INFLATION AND ECONOMIC GROWTH RELATIONSHIP IN THE WEST AFRICAN MONETARY ZONE

A Threshold Analysis.

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ABSTRACT

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Keywords: Inflation, Economic growth, Threshold model, Non-linear, West African Monetary Zone.

Inflation and output growth relationship is of interest to policymakers and researchers. In the West African Monetary Zone, the attainment of low inflation rate is considered as one of the convergence criteria for the successful implementation of monetary union in the zone. Although there has been empirical evidence that the relationship between inflation and output growth in the WAMZ is non-linear, the question yet to be answered is, “at what level is inflation detrimental to economic growth?” This paper extends the link of analysis by investigating the optimal inflation for the WAMZ countries using the quadratic approach to threshold estimation. The findings drawing from economic theory and analysis suggests that inflation rate in the WAMZ is significantly associated with lower growth only after it reaches 12.86 percent. The result further indicates that there are significant differences in the inflation threshold levels in the WAMZ countries. The findings of this research are not surprising given the institutional features and structure of the different countries in the zone. The findings of the research suggest that monetary authorities in the WAMZ countries could accommodate inflation rate up to the threshold level, even when that is higher than what is currently being targeted in the zone, so as not to stifle growth in the area. Also, although the WAMZ countries belong to the same geographical area, which could enhance group formation; there could be other sources of heterogeneity like different political, legal, economic, and national policies that drive individual growth processes in the zone.

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AD:	Aggregate demand
ADB:	African Development Bank
ARCH:	Autoregressive Conditional Heteroskedasticity
ARDL	Auto-Regressive Distributed Lag
AS:	Aggregate Supply
BCEAO:	Bank of West African States
CFA:	Coopération Financière en Afrique Centrale
CPI:	Consumer price index
ECB:	European Central Bank
ECOWAS:	Economic Community of West African States
EMI:	European Monetary Institute
ETLS:	ECOWAS Trade Liberalisation Scheme
EMCP:	ECOWAS Monetary Cooperation Programme
GDP:	Gross Domestic Product
GSE:	Ghana Stock Exchange
GF:	Guinean franc.
GS:	Guinean Syli
IFS:	International Financial Statistics
IMF:	International Monetary Fund
JSE:	Johannesburg Stock Exchange
LLC:	Levin, Lin, and Chu
LM:	Lagrange Multiplier
MTEF:	Medium Term Expenditure Framework
NSE:	Nigeria Stock Exchange
NBS:	National Bureau of Statistics
NLLS:	Non-linear least squares
OECD:	Organization for Economic Cooperation and Development
PPP:	Purchasing Power Parity
PSS:	Pesaran-Shin-Smith
PSTR:	Panel smooth transition
QTM:	Quantity Theory of Money

RESET:	Regression Specification Error Test
RMSE:	Root Mean Square Error
SDR:	Special Drawing Right
SLSE:	Sierra Leone Stock Exchange
UECM:	Unrestricted Error Correction Model
WAEMU:	West Africa Economic and Monetary Union
WAMA:	West African Monetary Agency
WAMI:	West Africa Monetary Institute
WAMZ:	West African Monetary Zone
WDI:	World Bank Development Indicators

CHAPTER ONE

"Avoiding inflation is not an absolute imperative but rather is one of a number of conflicting goals that we must pursue and that we may often have to compromise" – Paul Samuelson

1.0 Introduction

1.1 Background of the Study.

There has been increasing interest in economic and monetary integration around the world since the introduction of the euro in 1999. This is because monetary integration is considered essential in international economic relations as it involves the use of a common currency in two or more countries while centralising monetary authority in a single joint institution (Mundell, 1961; Mckinnon, 2000). The member countries of a monetary union usually relinquish their national currencies and adopt the union's common currency as a medium of exchange. The adoption of a common currency does not come without some costs to its members as they are expected to have the same response to external and internal inflation shocks (Frankel and Rose, 1997). However, the associated benefits of the union as noted by some authors (Corden, 1993; Kenen, 1995) tend to outweigh the costs. The union reduces the risk of high inflation, cuts transaction costs, reduces exchange uncertainties for firms trading within the union and strengthens the member countries' position in trade negotiations with other economies. It also creates opportunities within and beyond the constituent states by removing some of the payment obstacles to trade (Harders and Legrenzi, 2008). An independent institution is often established to provide a framework for member central banks to start the integration and preliminary preparations for the printing and minting of the currency (ECOWAS, 2014).

A survey of evidence from empirical studies reveals that the Africa region has been characterised by dismal economic performance as evident in their rising inflation rates, low output growth, rising unemployment rates and high dependence on imports among others (Iyoha, 2003). In an attempt to tackle these weak economic conditions, African nations including those in the West African sub-region have initiated a series of economic policy reforms and consolidated strategies. One of such policy strategies is the adoption of regional economic and monetary integration across the region. The quest for a monetary union within the Economic Community of West African States (ECOWAS) began with the establishment of a regional body in May 1975. After the establishment of the ECOWAS; there was only one monetary zone in West Africa; the West Africa Economic and Monetary Union (WAEMU[1]), which comprises the francophone West African countries. With the establishment of the WAEMU, the francophone member countries use CFA as their common currency, while the Anglophone West African countries use their independent currencies. To fast track the common monetary policy framework of ECOWAS, a second monetary zone, the West African Monetary Zone (WAMZ) for Anglophone West Africa was initiated in 1999. This second monetary zone is expected to later merge with the existing monetary union, the WAEMU to form a single currency in West Africa (Fwangkwal, 2014).

The West Africa Monetary Institute (WAMI), just like the European Monetary Institute (EMI), was established to undertake the preparation for the creation of this second West African union. The institute, which started operating in 2001 and has its headquarters in Accra, Ghana, was saddled with the supervision of six[2] West African member countries

[1]Which was established in 1994 with a single central bank BanqueCentrale des Etats de l'Afrique de l'Ouest (BCEAO) and a common currency (CFA) which was fully convertible within the French franc zone

[2]The WAMZ countries include the Gambia, Guinea, Ghana, Liberia, Nigeria and Sierra Leone

with the aim of introducing a common currency called the Eco. The institute set up four primary and two secondary convergence criteria, which must be met and sustained before the implementation of the common currency. One of the four primary macroeconomic convergence criteria for the West African Monetary Zone (WAMZ) is that the year-on-year inflation rate for the WAMZ member countries should be a single digit (WAMA, 2013). The reason for deciding on this is that inflation is an important economic indicator; it can be used to ascertain the past policy preference of a country. Given the fact that price stability is a precondition for the achievement of non-inflationary growth, the inflation rate can also be used to ascertain the sustainability of macroeconomic stability in the monetary union in the long run.

1.2 Research Problem and Motivation

As the decision to form a second monetary union in the ECOWAS sub-region gains momentum, its feasibility and sustainability, remain bleak in the minds of policymakers and economists. The level of commitment and efforts of some member nations towards establishing the monetary zone has been lackluster, partly due to political support from member countries in the region (Baldwin, 1998). Not only has there been differences in the inflation rate among the countries in the zone, the prospect for attaining its convergence has also been weak, thereby delaying the commencement prospect (Balogun, 2009). Since the establishment of the WAMI, assessment of the member countries showed that the average annual inflation rate for the WAMZ had increased from 10.1 percent in 2000 to 11.73 percent in 2011, before declining to 9.31 percent in 2014. Although some of the countries have attained the single-digit year-on-year inflation rate, only Gambia has been able to sustain it over a period. The non-sustainment of single-digit inflation in the WAMZ countries could be as a result of internal country-specific economic difficulties that have besieged the individual countries.

The insistence on this level of inflation, despite attainability constraints, has raised the issue of the optimum level of inflation for sustaining economic growth in the WAMZ. It is imperative to tackle this issue because the management of macroeconomic parameters is geared towards sustainable economic growth. However, the existence and nature of the relationship between inflation and economic growth have been one of the policy debates that have emerged in theoretical and empirical studies in recent times. The reason is that there is a general belief that inflation is harmful to any economy and thus, low and stable inflation is imperative for economic growth. Hence, policymakers across the globe are concerned with high levels of prices as they strive for the achievement and maintenance of price stability (Seleteng, 2012).

As widely held as the view that inflation is bad, it also presents a dilemma to policymakers and economists. The Tobin's (1965) effect is often read to mean that inflation is supportive of economic growth. Kormendi and Meguire (1985) disagree, posting a negative relationship, as do Fischer (1993), De Gregorio (1992) and Barro (1995, 1996). Faria and Carneiro (2001) had added a new dimension to the argument when they reported that with high-frequency data inflation does not influence growth in the long run but exhibits a negative impact on growth in the short-run. However, there is now a convergence of opinions that high inflation hurts economic growth. This convergence of views, while seeming a success, has created another divergence of opinions concerning what constitutes 'high inflation.' (Sarel, 1996; Espinoza,2010; Eggoh and Khan, 2014). The widespread consensus in identifying an appropriate inflation target should be that it ensures the narrowing of the output gap to a desirable level, consistent with the long-term inflation and economic growth objectives of the government. Thus, monetary policy should be focused on an inflation rate that maximises economic growth and not one that could stifle growth.

1.3 Problem Statement

A lot of empirical studies have been conducted to establish the optimal inflation rate for developing countries such as the WAMZ member countries, however, there has been inconclusive and significant prevalent differences in the results obtained from empirical studies (Hineline, 2003). While Ahortor et al. (2011), Sarel (1996) and numerous others favour single-digit inflation for the WAMZ, Khan, and Senhadji (2001), Kremer et al (2009) and a host of others are of the opinion that the optimal inflation rate for developing countries like the WAMZ is higher than 10.0 percent. One wonders if the difference in the established threshold point in the earlier studies is as a result of different time periods, methodological issues or structural differences in the countries. It is apparent that the impact of inflation on output growth in the WAMZ is still an unresolved issue in the empirical literature, thus necessitating the re-investigation of the threshold level of inflation for the WAMZ. Hence, the particular focus of this study is on the WAMZ region. The importance of this investigation stems from the notion that the member countries in the region are striving towards a common goal and therefore are likely to pursue similar macroeconomic policies. Apart from contributing to the existing literature on inflation-growth relationship in the zone; the motivation for the study stems from the fact the relationship between inflation and output growth in this zone may differ from the one that exists in other countries (especially in developed countries) as noted in some cross-country studies (Sarel, 1996). The reason is due to the level of economic development and the macroeconomic policies that are being practiced in those countries.

1.4 Objective of the Study

The main objective of this study is thus; to empirically examine the relationship between inflation and economic growth in the WAMZ. Specifically, this paper aims at ascertaining the level of inflation that would be conducive to economic growth in the WAMZ by:

- Reviewing literature on definitional, conceptual, relevant theories and methodological issues on the relationship between inflation and growth with the aim of identifying gaps in the literature and review;
- Determining the direction of causality between economic growth and inflation (if any) and;
- Estimating the exact relationship between inflation and output growth in the WAMZ countries.
- Estimating the target inflation level/range for the WAMZ countries and if the level of inflation before the establishment of the WAMZ is significantly different from its level after the commencement of WAMZ.

1.5 Research Question

To be able to achieve the stated objective and put this thesis in proper perspective, this study will try to answer the following questions:

- What is the causality between inflation and economic growth?
- Does an inflation threshold level/range exist for the WAMZ member countries?
- And where it does, should the target inflation rate be the same for all WAMZ countries or country-specific?

To answer the above questions, the research is decomposed into different specific objectives. Firstly, to investigate the direction of causality between inflation and output growth, a Granger causality test was used. Secondly, to investigate the nonlinearity of the inflation-

growth nexus, the study used a panel data econometric technique. Thirdly, the study estimates the threshold (optimal) level of inflation that is conducive for economic growth in the zone. Lastly, because of the contribution of Nigeria to the overall growth of the zone, and the benefits other countries in the region derive from Nigeria, a further analysis was done using Nigeria as a case study.

The study principally employed annual data on different variables based on available data at the time of estimation for the six WAMZ countries. The data was obtained in most part from the World Development Indicators published by the World Bank and the International Monetary Fund IFS.

1.6 Justification for the Study

The justification for this study is twofold, namely, methodological and empirical. Apart from contributing to the academic literature on optimal inflation in West Africa, the approach used in this paper adds value to the previous studies in West Africa by using a quadratic model for its analysis. Several studies on developing countries have used different models for analysing the inflation threshold, with a lot of them adopting the popular threshold endogenous model developed by Khan and Senhadji (2001) or its variants, while others used the Sarel (1996) approach. Although these studies tried to determine the optimal inflation level, it requires a significant amount of data to make a valid statistical inference. The method of this research study is different; it uses the quadratic function approach, which is estimated as a second-degree polynomial. Some authors have used this approach in other countries for the estimation of the non-linear relationship between inflation and output growth; however, this has not been applied in the estimation of inflation threshold in the WAMZ countries.

On the empirical aspect, this study uses an integrated approach involving the country-specific and group analysis. Apart from serving as a robustness check, the country-specific analysis was carried out to account for the heterogeneous factors pertaining to the different countries and to relate findings to specific policy designs.

1.7 Structure of the thesis

To achieve the objective of the study, the thesis is sub-divided into six chapters excluding the introductory and concluding chapters. Chapter two and three contain a comprehensive review of the theoretical and empirical literature on the inflation-growth relationship and the policy conditions; the discussions on inflation-growth theories and institutional arrangements for the emergence of the WAMZ Chapter four to six comprise the methodological, analytical and empirical exercises. Chapter seven dwelt on the inflation-growth analysis in Nigeria, while chapter eight concludes the thesis.

The specific contents of all the chapters are:

- Chapter one of the thesis is the introductory section. It provides an overview of the study and highlights the need for the study, nature of the problem, the significance of the study, objectives of the study, research questions to be answered and organisation of the thesis.
- The second chapter of the thesis discusses the theoretical underpinnings, the conceptual model and theoretical framework used in this study. Specifically, it looks at conceptual issues relating to inflation and economic growth; provides a comprehensive review of the competing theories that explain the nature of the relationship between inflation and output growth. It also provides a comprehensive theoretical framework that underpins the foundation of the central questions that are

pursued by this thesis and includes a review of the empirical literature on inflation and economic growth relationship, particularly in the WAMZ countries. Finally, the last section of the chapter deals with a comprehensive review of the econometric methods that have been used in determining inflation thresholds, highlighting their strengths and shortcomings.

- The third chapter of the thesis provides a comprehensive background with regard to the emergence of the second monetary union in the WAMZ while expounding on the theory of optimal currency. This chapter is split into two sections. Section one highlights the primary and secondary convergence criteria that need to be met before the establishment of the single currency in West Africa. The second section deals with the policy conditions and institutional arrangements surrounding the introduction of the Eco. It further highlighted the key distinguishing features of the six WAMZ member countries and presented a descriptive analysis of important macro-variables in the countries.

- The fourth chapter discusses the methodology adopted for the study. This chapter comprises two main sections. The first section defines the model and the research methodology and analytical tool used in the analysis. The second section deals with the data and the sources of the data used for the study.

- The fifth chapter which is split into three sub-sections describes the study's pre-estimation analysis. The test included unit root test and correlation analysis. The first section of the chapter provides the panel unit root preliminary analysis and suggests that in the presence of unit roots, cointegration analysis would be the most suitable model for the analysis. The second section of

the chapter presents the preliminary analysis for the country-specific data.

- Chapter six investigates the inflation and output growth relationship using both the panel data analysis and the country-specific analysis. The first section concentrated on the Granger causality analysis. The second section covers the panel analysis using both the dynamic and static models of panel estimations and the discussion on the rate of inflation vis-a-vis economic growth in the six WAMZ countries while examining the country-specific inflation threshold analysis. The third section discusses the major findings from both analyses.

- In an attempt to increase the robustness of the results, as well as provide a good of justification and economic explanation for the results obtained in the previous empirical chapter, the seventh chapter narrows the discussion to Nigeria.

- The last chapter concludes with a presentation of all the major findings of the whole research work and relates them to how they answer the posed hypotheses and research questions. It also presents the policy implications of the results and suggests policy recommendations from the findings. Furthermore, the chapter suggests further avenues of research revealed in this research work. It also highlighted the limitations of the research work and how future research can improve on them.

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1.8 Scope of the Study

The study focused mainly on the estimation of inflation threshold for the WAMZ. The study covered the six[3] integrating countries in the second West African Monetary Zone. Although the WAMZ was founded in 1999, the period covered in the study is from 1995 to 2014. The choice of this period was influenced by the availability of complete data on relevant output growth determinants for some of the countries in the WAMZ.

[3]Gambia, Guinea, Ghana, Liberia, Nigeria and Sierra Leone

CHAPTER TWO

A country's economic growth may be defined as a long-term rise in capacity to supply increasingly diverse economic goods to its population, this growing capacity based on advancing technology and the institutional and ideological adjustments that it demands"- Simon Kuznets.

2.0 Literature Review

2.1 Introduction

The relationship between output growth and inflation is one of the most investigated yet ambiguous relationships in macroeconomics both at the empirical and theoretical levels. The current chapter undertakes a theoretical, methodological and empirical exposition on the inflation-growth nexus. Specifically, the chapter looks at issues relating to inflation and economic growth; and reviews the various theories that explain the nature of the relationship between inflation and output growth.

2.2 Review of Theoretical Literature

2.2.1 Theoretical Models of Economic growth and Inflation

The theoretical propositions on economic growth have been mainly evolutional. Early growth models of Harrod (1939), Domar (1946) and Solow (1956) explained the long-run growth path of advanced capitalist economies with an emphasis on the role of accumulation of capital and technological progress. From an emerging country perspective, the relevance of the model is limited to the extent that an increase in accumulation of wealth is a necessary condition for the growth of economies. Romer (1986) tried to incorporate some of the development variables like human capital into the growth framework. Young (1994) in

his study also acknowledges the importance of increased labour force participation, improvement in education and inter-sectoral transfer of labour from agriculture to the industrial sector, a submission advanced by previous development literature. Generally, the theoretical literature on economic growth and inflation has been decomposed into four major areas such as the traditional theories, the neoclassical or exogenous theories, the endogenous theories of growth and the institutional approaches to growth.

2.2.1.1 Traditional Theories

The classical theorists view inflation as a cost-induced phenomenon. For instance, when wages exceed the marginal productivity of labour in a competitive market, a disequilibrium results in the labour market (Baird et al., 2017; Strydom, 1975). The implication is that more money than is required for the clearing of the goods market has been injected into the economy fuelling inflationary pressure. This usually occurs when price determination (including wages) in an economy is not left to market forces. Disequilibria and inflationary pressures such as this are common in societies where union's demands or government legislation determine prevailing wages. Employers' pay salaries above the equilibrium wage as an additional cost of production and pass them to the final consumers in the form of higher product prices especially for goods with inelastic demands.

