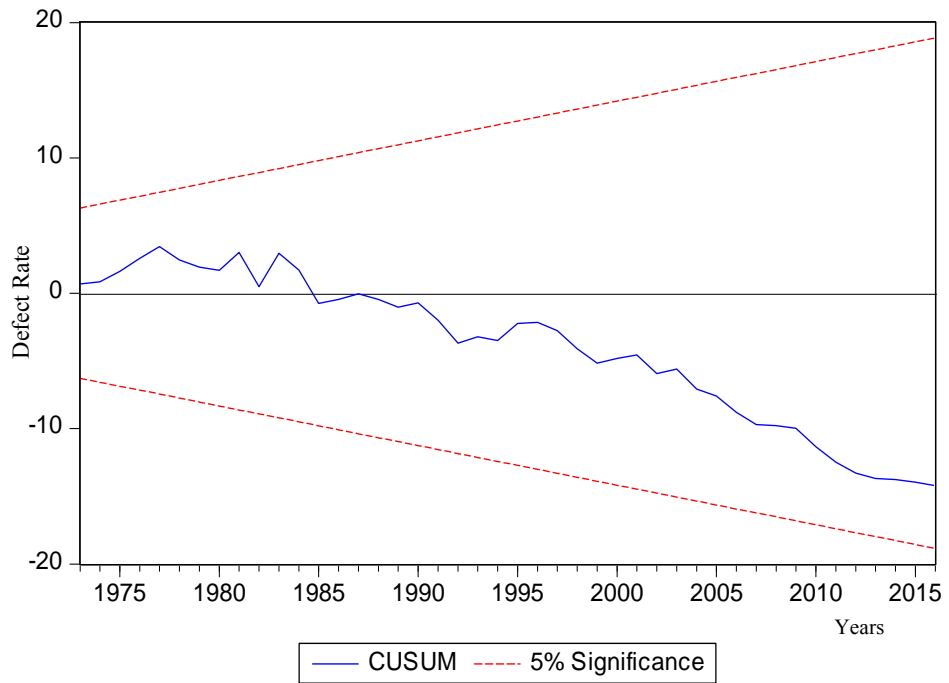


Figure 4. 19
CUSUM Stability Indicators for Ghanaian Inflation Persistence Model

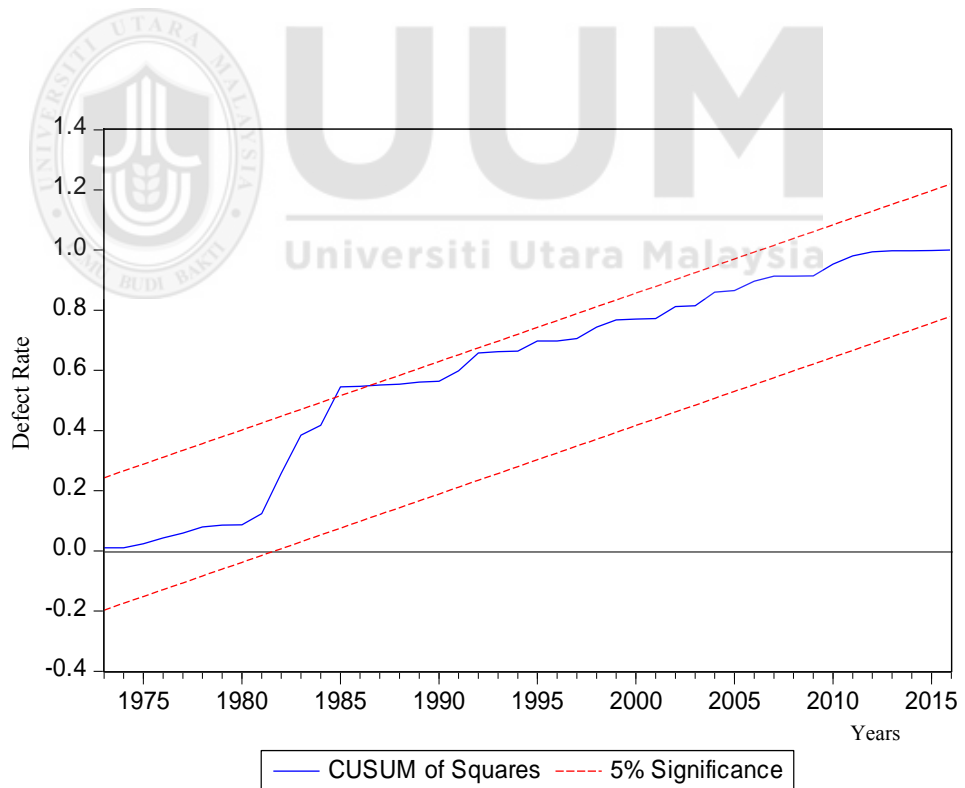


Figure 4. 20
CUSUMS of Squares Stability Indicators for Ghanaian Inflation Persistence Model

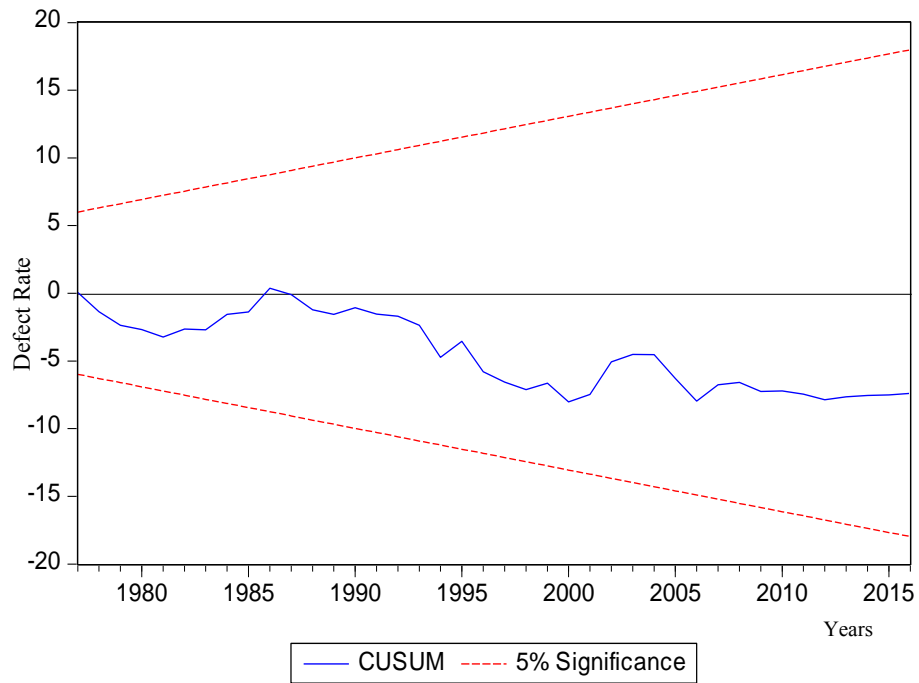


Figure 4. 21
CUSUM Stability Indicators for the Gambian Inflation Persistence Model

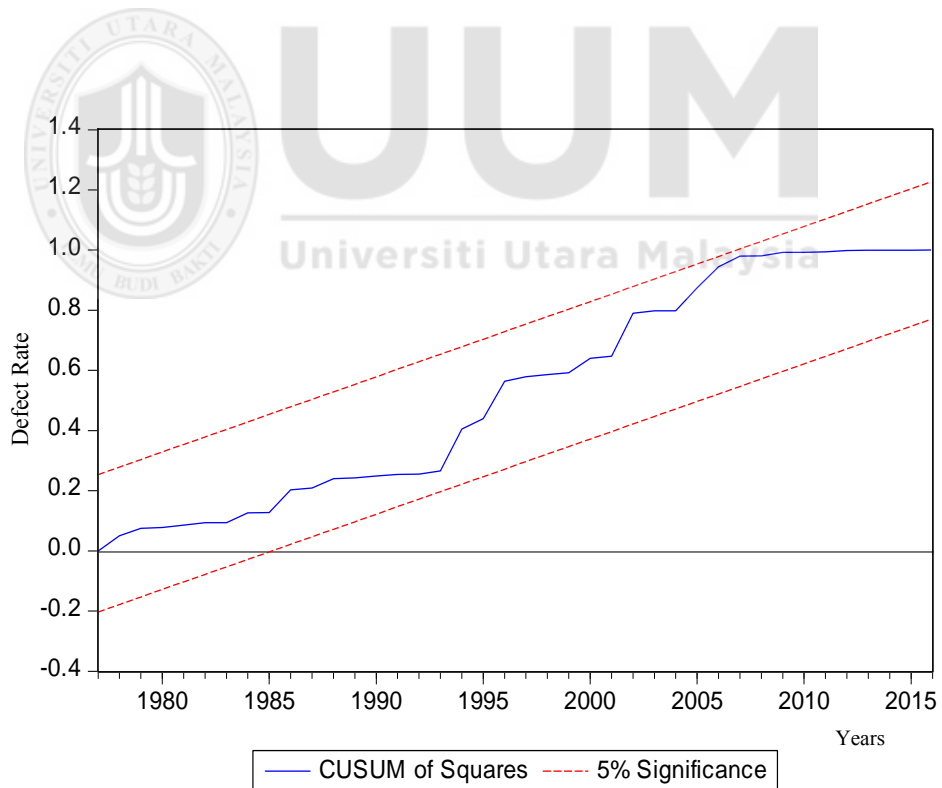


Figure 4. 22
CUSUMS of Squares Stability Indicators for the Gambian Inflation Persistence Model

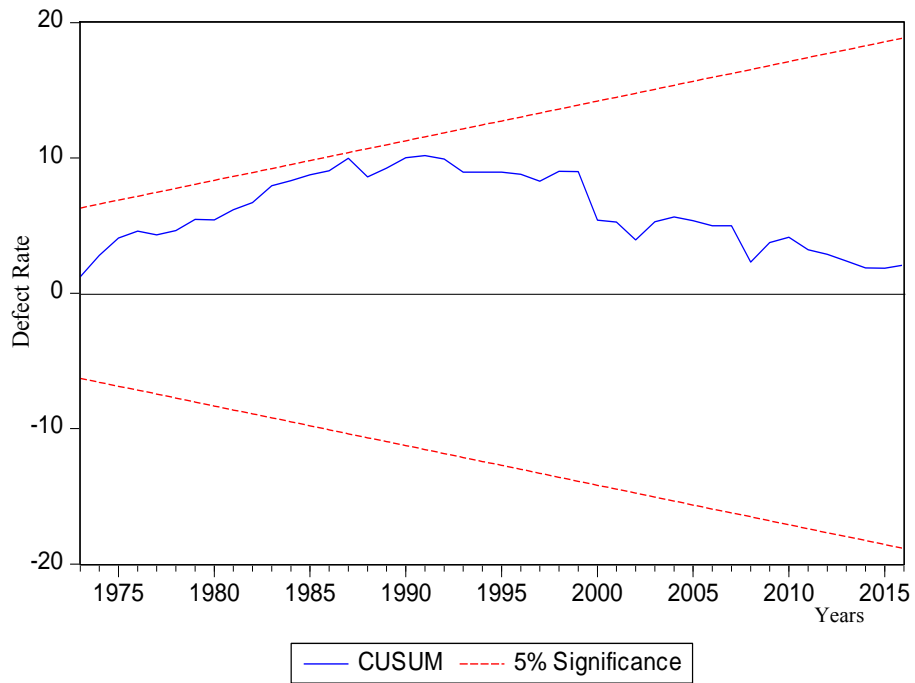


Figure 4. 23
CUSUM Stability Indicators for Sierra Leone Inflation Persistence Model

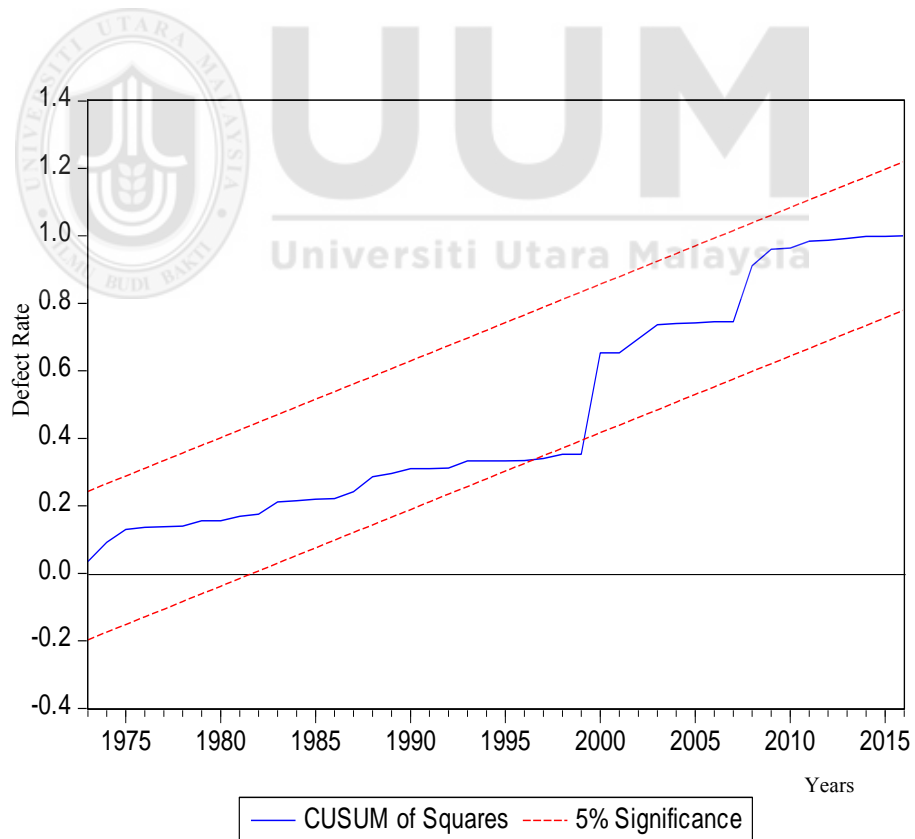


Figure 4. 24
CUSUMSQ Stability Indicators for Sierra Leone Inflation Persistence Model

Finally, the error terms, of the estimated models, are normally distributed with a probability of more than five percent on Jarque-Bera statistics which makes them white-noise, as indicated in Figure 4.25 to Figure 4.28;