The higher product prices neutralise the initial effect of increases in money wage. Depending on whether the increase in product prices exceed the rise in money wage or not, the worker may demand further increase in earnings which may result in a wage-cost spiral inducing in cost-push inflation in the economy. Factors that precipitate economic activities are dependent on the sources of inflationary pressure in a developing economy. It is within this interaction between economic

growth and inflation that the concept of ‘the structural theory of inflation’ is based. The major prediction of this theory is that better performance of macroeconomic indicators comes with attendant costs of an increase in the price level of the economy (see Blanchard, 2003).

In another version, inflation occurs due to excessive supply and structural rigidities in the characteristic features of developing economies. This theory asserts that inflation arises due to the unstable and slow growth rate of exports in the economy which is inadequate to support the required growth rate of the economy (Carmigiani, 2007). A uniform rate of increase of money wages throughout the economy must lead to permanent cost pressures in the service sector, which is assumed to have lower productivity growth. The structuralists argue that increase in investment expenditure and the expansion of money supply to finance it are only the proximate and not the ultimate factors responsible for inflation in the developing countries (Ndebbio,1998). In accordance with this theory, one should go deeper into the question as to why aggregate output, especially of food-grains, has not been increased sufficiently in the developing countries to match the increase in demand brought about by the growth in investment expenditure and money supply. The structural theory of inflation has been put forward as an explanation of inflation in the developing countries, especially in Latin America. The well-known economists, Myrdal and Straiten who have proposed this theory have analysed inflation in these developing countries regarding the structural features of their economies.

Kirkpatrick and Nixon (1967) have generalised this structural theory of inflation as an explanation of inflation prevailing in all developing countries. This has been argued by the exponents of the structural theory of inflation that economies of the developing countries of Latin America and Asian nations are structurally underdeveloped as well as

extremely fragmented owing to the existence of market imperfections and structural rigidities of various types. The result of these structural imbalances and rigidities is that whereas in some sectors of those developing countries we find shortages of supply relative to demand, in others, under-utilization of resources and excess capacity exist as a result of lack of demand.

According to structuralists, these structural features of the developing countries make the aggregate demand-supply model of inflation inapplicable to them. They, therefore, argue for analysing disaggregated and sectoral demand-supply imbalances to explain inflation in the developing countries. They mention various sectoral constraints or bottlenecks which generate the sectoral imbalances and lead to a rise in prices. Therefore, to describe the origin and propagation of inflation in the developing countries, the forces that generate these bottlenecks or imbalances of various types in the process of economic development need to be analysed. A study of these bottlenecks is, therefore, essential for explaining structural inflation in the developing countries. These bottlenecks are of three types: (1) agricultural bottlenecks which make the supply of agricultural products inelastic, (2) resources constraint or government budget constraint, and (3) foreign exchange bottleneck.

The traditional approach is anchored on the Classical theory of economic growth. This is the theory that a combination of an exploding population and limited resources will eventually bring economic growth to an end. Another name for the Classical growth theory is the Malthusian theory named after Thomas Robert Malthus. Classical growth theory suggests that an increase in real GDP per person (which was brought forth through advances in technology and the accumulation of capital) will be temporary because posterity will bring about a

population explosion and the population explosion will decrease real GDP per person. Interestingly, when the classical economists were developing their ideas about population growth, an unprecedented population explosion was underway. The classical economists used the concept of a real subsistence income (real GDP per person) to explain the high rate of population growth (Totonchi, 2011; Frisch, 1984). In classical theory, when real income exceeds the real subsistence income, the population grows. The increasing population decreases capital per hour of labour and eventually reduces real income to less than subsistence real income. If the actual real income is less than the real subsistence income, some people cannot survive, and the population decreases. Hence, no matter how much technological change occurs, real income (real GDP per person) is pushed back toward the subsistence level. This undesirable outcome led to Economics being described as a 'dismal' science.

Classical theorists laid the foundation for some growth theories. The basis for the classical growth model was laid by Adam Smith who believed in the supply side driven model of growth. The Classical production function is traditionally in the form:

$$Y = (L, K) \qquad 2.1$$

Gokal and Hanif (2004), modified this production function as follows:

$$Y = f(L, K, T) \qquad 2.2$$

where Y is output; L is labour; K is capital and; T is land.

Output relates to labour, capital, and land inputs. Consequently, output growth (gy) is driven by population growth (gL), investment (gK) and land growth (gT) and increases in overall productivity (g*f*).
Therefore;

$$gy = (gf, gK, gL, gT) \qquad 2.3$$

Smith (1778) argued that there is a self-enforcing growth with increasing returns to scale. Additionally, he saw savings as a creator of investment and hence growth, so that Smith viewed the distribution of income as being one of the most crucial determinants of how fast (slow) a nation would grow. Moreover, he held that profits decrease, not because of decreasing marginal productivity, but because of the upward trend of wage as a result of the competition of capitalists for workers.

The traditional theories of inflation are anchored on the disequilibrium between demand and supply in the exchange process. These theories began with the seminal contributions of Fisher (1956) and Friedman (1975) where inflation is conceived as the situation of an excessive supply of money beyond the absorptive capacity of the economy. Friedman (1975) typified inflation as being always and everywhere a monetary phenomenon in one of his celebrated writings. This position was an extension of the prediction enunciated with the equation of exchange advanced by Fisher (1947). The variants of the equation of exchange also surfaced in the theoretical literature on inflation when economists at the Chicago school of economics made a modification with the same prediction on how money remains a causal factor for inflationary pressures in the economy (see Blanchard, 2003). It is the combinations of Fisher's (1956) equation of exchange and Fisher's (1956) version of monetary inflation that is regarded as the classical theories of inflation.

In its growth model, the Classical assumptions were that all resources are privately owned, the existence of perfect market conditions and full employment equilibrium always exists. The emergence of the Keynesians questioned the thrust of the Classical argument that the market was 'self-correcting' and consequently, unemployment or market

disequilibria were a temporary phenomenon. The occurrence of the global depression of the 1930s and its protracted effect on output and unemployment debunked the Classical perspectives and gave credence to the Keynesian view as a probable alternative in explaining the behaviour of the market. Keynes (1936) posited that nominal rigidities exist and that disequilibrium remains a characteristic feature of all markets such that supply does not always equate demand. From the resulting demand theory, inflation results when there are disequilibria in the goods market arising from aggregate demand exceeding full-employment level. Essentially, the prevalence of an inflationary gap may be associated with excess demand, which exerts an upward pressure on commodity prices (Jhinghan, 2002)

A review of the classical growth theory did not specifically articulate the link between the change in inflation, and its tax effects on profit levels and output. However, the relationship between inflation and output growth are implicitly suggested to be negative. This is indicated by the reduction in firms‘ profit levels through higher wage costs.

2.2.1.2 Neoclassical or Exogenous Growth Theories

The earliest framework for economic growth was independently founded by Harrod (1939) and Domar (1946) and was then called the dynamic theory of growth. The initial model consisted only of capital and savings and states that economic growth originates solely through capital accumulation, which is as a result of improved savings in the country. Capital here refers to all physical capital including land, natural resources, and minerals. The Harrod-Domar model would serve as the foundation for the neoclassical growth theory. Solow (1956), an MIT professor, published his famous paper: ‘A Contribution to the Theory of Economic Growth,’ in which he formulated an economic model to describe and predict the future growth path of the US economy. The

model was an extension of the Harrod-Domar model which added labour, along with capital as factor inputs and similar models were also proposed by Swan (1956) and Meade (1961). This model became commonly known as the exogenous growth model or Solow-Swan model.

The neoclassical growth model lays great emphasis on the role of capital accumulation. The general concept of exogenous growth, which was developed during the 20th century, takes into cognisance the fundamentals of the neoclassical growth theory while expanding the concept to allow for events and scenarios related to economic growth in a contemporary setting. The Exogenous growth theory assumes that external rather than internal factors primarily determine economic growth. According to this belief, given a fixed amount of labour and static technology, economic growth will cease at some point, as ongoing production reaches a state of equilibrium.

The Solow-Swan model is based on the following assumptions:

- Countries produce a single, homogenous good of output.
- No government or international trade.
- All factors of production are fully employed.
- Technology stock is considered exogenous.
- Capital inputs are subject to diminishing returns.

This model, first constructed by Solow (1956) and Swan (1956), shows how economic policy can raise an economy's growth rate by inducing people to save more. However, the model also predicts that such an increase in growth cannot last indefinitely. In the long run, the country's growth rate tends to revert to the rate of technological progress. Hence, neoclassical theorists take this as being independent of economic forces or being exogenous. Underlying this pessimistic long-run result is the principle of diminishing marginal return, which puts an upper limit to how

much output an individual can produce by working with more and more capital, given the state of technology. We have a more positive view of the contribution that economic policy can make to long-run growth as we believe that the rate of technological progress is determined by forces that are internal to the economic system. Specifically, technological progress depends largely on the process of innovation, which is one of the most important channels through which business firms compete in a market economy, and the incentive to innovate depends very much on policies concerning competition, intellectual property, international trade, and much else. However, the neoclassical model is still a useful one, as its analysis of how capital accumulation impacts on national income, real wages, and real interest rates for any given state of technology is as valid when technology is endogenous as when it is exogenous.

Solow (1956) further extended his theory by introducing the influence of technological progress on the production process in his 1957 paper: 'Technological Change and the Aggregate Production Function.' The model presents total factor productivity growth, which is represented by parameter A, this is sometimes referred to as the available technology stock. The basic Solow model exhibits constant returns to scale and this is assumed to be capital-augmenting or Solow-neutral technology, as seen in equation 2.4 below. The success of this model owes first to its parsimony; only two equations describe the growth process: (1) a production equation that expresses the current flow of output as a function of the current stocks of capital and labour:

$$Y = AK^{\alpha}L^{\beta} \qquad 2.4$$

where A is a productivity parameter and where α and β are the output elasticity of capital and labour, respectively. These values are constants determined by available technology. A law of motion showing how

capital accumulation depends on investment (equal to aggregate savings) and capital depreciation is presented thus:

$$\Delta K = sY - \delta K \qquad 2.5$$

where; sY represents aggregate savings, and dK represents aggregate depreciation of capital.

What also makes this model the standard for growth analysis is, paradoxically, its suggestion that, in the long-run, economic growth does not depend on economic conditions. Specifically, economic policy cannot affect a country's long-run growth rate. Specifically, per capita GDP Y/L cannot grow in the long run unless we assume that productivity A also grows over time, which Solow (1956) refers to as "technical progress."

Although the pioneering articles of neoclassical propositions were published almost simultaneously by Solow (1956) and Swan (1956) where they present the neoclassical growth model with exogenous saving rates; later writers have effected various extensions and modifications. The neoclassical framework provided the benchmark for many subsequent extensions and applications developed over the last decades. The neoclassical growth models with endogenous consumer optimisation were subsequently developed in the seminal papers of Cass (1965) and Koopmans (1965).

In particular,

- Sidrauski (1967) developed an extension of the framework that includes money and inflation;
- Brock and Mirman (1972) analyse the neoclassical model with uncertainty;

- Blanchard (1985) presented a version of the neoclassical model with finite horizon, analysing the impact of government spending, debt, and deficits;
- Barro (1990) studies more generally the implications of public expenditure in the model;
- probably the best-known extension of the neoclassical model is the paper by Mankiw, Romer, and Weil (1992), who include human capital as the third factor of production to reconcile the neoclassical model with existing evidence on convergence rates;
- Caselli and Ventura (2000) allow for various forms of household heterogeneity within the Ramsey-Cass-Koopmans model (Stiglitz 1969 had earlier developed a model with heterogeneous agents but non-optimizing saving functions); and
- following Laibson's (1997) insights on hyperbolic time discounting, Barro (1999a) analysed the neoclassical model with non-constant time-preference rates.

The rational expectation theorists revolutionised economic thinking in the 1970s. The proponents advanced a theory that incorporates all available information in the decision-making process of economic agents. According to the rational expectation theory of inflation, public expectation of government policies enhances as well as alters the efficacy of such a policy. This is such that the desire to reduce inflation can only be effective if the monetary authority has credibility and is dynamically consistent (Lucas, 1972; Barro & Gordon, 1980; McCallum, 1980

With particular reference to the inflation-growth nexus, the rational expectation proposition is that the growth process of the economy is simply the outcome of the deviations between the actual and expected inflation coupled with the deviations between the actual and the potential output level in the economy. The formulation can either be the

minimisation of a loss function as evident in the Lucas (1972) framework of the maximisation of a utility function as espoused by the Barro & Gordon (1980) framework. In order to resolve the dynamically inconsistent problem that would keep inflation high, issues of delegation, credibility, and reputations of the monetary authority have been proposed (Romer, 2011). However, this usually comes at the cost of increased output volatility.

A new building block into the theory of inflation was provided by the new neoclassical synthesis (NNS) which lends credence to the theory of rational expectation as an important component of economic behaviour. The NNS also takes into cognisance the effects of intertemporal allocations of resources between the present and the future generations. Furthermore, the synthesis identifies the role of economic agents in the persistent and permanent increase in the price level. More so, the new neoclassical synthesis ascribes a role in demand and supply shocks in the economy as important inflationary factors. These shocks could be external, price-based, monetary, demand-driven, or fiscal with reference to the noneconomic explanation of inflation; the NNS is critically considered in the literature. Largely, NNS borders on the issues of strategic debt accumulation thesis of Alesina & Tabellini (1962) and also extends to the issue of central bank autonomy. Regarding the strategic debt accumulation thesis, political office holders tend to perpetuate themselves in office and devise various strategies and means which include accumulating debt; especially when it becomes obvious that the next officeholders would not share the same preference for them in terms of political administration.

However, the problem with the neoclassical model is that technical progress cannot be explained or even rationalised, the model hardly explains the sources of the technical change (Essien and Bawa, 2007).

Also, a review of the models in the neoclassical framework yielded different results regarding the relationship between inflation and economic growth. While some show that an increase in inflation can result in higher output (Tobin, 1972); others result in lower output (Stockman, 1981), while others have no change on output (Sidrauski, 1967). To analyse policies for growth, therefore, one needs a theoretical framework in which growth productivity is endogenous, that is, dependent upon characteristics of the economic environment. That framework must account for long-term technological progress and productivity growth, without which decreasing returns to capital and labour would eventually choke off all growth.

2.2.1.3 Endogenous Growth Theories

The neoclassical model previously discussed takes the rate of technological change as being determined exogenously, by noneconomic forces. There is a good reason, however, to believe that technological change depends on economic decisions as it comes from innovations made by profit-seeking firms and on the accumulation of human capital, and other such economic activities. Technology is thus an endogenous variable, determined by the economic system (Aderoju, 2013). Growth theories that take this endogeneity into account (especially since the rate of technological progress is what determines the long-run growth rate) are known as the endogenous growth theories. Incorporating endogenous technology into growth theory forces us to deal with the difficult phenomenon of increasing returns to scale.

The endogenous growth theories were borne out of the defects of the exogenous theories. Unsatisfied with Solow's (1956) explanation of exogenous growth, economists such as Romer (1996) and Barro (1990) worked to "endogenise" technology. They developed the endogenous growth theory which includes a mathematical explanation of

technological advancement (Aderoju, 2013). The model also incorporated a new concept of human capital, the skills, and the knowledge that make workers productive. Distinct from physical capital, human capital, on the other hand, has increasing rates of return. Therefore, on the whole, there are constant returns to capital, and economies never reach a steady state. Growth does not slow as capital accumulates, but the rate of growth depends on the types of capital a country invests in. A number of studies (Izushi and Huggins, 2004; Romer,1990) carried out in this area have focused mainly on what increases human capital (e.g.education) or technological change (e.g., innovation).

More specifically, the endogenous theories enunciate that people must be given an incentive to improve technology. However, because the aggregate production function exhibits constant returns to capital and labour alone, Euler's theorem states that it will take all of the economy's output to pay capital and labour their marginal products in producing final output, leaving nothing over to pay for the resources used in improving technology. Thus a theory of endogenous technology cannot be based on the normal theory of competitive equilibrium, which necessitates that all factors be paid their marginal products (Romer, 2011). Arrow's (1962) solution to this problem was to assume that technological progress is an unintended consequence of producing new capital goods, a phenomenon tagged "learning by doing." Learning by doing was presumed to be purely external to the firms responsible for it. This implies that if technological progress depends on the aggregate production of capital and firms are very small; then they can all be expected to take the rate of technological progress as being given independently of their production of capital goods. So each firm maximises profit by paying K and L their marginal products, without

offering any extra payment for their contribution to technological progress.

Learning by doing formed the basis of the first model of endogenous growth theory, which is referred to as the AK model. The AK model assumes that when people accumulate capital, learning by doing produces technological progress that tends to increase the marginal product of capital, thus, offsetting the tendency for the marginal product to diminish when technology remains the same. The model results in a production function of the form

$$Y = AK \qquad 2.6$$

where the marginal product of capital is equivalent to the constant A. The AK model predicts that a country's long-run growth rate will depend on economic factors such as thrift and the efficiency of resource allocation. However, given its historical place as the first endogenous growth model, the AK paradigm is an important part of any economist's toolkit.

Specifically, the first AK models go back to Harrod (1939) and Domar (1946), who assume an aggregate production function with fixed coefficients. Frankel (1962) developed the first AK model with substitutable factors and knowledge externalities, with the purpose of reconciling the positive long-run growth result of Harrod-Domar with the factor-substitutability and market-clearing features of the neoclassical model. The Frankel model has a constant saving rate as in Solow (1956), whereas Romer (1986) develops an AK model with intertemporal consumer maximisation, later refined by Romer (1990).

In Romer (1986), growth is sustained in the long-run by the fact that output is produced by expanding the set of inputs, which in turn prevents aggregate capital from running into decreasing returns. However,

Segerstrom et al. (1990), suggest that the innovations that drive growth by creating new technologies also destroy the results of previous changes by making them obsolete. The idea that productivity could increase as the result of learning-by-doing externalities was most forcefully pushed forward by Arrow (1962). Lucas (1988) developed an AK model where the creation and transmission of knowledge occur through human capital accumulation. Rebelo (1991) uses AK models to explain how heterogeneity in growth experiences can be the result of cross-country differences in government policy. King and Rebelo (1990) use the AK model to analyse the effect of fiscal policy on growth. Jones, Manuelli, and Stacchetti (2000) again use the AK framework to analyse the impact of macroeconomic volatility on growth.

2.2.2 Institutional Approach to Economic Growth

The institutional approach to economic growth, which can be traced to the work of Coase (1937), has allowed researchers to expand on the importance of property right. The quality of a state's political, legal and educational institutions can vary greatly depending on its history and geography. This can prove to be a significant cause of a country's development (or lack thereof). It can be argued that a stable rule of law and a healthy investment climate in which property rights are actively enforced can contribute significantly to economic performance. The institutional approach, as noted by Rispen (2009), recognises the following four fundamental determinants of economic growth:

1. Institutions ('man-made factors,' like., enforcement of property rights, equality of opportunity and effectiveness of markets).
2. Geography ('role of nature,' like., natural endowments, climate, and disease burden).
3. Culture (religion, 'social capital,' norms, preferences and values of the population).
4. Luck (multiple equilibriums, 'right place at the right time').