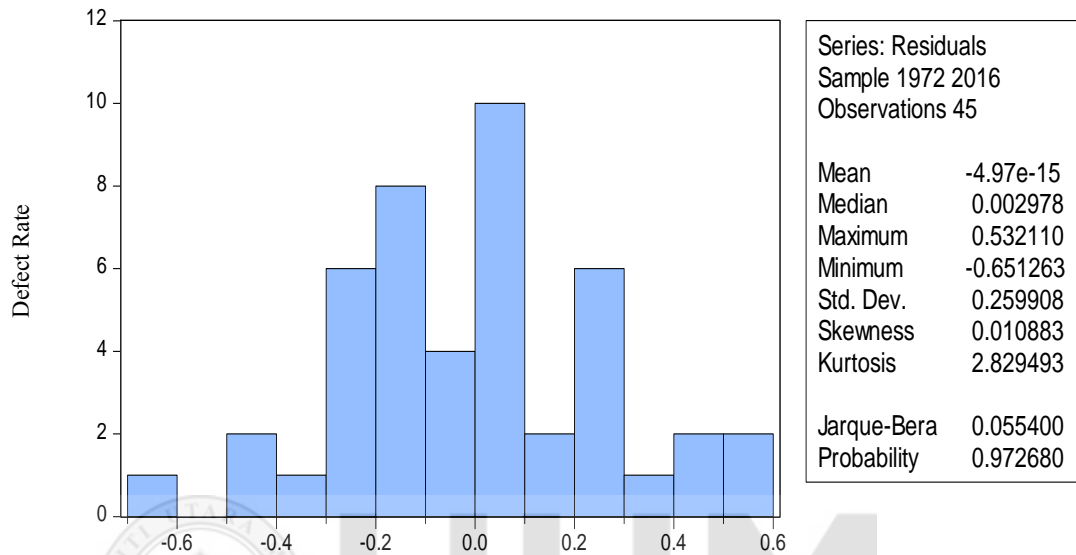


Figure 4. 25
Inflation Persistence Model Error Term's Normality for Nigeria

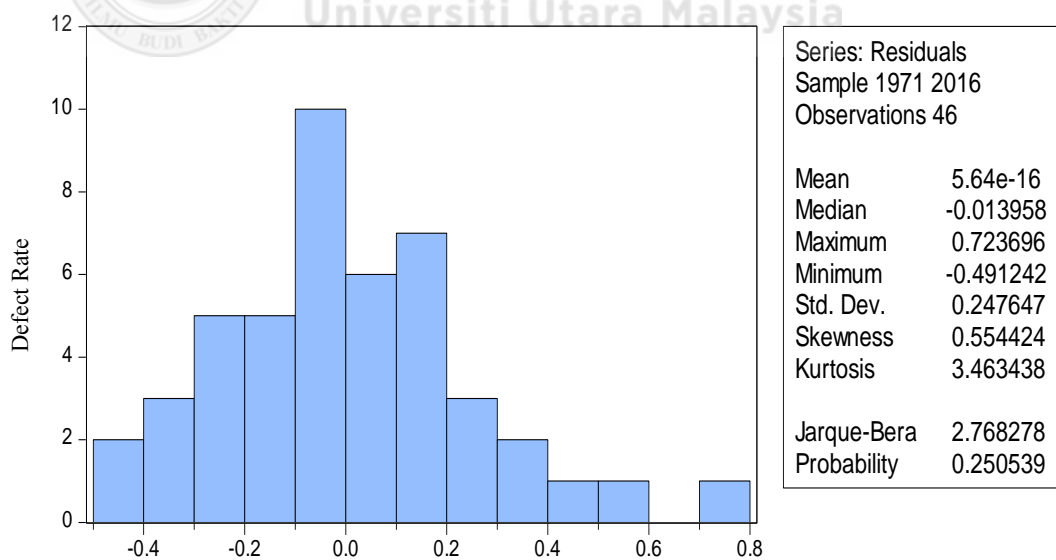


Figure 4. 26
Inflation Persistence Model Error Term's Normality for Ghana

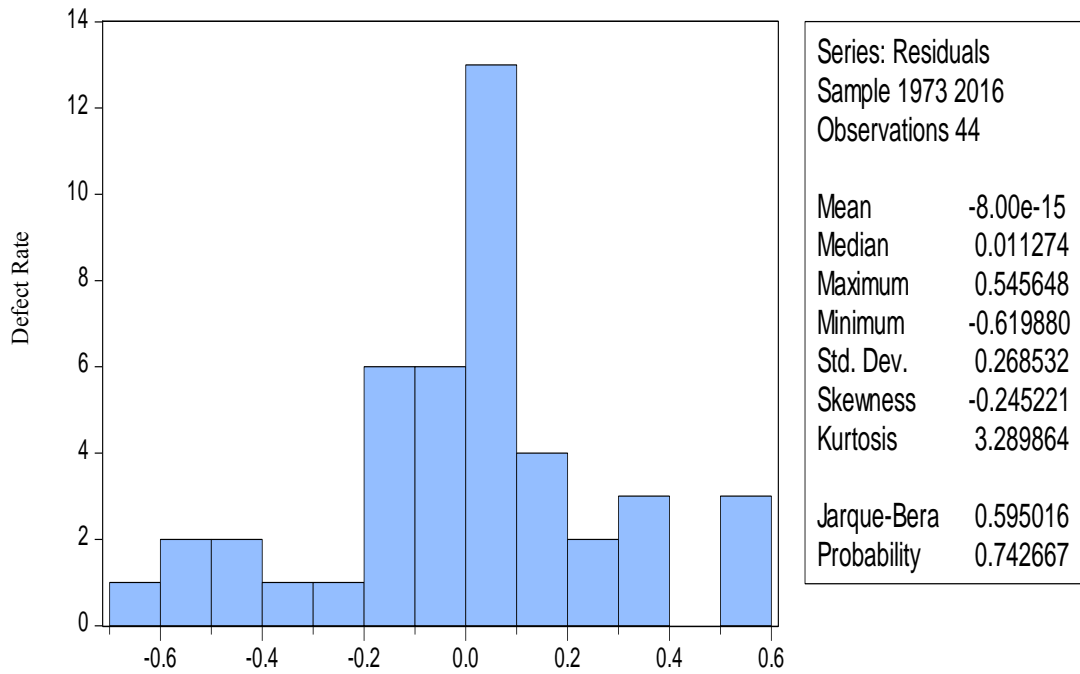


Figure 4. 27
Inflation Persistence Model Error Term's Normality for the Gambia

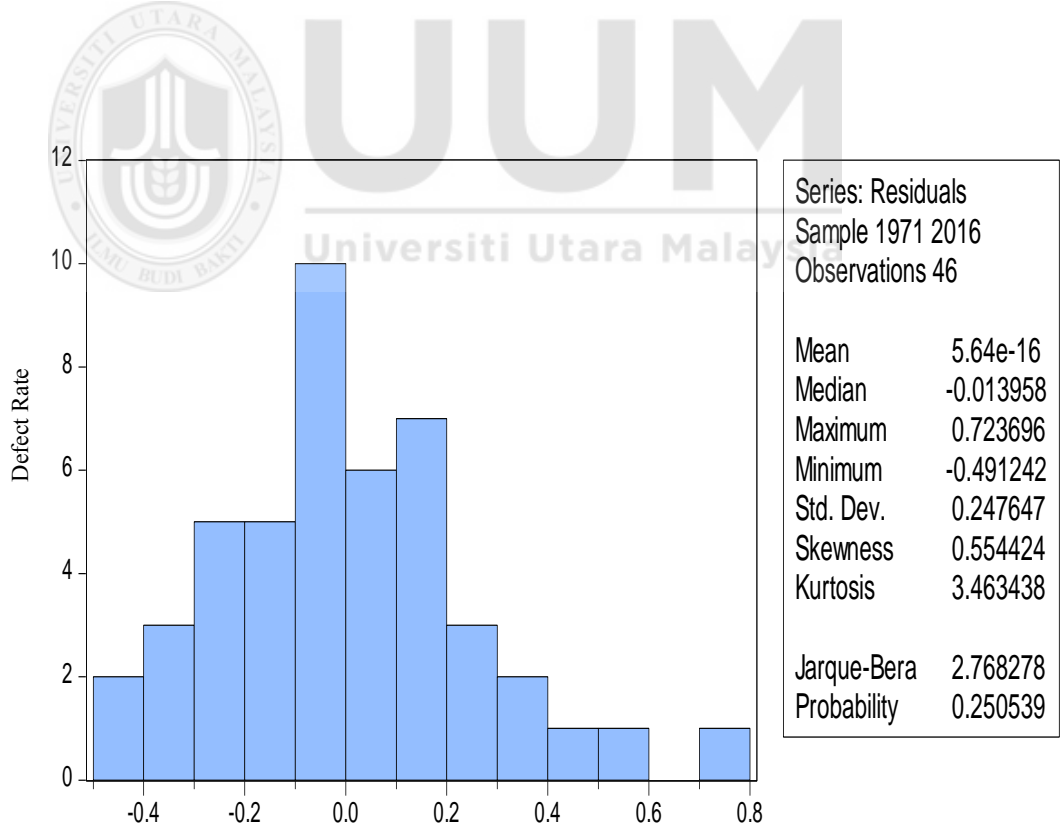


Figure 4. 28
Inflation Persistence Model Error Term's Normality for Sierra Leone

4.5.5 Robustness of the Inflation Persistence Models

To check and established the robustness of the inflation persistence models, it has being re-estimated using ordinary least squares (OLS), and it gives a replica results with that of AR estimation as presented in Table 4.29 having the same explanation with that of the estimated AR model.

Table 4. 29

Results of Robust Inflation Persistence Estimations

Countries	Variable	Coefficient	St error	t-stat	Prob
Nigeria	INFL _{t-1}	0.629***	0.148	4.245	0.000
	INFL _{t-2}	-0.287*	0.149	-1.930	0.060
	C	0.759***	0.177	4.288	0.000
Ghana	INFL _{t-1}	0.553***	0.111	4.978	0.000
	C	0.619***	0.155	4.003	0.000
The Gambia	INFL _{t-1}	0.486***	0.146	3.324	0.002
	INFL _{t-2}	0.434**	0.155	2.804	0.008
	INFL _{t-3}	-0.274*	0.138	-1.977	0.055
	C	0.291**	0.119	2.449	0.019
S. Leone	INFL _{t-1}	0.676***	0.110	6.125	0.000
	C	0.382*	0.142	2.694	0.010

Note: '****' '***' '*' implies significant at one, five and ten percent, respectively.

4.6 Estimations of Threshold Inflation Rate of WACCs

This section presents the result obtained on the threshold inflation rate of WACCs, which is the third and the final objective of the research. It is estimated using Hansen (1999, 2000) and Iqbal and Nawaz (2009) threshold model of regime switching. It started with ascertaining the level of stationarity of the model variables, followed by the model estimations and the section is ended with the postestimation diagnostic checking of the estimated model.

4.6.1 Unit Root Tests Results

The results of the ADF unit root test presented in Table 4.30 indicate that, at the conditioned level, all the variables are stationary in all the countries. For instant,

ΔGDP is stationary having F -Statistics value of -6.20, -5.56, -5.84, and -5.89 for Nigeria, Ghana, the Gambia, and Sierra Leone, respectively, with a corresponding probability of 0.00 percent for each.

Meanwhile, the $\Delta LINF$ is also stationary with the computed value of F -Statistics of -7.28 for Nigeria, -6.26 for Ghana, -10.06 for the Gambia and -9.16 for Sierra Leone having a probability of 0.00 percent for all the countries. Finally, ΔLTB is also stationary, having the value of F -Statistics as -6.53 for Nigeria, -9.53 for Ghana, -5.04 for the Gambia and -7.91 for Sierra Leone which corresponds to the value of probability 0.00 percent for all the countries.

Table 4. 30
Results of Unit Root Test for Threshold Model

Variables	Nigeria		Ghana		The Gambia		Sierra Leone	
	ADF Level	ADF 1 st Difference	ADF Level	ADF 1 st Difference	ADF Level	ADF 1 st Difference	ADF Level	ADF 1 st Difference
$\Delta LGDP$	-6.20 (0.00)***	-11.85 (0.00)***	-5.56 (0.00)***	-9.95 (0.00)***	-5.84 (0.00)***	-7.83 (0.00)***	-5.89 (0.00)***	-8.22 (0.00)***
$\Delta LINF$	-7.28 (0.00)***	-6.71 (0.00)***	-6.26 (0.00)***	-6.35 (0.00)***	-10.06 (0.00)***	-17.70 (0.00)***	-9.16 (0.00)***	-5.67 (0.00)***
ΔLTB	-6.53 (0.00)***	-8.10 (0.00)***	-9.53 (0.00)***	-9.46 (0.00)***	-5.04 (0.00)***	-8.41 (0.00)***	-7.91 (0.00)***	-8.53 (0.00)***

Note: '***' '**' '*' implies significant at one, five and ten percent, respectively.
Figures in the parenthesis represent probability

4.6.2 The Results of Threshold Inflation Rate Estimations

Among the main reasons behind inflation rate analysis is its adverse effect on the economy. Though it has been affirmed that not all rates of inflation are bad, some rates, below the threshold, are needed to ginger rate of growth of the economy (Aydin, Essen & Bayrak, 2016; Thanh, 2015; Doguwa, 2012). The results of the threshold inflation rate estimations are presented in Table 4.31, which shows that

there exist three different regimes based on the nature of the effect of inflation on the economy.

On the basis of Iqbal and Nawaz (2009) and Bai and Perron (1998), the first regime consists of the lower threshold rates of inflation by which below it, inflation has no significant effect on economic growth are; 10.56 percent is for Nigeria, 9.70 percent is for Ghana, while 8.14 percent and 9.03 percent are for the Gambia and Sierra Leone, respectively. Meanwhile, the second regime consist of the rates of inflation that are in between the upper threshold and the lower threshold are inimical to the economic growth of the countries, but the rate of growth of the economy outweigh the harmful effect of the inflation rates. It is when the rates of inflation reach the upper threshold (from the upper threshold and above) that the harmful effects of the inflation rates outweigh the rates of growth of the economy.

On the other hand, the third and final regime consist of the upper threshold inflation rates by which, from it and above, inflation is highly inimical to economic growth of WACCs, and they are 10.94 percent which is for Nigeria while 10.03 percent is for Ghana, 8.43 percent and 9.16 percent are for the Gambia and Sierra Leone, respectively. (Iqbal & Nawaz, 2009; Khan & Senhadji, 2000).

Table 4. 31
Results of WACCs Inflation Threshold Rates

Country	Threshold Rates	
	Lower Threshold Rates	Upper Threshold Rates
Nigeria	10.56	10.94
Ghana	9.70	10.03
The Gambia	8.14	8.43
Sierra Leone	9.03	9.16

The upper threshold inflation rates for Nigeria is similar to that of Ghana in the sense that they are double-digit threshold rates (10.94 and 10.03 percent) while that of the Gambia is similar to the threshold rates of Sierra Leone, having a single-digit rate as their upper threshold inflation rate (8.43 and 9.16 percent). Hence, the upper threshold inflation rates for Nigeria and Ghana differ with that of the Gambia and Sierra Leone, as the former have double-digit upper threshold rates while the latter have single-digit upper threshold rates. On the other hand, considering the lower threshold rate, it is only that of Nigeria that differs with the rest of WACCs having double-digit lower threshold inflation rate, the rest (Ghana, the Gambia, and Sierra Leone) have single-digit lower threshold inflation rate.

The results of the lower threshold rates for Nigeria and upper threshold rate for Nigeria and Ghana correspond to the findings of Boglan and Yoldas (2014), which also double-digit threshold inflation rate for developing economies. Also, it corresponds to the upper range and lower range findings of Doguwa (2010), which are double-digits for Nigeria and also corresponds to the double-digit threshold rates findings of Bawa and Abdullahi (2012). Similarly, the lower threshold rates for Ghana, the Gambia and Sierra Leone as well as the upper threshold rate of the Gambia and Sierra Leone corresponds to the single-digit findings of Aydin, Essen and Bayrak (2016) for Turkey, and the findings of Thanh (2015) in five Asian countries as well as the findings of single-digit threshold rates of inflation by Salami and Kelikume (2010) of Nigeria.

4.6.3 Diagnostic Checking

Table 4.32 presents the results of the postestimation diagnostic checks of the estimated threshold models. The table shows that the estimated threshold models are free from serial correlation in all the countries, with the result obtained from Breusch-Pagan test for autocorrelation, having probability values of more than five percent in all the countries. In addition to this, the estimated models are free from heteroskedasticity as attested by Breusch-Godfrey test result with probability values of more than five percent in all the countries.

Many scholars, such as Hansen (1999, 2000), Khan and Senhadji (2000), and Iqbal and Nawaz (2009) highlighted that normality of the error term of a threshold model is not necessary, being a model of non-linear estimation, though it is desirable. The results of Jarque-Bera normality test indicates, with probability values of more than five percent that the estimated threshold models are normally distributed in all countries except Sierra Leone, as shown in Figure 29, Figure 30, Figure 31 and Figure 32 for Nigeria, Ghana, the Gambia, and Sierra Leone, respectively.

Table 4. 32
Post-Estimation Diagnostic Check of the Threshold Models

Countries	Normality: Jarque- Bera	Serial Correlation: Breusch-Pagan	Heteroskedasticity: Breusch-Godfrey
Nigeria	1.25 (0.54)	1.03 (0.53)	1.07 (0.42)
Ghana	4.04 (0.13)	6.68 (0.30)	0.66 (0.78)
The Gambia	0.45 (0.80)	0.95 (0.56)	0.83 (0.59)
Sierra Leone	8.25 (0.02)	0.48 (0.90)	0.87 (0.60)