In their study, Glaeser et al. (2004) investigated if political institutions can cause economic growth and whether human capital and growth lead to institutional improvements. They measured institutional quality through government effectiveness and the degree of executive constraints. The authors conclude that institutions are not a source of growth in itself, but rather the accumulation of human capital. They also show that developing nations often experience high growth during dictatorial regimes that are effective in promoting beneficial economic policies. Subsequently, as developing countries develop, institutional improvements will take place over time.

Acemoglu et al. (2000) and Robinson (2000) offered a historical explanation of the presence of institutions that favour economic progress. They studied the effects of the decision of Europeans to settle in particular regions and its long-term effects on a country's future development. Acemoglu et al. (2000) argue that potential mortality rates of early European settlers is a good instrument for institutions. Their idea is that colonies, which, were ideally suited for settlement would model the institutions to those of their mother country and that these managed to persist till the present day. This would give way to a sophisticated institutional framework, which they argue is the cause of current day economic performance. The study further shows that countries, where Europeans established a settler colony, were much better off than those who were merely used as 'exploitative' colonies. Hence, they cited the lack of adequate legal and political institutions as being the main cause of their weak economic performance.

2.2.3 Review of Theoretical Linkages between Inflation and Growth

This section reviews a collection of theories in the extant literature that have been purposefully employed in the study of inflation and growth of the economy. These theories are often regarded as monetary theories of growth; which generally are reformulations of the fundamental theories of growth that have been discussed in four major strands of traditional, neoclassical as well as exogenous, endogenous and institutional theories of growth. A collection of these theories is termed the economic growth theories of transactional demand for money, such as the Shopping-time model of Baumol (1952) and Tobin (1956); Cash-in-advance theory enunciated by Clower (1967), Grandmont & Younes (1972) and Lucas (1980). Another strand of these monetary growth theories is the money-in-utility (MIU) model of Sidrauski (1967).

The Sidrauski (1967) model is prominent in this area, and it revolves around the baseline classical assumptions of a competitive market, prices (including wage) flexibility and money neutrality. The baseline formations of the model are depicted below;

The Sidrauski (1967) model is specified as a representative agent model that solves:

$$\max_{(c_t, m_t)} \int_0^{\infty} e^{-pt}\, u(c_t, m_t)dt, s.t. \qquad 2.7$$

$$a_t = f(k_t) - \delta k_t - \pi_t m_t + v_t - c_t \qquad 2.8$$

$$\lim_{t\to\infty} (e)^{-pt}\, a_t \geq 0 \qquad 2.9$$

where; c_t is consumption, m_t is the real money balances, k_t is capital, $a_t = k_t + m_t$ is the asset, π_t is the rate of inflation, v_t is lump-sum government transfers, $_p$ is the rate of time preference while δ is the rate of depreciation.

The Sidrauski (1967) model provides a microeconomic framework in explaining the contribution to the growth-generating process of all economic agents such as individuals as well as households, the firms, and the central bank and the government. It is a model of monetary transmission mechanism without the use of open market operations but importance is given to money growth, and the expectation of private agents plays a significant role.

Money is considered neutral as the level and evolution of the real variables of capital and consumption per unit of effective labour are each independent of the level of money supply. In the same vein, money is super-neutral for the same reason. The supply of money does not occur through an open market operation but as a once-and-for-all nominal income transfer likened to a 'helicopter drop of money' (Groth, 2011). He concluded that inflation is only affected by money growth. This possibility is generally anchored on the dimension as well as the dynamics of the interest elasticity of money demand.

Regarding the transactional demand for money, the model of Baumol (1952) and Tobin (1965) is the most classical. It was Saving (1971) who popularised this model. Lucas (1986), Lycas & Stokey (1987) and Cooley & Hansens' (1988), cash-in-advance model, assumes that before a consumer buys goods, they must be paid for by cash. In other words, the model treats money primarily as a medium of exchange.

According to Tsiang (1989), money demand is determined by the transaction motive. However, this approach assumes that money is used for transactions. He assumed that the motivation behind the use of money for transactional purposes is that market imperfection creates a need for a medium of exchange that does not exist in a frictionless Walrasian world. He argued that the approach fails to capture any short-run effects of money since it tends to minimise the presence of friction in an economy hence, can be presented as an explicit argument into the representative agent's utility function. Nonetheless, the opponents of this approach argue that assets (including money) do not yield utility directly. Money is held because it reduces transaction costs. Brock (1974), McCallum (1983), King & Plosser (1984), Feenstra (1986) and Kydland (1987) argue that money is allowed to enter the utility function only if the latter is an indirect one. They propose a micro-foundation model of money, which functionally is tantamount to the money-in-utility approach. This is the shopping time model, which, was first developed by Saving (1971). This approach justifies the role of money as a tool for facilitating transactions. In particular, agents value leisure, so they dislike shopping (i.e., the more time they spend on shopping, the less leisure as well as a utility they have). Money reduces the time agents spend on shopping and thus, increases both the amount of leisure and utility.

In general, both the money-in-utility function model and the shopping time technology model are functionally equivalent (Feenstra, 1986). In the three models of cash-in-advance, money-in-utility and shopping time technology, only two explanations are plausible for the role of money. According to the first, money emerges as a means of exchange for all assets. The second explanations state that the government imposes legal restrictions to make necessary transactions. In any explanation, the main implication is that the competitive equilibrium allocative is

Pareto-optimal. Money is posited to be an important component of the growth process if there is no liquidity constraint (Bewley, 1983) and if trade barriers or restrictions are demolished (Townsend, 1983).

Another significant contribution to the monetary theory of growth that links the inflation-growth nexus is Tobin's (1965) theory. Tobin (1965), is a reflection of the Keynesian short-run model and proposed a long-run theory of growth that explained the role of monetary factors in determining the degree of capital intensity of an economy. It is an extension of the Solow (1956) neoclassical growth theory that suggests capital formation as the major driver of the growth process and took technology as an exogenous factor (see Romer, 2011).

Solow (1956) posited that accumulation of capital and its dynamics is the net difference between the exogenous savings and break-even investment in the economy while Tobin (1965) ascribed a role for money as an intervening factor in the capital formation process where capital is decomposed into two forms: physical capital and money. Individuals can decide to hold capital in either of the two forms. Holding capital in physical form comes with a return but is considered illiquid while money is highly liquid but has an opportunity cost of loss of interest. More so, inflationary pressure tends to affect the value of money and erodes its purchasing power. Basically, there are two underlying decisions; capital accumulation decision and portfolio adjustment decision. The binding assumptions for this theory are that money has a fixed yield, serves as the medium of exchange and can only be supplied by the central government.

Concisely, this theory predicts that the equilibrium interest rate and degree of capital intensity are in general affected by monetary supplies and portfolio behaviour, as well as by technology and thrift. The transmission to the growth process is traced through disequilibrium in

the portfolio balance that is possibly necessitated by any or a combination of shock effects from irregular technological progress, labour force growth, saving behaviour, change in yield expectations or portfolio preferences. This portfolio misalignment produces two effects termed the Pigou effect and the Wicksell effect.

The former is output stabilising and the latter, output destabilising. Assuming a deflationary shock that results in an accelerated decline in prices, only augmented real money balances can restore portfolio imbalances. More so, the capital formation would improve as saving declines. This is the Pigou effect. However, accelerated decline in prices indicates a more attractive yield on money and encourages a further shift in portfolio demand in the same direction as the original shock. This is the Wicksell effect. Although there is no theoretical exposition on which of these two effects supersedes, the Pigou effect eventually exceeds that of Wicksell effect but not without a period of prolonged deflation characterised by zero or negative capital formation, which, then, retarded growth.

Finally, there are some reformulations of the endogenous growth theory to incorporate the role of money, and by extension, inflation, into the growth process. Starting from the mid-1980s and thriving in the early 1990s many macroeconomists moved their focus to the long-run and started "new growth" theories, including endogenous growth.

The Endogenous growth theory conceives economic growth as generated by components within the process of production, such as; increasing returns, economies of scale or induced technological change; in contrast to external or exogenous factors like population increases. According to this theory, the growth rate of the economy depends on a single variable, which is the rate of return on capital (Gillman et al., 2002). Variables such as inflation reduce this rate of return, which

subsequently decrease capital accretion and reduce the growth rate. Notably, one essential element differentiates the endogenous growth model from the neo-classical approach.

In its most basic form, the endogenous growth model suggests that per capita output consistently increases since the return on capital does not decrease below a positive lower limit. The underlying premise here is that individuals will only be prompted to continue accumulating capital if the return on capital is adequately high. Endogenous growth models also allow increasing returns to scale in aggregate production and also incorporate the function of externalities in establishing the performance of the capital rate.

Other endogenous growth frameworks that describe growth using human capital establish the growth theory by suggesting that the rate of growth is also dependent on the human capital rate of return and physical capital. Notably, the return rate on all types of capital should be constant in the balanced-growth equilibrium. Any tax on either kind of capital triggers a lesser return. When such a model is examined within the monetary exchange approaches suggested by Lucas (1980), Lucas and Stokey (1987), or McCallum and Goodfriend (1987), the rate of inflation decreases both the growth rate and the return on all capital.

Essentially, a tax on capital wage directly decreases the growth rate whereas a tax on human capital will negatively affect human capital by reducing hours worked. The decline in hours worked reduces the rate of return to human capital investment and may also decrease the rate of growth (Lucas, 1990), Manuelli and Jones (1995) developed an endogenous model that computed the supply of efficient labour to demonstrate the impact of money growth on economic growth and welfare. The model was founded on the assumption that money demand occurs primarily for transaction uses. Thus, as the rate of inflation

increases, the real value of depreciation tax credits declines and thus, the effective tax on capital income rises. Subsequently, individuals will reduce their capital accretion rate because of decreased after-tax return on capital. Ultimately, this impedes economic growth rate.

Further, alternative models of endogenous growth conclude that the effects of the inflation rate on economic growth are minimal. Gomme (1993) investigated the model identical to the one conceptualised by Cooley and Hansen (1989), which indicates that an increase in the rate of inflation causes a decrease in employment. Gomme's study shows that efficient allocations meet the criterion that the marginal value of the final unit of today's consumption matches or balances the marginal cost of the final unit of labour. Consequently, an increase in inflation decreases the marginal value of today's final consumption unit subsequently prompting individuals to work less. As labour reduces, the marginal product of capital also reduces and in the end, results in a declined rate of capital accretion. The findings by Gomme demonstrated that in this economic model, excluding a moderate inflation rate (say of about 10 per cent) elicits a minute (less than 0.01 per cent) gain in output growth.

It is along this extended theory of growth that the theoretical framework for investigating the inflation-growth nexus for this study would hinge. The basic justification for this is predicated on the fact that, unlike other reformulations, this framework has human capital as the major driver of the growth process through an increasing return to scale. Essentially, the countries that constitute the West Africa Monetary Zone (WAMZ) have a population as their major asset and resources usually navigate the growth process. West African countries do not have the baseline driver such as savings, abundant capital, and technological drive, which are the major drivers of other growth models.

2.3 Review of Empirical Literature

2.3.1 Empirical Methodology on Inflation and Economic Growth Relationship

This particular section considers the methodologies employed/adapted by several authors in determining the relationship between inflation and growth, to ascertain the rate at which inflation beyond a threshold becomes detrimental to growth. Different methodologies (Khan and Senhadji, 2001; Sarel, 1996) have been adopted/adapted in the literature to investigate the relationship between inflation and economic growth across various jurisdictions. Although most of these models require a large number of data in order to make valid inferences, these various methods present both their strengths and weaknesses in the estimation of the threshold inflation rate, hence, there is no comprehensive analytical method for evaluating optimal inflation. A lot of modeling frameworks have been used in the analysis of the inflation-growth relationship, these approaches include:

2.3.1.1 Khan and Senhadji Approach

Khan and Sehnadji (2001) utilised an econometric technique for optimal inflation estimation and derivation that were developed by Chan and Tsay (1998) and Hansen (2000). In testing for the threshold level of inflation for the industrialised and developing countries, the following equation was estimated using a non-linear least square (NLLS) estimation technique:

$$\mathrm{dlog}\,(Y_{it}) = \mu_i + \mu_t + \alpha_1 \log(\pi_{it}) + \alpha_2 D_{it}(\log(\pi_{it}) - \log(k)) + \Theta' X_{it} + \varepsilon_{it} \quad 2.10$$

where the variables employed are defined as follows:

$\mathrm{dlog}\,(Y_{it})$ is the growth rate of real GDP

μ_i is a fixed effect

μ_t is a time effect

$\pi_{it}$is inflation based on the CPI index

k is the threshold level of inflation

D_{it} is a dummy variable

X_{it} is a vector of other control variables that affect GDP

ε_{it} = error term

The dummy variable is defined thus:

$$D_{it} = \begin{cases} 1 \text{ if } \pi_{it} > k \\ 0 \text{ if } \pi_{it} \leq k \end{cases} \quad i = 1, \ldots\ldots, N; \qquad t = 1, \ldots\ldots, T \qquad 2.11$$

The dummy variable takes the value of one (1) if π_{it} is greater than k and zero (0) if π_{it} is less than or equal to k.

The parameter k represents the threshold inflation level with the property that the relationship between output growth and inflation is given by:

(i) α_1 representing low inflation;

(ii) $\alpha_1 + \alpha_2$ represents high inflation, this only happens when the value of inflation is higher than the threshold. High inflation implies that when α_2 is significant, and then both $(\alpha_{1+}\, \alpha_2)$ would be added to see their impact on economic growth, and that would be the threshold level of inflation.

In estimating different regressions for values of k, the value of k would be chosen arbitrarily in ascending order. The optimal k would be obtained by finding the value which maximizes the R-square or minimizes the Root Mean Square Error (RMSE). This particular threshold methodology or its variant had been used by different authors (Fabayo and Ajilore, 2006; Bawa and Abdullahi, 2011) in the analysis of inflation threshold.

2.3.1.2 Drukker Approach

Drukker et al. (2005) applied another econometric methodology for estimating the inflation-growth threshold. They used a non-dynamic, fixed-effects panel data model with an unknown number of thresholds to estimate the number of thresholds, their values and regression coefficients of the model. The model is of the form.

$$Y_{it} = \mu_i + \mu_t + \sum_{p=0}^{n} \varphi_p \, d_{itp} \pi_{it} + \Theta' x_{it} + \varepsilon_{it} \qquad 2.12$$

where the variables are defined as follows:

Y_{it} is the percentage growth rate country i at time t

μ_i is the level of country i's fixed effect

μ_t is the level of time t's fixed effect effect

$\pi_{it}$is inflation based on the CPI index

$\varphi_p$denotes the coefficient on the semi log transformation of inflation (π_{it}) for country i at time t

The semi-log transformation to inflation is defined as

$$\dot{\pi}_{it} = \begin{cases} \pi_{it} - 1, \text{if } \pi_{it} \leq 1\% \\ \ln(\pi_{it}), \text{ if } \pi_{it} > 1\% \end{cases} \qquad 2.13$$

X_{it} is a vector of other covariates

Θ' is a vector of coefficients on X_{it}

ε_{it} is the error term

d_{itp} is the indicator variable for region p

The threshold region indicator variable is defined as:

$$d_{itp} = \begin{cases} 1 \text{ if} k_p < \pi_{it} \leq k_{p+1} \\ 0, \text{otherwise} \end{cases} \qquad 2.14$$

Where; k_p for p ϵ {1, 2, …n} are the n threshold inflation points. The methodology applies the results of Gonzalo and Pitarakis (2002), in order to estimate the number of threshold points (n). The optimization

method selects the estimated model that minimizes the Root Mean Square Error (RMSE). One of the major benefits of this methodology proposed by Drukker et al. (2005) is that it offers the solution to the issue of endogeneity bias by eliminating preliminary or original income from growth regression. In addition, this experiential model employs similar covariates, which helps in the selection of control variables. This methodology variant had been used by some authors (Doguwa, 2012) in inflation threshold analysis.

2.3.1.3 Panel Smooth Transition (PSTR) Models

Panel smooth transition (PSTR) model is an extension of a smooth transition regression (STR) modeling to panel data. It is beneficial for outlining heterogeneous panels, with regression coefficients that show a discrepancy across persons as well as over time (Chang and Chiang, 2011). The PSTR model allows for heterogeneity in the regression coefficients by assuming that coefficients are continuous functions of an observable variable through a bounded function of such a variable, referred to as a transition function and, it fluctuates between extreme regimes (González et al., 2005). This model developed by González et al. (2005) and Fok et al. (2005) is a transition model where the switch from one regime to the other is smooth rather than discrete. The PSTR model has several features distinguishing it from the other models. One is the fact that the transition variable is cross section-specific and time-varying, which implies that it allows the regression coefficients to vary with respect to each cross-section; and each to move between groups and over time, depending on changes in the threshold variables. A simple case is a PSTR with extreme regimes and a single transition function.

The model can be expressed thus:

$$Y_{it} = \mu_i + \beta_0 \pi_{it} + \beta_1 \pi_{it} \varphi(s_{i,t}; \gamma, c) + \Theta' X_{i,t} + \varepsilon_{it} \quad 2.15$$

where

Y_{it} is the GDP growth rate

μ_i is an unobservable time invariant regressor

$\pi_{it}$is the inflation rate

$s_{it}$is the transition variable which governs the regime switching.

X_{it} is a $k-$ dimensional vector of control variables

ε_{it} is error term

$\varphi(s_{i,t}; \gamma, c)$ is a continuous transition function defined by

$$\varphi(s_{i,t}; \gamma, c) = \left[1 + \exp\left(-\gamma \prod_{j=1}^{n} (s_{it} - C_j)\right)\right]^{-1} \quad 2.16$$

The function is continuous, normalised and bounded between 0 and 1, γ is the speed of transition from one regime to the other and c denotes the threshold parameter $C_1 \leq C_2 \leq \cdots \leq C_n$. As $\gamma \rightarrow 0$, the transition function becomes a homogenous or linear panel regression model with fixed effects. As $\gamma \rightarrow \infty$, the transition function approaches an indicator function $I(s_{i,t} > C_j)$ that takes the value of 1 if $s_{i,t} > C_j$. If γ is sufficiently high, then the PSTR model reduces to a threshold model with two regimes as in Khan and Senhadji (2001). Therefore, in a case like that, the direct effect of inflation on economic growth will be β_0 for those countries with inflation less than or equal to C_j , and $\beta_0 + \beta_1$ for those countries where inflation exceeds C_j (Ibarra and Trupkin, 2011). Some of the authors that have used this methodology include Eggoh and Khan (2014), Baglan and Yoldas (2014).