Note: Figures in the parenthesis represent probability

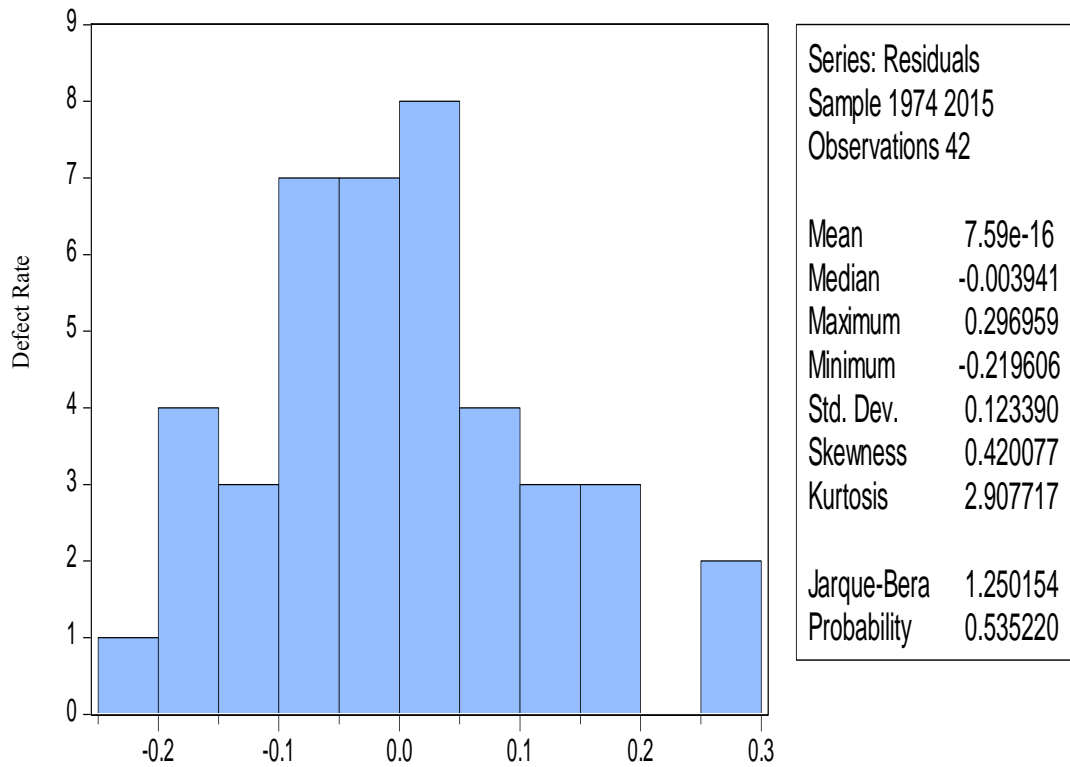


Figure 4. 29
Threshold Model Error Term's Normality for Nigeria

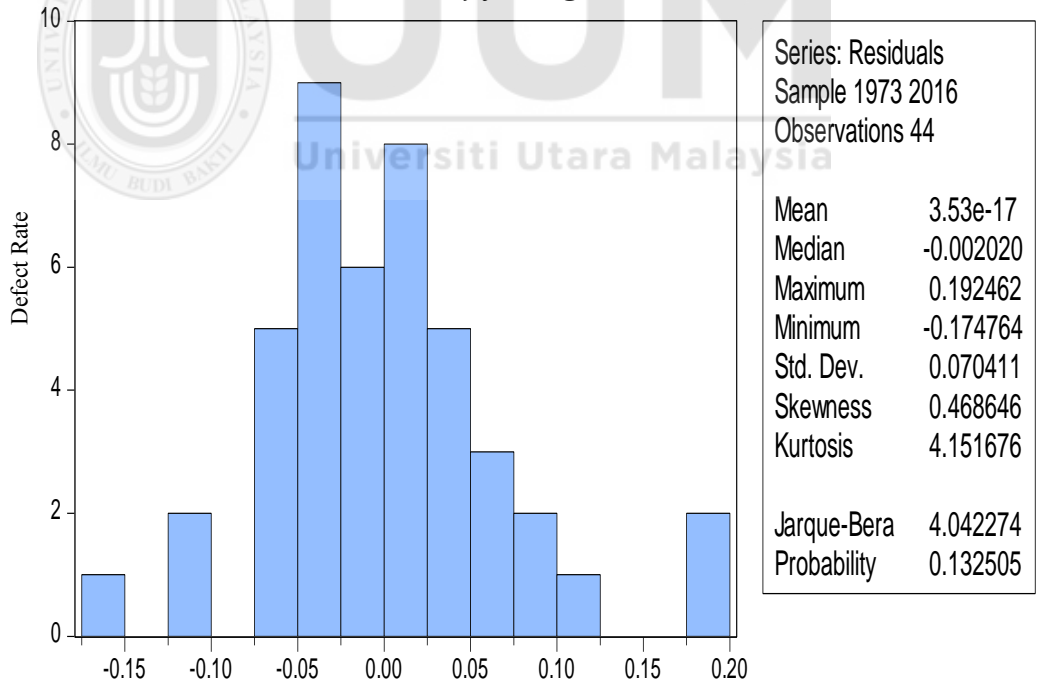


Figure 4. 30
Threshold Model Error Term's Normality for Ghana

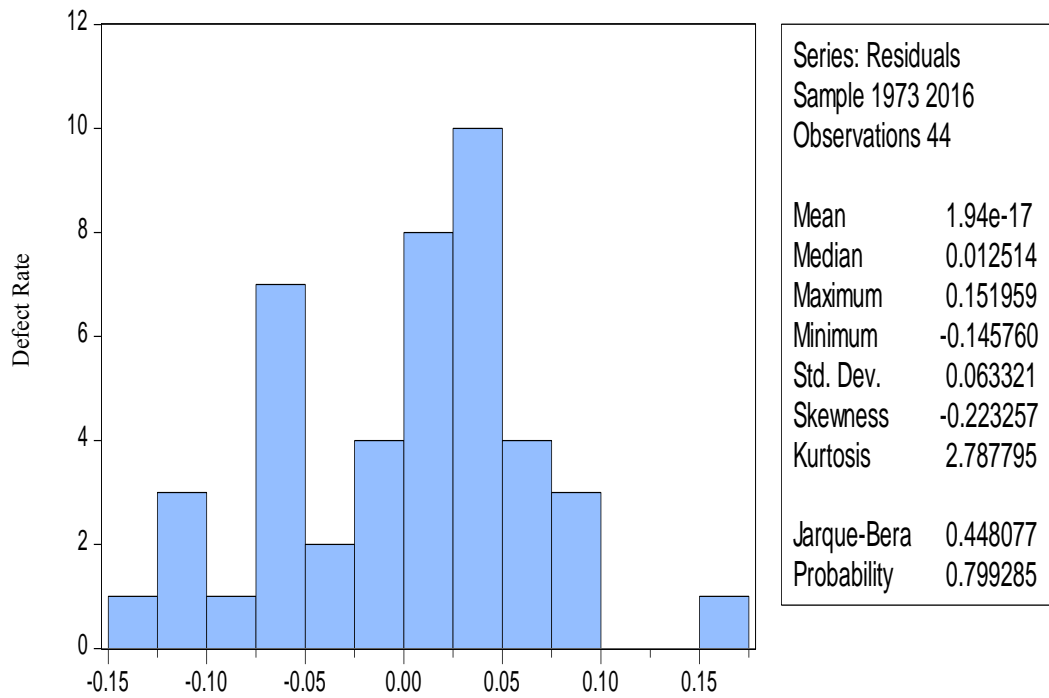


Figure 4. 31
Threshold Model Error Term's Normality for the Gambia

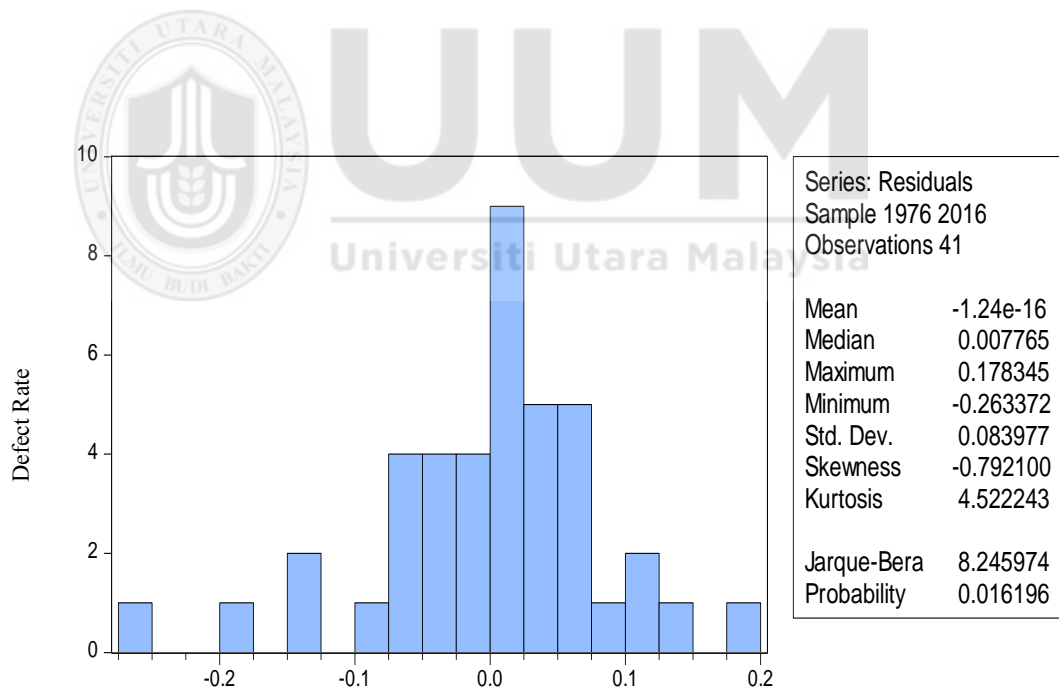


Figure 4. 32
Threshold Model Error Term's Normality for Sierra Leone

Furthermore, regarding the stability of the estimated threshold models, the Brown, Durbin and Evans (1975) CUSUM and CUSUM of squares shows that the estimated threshold models are dynamically stable as the line of the estimated models lies

between the upper and the lower ridged lines of the stability indicators, as shown Figure 33 to Figure 40.

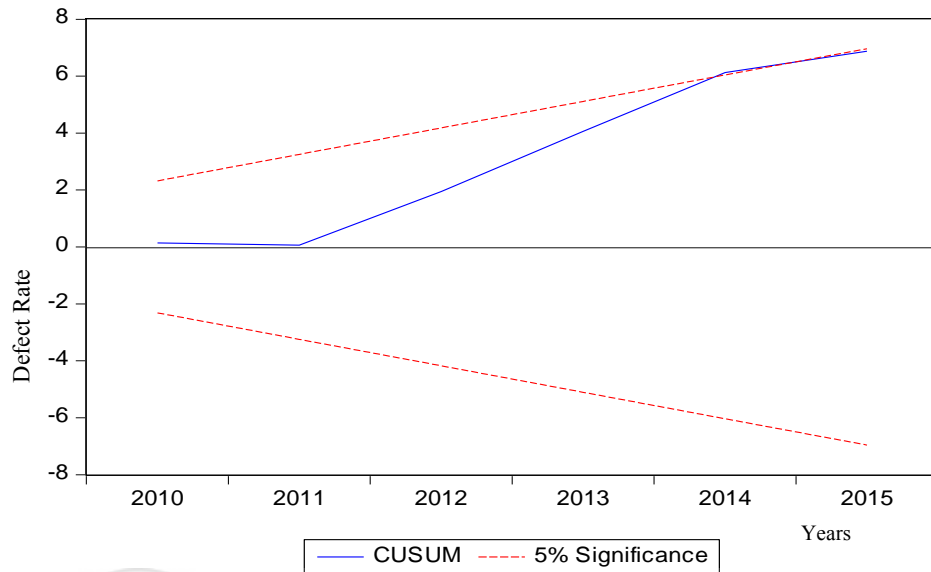


Figure 4. 33
CUSUM Stability Indicators for Nigerian Threshold Model

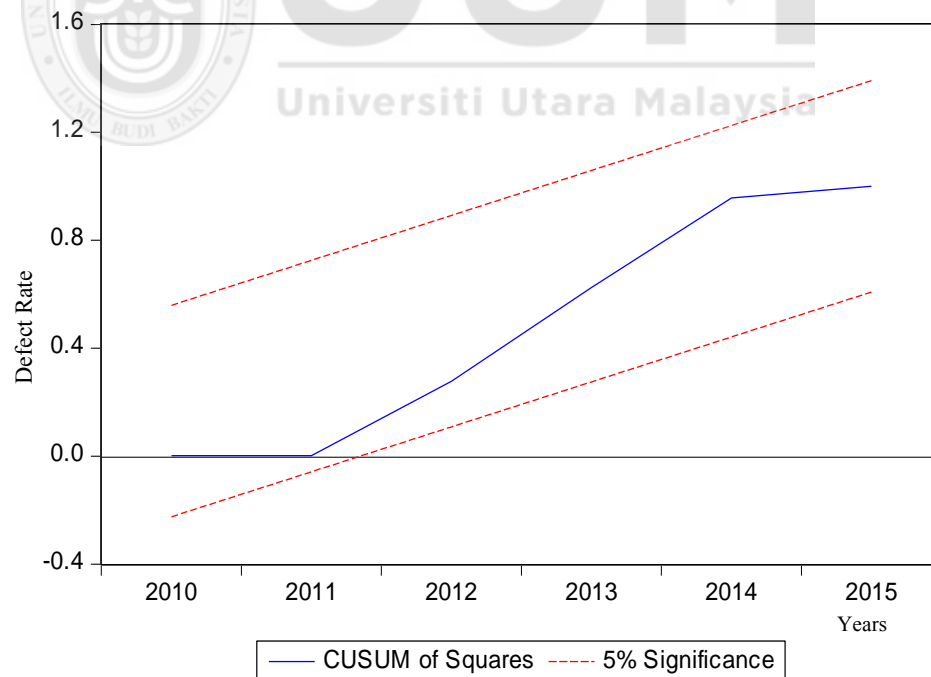


Figure 4. 34
CUSUMSQ Stability Indicators for Nigerian Threshold Model

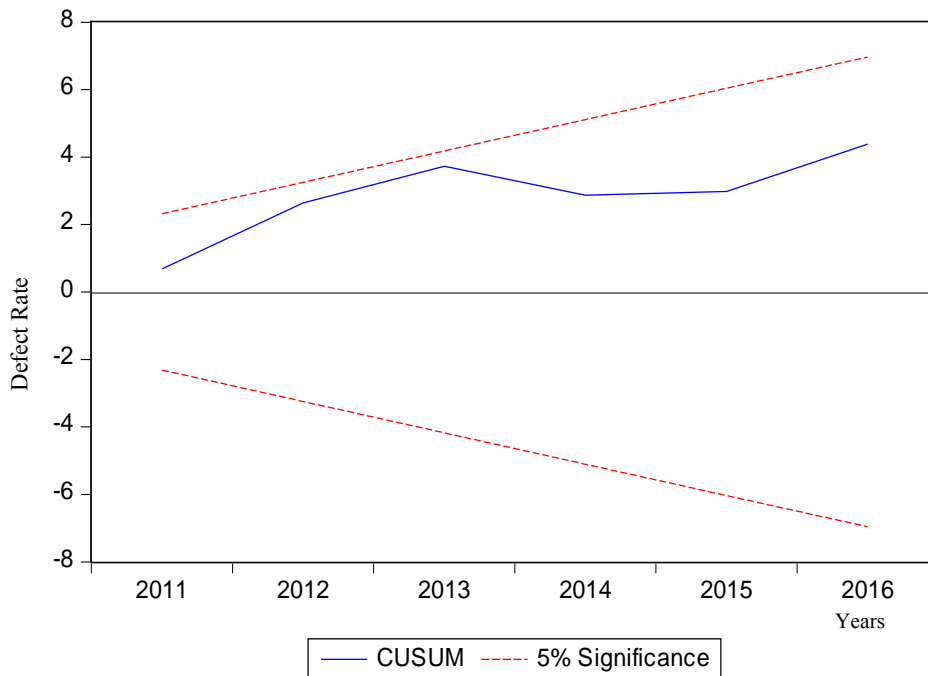


Figure 4. 35
CUSUM Stability Indicators for Ghanaian Threshold Model

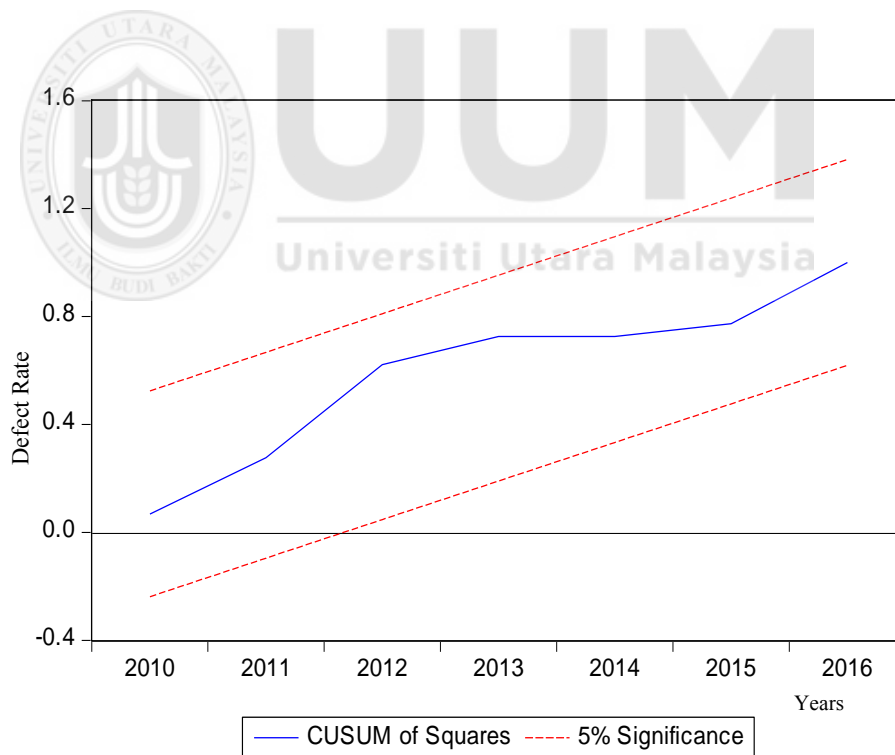


Figure 4. 36
CUSUMSQ Stability Indicators for Ghanaian Threshold Model

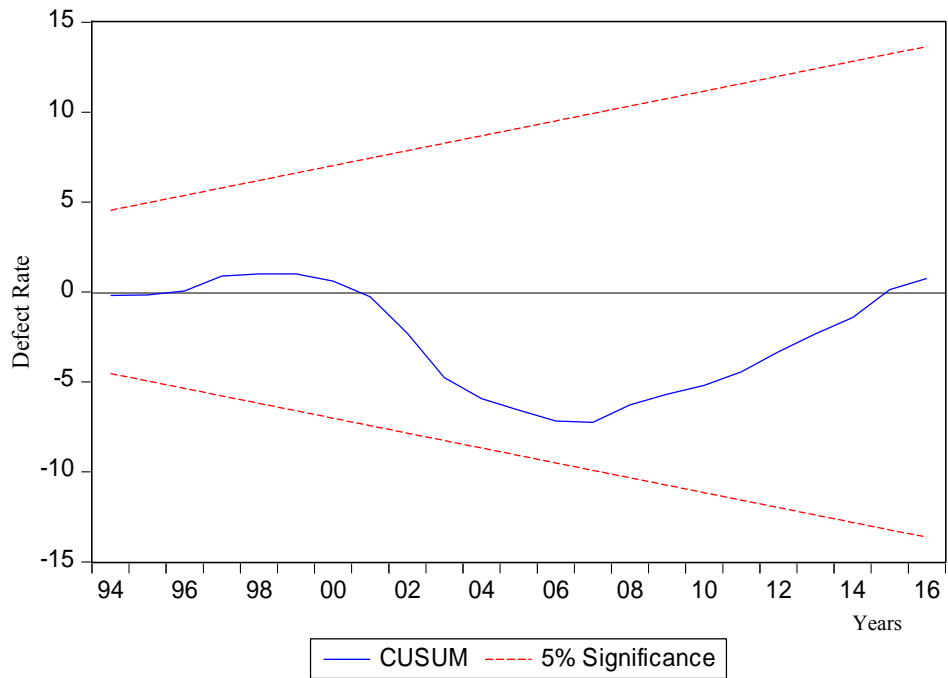


Figure 4. 37
CUSUM Stability Indicators for the Gambian Threshold Model

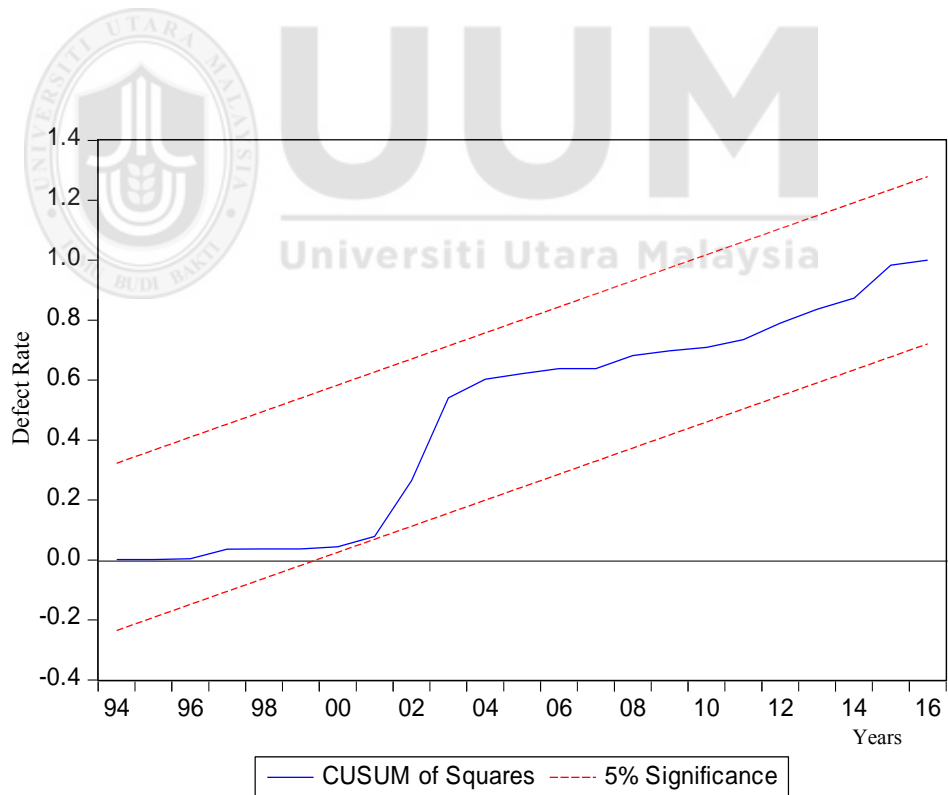


Figure 4. 38
CUSUMSQ Stability Indicators for the Gambian Threshold Model

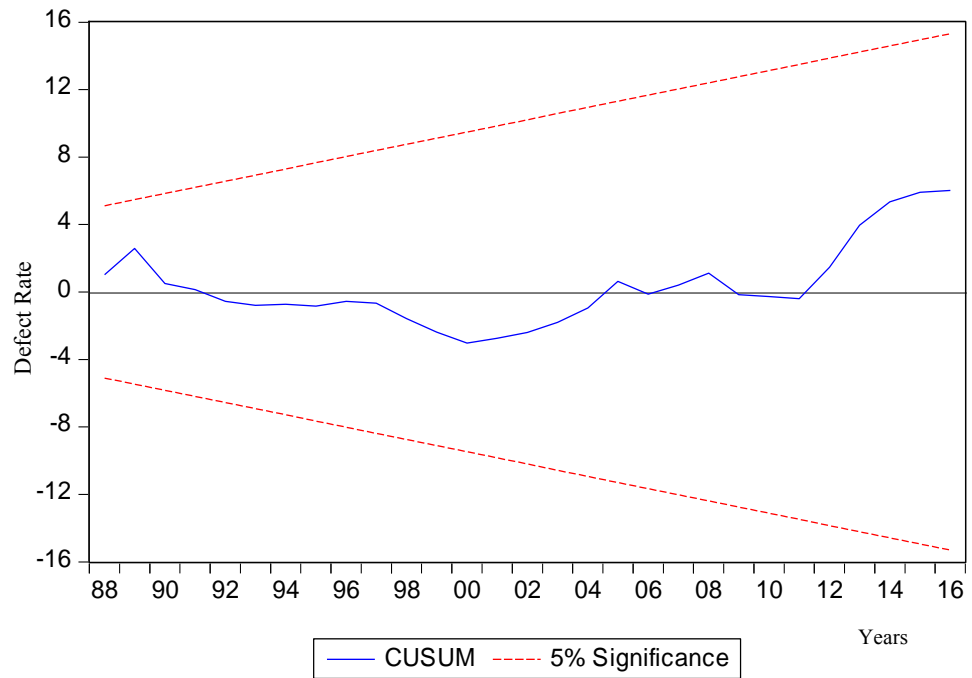


Figure 4. 39
CUSUM Stability Indicators for Sierra Leone's Threshold Model

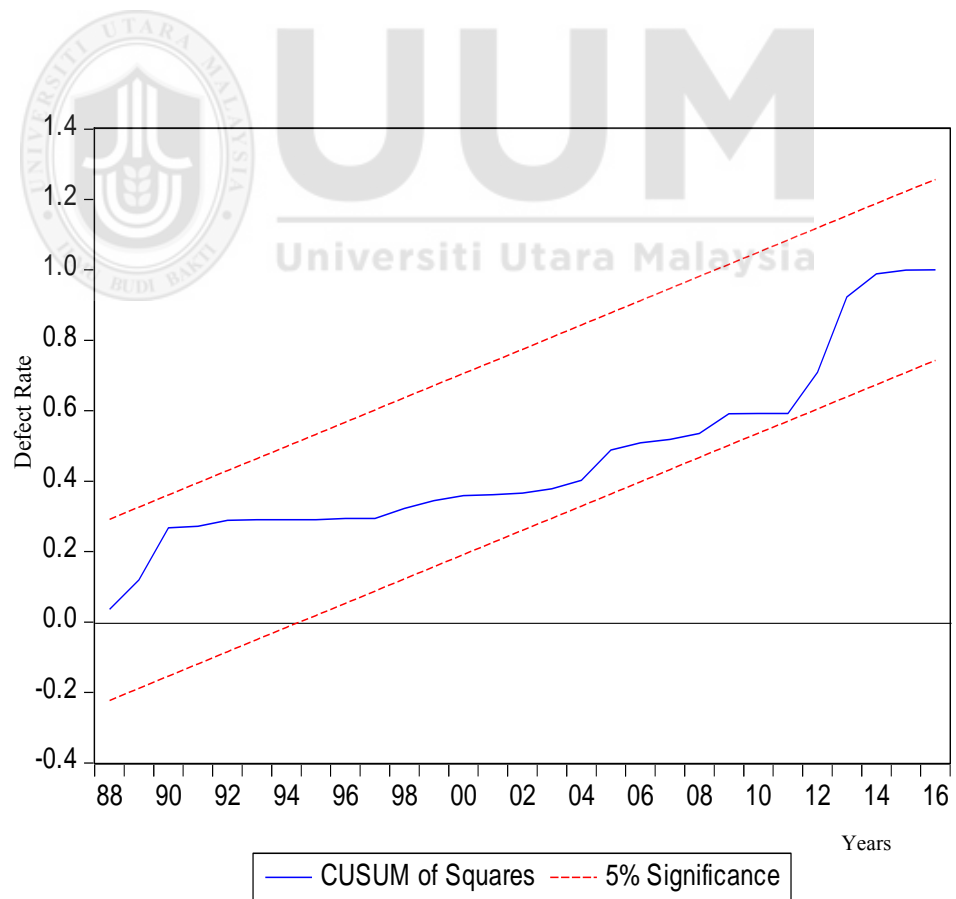


Figure 4. 40
CUSUMSQ Stability Indicators for Sierra Leone's Threshold Model

Nevertheless, Variance Inflation Factor (VIF) tests conducted, reveals that there is no problem of multicollinearity in all the estimated models in all the countries, as the variance coefficients are less than 10 in value. When the variance coefficients are less than the five in value, it implies that there is no multicollinearity, with values less than 10 but more than five, it implies the existence of some elements of multicollinearity. If the variance coefficients have values of 10 and above, it implies an existence of severe multicollinearity. The results are presented in Table 4.33.

Table 4. 33
Results of VIF Test for the Threshold Models

Variables	Coefficient for Nigeria	Coefficient for Ghana	Coefficient for the Gambia	Coefficient for Sierra Leone
Lower Range Threshold				
C	0.044	0.014	0.026	0.012
Δ LINF(-1)	0.015	0.005	0.026	0.004
Δ LINF(-2)	0.018	0.006	0.013	0.004
Δ LINF(-3)	0.017	0.005	--	0.004
Δ LINF(-4)	0.011	--	--	0.003
Between Lower Range – Upper Range Thresholds				
C	0.276	0.049	0.011	0.057
Δ LINF(-1)	0.119	0.011	0.009	0.016
Δ LINF(-2)	0.091	0.009	0.009	0.043
Δ LINF(-3)	0.105	0.009	--	0.055
Δ LINF(-4)	0.087	--	--	0.073
Upper Range Threshold				
C	0.477	0.140	0.002	0.331
Δ LINF(-1)	0.141	0.065	0.002	0.130
Δ LINF(-2)	0.152	0.074	0.002	0.026
Δ LINF(-3)	0.166	0.040	--	0.037
Δ LINF(-4)	0.117	--	--	0.020
Non-Threshold (Control) Variable				
Δ LTB	0.036	0.077	0.037	0.033

4.6.5 Robustness of the Threshold Model

A robust estimation has been conducted using convention threshold model without regime switching. In the original model, regime switching provides the room for estimating the lower threshold rate while this conventional threshold only provides

room for estimating the threshold without splitting it into the lower and upper threshold. The result of the robust estimation is presented in Table 4.34, which shows that the estimated threshold inflation rates for the WACCs are higher than the lower threshold rate estimated based on regime switching model, but they are slightly lower than the upper threshold rates.