2.3.1.4. Quadratic Function Approach

The quadratic approach to obtaining the threshold inflation rate is an adaptation of the Bruno-Easterly (1998) framework. This technique is a widely used straightforward procedure for estimating nonlinear relationships. This allows for changes in slopes as a function of changes in the independent variable. The model is specified thus,

$$Y_t = \beta_0 + \beta_1(\pi_t) + \beta_2(\pi_t^2) + \beta_3 X_{it} + \varepsilon_t \qquad 2.17$$

where

Y_t is the per capita GDP.

π_t is the percentage change in the CPI.

π_t^2 is the square of π_t and represents the non-linear relationship between inflation and output growth.

X_t is the vector of control variables

$\boldsymbol{\varepsilon_t}$ is a random error term

To obtain the inverted-U shape, we expect $\boldsymbol{\beta_1} > 0$ and $\boldsymbol{\beta_2} < 0$ implying that inflation has a positive effect on growth at low levels, but a negative effect at a higher level.

This approach has been applied by a lot of authors in the analysis of inflation threshold; they include Pollin and Zhu (2005) in their cross-country analysis, Younus (2010), López-Villavicencio and Mignom (2011), Thanh (2015).

2.3.2 Review of Empirical studies

The review of empirical literature can generally be categorised into two main strands; those that considered the nexus between inflation and economic growth as a linear relationship and those that found evidence for nonlinear interactions. The relationship of linear and nonlinear nexus has suggested a plethora of models, techniques as well as methods for empirical investigations. More so, the type of data frequency (such as yearly, quarterly, bi-annual and even monthly data) is said to be a significant factor that can alter the results obtained from empirical investigations (Ayinde, 2015). Empirical studies can also be categorised into studies that generally worked on inflation and output growth and the studies that focus on the WAMZ economies or developing countries generally along with country-specific and cross-country studies respectively. It is along these threads that this review of the empirical literature would be categorised. It will not be out of place to note that some of these factors undoubtedly overlap, but contradictions and consensus from each of these factors will be carefully highlighted in the end. The basic categorisation becomes a review of general studies on the inflation and growth relation, cross-country studies and country-specific studies. Importantly around the cross-country studies are mainly those studies that focus on the countries of the West African Monetary Union.

2.3.2.1 Empirical Literature on Inflation-growth relationship

2.3.2.1.1 Empirical review for causality relationship between inflation and economic growth

In the empirical review of the relationship between inflation and economic growth, most of the studies tend to assume that there is unidirectional causality from inflation to economic growth. Although some empirical studies (Erybaykal and Okuyan, 2008; Chimaobi,2010; Mubarik,2005) support this notion, others (Datta, 2011; Chuan Yeh, 2009) are of the view that there is bi-directional causality running from inflation to economic growth and vice versa.

Erbaykal and Okuyan (2008) tested the causality relationship between inflation and economic growth using data from 1997 to 2006 for Turkey's economy. The direction of causality was tested using the framework of the causality test developed by Toda Yamamoto (1995). The result of the analyses, within the stipulated period, shows the existence of causality in their relationship from inflation to output growth. According to their findings, in Turkey, while there is no causality relationship from economic growth to inflation, there is evidence of causality from inflation to economic growth.

Adopting the Johansen-Juselius co-integration technique and the Engle-Granger causality test to examine the existence of causality between inflation and economic growth in Nigeria, Chimaobi (2010) found a unidirectional causality from inflation to economic growth and also concluded that inflation has an adverse impact on economic growth at all times.

Datta (2011) examined the relationship between inflation and economic growth in Malaysia using data covering from 1971 to 2007. The findings

of the study show that there exists causality between the variables and that the direction of causality is from inflation to economic growth, The study further shows that in the long run, economic growth Granger causes inflation.

Chuan Yeh (2009) estimated the causal interrelationships between inflation and economic growth within a simultaneous equation framework. They used cross-sectional data from 140 countries over the 1970-2005 period. The result indicated a bilateral causal relationship between growth and inflation.

Michaelides & Milios (2009), inter-alia, evaluated the relationship between the output gap and inflation in the Russian economy for the period 1994 – 2006 and found a strong (causal) relationship. The results obtained were consistent with theoretical propositions as production as well as output gap has remained an important link between the real economy and inflation.

2.3.2.1.2 General Empirical review on the Linearity of inflation and economic growth relationship

The existence and nature of the relationship between inflation and economic growth have been subjects of considerable interest and debate. The literature on inflation-growth relationships is quite extensive. The concern of previous studies was not only finding a simple relationship between inflation and economic growth but also finding whether the relationship holds in the long run or it is just a short run phenomenon and whether the relationship is linear or nonlinear.

Economic theories have reached a variety of conclusions about the responsiveness of output growth to inflation. Different schools of thought offer diverse evidence on this relationship. The early economists are of the view that, as the economy grows, the rate of inflation increases,

thus, postulating a positive relationship between inflation and economic growth. There has been empirical evidence that supports this finding of Mundell (1963) and Tobin (1965) of a positive relationship between output growth and inflation. Mallik and Chowdhury (2001) are among the supporters of positive relationships between the two variables. To reach this conclusion they used a co-integration and error correction model to analyse data collected from four South Asian countries (Bangladesh, India, Pakistan, and Srilanka) and found a long run positive relationship between inflation and economic growth. They concluded that moderate inflation is helpful to economic growth.

However, with the concept of stagflation[4] gaining prominence in the 1970s, with little or no change in economic growth, the validity of the positive relationship was questioned. This was also buttressed by periods of low or negative output growth with inflation rates moving up continually. Some empirical studies found a zero relationship between inflation and economic growth. Bruno and Easterly (1995) have shown an insignificant relationship between inflation and economic growth; they found this result after eliminating high observation of inflation. Ahmed and Mortaza (2005) studied the threshold between inflation and economic growth in Bangladesh using annual data on GDP and CPI from 1980 to 2005. The empirical evidence of the cointegration and error correction model revealed that a statistically significant long-run negative effect exists between inflation and economic growth in Bangladesh. There are also studies that indicate an insignificant relationship between the two variables below the threshold level of inflation. For example, Christoffersen and Doyel (1998) detected 13 percent threshold level of inflation below which there is no significant

[4] Stagflation is a period of rising inflation but falling output and rising unemployment (Tejvan, 2016)

relationship between economic growth and inflation, but above that level, they have a negative relation.

On their part, Faria and Carneiro (2001) added a new dimension to the argument when they reported, with high-frequency data, that inflation does not affect output growth in the long run but has a negative impact on growth in the short run. They examined the inflation-output nexus in the context of persistently high inflation shocks. Their study was founded on the hypothesis that inflation shocks can be categorised into temporary and permanent components, the findings show that in the long-term, the reaction of output to a permanent inflation shock in increased inflation is not substantially varied from zero. Notably, this result provides crucial evidence for a reliable relationship between output and inflation in the long term (Faria & Carneiro, 2001). Moreover, Faria and Carneiro's findings support the super-neutrality concept suggested by Sidrauski (1967) in that inflation has no impact on output. Conversely, the results contradict Sidrauski when examined in the short run, since they found an adverse effect of inflation on economic growth (Faria & Carneiro, 2001). Their finding has brought about a convergence of opinion that high inflation hurts economic growth.

Friedman (1977) argued in his Nobel Lecture that inflation negatively affects output growth by snowballing inflation uncertainty (Friedman, 1977). A further investigation of Friedman's ideas by Ball (1992) showed that the rate of inflation worsens inflation uncertainty (Ball, 1992). On the other hand, Cuikerman and Meltzer (1986) stated that the positive correlation between inflation uncertainty and inflation might result from the positive influence of inflation uncertainty on the average rate of inflation (Cukierman & Meltzer, 1986). Feldstein (1997) also argued about the adverse impact of inflation on growth since it (inflation) has a potentially negative impact on capital accumulation (Feldstein, 1997).

To confirm the changing views of the 1970s and 80s, that inflation has an adverse effect on growth, Kormendi and Meguire (1985) are among some of the first researchers to empirically document the inflation-output nexus. They helped the shift from the conventionally perceived positive inflation-output relationship to a negative one. Specifically, they concluded that inflation has an adverse effect on output growth. In another study, Fischer (1993) examined the inflation-output nexus using cross-section, time-series and panel data sets for numerous countries. In his findings, Fischer (1993) found that inflation negatively affects growth by reducing productivity and investment growth. He maintained that inflation impedes the efficient allocation of resources as a result of detrimental changes in relative prices. Further, Fischer (1993) noted that small deficits and low inflation are not critical for increased growth even in the long run; similarly, increased inflation is inconsistent with sustained output growth. Fischer's conclusions were confirmed by Barro (1996) who examined the impact of inflation alongside other variables such as democracy and fertility among others on the economic growth of various countries. Barro used a growth model incorporating inflation as an explanatory variable in each period alongside other economic growth determinants (this eliminated the endogeneity problem associated with inflation). Barro's outcomes indicate a negative inflation-output relationship as higher inflation (15 -20%) was associated with the lower output. However, Barro also concluded that the relationship might not be linear as the relationship between inflation and output was not statistically significant at moderate levels of inflation.

Sarel (1996) tested for a negative inflation-output relationship using a panel dataset involving 248 observations across eighty-seven countries. This study also investigated the level at which inflation stops hurting growth. The results confirmed the occurrence of a threshold inflation

rate of eight per cent. Sarel (1996) also found that below the 8 per cent, inflation did not have any impact on economic growth and suggested a minimal positive influence. Conversely, where the rate of inflation exceeded 8 per cent, inflation had a negative, robust and significant effect on output growth. Sarel's findings also illustrate the nonlinearity of the inflation-growth nexus (Sarel 1996).

This convergence of opinions, seeming like success has created another kind of divergent opinion with respect to determining what constitutes 'high inflation' as 'high' implies that there is low inflation which might support or have a neutral effect on the growth process. While the likes of Kormendi and Meguire (1985) maintain that inflation has an adverse effect on output growth, Levine and Zervos (1993) and Sala-i-Martin (1997) point to inflation as being neutral to growth. If we are allowed to visualise the possibility of these extremes that confer non-linearity on the growth-inflation path, can it also enable us to situate the exact point where low inflation begins to be high inflation that impedes growth?

Singh and Kalirajan (2003) also examined the threshold effect using annual data from India. They found that from any level, a rise in inflation exerts a negative impact on output growth and that significant benefits can be accrued from a price stability-oriented monetary policy. Using the growth accounting equation, Hwang and Wu (2011) examined the likely threshold influence on China's economic growth. They discovered that this threshold effect of inflation is highly substantial and robust whereby beyond 2.5 per cent, increases in inflation hinder growth; while inflation levels below this mark facilitate growth (Hwang & Wu, 2011).

Fischer and Easterly (1993) empirically observed that the marginal effects of inflation on economic welfare fluctuate across escalating bands of inflation ranges. The study concluded that some economies

could survive moderate inflation rates of about 20 to 30 per cent without suffering any undesirable consequences on growth, but once inflation reaches a critical level of (40 per cent as stated by the authors), then inflation may be unfavourable for growth. The policy implications stated by these authors proved vague as they were not able to determine a specific inflation point at which economic welfare can be maximised, and the level where welfare losses are minimised.

Frackler & Rogers (1995) investigated a small open-economy macro model in which movements in inflation and output were driven by fiscal, real, monetary, exchange rate and asset disturbances for both Bolivia and Brazil; each being countries that undertook stabilisation programmes in the 1980s. Unconstrained Vector Auto-regression (VAR) and Structural Vector Auto-regression (SVAR) techniques, coupled with the post-estimation tests of Impulse Response Function (IRF) and Variance Decomposition were employed to estimate a Bernanke-type (1980) methodology with a different data structure for both countries. The authors used quarterly data that spanned 1980 – 1990 for Bolivia while for Brazil monthly data for the period 1983 – 1990 were employed. The study departs from other studies as scenario analyses were conducted to trace the effect of actual and counterfactual programmes on inflation and output. The results showed that the fiscal factor was inflationary in the case of the Bolivia stabilisation programme while output was unaffected. For Brazil, external factors accounted more for inflation and called for the need for price control mechanisms.

Savvides (1995) examined the factors behind differences in per capita growth rates across a panel of 28 countries for the periods 1960 – 1987. The fixed-effect panel technique was employed, and disaggregation into four seven-year sub-periods of 1960 – 1967; 1967 – 1973; 1974 – 1980 and 1981 – 1987; coupled with a holistic and region-specific analysis of the CFA region were undertaken. While many determinants of growth

were investigated, a reference to inflation rate suggested that it impacted negatively on the growth process in Africa and a comparison with the results obtained for the members of the CFA Franc zone showed no significantly different result.

In addition, anchored on the new Keynesian sticky-price models, Roberts (1997) enquired about the stickiness of the inflation rate. The author used semi-annual data decomposed into two periods 1961:1 – 1995:2 and 1967:1 – 1995:2 for the United States and the technique of two-stage least square was employed. The author found evidence that inflation expectation was less than perfectly rational. The implication was that the cost of increased inflation was depressing output growth.

Andres and Hernando (1997) in studying the correlation between growth and inflation for the OECD countries found out that the negative correlation between growth and inflation was not explained by the experience of high-inflation economies in the long run. They argued that inflation reduces the level of investment as well as the efficiency with which production factors are used. Specifically, inflation exerts a temporary negative effect on long-term output growth, which subsequently results in a decline in the per capita income. Besides, Andres and Hernando (1997) concluded that the long-run costs of inflation are not negligible, hence, lowering inflation is rewarding in terms of improved economic growth (Andres & Hernando, 1997). Gosh and Phillips (1998) sought to determine the robustness of the correlation between inflation and growth using a dataset of 3603 real per capita GDP growth observations for approximately 145 countries. The researchers also investigated the nonlinearity of the inflation-growth nexus. The outcomes of the study confirmed a negative but convex correlation between the variables. Gosh, and Phillips, found the threshold at 2.5 per cent, whereby rates of inflation above this point

exerted a negative influence on growth. Lower inflation below 2.5 per cent was associated with a positive correlation (Ghosh & Phillips, 1998).

Gylfason (1999) carried out a study to examine the main determinants of export and economic growth for the period 1985 – 1994 for a panel of 160 countries. A disaggregation into low-income, middle-income, high-income, open, closed, low inflation (less than 20 percent) and high inflation (at least 20 percent) countries were also investigated. The technique of analysis employed was the Classical Linear Regression Model (CLRM) model, and the main conclusion reached was that high inflation and abundant endowed natural resources spurred low exports and slow growth.

Espinosa and Yip (1999) analysed the interaction between growth and inflation, using an endogenous growth model that incorporated financial intermediation to access the effect of government financing on output growth and inflation. They found out that a marginal increase in government spending (especially if financed through an increase in tax rate) reduces output growth and raises inflation. In another study, Hung (2001) examined the inflation-economic growth correlation using an endogenous growth model. Hung demonstrated that when the costs of banking do not exhibit any externalities, a positive relationship exists between inflation and output growth. Conversely, where the cost of banking exhibits economies of scale; the initial rate of inflation determines the inflation-output growth relationship. As such, with a higher initial rate of inflation, a rise in the rate of inflation causes a decline in output growth and vice versa (Girma, 2012).

On a more positive note, Gillman and Nakov (2003) investigated the impacts of inflation in the context of an endogenous growth model. They discovered that rapid inflation increases the real wage to real interest rate ratio and thus increases the consumption of physical capital

comparative to human capital in all sectors of the economy. Bruno and Easterly (1998) investigated the relationship between inflation and economic growth using cross-country data. The authors found that inflation had a negative effect on the medium to long-term economic growth and showed that the relationship is influenced by countries with extreme values. They argued that inflation rates in excess of a critical value of 40 per cent are inimical to growth and went ahead to investigate only cases of discrete high-inflation (40 per cent and above) crises. This yielded a very robust empirical result that growth falls sharply during high inflation episodes and recovers rapidly as inflation falls to moderate levels.

Lee and Wong (2005) analysed the threshold levels of inflation using quarterly data for Taiwan for Taiwan 1965-2002 and 1970-2001 for Japan. Their analysis of the threshold model revealed that an inflation rate beyond 7.3 per cent is detrimental to the economic growth of Taiwan. For the case of Japan, they found two different threshold levels, at 2.5 and 9.7 per cent. It was concluded that an inflation rate below the estimated threshold level is favourable to economic growth and that inflation above the threshold level is harmful to the economic growth.

Munir et al. (2005) estimated the threshold effects in the relationship between inflation and economic growth in Malaysia using annual time-series data from 1970 to 2005. The results suggest the existence of one threshold at 3.9 per cent implying that there is a nonlinear relationship between inflation and economic growth in Malaysia. The estimation result shows that that inflation may promote economic growth when it is below 3.9 per cent and inflation may exert a negative effect on economic growth when it is higher than 3.9 per cent.

Dibooglu & Kutan (2005) investigated the sources of inflation and output movements in Poland and Hungary and provided policy implications for

the accession to the European economic and monetary union. The period of investigation spanned 1991 – 2001, with a monthly data frequency, while the technique of analysis employed; after a battery of stationarity and cointegration tests was the recursive-type Structural Vector Autoregression (SVAR) method, they found a mixed result. External shocks accounted for inflationary pressure in Hungary while nominal shocks held sway for price movement in Poland. It was found that monetary shocks affect output in the short-run in Hungary while supply shocks drive output movements in Poland.

The study of Narayan, Narayan & Smyth (2009) examined several hypotheses that relate to output and inflation dynamics in China for the quarterly period 1987:1 – 2006:1. The technique of analysis employed was Exponential Generalised Autoregressive Conditional Heteroskedasticity (EGARCH) and the hypotheses tested were to check if increased inflation uncertainty lowers average inflation; whether inflation volatility reduces economic growth; if higher output volatility increases economic growth and whether higher output volatility increases the average inflation rate. While the results obtained suggested consistent outcomes with the first three hypotheses, no evidence was found for the fourth.

Amano, Moran, Murchison & Rennison (2009) investigated trend inflation, wage and price rigidities and productivity growth and performed a series of calibration and scenario analyses. The optimal level of inflation was defined under no growth and a version of annual real per capita output growth of 2 per cent conditions. The no-growth condition showed an optimal inflation rate of 0.03 per cent on an annualised basis while a modeled version with output growth threw up a much lower optimal rate of inflation at -1.9 percent per annum. Generally, wage and

price rigidities were found to be important intervening variables in the inflation-growth relationship.

Hayat and Karajan (2009) reported that the recent increase in conducting country-specific studies for developing economies is attributed to two factors. Firstly, the more extended time periods employed in panel data studies tend to include high inflation periods associated with data from the 1970s which may influence the obtained threshold estimates. Secondly, the grouping of economies with vast differences in inflation experiences and generalising their estimated threshold for the whole group of observations may result in a biased threshold estimate that is driven by the inclusion of high inflation outliers. Malik and Chowdhry (2001) investigated the impact of inflation on economic growth for four south Asian countries (Bangladesh, India, Pakistan and Sri Lanka) using annual time-series data. Julius cointegration and error correction models were employed. The result of the cointegration tests revealed that a positive long-run relationship exists between inflation and economic growth in all the four countries even though they did not find any threshold effect of inflation on economic growth.

Phiri (2010) used quarterly data between February 2000 and July 2010 in order to determine which level of inflation is least detrimental towards finance-growth activity in South Africa. The ordinary least square technique was employed to estimate the model while robustness checks were confirmed by re-estimating the model using the two-stage least squares instrumental variable (2SLS-IV) method. The findings of the study revealed that inflation has an adverse effect on economic growth at all levels of inflation. The result also revealed that the least adverse effects of inflation on economic-growth are established at an inflation level of 8 per cent.

Brito & Bystedt (2010) considered inflation targeting in emerging economies for a panel of inflation-targeting and non-inflation-targeting countries as contained in the Goncalves & Salles (2008) and Batini & Laxton (2007) samples of emerging market economies; which spanned the period 1980 – 2006. A partial adjustment model within a barrage of estimation techniques such as pooled OLS, time-varying effect OLS, time and country-effect OLS and the two-staged Generalized Method of Moment (GMM) panel approach was used; to check for robustness. Both baseline and extended results were obtained, and evidence found showed that inflation targeting reduced inflation in an inflation-targeting (IT) regime but had a negligible effect on the volatilities of inflation and output. Further results suggested that IT central banks' goal of lower inflation significantly hindered output growth.

Younus (2012) examined the linkage between inflation and economic growth in Bangladesh using time-series data for the period 1976 to 2012. Correlation matrices, pairwise Granger causality, and ordinary least square were adopted in order to estimate the equation. The analysis revealed that a nonlinear relationship exists between inflation and economic growth with the existence of 7 to 8 per cent threshold of inflation.

Amusa, Gupta, Karolia & Simo-Kegne (2013) tested the long-run super-neutrality of money within the context of the South African economy for the period 1960 – 2010. The data frequency used was quarterly and the estimation technique employed was the Structural Vector Autoregression (SVAR) under a trivariate framework. The results obtained suggested that technological improvement was the driver of growth and that the inflation-growth nexus; which occurred through the interest rate link showed that monetary policy was found to be super-neutral in the South African economy. Budina, Maliszewski, de Menil &

Turlea (2006) investigated the long-run relationship and short-run dynamics among money, inflation, and output in Romania. A monthly data structure that spanned 1992 – 2000 was confronted with a battery of stationarity tests coupled with cointegration tests while a vector error correction method served as the technique of analysis. The results showed that the three variables lent credence to an expanded Cagan (1956) money demand function. Inflation was found to be a monetary phenomenon and output was shown to be strongly exogenous.

Neanidis & Savva (2013) analysed the effect of macroeconomic uncertainty on inflation, and output growth in G7 countries for the period 1957 – 2009 with monthly data frequency. The technique of analysis was the bivariate smooth transition VAR GARCH-M model with constant conditional correlations (CCC) which allowed the authors to test the effects of inflation uncertainty and output growth uncertainty on the levels of inflation and output growth on different transition regimes. The results showed that higher inflation uncertainties have a negative impact on output growth. This is because higher inflation uncertainty diminishes output growth, especially during high inflation periods. The result further showed that real and nominal output growth uncertainty has mixed effects on the average rate of inflation.

The study of Anthonisen (2013) built a monetary overlapping generations model anchored on spatial differentiation of markets and examined the relationship between inflation and the steady state level of output, on the one hand, and the relationship between inflation and the steady-state distribution of output across the economy; on the other hand. The author found that a change in money-growth induces a change in the distribution of money, which led to a change in labour supply and production throughout the economy. The velocity of money provided a nominal anchor through which inflation affects the real

sector. Fountas & Karanasos (2007) examined the effect of macroeconomic uncertainties on inflation and output growth in G7 countries for the period 1957 – 2000 with the technique of univariate GARCH models. A number of empirical results were obtained, but the most striking was that the inflation rate was found as the major determinant of inflation uncertainty while output growth uncertainty was found to be a major determinant of output growth in the G7 countries.

Seleteng, Bittencourt & van Eyden (2013) conducted a study on nonlinearities in the inflation-growth nexus in the SADC region and used the panel smooth transition regression approach – a fixed effect model with exogenous regression – to address endogeneity and heterogeneity problems. The major aim of the paper was to identify the threshold level with which the rate of inflation was considered optimal for the growth process in the region. At a double-digit figure of 18.9 percent threshold level, inflation was found detrimental to growth in the SADC region. The results also showed evidence for nonlinearities of inflation-growth nexus; therefore, the result justified the panel smooth transition regression approach. The period of investigation spanned 1980 – 2008 with eleven countries considered as four countries were dropped due to data paucity.

Tiwari, Oros & Abulescu (2014) revisited the inflation-output gap relationship using a wavelet transform approach which combined classical time series analysis with frequency domain analysis; this approach allows for co-movement of both series with both time and frequency dimensions. The wavelet transform approach has the advantage of dealing with structural breaks, nonlinearities in data and reconciliation of both time and frequency domain analyses. Essentially, the study tested the impact of output-gap on inflation dynamics in

France, and the results showed that output-gap was a major driver of inflation in short- and medium-runs.

Ayres, Belasen & Kutan (2014) enquired if inflation targeting could lower inflation and spur growth in a cross-country study that comprised fifty-one (51) developing countries of various regional blocs with quarterly data frequency that spanned the period 1985 – 2010. Due to some missing observations, the data structure used for the model was unbalanced, and an augmented Ordinary Least Square (OLS) specification was found appropriate for analyses. The study found mixed results of growth impacts of inflation targeting. Overall, the growth impact was short-term in nature. While Sub-Saharan Africa, Asia, and Oceanic nations experienced rising inflation and insignificant growth; those regional blocs of Middle East; North Africa and South & Eastern European nations had lower inflation rates and improved growth. The study of Chu, Cozzi, Lai & Liao (2015) explored the long-run effects of inflation in a two-country Schumpeterian growth model with cash-in-advance constraints on consumption and R & D investment. The study covered 34 OECD countries for the period 1960 – 2012; with the technique of analysis being panel fixed effects model. The results showed the damaging effects of increased domestic and foreign inflation rates on the growth process, and by extension, on welfare.

The study of Souza, de Mendonca & de Andrade (2016) contributed to the empirical literature on inflation targeting (IT) and output growth through the combination of econometric models that sought to capture the effects of IT on economic growth. A composition of three samples was considered. The samples comprised advanced countries, developing countries, and all countries. The study showed that the idea of a successful IT in maintaining low, stable inflation rates improved monetary authorities' credibility and thus fostered an environment that

stimulated output growth. The results obtained indicated that there is a constant positive effect on output after the adoption of IT.

2.3.2.2 Cross-country literature on inflation and economic growth relationship in the WAMZ Region

This subsection focused specifically on the relationship between inflation and growth in the WAMZ region and developing countries generally. In their study, Khan and Senhadji (2001) examined the issue of the existence of threshold effects in the relationship between inflation and economic growth using a new econometric technique that allows for appropriate estimation procedures and inference. Their investigation using a nonlinear least square (NLLS) estimation technique and an unbalanced panel dataset from 1960 to 1998 for 140 developing and industrialised countries, revealed the existence of a threshold inflation rate between 1 and 3 per cent for industrialised countries and between 7 to 11 per cent for developing countries. Confirming the threshold result, Fang et al. (2007), used cross-sectional data from 152 countries to examine the relationship between inflation and its variability. They found evidence of a threshold for inflation rates below 3 per cent.

Kremer et al. (2009) established the effect of inflation on long-term economic growth by using a dynamic panel threshold for 63 industrialised and non-industrialized countries. Their analysis showed that if inflation in the industrialised countries is above 2 per cent, it impedes growth while a threshold level of inflation of 11 percent impedes growth for non-industrialized countries. They, however, suggested that country-specific analysis might be a better option for the non-industrialized countries.

López-Villavicencio and Mignom (2011) used both panels smooth transition and Generalised method of moments (GMM) models to

estimate the inflation threshold for the industrialised and emerging economies. Their findings offer strong evidence that inflation impact on output growth is nonlinear. They found a threshold point of 2.7 per cent for industrialised economies and 17.5 per cent for emerging economies. Ahortor, C.R. et al. (2011), adopted conditional least square estimation technique used by Khan and Senhadji (2001) to re-estimate optimal inflation threshold for economic growth in the West African Monetary Zone with focus on Ghana and Nigeria. The results indicate a 13 per cent inflation threshold in Nigeria with 9-14 per cent as the pro-growth inflation rate. In the case of Ghana, 10 per cent inflation threshold inflation with pro-growth optimal inflation range of 6-12 per cent was reported.

Alagidede, Coleman & Cuestas (2012) examined the implications for West African monetary union membership of trends within the monetary union. A total of four of the six candidates for membership of WAMZ was considered with varying data structure. A collection of both basic and modified unit-roots and fractional integration tests were employed, and the study found, inter-alia that inflation was persistent and non-mean-reverting; though, with varying degrees for the countries considered; except Nigeria. The persistent level of inflation was found to be detrimental to macroeconomic aggregates, including economic growth.

Eggoh and Khan (2014) employed the panel smooth transition approach and a dynamic generalised method of moment's techniques in estimating the inflation threshold in 102 developed and developing economies. They confirmed a nonlinear relationship between inflation and output growth. Their result showed an inflation threshold of 12.4 per cent for the global data set. Estimating further after dividing the sample into four groups based on their income levels, their results showed an optimal inflation threshold of 3.4 per cent for the advanced countries,

10.0 per cent for the upper-middle income countries, 12.0 per cent for the middle-income countries and 20.0 per cent for the low-income countries.

Balogun and Yoldas (2014) used data on 92 developing economies to estimate a flexible semi parametric panel data with country-fixed effect. They found an inflation threshold of about 12.0 per cent. They further established that the relationship between inflation and output growth ceases to be statistically significant at very high levels of inflation.

2.3.2.3 Country-specific Evidence from WAMZ countries

Apart from the studies mentioned above, studies on inflation threshold for the WAMZ countries (except Ghana and Nigeria) have been sparse. Hence, this subsection focuses on country-specific empirical literature in the WAMZ. A number of studies have documented the existence of a country-specific level of inflation that is consistent with sustainable output growth; they include Mubarik (2005) who estimated the threshold level of inflation for Pakistan using an annual data set from 1973-2000. The estimated model suggests a 9 per cent threshold level of inflation above which inflation is harmful to economic growth. Using annual data spanning from 1993 – 2005, Hussain (2005) also conducted similar research for Pakistan. He found out that inflation rates exceeding a range of 4-6 percent would be detrimental to economic growth. Lee and Wong (2005) in their study using quarterly data set from 1970-2001 for Japan, found two threshold levels at 2.52 per cent and 9.66 per cent for Japan. Joao and Galrao (2001) investigated the relationship between inflation and growth in Brazil. The authors, using a bivariate time series model, found that inflation did not impact growth in the long-run, but there existed a significant negative effect of inflation on output in the short-run.

For most developed countries, an optimal inflation rate sustainable for growth is seen to be around 1.0 and 3.4 per cent, while for developing countries it is suggested to be within a range of 11 and 18 per cent (Akerlof et al., 2000; Khan and Senhadji, 2001; and Pollin and Zhu, 2006). All these studies showed evidence that the level of inflation in developing countries is higher than that for industrialised economies. Some of the empirical studies on the inflation-growth nexus have focused on country-specific studies. A number of studies (Ahortor et al., 2012; Balogun and Yoldas, 2014) have provided different views on the inflation threshold for the WAMZ countries.

The study by Ajilore and Fabayo (2006) adopting the Khan and Senhadji methodology (2001), estimated a threshold level of inflation for Nigeria using data from 1970 to 2003. They found evidence of inflation threshold level at 6.0 per cent, thus suggesting that the macroeconomic goal of Nigeria should gear towards attaining single-digit inflation in line with the WAMZ convergence criteria. Investigating further, using annual data from 1970 to 2008, Salami and Kelikume (2010) found a higher threshold level of inflation for Nigeria at 8 per cent.

Frimpong and Oteng-Abayie (2010) investigated the inflation threshold for Ghana over the period 1960-2008. Adopting a threshold model designed to estimate inflation thresholds rather than imposing a threshold level, they found a threshold effect of inflation at 11 per cent although the result failed the test of significance. They, therefore, concluded that the medium-term inflation target of 6 to 9 per cent annual average set by the Bank of Ghana was a policy in the right direction.

In a study of the WAMZ countries, Ahortor, C.R. et al. (2012) empirically estimate the threshold level of inflation in the WAMZ using a conditional least square technique. The analysis based on data availability used an annual dataset spanning from 1970 to 2010 for Nigeria, Ghana and

Sierra Leone and data spanning from 1980 to 2010 for the Gambia, Liberia, and Guinea. Their findings suggested the existence of a threshold level of inflation of 9 per cent for the WAMZ countries, which is within the convergence criteria of maintaining single digit inflation. Further analysis revealed country-specific inflation ranges of 7 to 11 per cent for the Gambia, 6 to 12 per cent for Ghana, 3 to 9 per cent for Guinea and Liberia, 9 to 14 per cent for Nigeria and 7 to 12 per cent for Sierra Leone. They thus recommended the need for policymakers to keep inflation rate within their country's threshold level.

A study by Bassey and Onwioduokit (2011) using the Li framework, established a statistically insignificant threshold level of inflation at 18 per cent. Bawa and Abdullahi (2012) used quarterly time series data for the period 1981 to 2009 to estimate an inflation threshold level for Nigeria. They also used the famous threshold regression model developed by Khan and Senhadji (2001) and estimated a threshold level of inflation for Nigeria at 13 per cent.

In the same vein, Doguwa (2012) uses three different approaches to re-examine the issue of the existence and the level of inflation threshold in the relationship between output growth and inflation in Nigeria. His findings using Sarel's (1996) approach suggested a 9.9 per cent inflation threshold and a 10.5 per cent threshold based on Khan and Senhadji (2001) methodology. Using the Drukker et al. (2005) approach, he found two threshold points of 11.2 and 12.0 per cent. He thus, concluded that the inflation threshold above which inflation becomes inimical to economic growth in Nigeria is estimated at 10.5 and 12.0 per cent.

Table 2.1: Summary of Empirical Literature.

Author(s)	Country	Methodology/Key findings Remark
Positive Relationship between Inflation and Economic growth		
Mallik and Chowdhury (2001)	India, Pakistan, Bangladesh and Sri Lanka	Applying a co-integration and error correction models to the annual data for the four countries found a positive relationship between the two variables in the four South Asian countries.
Dotsey and Sarte (2000)	United States of American	They found out that variability increases average growth through a precautionary savings motive. Hence a positive impact on growth in the short-run.
Negative Relationship between Inflation and Economic growth		
Barro (1995)	100 countries from 1960 to 1990	He found inflation harmful to growth, but his findings were driven by observations where inflation exceeded 20 per cent. Below that, the point estimate was negative but statistically insignificant.
Sweidan (2004)	Jordan	Using annual data from 1970 to 2003, he found a structural breakpoint effect at an inflation rate equal to 2per cent, beyond which inflation exhibits a negative effect on economic growth

De Gregorio (1996)	OECD and some developing countries for the period between 1960 and1985	He found a robust negative relationship between inflation and growth.
Motley (1998)	A cross-section of countries for the period between 1960 and 1990	Using a Solow growth model, he found that a reduction in inflation would increase the growth rate of real GDP.
Gokal and Hanif (2004)	Fiji	Examination of a bivariate relationship between the two variables using a causality test shows that causality runs from economic growth to inflation
Erbaykal and Okuyan (2008)	Turkey	Used quarterly data from 1987Q1 to 2006Q2. They employed the bound test is in examining the co-integration relationship and the WALD test developed by Toda & Yamamoto (1995) to investigate the causal relationship between the two variables. They found no statistically significant long-term relationship between the two macroeconomic variables under study. They found a negative and statistically significant short-term

		relationship.	
Faria and Carneiro (2001)	Brazil	They utilise a bi-variate time series model while employing the data from 1980 to 1995. The VAR modeling technique showed a short-run negative association between inflation and economic growth. But, they also found that there is no such relationship in the long run.	
Non-linear Relationship between Inflation and Economic growth			***Threshold Level***
Sarel (1996)	87 developed and developing countries	Using continuous annual data from 1970 to 1990 comprising of 87 countries, established that there is evidence of a structural break when the inflation rate is 8.0 per cent. Thus, inflation rate above 8.0 per cent was found to have a negative and robust effect, while that below 8 per cent did not affect growth, implying a threshold Inflation rate of 8.0% for the WAMZ	8.0%

Espinoza et al. (2010)	165 countries including oil exporting countries.	Using a smooth transition model with data that covers from 1960 to 2007, the result of the analyses indicates a threshold level of 10.0 per cent for all the countries, except for the advanced countries, which were lower. Implying a 10.0 per cent inflation threshold for the WAMZ	10.0%
Khan & Senhadji (2001)	140 developing and industrialised countries	Used non-linear least squares (NLLS) estimation technique and unbalanced panel data from the WEO[5] database spanning from 1960 to 1998. ; they found the existence of a threshold inflation rate between 1 and 3 per cent for industrialised countries and between 7.0 to 11.0 per cent for developing countries (including Nigeria)	7.0 to 11.0%
Kremer et al. (2009)	63 industrialised and non-industrialised countries	Used panel data to estimate the threshold level of inflation. The result showed that if inflation in the industrialised countries is above 2.0 per cent, it impedes growth while for non-industrialised	12.0%

[5]World Economic Outlook.

		countries including the WAMZ countries; it is above 12.0 per cent.	
Ahortor, C.R., Tarawalie, A.B., Sissoho M. and Conte, M. (2012)	WAMZ	Used annual data from 1970 to 2010 for Nigeria, Ghana and Sierra Leone and annual data set from 1980 to 2010 for Liberia, Guinea, and the Gambia. They estimated both the panel and the country-specific threshold level of Inflation for the WAMZ countries using Khan & Senhadji (2001) methodology. They found a threshold level of inflation of 9 per cent for the WAMZ, 3 to 9% for Guinea and Liberia, 6 to 12 % for Ghana, 7 to 11% for the Gambia, 7 to 12% for Sierra Leone and 9 to 14% for Nigeria.	WAMZ = 9% Guinea = 3-9% Liberia = 3-9% Ghana = 6-12% Gambia = 7-11% S/Leone = 7-12% Nigeria = 9-14%
López-Villavicencio	Industrialised and	The dataset includes 44 countries and covers the	17.5%

and Mignon (2011)	Emerging Economies	period 1961–2007. Based on PSTR and GMM models, their result showed that optimal inflation in the industrialised countries is 2.7 per cent, while that for the emerging (including WAMZ countries) is 17.5 per cent.	
Eggoh and Khan (2014)	102 developed and developing economies	Used annual data series from 102 countries for the period of 1960–2009. Applying the PSTR model, their result showed 12.0 per cent threshold for the global data set, 3.4 per cent for the advanced countries, 10.0 per cent for the upper-middle-income and 12.0 per cent for the middle-income countries (like WAMZ countries) and 20.0 per cent for the low-income countries.	12.0%
Balgon and Yoldas (2014)	Developing economies	Used a balanced panel of 92 developing countries. They estimated a flexible semiparametric panel data model between 1975 and 2004. They found an inflation threshold of about 12.0 per cent for the WAMZ countries.	12.0%
Fabayo & Ajilore	Nigeria	Used annual data from 1970 to 2003. Estimated	6.0%