For instant, the estimated threshold model for Nigeria is 10.83 percent, which higher than the 10.56 percent lower threshold and lower than the 10.94 upper threshold estimated based on regime switching threshold model. Meanwhile, the threshold inflation rate for Ghana is estimated to be 9.95 percent higher than the 9.70 percent lower threshold and lower than the 10.03 percent upper threshold estimated using the regime switching model. On the other hand, the threshold inflation rate for the Gambia is 8.25 percent higher than the lower threshold of 8.14 percent and lower than the upper threshold of 8.43 percent based on the regime switching model. Finally, the Sierra Leone threshold inflation rate estimated is 9.14 percent higher than the lower threshold of 9.03 percent and higher than the 9.16 percent upper threshold rate estimated based on regime switching model. Therefore, the robust models technically show that the threshold inflation rates for WACCs lay between the upper and lower threshold inflation rates estimated based on regime switching models.

Table 4. 34
Robust Threshold Inflation Rate Estimation

Country	Threshold Inflation Rate
Nigeria	10.83
Ghana	9.95
The Gambia	8.25
Sierra Leone	9.14

4.7 Conclusion

Being the fourth chapter of the study, data analysis and discussions of findings are carried-out. The chapter started with data descriptions using the statistical measure of central tendencies and relationships among the variables are analyzed using correlation analysis. Later on, time series analysis is conducted on the basis of the research's objectives. The time series analysis involves the usage of ARDL method to analyze the *ERPT* to inflation of WACCs. The ARDL model is necessitated by the fact that the results of the unit root test conducted reveal that the variables are mixed stationary, and therefore, ARDL is used for the estimation. The results confirmed the existence of *ERPT* to inflation in WACCs; hence, local currency devaluation is inflationary. Whereupon, univariate analysis, specifically, AR is used in estimating the inflation persistence models of WACCs based on the data, high inflation rate persistence is identified with a one-year lag of inflation, and low inflation persistence is identified with the lag of two years inflation rate except for the Gambia where it is still high. Finally, conventional threshold models of regime switching were used to establish the threshold inflation rate of the WACCs which indicates that single-digit rates are the lower threshold boundary of inflation rates in Ghana, the Gambia, and Sierra Leone while the lower threshold boundary for Nigeria is double-digit. On the other hand, the upper threshold boundary for Nigeria and Ghana are double-digit while that of the Gambia and Sierra Leone are single-digit.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

As the last part of the study, the chapter is aimed and designed at presenting the summary of the main findings and conclusion of the study. It also highlights the policy recommendations on the basis of the research findings. The chapter presents the limitations of the study and offers some suggestion for future researchers that may be carried out in the relevant area.

5.2 Summary of Findings

This research was conducted with the aim of studying the inflation rates of WACCs. Specifically, to analyze the exchange rate pass-through to inflation of WACCs being the first objective, followed by examining the persistence of inflation rate, and finally, it establishes a threshold inflation rate of WACCs. To achieve the set objectives, the time series data were used in the study. The data gathered for a period 1980 – 2016 is for the first objective and data for the period 1970 – 2016 is for the second and third objectives of the study.