(2006)		a threshold level of Inflation to be around 6.0 per cent using Khan & Senhadji (2001) methodology.	
Salami & Kelikume (2010)	Nigeria	Used annual data for the period between 1970 and 2008 to estimate an inflation threshold for Nigeria. They detected an inflation threshold of 8.0 per cent for the period between 1970 and 2008, and an insignificant threshold of 7.0 per cent from 1980 to 2008.	7.0-8.0%
Bassey & Onwioduokit (2011)	Nigeria	Using annual data from Nigeria. Adopting Li framework, established a statistically insignificant threshold level of inflation at 18.0 per cent for Nigeria, though not conclusive.	18.0%
Bawa & Abdullahi (2012)	Nigeria	Using quarterly data from 1981 to 2009, applied the threshold model developed by Khan and Senhadji (2001), they arrived at an inflation rate level of 13.0 per cent for Nigeria.	13.0%

Doguwa (2012)	Nigeria	Using quarterly data spanning from the first quarter of 2005 to the first quarter of 2012. Estimated the threshold level of inflation at 9.9, 10.5 and 11.2 to 12.0 per cent using Sarel, Khan & Senhadji and Drukker methodologies, respectively. Thus, the paper concluded a threshold range of inflation between 10.5 and 12.0 per cent.	10.5-12.0%
Mbutor, Nwosu & Balarabe (2012)	Nigeria	The findings reveal a non-linear growth-inflation function with the inflexion point occurring at 12 per cent. After this point, there is a sharp reversal of the positive effect of inflation on growth, from +0.07 per cent to -0.24 per cent at 13 per cent level of inflation.	12.0%
Frimpong and Oteng-Abayie (2010)	Ghana	Used annual data from Ghana. Applied the Khan and Senhadji (2001) framework to model inflation threshold in Ghana. They found a threshold of 11 per cent for Ghana although the result failed the test of significance at that level.	11.0%

Than S.D (2015)	ASEAN-5 Countries	Annual data from 1980 – 2011. Applied the Panel Smooth Transition Regression to ascertain the threshold effect of inflation on growth in Indonesia, Malaysia, Philippines, Thailand and Vietnam. Found an inflation threshold level of 7.84%	7.84%
Ahortor, C.R., Adenekan, A. and Ohemeng, W. (2011)	Ghana & Nigeria	Used annual data from Ghana spanning from 1970-2008. Adopted Khan and Senhadji (2001) model based on general-to-specific dynamic modelling approach. Their results indicate 13 per cent inflation threshold in Nigeria with 9-14 per cent as pro-growth inflation rate. In case of Ghana, 10 per cent inflation threshold inflation with pro-growth optimal inflation range of 6-12 per cent.	Nigeria = 9-14% Ghana = 10%

In summary, many studies in Nigeria have provided diverse views on the inflation threshold, starting with the study by Ajilore and Fabayo (2006) who estimated a threshold level of inflation to be around 6.0 per cent. Investigating further using annual data set spanning from 1970 to 2008, Salami and Kelikume (2010) applied the Khan and Senhadji (2001) methodology and found a higher threshold level of inflation for Nigeria at 8 per cent, while, using a co-integration technique and Granger causality test, Chimaobi (2010) examined the relationship between economic growth and inflation in Nigeria. His analysis showed a unidirectional causality from inflation to economic growth; hence, he concluded that inflation has a negative impact on economic growth at all levels.

Bassey and Onwioduokit (2011) used the Li framework, to establish a statistically insignificant threshold level of inflation at 18 per cent. Ahortor et al. (2011), adopted the Khan and Senhadji (2001) model based on a general-to-specific dynamic modeling approach. Their results indicate an inflation threshold for Nigeria, with pro-growth optimal inflation range of 6-12 per cent. Doguwa (2012) used three different approaches to examine the existence of inflation threshold in the relationship between inflation and growth in Nigeria. Using Sarel's (1996), Khan, and Senhadji (2001) approach, he discovered an inflation threshold of 9.9 per cent and 10.5 per cent, respectively. Using the Drukker et al. (2005) approach, he found two threshold points of 11.2 and 12.0 per cent. He thus concluded that the optimal inflation for Nigeria is estimated at a range of 10.5 to 12.0 percent.

In Ghana, Frimpong and Oteng-Abayie (2010) adopted a threshold model designed to estimate inflation thresholds rather than imposing a threshold level and found a statistically insignificant threshold effect of inflation at 11 per cent. Investigating further, Marbuah (2011) re-estimated the inflation threshold for Ghana. He found a threshold level

of 6 percent, however, after accounting for structural breaks, the threshold level increased to 10 per cent.

It can be deduced that the theoretical models engender various possible outcomes on the link between economic growth and inflation, including neutral, positive, negative or non-linear relationships among these variables. Some of the key theories that contribute to the inflation-growth relationship include Classical, Keynesian, Neo-Keynesian, Monetarist, Neo-classical and Endogenous growth theories. Notably, the classical view evokes supply-side theories, which lay emphasis on the need for incentives to invest and save if the economy of a nation is to grow, associating it with capital, labour, and land. Keynesian and Neo-Keynesian views offer a broader model for relating inflation to output growth based on the aggregate supply-aggregate demand (AS-AD) framework. Neoclassical and Endogenous Growth views attempt to explain the impacts of inflation on output using its effect on capital accumulation and investment. Lastly, monetarism apprises the Quantity Theory to reemphasise the crucial role of fiscal growth in determining inflation. It is evident that the outcomes of these models rely on the hypothesis reading the economy identified and the setup of each model. Notably, all theories attempt to develop conclusions that are aligned with economic theories.

Similar to the theoretical models, the findings of these studies vary through time from the conventional positive outlook to negative to a non-linear relationship in recent studies. From the reviewed literature, it is evident that some level of inflation is not detrimental to growth, implying that there is a point of inflexion beyond which the relationship between the two variables changes. However, with the differing results from various studies in the WAMZ, it is apparent that the impact of inflation on real output growth is still an unresolved issue in the empirical literature,

hence the question that needs to be answered is “where does the point of inflexion lie in order to deliver proper policy prescriptions?”, “could the differences in the established threshold point in the earlier studies be as a result of different time periods or methodologies?”, Could the inflation threshold for the various WAMZ countries be country-specific rather than the single digit inflation targeted by WAMI?. Considering the questions above, the flaws in some of the methodologies used, the non-significant results and non-conclusive studies, this paper aims at re-investigating the threshold level of inflation in the WAMZ.

2.4 Conclusion

This chapter intended to conduct a review of the relationship between inflation and economic growth, both at the empirical and theoretical level. To examine the different claims on the relationship between these variables, a number of theoretical and empirical literature were examined. An extensive review revealed a controversial concept both in the empirical and theoretical findings. According to Bruno and Easterly (1996), these theories can be classified into three. The first being the traditional 1960s that viewed high growth-low inflation era (Phillips Curve), they believe that inflation was highly correlated with economic growth in the short-run and to some degree in the long-run. On the one hand, macroeconomic models that integrate real or nominal rigidity forecast positive relationship between economic growth rates and inflation, at least in the short term. According to this forecast, this positive relationship may occur even in instances where market imperfections or stickiness are not present as a result of erroneous expectations regarding the future rates of inflation (Friedman, 1968) or misconstruction of nominal shocks (Lucas, 1972). For instance, using a sample of 127 countries, Bruno (1995) empirically demonstrated the existence of a positive relationship linking the rate of inflation and growth

but cautioned that with the inflation rate of more than 30% this relationship becomes a negative one.

There are the 1970s to 1980s era that focused on the short-run inflationary behaviour. The consensus in this era as restated by Bruno (1996) was that “stabilisation of hyperinflation had little output costs, whereas sterilisation of mere inflation was indeed costly.” Bruno, 1995, stated that inflation has its costs. Moreover, higher inflation rates may trigger the reallocation of limited resources to unproductive undertakings, subsequently, interfere with economic efficiency, and reduce output growth. The last classification is the 1990s that postulated an inverse relationship in the inflation-growth nexus. The new-growth theorists postulated that although persistent inflation will reduce the level of output, in the long run, relatively low inflation imposes a significant burden of losses on the economy.

In addition, the chapter considered a comprehensive review of the several techniques or models which are used in analyzing inflation threshold, highlighting their strengths and weaknesses. Although earlier studies on the threshold analysis relied heavily on the Khan and Sehnadji (2001) methodology and its variants, recent empirical studies utilised the PSTR and the quadratic approaches in investigating the nature of this relationship.

CHAPTER THREE

"Low and stable inflation in many countries is an important accomplishment that will continue to bring significant benefits"- Ben Bernanke

3.0 Inflation-growth relationship in the WAMZ countries: Stylized facts

3.1 Introduction

Regional integration in Africa is not new, as Africa has been the forerunner of economic integration initiatives as far back as 1910. South African Customs Union (SACU) is one of the oldest custom unions in the world. Moreover, since then, the number of regional economic units has increased; especially in Africa leading to the creation of a lot of regional economic groupings. As the numbers of regional arrangements between industrialised nations grow and advance, the push for meaningful integration initiatives across Africa has taken centre stage. Hence, the West African countries are taking significant steps towards becoming an important economic zone through integration.

This chapter provides a comprehensive background on the issue of monetary union and economic integration, with emphasis on the WAMZ; as a monetary union as well as the individual countries that constitute the WAMZ. As a prelude to the study, the primary and secondary convergence criteria that need to be met before the establishment of the single currency in West Africa are highlighted. It is against this backdrop that comparisons of the quantitative measures for the monetary union were made. In addition, various trends analyses and descriptive analyses that revolve around the inflation-growth nexus of the individual

countries of Gambia, Ghana, Guinea, Liberia, Nigeria and Sierra Leone were provided in order to underscore some stylized facts.

3.2 Background to the Emergence of the WAMZ

Monetary union can be defined as a currency zone where a single monetary policy prevails with a free circulation of a single currency or currencies that are perfect substitutes (Masson and Pattillo, 2001). Mankiw (2003) defined the monetary union as a group of economies that have decided to share a common currency and thus a common monetary policy. Hence, a monetary union could incorporate several currencies that are fully and permanently convertible into one another at irrevocably fixed exchange rates. This could be likened to having a single currency with various denominations, each printed by another member of the Union. A successful monetary union like that of the European Union is hinged on some criteria, which must be satisfied. Firstly, there must be a degree of factor mobility within the zone (Mundell, 1961). This implies that there is no restriction on the movement of labour and capital goods across the borders such that it is easy for factors to move to areas where they can earn maximum remuneration for services rendered.

Secondly, there is a need for openness and regional interdependency especially in the area of intra-regional trade, such that the use of a common currency will bring about a reduction in transaction cost (McKinnon, 1963). Also, a mix of macroeconomic policies is needed to counter any country-specific real shocks and stabilise the economy from economy-wide disruptions (Frankel and Goldstein, 1991). The idea of monetary union among sovereign states was widely promoted in the nineteenth century, mainly in Europe, despite the fact that most national currencies were already tied together closely by the fixed exchange

rates of the classical gold standard. Some of them included Zollverein union, the Latin Monetary Union, Scandinavian Monetary Union, United States Monetary union, African CFA Franc Union, European Monetary Union.

Table 3.1: Some Monetary Unions before WAMZ

Some Monetary Unions before WAMZ	
Monetary Union	**The aim of the Union and Member countries**
The German Monetary Union	This was built with the aim of increasing trade and political unity among the fragmented states of German Confederation. This proved to be a great success as it helped to secure the political unification of Germany in 1871 with Reichsbank (formally Prussian Bank) controlling the coinage of Germany's unified currency (Reichsmark).
Latin Monetary Union (LMU)	The success of the German Zollverein, paved the way for the establishment of this union in 1865, with France, Belgium, Italy, Switzerland and Greece entering into a currency union. They made the gold and silver coins of each of the member country as legal tender and freely interchangeable across the area. The union which was formally successful was however disrupted by pressures of wars and the rising disparity between the value of gold and that of silver.
Scandinavian Monetary	Formed in 1873 by Sweden and Denmark, with Norway joining after two

Union (SMU)	years. They used a currency based solely on the gold standard. The Union established the krone (crown) as a uniform unit of account, with national currencies permitted full circulation as legal tender in all the three countries. The suspension of convertibility disrupted the Union and floating of individual currencies at the start of World War 1. The agreement was finally abandoned following the global financial crisis of 1931, despite subsequent efforts during and after the war to restore some elements of the Union.
Africa's CFA Franc Zone	CFA franc was established in 1945 in order to consolidate the diverse currencies of many French colonised African countries. It was later replaced in the early 1960s with two regional currencies as most of France's African domains gained independence. The currencies issued by the Central Bank of West African States (for the West African Monetary Union) and Bank of Central African States (for the Central African Monetary Area) are equivalently defined. These currencies have always remained jointly managed under the aegis of the French Finance Ministry as integral parts of a single monetary union, commonly known as the CFA Franc

	Zone.
United States Monetary Union	At inception, all the states in the US had no mutually unified currency, but America's first Central Bank oversaw their currency. Later the second Central Bank was created in 1816, and it took over supervision until 1832. During this period, different currencies traded at a premium or discount to each other. However, with several types of bank notes in circulation, there was a need for unification of currency. Thus a national currency was passed in 1863. The national bank notes was produced and distributed across the country until the creation of the Federal Reserve Bank in 1914. The Federal Reserve Bank since its creation, produced and regulated the dollar, which is the national currency.
European Monetary Union (EMU)	The Union was formed in 1999 by a group of fully independent European states that have voluntarily agreed to replace existing national currencies with one newly created currency, the "Euro." By 2002, member governments formally delegated all monetary sovereignty to a single joint authority, the European Central Bank. Despite the failure of many past monetary unions, the EMU stood out, thus stimulating growing interest in a

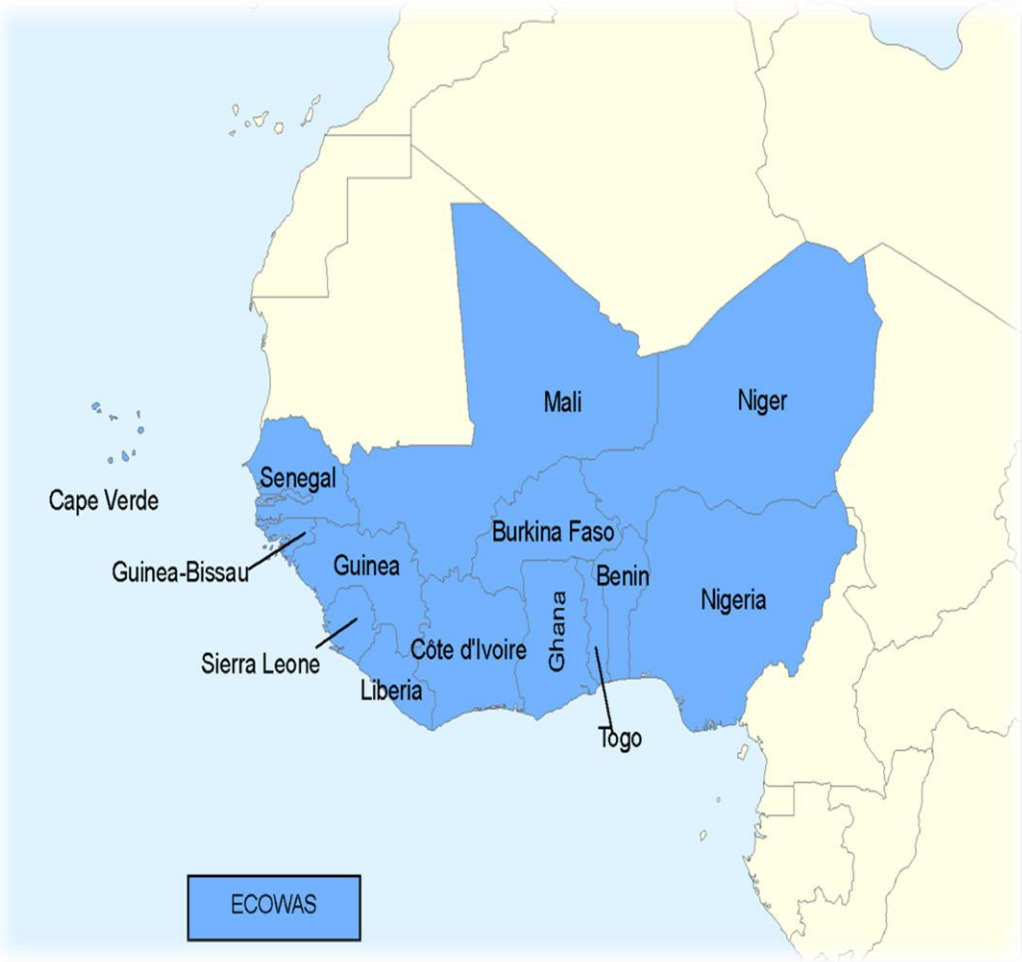
	monetary union in many parts of the world.
South African Customs Union (SACU)	This consists of South Africa, Botswana, Lesotho and Swaziland that signed an agreement in 1974 that the Southern African Rand will circulate freely in all the four countries as legal tender alongside the individual national currencies. Botswana, however, opted out from the agreement in 1975. All the states of the union accept common monetary policy determined by the Reserve Bank of South Africa (which is the leading power in the coalition), although, they still keep their currency and central banks.
Economic Community of West African States (ECOWAS)	Proposed to come up in 2020. To be formed by eight CFA countries plus Nigeria, Ghana, Guinea, the Gambia, Cape Verde, Sierra Leone, and Liberia. ECOWAS monetary union could constitute a more economically coherent alternative to the CFA franc zone.

Source: Author's compilation based on information from https://eh.net/encyclopedia/monetary-unions/

3.2.1 Establishment of the Second WAMZ

At the moment, ECOWAS is a strong economic force that has influenced the overall bargaining power of the countries in the global market of goods and foreign exchange. The West African countries are endowed with natural resources that include crude oil, other minerals, and agricultural potential. This means that they need sound socio-economic structure and political goodwill to expand their economic performance. Thus, integration will help to increase market size and opportunities for member countries.

Figure 3.1: The ECOWAS countries



Source: *https://www.businessinafricapays.com/wp-content/uploads/2015/04/ECOWAS-Region.png*

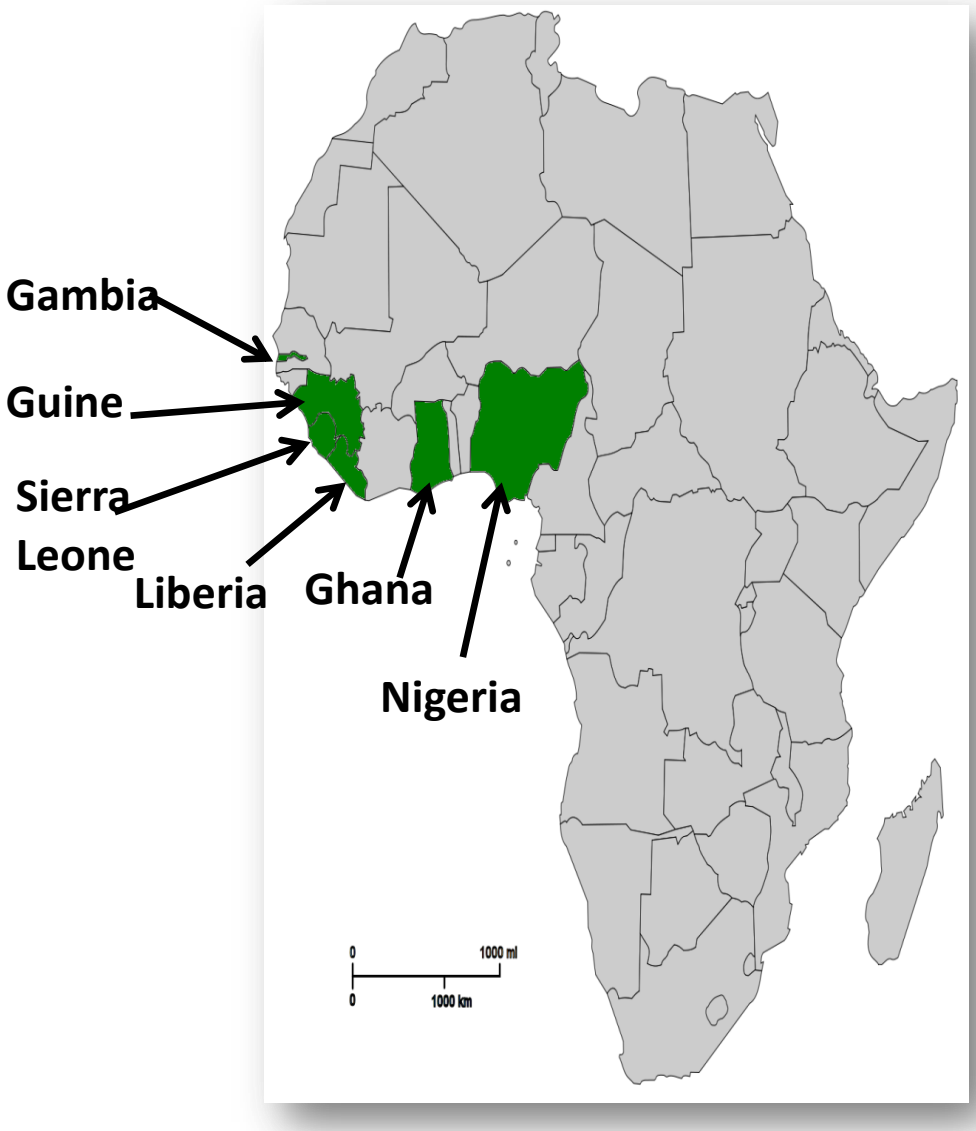
Deeper financial integration achieved through economic and monetary integration is expected to lead to greater financial stability. More so, there are potential trade gains for member states through trade creation and the enlarged market leads to improved foreign direct investment flows from both within and outside the region.

In order to harness these perceived dividends of regional integration as a move toward rapid economic growth, development, and transformation, ECOWAS was established in 1975. The establishment of ECOWAS was to propel West Africa's integration process by bringing together the West African Economic and Monetary Union (WAEMU) and the other countries that had their individual currencies to operate under a common umbrella. The main elements of the ECOWAS integration effort were: the ECOWAS Trade Liberalisation Scheme (ETLS); the ECOWAS Monetary Cooperation Programme (EMCP); free mobility of goods and persons; development of regional infrastructure, especially transport and communication; enhancement of regional production base; and harmonisation of macroeconomic policies.

Under the EMCP, adopted by the Authority of Heads of State and Government of ECOWAS in 1987, ECOWAS was to achieve a harmonised monetary mechanism through the implementation of joint policy initiatives. Following years of economic bottlenecks and political instability, the initial commencement date of 1992 for the establishment of a single monetary zone under the EMCP could not be met and was postponed to the year 2000. In a bid to consolidate the gains from this regionalisation and quicken the pace of integration, the Francophone countries established a monetary union and strengthened the union with macroeconomic convergence and harmonisation moves in 1994 (ECOWAS, 2014). Given the likelihood that the common currency goal may not be achieved, a decision to approach the

integration process through a two-track approach, conceived by Nigeria and Ghana, was agreed in Lome, Togo, in December 1999 by the Authority of Heads of State and Government of ECOWAS.

Figure 3.2: The second WAMZ countries



Source: Adapted from https://upload.wikimedia.org/wikipedia/commons/0/0b/States_of_the_WAMZ.png

Hence in the year 2000, the Anglophone countries followed suit with the formation of the second monetary zone involving the non-CFA countries. The establishment of the second WAMZ is based on the belief that economic integration can enhance the welfare of the member states. The main objectives of WAMZ are to promote trade integration in the region, trade and financial facilitation, harmonisation of legislation and statistics, payment systems, or macroeconomic convergence.

It is envisioned as a platform to promote cooperation and integration in order to raise the living standards of its people. Its establishment is for its institutions, policies, political support, legal and administrative arrangements to serve as a catalyst that would hasten the attainment of monetary integration among the member states through the introduction of a single currency in the zone. This is intended to fast-track the monetary integration among the ECOWAS sub-region. To achieve this, four Anglophone and one francophone country in the West African sub-region, came together in the year 2000 and pledged to adopt a common currency and also restructure their economies through meeting certain convergence criteria within a given time frame. The countries under question, in this case, are Nigeria, Ghana, Gambia, Sierra Leone, and Guinea (Cham, 2009). Liberia later acceded to join the zone in 2010.

The Union of these six countries was set to be called the second West African monetary zone (WAMZ) with a common currency called “ECO” to serve all of them (Nnanna, 2006). The goals of such economic plan are to strengthen local economic productivity, streamline systems and gain political bargaining power in the region, Africa and the rest of the world. There are plans in progress to undertake feasibility tests by the West African monetary institute which is headed by economic experts, political scientists and social scholars. It can be noted that the countries have different political structure, economic size, and social policies. A

successful take-off of such an economic union requires that each member state meet some requirements, and that remains the center of focus. Macro parameters are critical in determining the potential of each interested nation. It has, therefore, been the role of the West African monetary institute to keep a record of accomplishment of all the nations that seek to join.

According to Sachs, Stiglitz & Humphreys (2007: p121), some of the macroeconomic variables that act as a pillar to the sustainability of internal and external survival of an economy include price levels, employment levels, the inflation rate, gross domestic product and foreign exchange rates. In the event that a state fails economically, stern measures should be used to regulate the variables mentioned above. The West African Monetary Institute (WAMI) was established in December 2000 and started operations in March 2001. It was established to undertake the technical preparations toward the establishment of a West African Central Bank (WACB), introduction of the single currency, and to oversee the efforts of each member country towards strengthening macroeconomic policies which would enhance the Union. The Institute also had the responsibility of monitoring the performance of member countries in relation to macroeconomic convergence based on a set of criteria.

In order to relate the inflationary and GDP trend with the economic potential of all member countries, it would be appropriate to describe the WAMZ convergence criteria. The convergence criteria define the requirements to be satisfied by member countries to be eligible to participate in the union. The criteria consist of four primary and two secondary criteria. The four primary requirements are a function of macroeconomic variables while the other two secondary convergence conditions also constitute internal and external macroeconomic

variables (WAMI, 2007). These convergence criteria which are classified into primary and secondary criteria are listed in Table 3.2.

Table 3.2: The Second WAMZ convergence Criteria

Primary Criteria
• Maintain the inflation rate not exceeding single digit level at the end of every year. • Ratio of budget deficit (commitment basis) to GDP: less than or equal to 3 per cent. • Gross external reserves: greater than or equal to three (3) months of imports cover. • Central Bank Budget Deficit Financing: lower than or equal to 10 per cent of the previous year's tax revenue.
Secondary Criteria
• Nominal exchange rate: stable (+/- 10%); • Public debt to GDP ratio: Less than or equal to 70.0%.

Source: WAMI (2007, 15)

The convergence criteria were revised in 2015 from 10 (4 primary and 6 secondary) to 6 (with 4 primary and 2 secondary) with the criterion on Central bank budget deficit financing adopted first as a secondary criterion before it was later upgraded to a primary criterion due to concerns raised by the Convergence Council of the WAMZ. The upgrade was done to underscore the importance of fiscal dominance which is a major challenge hindering the attainment of price stability in member states. The Authority of Heads of States and Government of ECOWAS Member States approved this review in May 2015 based on a recommendation from the Presidential Taskforce on the EMCP.

The launch of the common currency, which is to be called “ECO,” was initially set for 1st of January 2003, but this was postponed to 1st of July, 2005 owing to the member countries’ inability to effectively comply with all the primary criteria simultaneously and on a sustainable basis. The Zone has also witnessed two further postponements of the launch dates to 2010 and 2015, still with no success, due to the insufficient preparation and economic convergence among the Member States of WAMZ. The inability of the WAMZ member countries to meet the set targets, thus, prompting several postponements, led the ECOWAS Heads of State to decide to adopt the Modified Gradualised Approach to monetary integration by 2020 (Fwangkwal, 2014).

Successful establishment of an ordinary exchange rate and monetary policy requires a minimum set of macroeconomic performance criteria. Failure to consider such criteria may render the union costly as the smaller, and disorganised economies may not survive the pressure in the face of financial crises as experienced by the European Union. Apart from that, the developed economies are likely to bear the brunt of the inability of other members to cope with the required standards, and this is a potential risk faced by Nigeria (Rotberg, 2004). In this respect, the emphasis is made on trend analysis of the macroeconomic variables of the countries mentioned above since they have been entangled in civil strife and poor governance characterised by widespread corruption and weak fiscal policies. A politically unstable environment reduces the investment rate, increases poverty, heightens mismanagement of resources and culminates in high inflation rates and lower GDP.

3.3.3 The Economies of the West African Monetary Zone (WAMZ)

The WAMZ countries are heterogeneous in terms of their GDP, population, and location, with only Guinea, Sierra Leone and Liberia sharing common borders. The WAMZ economies tend to rely on a few export goods (majorly primary products) despite being open economies. According to the United Nations (UN, 2015), the total land area for the zone is about 1.60 million square kilometres with a total population of about 228.9 million[6] people. The Nigerian population dominates with over 77.6 per cent of the total WAMZ population. The WAMZ economy measured by a combined nominal GDP of $1,192.6 billion (PPP) represents about 73.3 per cent of ECOWAS GDP put together. Although the zone is relatively large within the ECOWAS sub-region, it is a small open economy globally, accounting for less than one per cent of the global GDP (UNECA, 2015).

The WAMZ economies differ in terms of their pattern of trade across countries which are largely based on the structure of the economy, availability of natural resources and domestic demand. Agricultural products remained the major exports of The Gambia, Ghana and Sierra Leone while, fuel, agricultural raw materials ore and metal accounts for a small proportion of their total exports. Crude oil exports account for over 97.0 per cent of Nigeria's exports (IMF, 2012). Ores and metal form a larger share of Guinea's export, Rubber, gold, and diamonds constitute the main exports for Liberia.

In terms of financial integration, the WAMZ presently have only three operational Exchanges, the Ghana Stock Exchange (GSE), Nigeria

[6]Based on mid-year population estimate, from United Nations

Stock Exchange, (NSE) and the Sierra Leone Stock Exchange (SLSE). They operate within the confines of the national boundaries and have few linkages to other WAMZ member countries, although each of them has such a relationship with other exchanges (GSE with London Stock Exchange and NSE with Johannesburg Stock Exchange). The Gambia and Guinea are at the preparatory stage of establishing stock exchanges, having passed through a conceptual stage of setting up stock exchanges. A legal framework to establish the Conakry Stock Exchange and a Securities and Exchange Commission was passed in 1997 but is yet to be operationalized. The Gambia is still undertaking a comprehensive study for an exchange. A Joint Technical Committee for the Integration of the West African Securities Market has been instituted to consider harmonization options for integration. The GSE and the NSE alongside the Bourse Regionale des Valeurs Mobilieres (BRVM), West Africa Stock Exchange are fashioning modalities for the harmonisation and integration of rules and procedures.

Recent assessments of the WAMZ member countries' efforts to meet the convergence criteria are very bleak as shown in Table 3.3. From Tables 3.3 and 3.4, only Liberia satisfied all the four primary criteria in 2009 and 2010, while Ghana was the only country that satisfied all the criteria in 2011. In addition, Nigeria was able to satisfy all the four primary criteria in 2006, 2007 and 2013. The Gambia satisfied the criteria for three consecutive years from 2006 to 2008. No two countries satisfied all the four primary criteria simultaneously between 2009 and 2012.

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Table 3.3: Primary criterion met by WAMI member Countries

Number of Primary criteria met by WAMI member Countries													
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
	Dec	Dec	Dec	Dec	Dec	Dec	Dec	Dec	Dec	Dec	Dec	Dec	Dec
Gambia	2	1	1	3	3	4	4	4	3	2	3	3	2
Ghana	1	0	2	1	2	2	2	0	2	3	4	3	2
Guinea	3	2	0	0	2	1	2	1	1	0	2	2	2
Liberia	n.a	n.a	n.a	n.a	n.a	n.a	1	3	4	4	3	3	3
Nigeria	3	3	2	3	3	4	4	3	3	2	3	3	4
Sierra Leone	2	2	0	2	2	2	2	2	1	1	1	2	3
WAMZ	2.2	1.6	1.0	1.8	2.4	2.6	2.5	2.2	2.3	2.0	2.7	2.7	2.7

Source: WAMZ 2014

Table 3.4: WAMI member Countries Inflation Rates

WAMI member Countries Inflation Rates														
	Target of Inflation Rate < 10%													
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
	Dec	Dec	Dec	Dec	Dec	Dec	Dec	Dec	Dec	Dec	Dec	Dec	Dec	Dec
Gambia	4.49	8.61	17.03	14.21	4.84	2.06	5.37	4.44	4.56	5.05	4.80	4.25	5.70	5.95
Ghana	32.91	14.82	26.67	12.62	15.12	10.92	10.73	16.52	19.25	10.71	8.73	9.16	11.61	15.49
Guinea	1.1	6.1	14.8	27.6	31.37	34.70	22.84	18.38	4.68	15.46	21.35	15.22	11.89	9.71
Liberia	n.a	14.16	10.33	7.83	10.83	7.34	11.39	17.49	7.43	7.29	8.49	6.83	7.57	9.9
Nigeria	18.87	12.88	14.03	15.00	17.86	8.24	5.38	11.58	11.54	13.72	10.84	12.22	8.48	8.06
Sierra Leone	3.4	-3.1	11.3	14.4	13.1	8.3	11.65	14.83	9.25	16.64	16.19	12.87	10.27	7.33
WAMZ	12.15	8.91	15.69	15.28	15.52	11.92	11.23	13.88	9.45	11.48	11.73	10.09	9.25	9.31

Source: World Bank Development Indicators (2015)

Periodic review of inflation rate trend and Gross domestic product are essential in determining the macroeconomic policy reforms and the creation of a common monetary union. This will be discussed in the following sub-sections.

3.3.3.1 Gambia

The Gambian economy is a small open economy that relies primarily on tourism, agriculture, and remittances, with a population of about 2 million in 2014 (United Nations, 2017). Over the years, the real sector of the Gambian economy has witnessed some fluctuations in the national output occasioned by changes in its economic policies. In the monetary sector, the rise and fall of the inflation rate have reflected the changes in the money supply. The external sector development mirrors the weak economic base of the country as the country exports mainly primary products and largely imports manufactured goods. In the fiscal aspect, the Gambian economy is known to have excessive budget deficits (Onwioduokit and Bassey, 2014). The Gambia is a small nation in terms of geographical size and economy. It has the potential for realising strong economic performance but is engulfed in widespread poverty. Despite its Agricultural and tourism prospects, it has suffered a series of economic setbacks characterised by the double-digit inflation rate, high unemployment, and low gross domestic product growth. It has also been a victim of political instability including a military coup. This has been very costly to it in terms of foreign trade and local currency value.

The Gambian economy has witnessed mixed performance due to changes in its economic policy. The economic structure of the Gambian economy shows that initially, the main sector of the economy is agriculture as 75 per cent of its population depends on crops and livestock. In recent years, Gambia’s economy has been steadily growing due to development of tourism and the inflow of remittances in the

country. Output growth in the 60s was modest following the broad stable macroeconomic conditions until the 1970s when the economic performance deteriorated significantly because of unsuitable domestic policies and deterioration in the domestic and international terms of trade as well as adverse effects of the oil shock. Trend analysis of inflation performance in the Gambia between 1970 and 1979 showed that the country's inflation rate averaged 10.9 per cent with its real GDP growth averaging 4.9 per cent. Weak trade interactions in terms of exports against the increasing import dependence resulted in negative terms of trade shocks, export volatility, and instability in the domestic economy leading to low output growth. According to Gulde & Tsangarides (2008), from the 1980s, Gambian economy was characterized by frequent internal and external shocks that were reflected in significant inflation rate upsurge and a decline in economic activities coupled with an inverse trend in growth of gross domestic product that fell from 6.3 per cent in 1980 to 4.1 per cent in 1986. The fall in output growth and loss of competitiveness in the external sector continued and worsened the economic performance of the economy. The series of external and internal shocks in the economy in the early 80s pushed up the inflation rate to double-digit, peaking at 56.6 per cent in 1986.