On the basis of the objectives of the study and the nature of the variables, three different models and methods of analysis are employed to analyze the data. The methods of analysis include ARDL, which was used to analyze the *ERPT* to inflation in WACCs. Also, the univariate method of analysis, specifically, the AR model was used to examine the persistence of inflation in WACCs. Whereas, the conventional threshold model of regime switching was used in establishing the inflation threshold

rates of the WACCs and estimating rates of inflation that have no harm to economic growth. On the basis of the methods of analysis utilized, various postestimation tests were carried out to ascertain the validity of the estimated models, and they scaled all the postestimation diagnostics checks. Therefore, the findings of this study can be summarized as follows:

5.2.1 The Exchange Rate Pass-Through to Inflation

The results of the *ERPT* to inflation estimations show that; during the short run, there is no evidence of *ERPT* in Nigeria, although, after one year, *ERPT* has a disinflationary effect in the short-run of Nigeria only, while complete positive *ERPT* exist in Ghana, the Gambia, and Sierra Leone during the short-run. Meanwhile, during the long-run, complete and positive *ERPT* exist in all the countries, although, the Gambia has the highest *ERPT* followed by Nigeria and Sierra Leone, Ghana has the lowest *ERPT* from the result. Hence, *ERPT* to inflation does really matter to WACCs.

Even though, there are some studies on *ERPT* in different areas like Amoah and Aziakpono (2018) in Ghana, Savoie-Chabot and Khan (2015) in Canada, Adeyemi and Samuel (2013) in Nigeria, and Leigh and Rossi (2002) in Turkey. Most of these mentioned studies were conducted to study *ERPT* to import price, in addition to this, the studies utilized either vector autoregression or vector error correction model in their research, this study utilized ARDL in estimating *ERPT* to inflation and investigated the existence of delay or not in the short run of the *ERPT* process of which is lacking in the previous studies.

5.2.2 The Persistence of Inflation Rate

The results of the univariate analysis, specifically, the autoregressive model reveals that past inflation rates affect the current rate of inflation positively in all the countries. Specifically, high inflation persistence is associated with the effect of one-year lag inflation (effect of changes in the inflation rate last year on the current rate of inflation). And low inflation persistence is associated with the effect of the two years lag inflation (effect of the changes in inflation rate two years ago on the current inflation rate) in Nigeria only as it causes high inflation persistence in the Gambia. It is only the third year lag inflation rate that is associated with low inflation persistence in the Gambia.

A number of studies such as by Zhang (2011), Primeceri and Sargent (2010), Zhang and Clovis (2010), and Levin and Piger (2004), exist in this regard, but their studies are mostly based on developed economies that hardly have a high rate of inflation compared to developing countries.

5.2.3 The Threshold Inflation Rate

Finally, the results of the threshold inflation rate, based on conventional threshold model of regime switching, shows that there are three regimes on the basis of the effect of inflation rate on the economy; the first regime consists of the lower threshold inflation rates and those rates below it. The lower threshold rates are 10.56 percent for Nigeria, 9.70 percent for Ghana, 8.14 percent for the Gambia and 9.03 percent for Sierra Leone. The rates of inflation below the lower threshold rates have no significant effect on economic growth (Iqbal & Nawaz, 2009; Khan & Senhadji, 2000). The second regime consists of the rates of inflation that lie between the lower

threshold and the upper threshold, such rates are inimical to economic growth, but the growth rate of the economy outweighs the harmful effect of the inflation rates at those ranges. The third and final regime consists of the rates of inflation from the upper threshold onward, 10.94 percent for Nigeria, 10.03 percent for Ghana, 8.43 for the Gambia, and 9.16 percent for Sierra Leone, are the rates of inflation that are harmful to economic growth and their harmful effect outweighs the rate of growth of the economy, and therefore, they should be avoided.

Previous studies on the threshold inflation rate exist, among them include; Aydin, Essen and Bayrak (2016), Thanh (2015), Baglan and Yoldas (2014), Vinayagathan (2013), Bawa and Abdullahi (2012), Doguwa (2012), Salami and Kelikume (2010), Risso and Sanchez-Carrera (2009), and Khan and Senhadji (2000). All these studies concentrated majorly, on findings the inflation threshold rate only, placing less attention to the rates of inflation that are harmless to economic growth.

5.3 Policy Recommendations

Having empirically established the positive nature of *ERPT* to inflation in WACCs and persistence as well as the threshold inflation rate; therefore, the study makes the following recommendations:

It has been established that complete and positive *ERPT* to inflation exist in all countries. Thus, a sound policy is needed that will be executed to reduce the demand for foreign exchange in all the WACCs. The policy can be through revisiting and strengthening import substitution strategy to cut import which will eventually cut the demand for foreign exchange, also, revisiting and strengthening export promotion

strategy to boost the supply of foreign exchange. Furthermore, the conducive and enabling environment should be provided by the policymakers, to local manufacturers and industries with the aim of producing most of the goods and services, needed by the country, within the country. This is possible through infrastructural developments, as most infrastructures; like electricity, are lacking in most developing nations.

Specifically, WACCs and Sub-Saharan Africa are known to have low generation capacity of electricity compared to its demand as they barely generate between 30 to 40 percent of the electricity needed in the region (Iwayemi, 2008; Gnansounou, Bayem, Bednyagin & Dong, 2007; Karekezi, 2002; Turkson & Wohlgemuth, 2001). Investing in infrastructure and generating the required sustainable uninterrupted electricity will, for sure, attracts investors within the countries, and this will cut down the level of importation. By this, the demand for foreign exchange will be reduced, and economic activities within the countries will be enhanced, and there will be no need to devalue local currencies. For the meantime, currency devaluations should be minimized to once or not more than twice in a decade. And if it must frequently be carried-out, the devaluation should be at a decreasing rate to reduce the inflationary pressure.

Nevertheless, the presence of high inflation persistence of one period (one year) is also a serious issue that should not be taken lightly. Having a high inflation rate in the current year just because last year's inflation was high, then automatically, this year's high inflation will make next year's inflation high, the persistence will continue in the future unless policymakers intervene and break the inflation

persistence. This research recommends the policymakers' intervention through long-term Inflation Targeting (IT) to target a low inflation rate for the economies to break such inflation persistence.

Finally, on the basis of the findings of the threshold model estimations, the research recommends that policymakers of WACCs, to take IT serious and to give it all the necessary and needed attention. It can be made in the form of a program with a specific long-term lifespan- based on three stages lifespan (as the threshold model shows that there exist three regimes in all the countries). In the first stage, a high single-digit inflation rate should be the target once achieved then the target should be changed to low rates of inflation which are the rates of inflation that do not affect economic growth, in the second stage. The final stage is monitoring stage where plans are maintained or redrawn. Moreover, the behavior of the WACCs inflation rates should constantly be in check, for the purpose of taking corrective measures, on the policies that are being implemented, where needed and reinforce performance where appropriate.

5.4 Limitations of the Study

This research endeavored to analyze the *ERPT* to inflation rates of WACCs, examine the inflation persistence of WACCs, and to establish a threshold by which inflation rate is inimical to the economic growth of WACCs. The study is not without some limitations, which include:

The effects of variables on inflation rate investigated by the research are limited to the changes in the exchange rate (*ERPT*), and the effect of previous inflation rates on

the current inflation rate (inflation persistence) as the major drivers of inflation in WACCs. Some categorical and behavioral variables such as culture, race, region and some qualitative variables such as beliefs and perceptions may have a significant effect on inflation and are not considered in this research, could be studied by qualitative researchers.

Furthermore, the findings of the study are limited to WACCs, other West African countries that are not members of a commonwealth are not part of the study due to the heterogeneity and differences exist between members of commonwealth and non-members. Moreover, the findings of the research are based on the methodology utilized (ARDL, AR as well as Hansen (1999, 2000) and Iqbal and Nawza (2009) conventional threshold Model of Regime Switching). Other methods of estimations such as Generalized Method of Moment (GMM), Vector Autoregression (VAR) and Vector Error Correction Model (VECM) are not utilized due to the nature of stationarity of the data (mixed stationary data).

5.5 Suggestions for Further Research

On the basis of the limitations pointed-out by this research, the following further studies are recommended:

The study coverage should be expanded to the whole of West African Countries (WACs), and their heterogeneity, as well as differences, should be taken note of and accounted for; as the issue of high inflation rate may not be limited to only WACCs, it may exist in the whole of West Africa.

Nevertheless, this research examines the nature of *ERPT* to inflation, and inflation persistence as well as the threshold inflation rate in WACCs. Other categorical and qualitative variables mentioned earlier may be considered as the major variables in other studies in the future.

Finally, the methodology and methods of estimations utilized by this research include ARDL, AR model and conventional threshold model of regime switching due to the level of stationarity of the variables; future studies may consider other vast methods of analysis like VAR, Panel VAR, VECM, and its panel, GMM and even traditional panel, for stationary variables, may be considered.

5.6 Conclusion

Being the last chapter of the study, the major findings of the study are summarized. Also, the chapter presents the policy recommendations, among the recommended policies, are enhancing import substitution strategy and export promotion policies, to reduce the demand for foreign exchange and reduce the pressure for local currencies' devaluations. Furthermore, the limitations of the study were highlighted; among them include the variables used in the study, the methodology employed, and the countries covered. Nevertheless, on the basis of the limitations, the research makes some suggestions for further studies that may cover the whole of West Africa, and that may explore other methods of analysis. Finally, this conclusion closed the chapter.

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