To restore economic stability, the government in June 1985 implemented a comprehensive adjustment program (The Economic Recovery Program) which was targeted at reversing the ailing economic progress. Furthermore, in 1986, the authorities introduced the interbank foreign exchange market to allow for a managed float of its currency, which was hitherto pegged, to the UK pound. This stabilised the exchange rate. Furthermore, the monetary authorities adopted a flexible foreign exchange regime from the 1990s, which saw the country increase its currency value against the US dollar. The existing

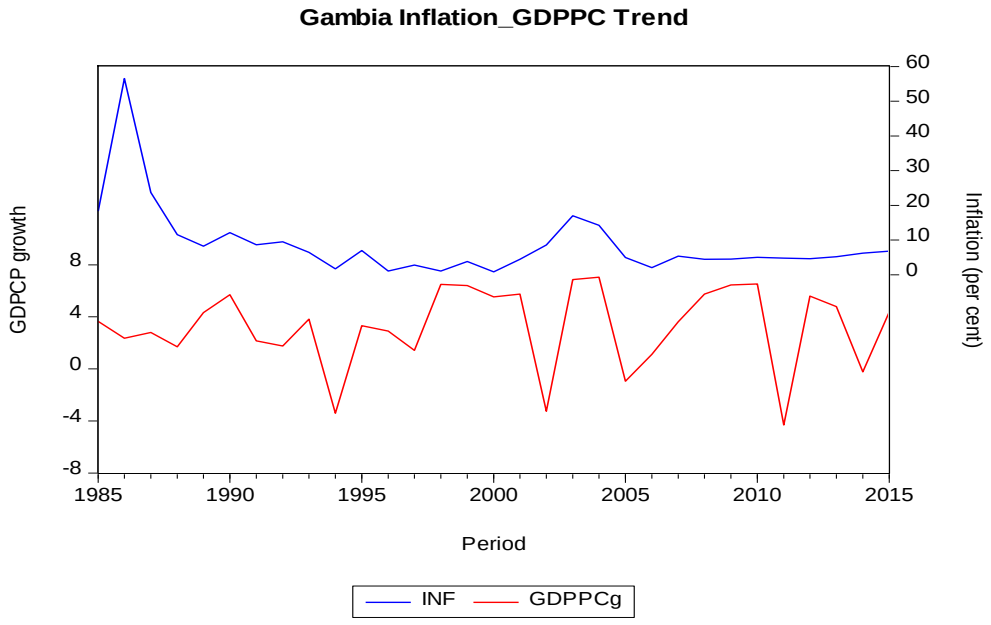
macroeconomic policy helped the Gambia realise a single digit inflation rate although the economy recorded a moderate output growth rate of 3.6 per cent by 1990.

From 1990 to 1993, the authorities adopted yet another program (Program for Sustained Development) which led to significant improvements in economic performance despite continued poor rainfall and the low price of groundnuts globally (World Bank, 2003). However, between 1993 and 1996, the economy was set back by a series of adverse shocks due to the reinforced border and transit controls in Senegal as well as the 1994 coup, which significantly disrupted economic activities. The agricultural sector was particularly affected leading to a massive shortage of food against high demand hence, inflationary pressure. In addition, the suspension of donor funding led to a contraction in government expenditure, which affected the foreign exchange rate, employment, and general price levels.

By 1995, the economic trend reversed, and the GDP growth increased from 0.2 per cent in 1994 to 4.9 per cent in 1997 and further to 5.5 per cent in 2000. The agricultural sector was the critical catalyst to this because of favourable bumper harvests, which attracted foreign donors as well as the renewed commitment by the government following the political stability attained after the 1997 and 2001 elections. The continuous decline in external reserves in 2001 and the accommodating monetary policy during the same period brought about a depreciation of the currency and a surge in the inflation rate from 1.0 per cent in 2000 to 7.0 per cent in 2003. The factors that accounted for the acceleration in inflation during this period were liquidity injection and the depreciation of the exchange rate of the Dalasi.

Despite the improved economic performance, the economy remained weak and highly vulnerable to external shock due primarily to the volatile nature of its major sources of growth. Although very bad weather led to a 3.0 per cent decline in the real GDP in 2002, the authorities responded by implementing a contractionary monetary and fiscal policy. The government introduced the National Emergency Fiscal Committee (NEFCOM) in 2002 to rationalise non-statutory expenditures and to control government commitments. The government also enacted budget management and the Accountability Act in 2004 to enhance budget formulation and execution.

Figure3.3: Inflation-growth in the Gambia



Source: World Bank Development Indicators& IFS CD-ROM

Furthermore, the Medium-Term Expenditure Framework (MTEF) introduced by the IMF was adopted as well as the introduction of a tight monetary policy stance in 2003 following the increasing surveillance imposed by the convergence council of WAMZ. All these policies

brought about a marked improvement in fiscal consolidation leading to a growth rebound in real GDP in 2003. From 2003 to 2006, average real GDP growth reached 6.4 per cent with an annual growth rate of 4.7 per cent between 2001 and 2006. Similarly, the inflation rate fell from 4.25 per cent in 2002 to 0.4 per cent in 2006. The depreciation of Dalasi coupled with the effect of expansionary fiscal policy and external shocks to the economy during the 2008/2009 global financial crisis mounted pressure on prices. This affected the inflation rate as it increased to 4.3 per cent in 2012 and further to 5.7 per cent in 2013. Real output growth in the economy averaged 5 per cent between 2008 and 2010. The growth was mainly a result of the robust growth in agriculture coupled with the inflow through the foreign direct investment in the tourism sector (UNECA, 2016). Between 2011 and 2014, GDP growth has been highly volatile. Output growth contrasted by 4.3 per cent in 2011 as a result of the decline in the agriculture sector. However, with the different macroeconomic policies implemented in the country, the economy picked up with real GDP growing at over 4.8 per cent in 2012 and 2013.

3.3.3.2 Ghana

The Ghanaian economy is one of the economically sound countries in Africa with a diverse and rich resource base, which has made the country one of the richest countries in Africa in terms of GDP per capita. However, the ineffective economic policies of past military governments and regional peacekeeping commitments have led to continued inflationary deficit financing and the depreciation of its currency.

Ghana has a history of inflation rate changes, GDP deteriorations, and different government intervention policies. Its economic progress started gaining momentum from the early 1960s immediately after independence under the leadership of Kwame Nkrumah. Ghana used conservative fiscal and monetary policy to contain inflation that floated at

a range of 1.7 per cent to 6.8 per cent from 1961 to 1963. After independence, the country emphasised industrialisation with an emphasis on import substitution. This was aimed at transforming the industrial structure and reducing its dependence on foreign goods (UNECA, 2004, pg. 112-6). However, due to poor governance, the domestic currency was not competitive in the foreign exchange market, and little demand for local products led to a hike in prices. Between 1980 and 1983, major macroeconomic indicators were sluggish as a result of high inflation which ranged between 50.1 and 122.9 per cent (IMF, IFS).

The upward movement in inflation was explained by high public expenditure, excess growth in money supply, external shocks among others. In an attempt to reduce the effects of inflation, the government initiated a price control mechanism. This distorted the economic structure, stagnated productivity and reduced GDP growth to negative 7.2 per cent in 1982. In April 1983, the government intervened by adopting an economic recovery programme (ERP) which was focused on minimising internal and external balances and establishing a path to sustainable growth.

With such a strategy, an average of 5.2 per cent economic growth was achieved by Ghana between 1985 and 1989. The average inflation rate fell from 123.0 per cent in 1983 to 25.2 per cent in 1989. It is notable that between 1990 and 2004 expansionary monetary policy; increased demand pressure led to the exponential price increase. In the opinion of Tenney, et al. (2011), the government increased expenditure, and this promoted an expansionary economic process with significant infrastructural growth. Thus, from the 1990s to the late 2000s inflation rate averaged 23.04 per cent while achieving positive growth in the gross domestic product at an average of 4.8 per cent.

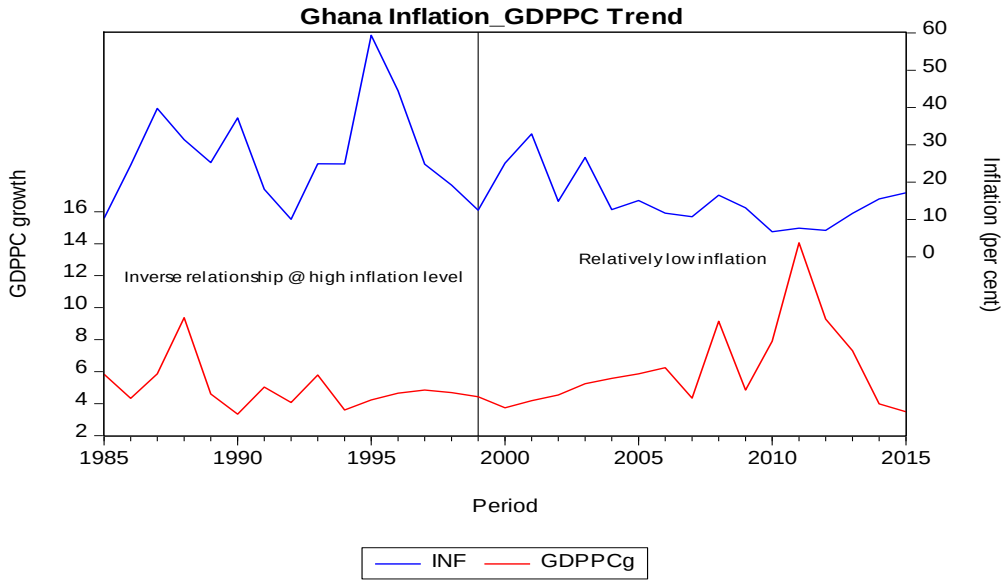
Table 3.5: Ghana Inflation_GDP

Years	Average Inflation rates	Average Real GDP Growth Rates
1980-84	70.3	-1.1
1985-89	26.3	6.0
1990-94	23.0	4.2
1995-99	32.1	4.7
2000-04	22.4	4.8
2005-9	13.4	6.4
2010-14	9.7	8.3

Source: Author's computation based on data from the WDI database and IMF, World Economic Outlook Database, 2015.

Looking at the trend from the year 2000 when WAMI was established, the inflation rate has been trending downwards, while growth in GDP has assumed an upward trend. Ghana inflation rate was 12.4 per cent in 1999, rose to 24.9 per cent in 2000 and then to 26.7 per cent in 2003 owing to unsustainable macroeconomic policies, exchange rate depreciation and an increase in petroleum products. The rate, however, fell to an average of 10.7 per cent between 2004 and 2007 as a result of new aid flows, inward private transfers and debt relief. With the adoption of inflation targeting in 2008, the rate has maintained a downward trend averaging 13.1 per cent between 2009 and 2014. The current inflation rate of Ghana is encouraging, and unemployment level is comparatively better than the entire West Africa region. However, the country has been experiencing economic shocks, especially during elections this has contributed to the country not meeting up with the expected WAMZ criteria.

Figure3.4: Inflation-growth in Ghana



Source: World Bank Development Indicators& IFS CD-ROM

Ghana's national development policy framework has been guided since 2010 by the Ghana Shared Growth and Development Agenda (GSGDA). Ghana's economic performance under its first Shared Growth and Development Agenda (2010-2013) was quite impressive, with an average real GDP growth rate of 9.6 per cent. The impressive growth was mainly due to oil production and its export, which began towards the end of 2010 (UNECA, 2016). The Ghanaian economy, however, has since 2013 endured growing fiscal and trade deficits, high inflation and a weakening currency leading to a decline in the country's real GDP growth of 4.0 per cent in 2014.

3.3.3.3 Guinea

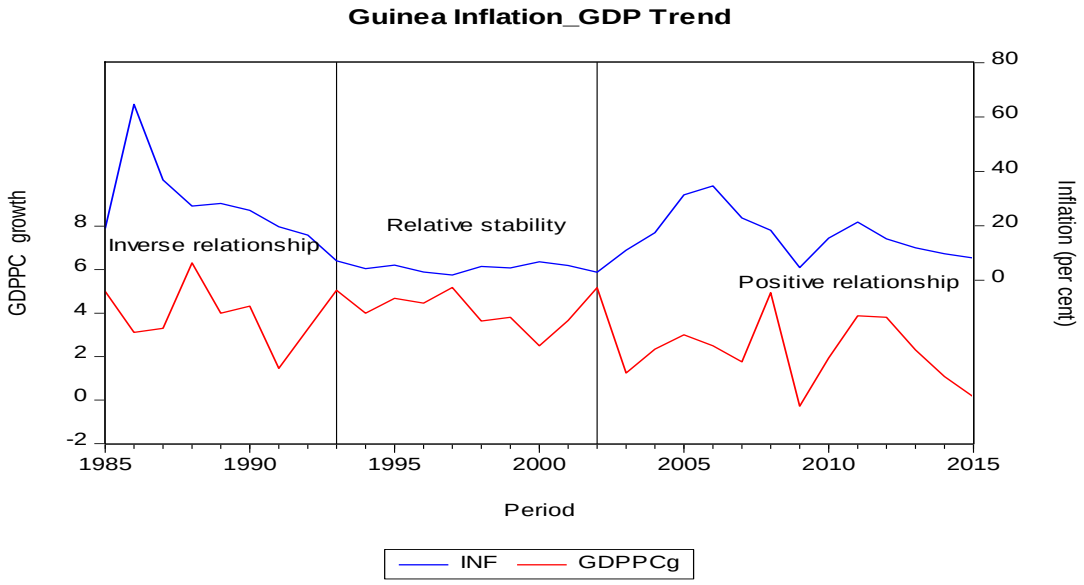
Guinea is a country that is richly endowed with natural resources. It is also seen as having considerable potential for growth in the agricultural and fishing sectors. The industry and services sub-sector accounts for more than 70.0 per cent of its GDP. Guinea started its economic progress system since independence in 1958.

The major components of Guinea GDP include agriculture, mining and the tertiary sector. The nation depends on these primary products for domestic consumption, exports, and foreign exchange. Although the inflation rate was relatively low in the 70s, it gradually grew to peak at 65.0 per cent in 1986. The high rate was attributed to partial economic liberalisation in the context of significant fiscal imbalances and loose monetary policy, combined with weak supply responses. A major development witnessed globally in the mid and late 1980s was the general fall in the prices of most primary products in the international market which adversely affected the economic performances of most developing countries in Africa. This led to the structural adjustment programme, which was aimed at diversifying the productive base of the economy and the creation of market-driven economies in 1986. To further stem the inflationary pressure, the government through its fiscal and monetary reforms brought down the level of inflation to an average of 8.7 per cent between 1990 and 2000. The reforms include devaluation of the national currency, trade liberalisation, and removal of price controls.

Between 2000 and 2010, Guinea's inflation rate edged up to an average of 18.1 per cent peaking at 27.6 per cent in 2004. The unsterilised nature of the foreign exchange market and the continuous depreciation of the Guinea franc were among other factors that caused inflation. The inflation rate, however, fell to 15.2 per cent in 2012 and further to 9.7 per

cent in 2014 owing to tighter money creation control and better management of public finances.

Figure3.5: Inflation-growth in Guinea



Source: World Bank Development Indicators& IFS CD-ROM

Annual real GDP growth, which was 4.3 per cent in 1990, increased to 4.7 per cent in 1993 and further to 4.8 per cent in 1998 following the moderate recovery effects after SAP (Ahortor et al., 2011). Real GDP growth, however, fell to 3.7 per cent and further to 1.2 per cent in 2001 and 2003, respectively, owing to the fall in the world prices of alumina and the adverse effects of political instability and civil wars in the neighbouring countries. Agriculture contributed more than 20 per cent to GDP between 1994 and 1999 as over 89 per cent of the nation's workforce is engaged in these activities. GDP growth, which averaged 4.1 per cent between 1990 and 2000, declined to an average of 2.7 per cent between 2000 and 2010. Unfavourable weather conditions, pest infections, low input supplies of water and electricity, rising prices of petroleum products and the decline in the world market price of the

country's main export, bauxite were the factors that led to the decline in GDP during the period. GDP growth further fell to 2.3 per cent in 2013, while recording a negative growth of 0.3 per cent in 2014. The fall could be attributed to political unrest linked to holding parliamentary elections and drop-in mining investment coupled with the short-term crisis resulting from the appearance of the Ebola virus epidemic in 2014.

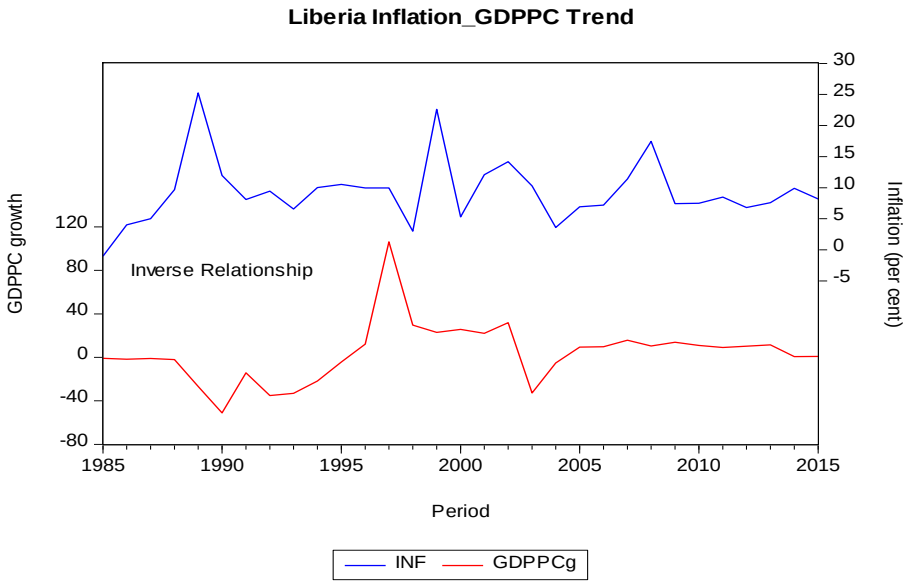
3.3.3.4 Liberia

Liberia is a low-income country that is richly endowed with water, mineral resources (gold, diamond, iron-ore, rubber, and oil), and a climate favourable to agriculture. Mining is a significant sector of the Liberian economy, given that the country is endowed with a vast amount of both metallic and non-metallic minerals (AER, 2014). However, civil war in the country and government mismanagement destroyed much of Liberia's economy, especially the infrastructure, making them heavily reliant on foreign assistance. Liberia has been at the centre of macroeconomic struggles since the 1980s. Their effort to attain a stable economy was shaken by great political instability and weak governance. The poverty level was lower than the global threshold, and this meant that a lot needed to be done in respect of the socio-economic reforms.

The civil war, which spans between 1985 and 1989, saw a slump in the GDP, recording negative values from 1980 up till 1995. It is evident that during the civil war, little could be done about economic progress. However, from 1995, the government initiated economic recovery programs and resuscitation, which resulted in an increase in the GDP. The economy began to reflect positive GDP growth, which increased from 12.1 per cent in 1996 to 31.9 per cent in 2002. During this period, inflation fell considerably to 0.7 per cent due to good economic progress. The outbreak of the second civil war between 1999 and 2003 however, pushed down the GDP by negative 32.8 per cent by 2003,

while the inflation rate worsened due to high demand versus great shortage, which significantly hampered economic progress.

Figure 3.6: Inflation-growth relationship in Liberia



Source: World Bank Development Indicators& IFS CD-ROM

A review of the existing statistics indicates that Liberia had experienced a boost in economic growth since the election of Ellen Johnson Sirleaf. Since 2006, there has been a shift in focus from agriculture towards service-led growth. After the change of power from the dictatorial Taylor, GDP growth improved to 9.5 per cent in 2005, while inflation rate fell to 10.8 per cent.

It is also worth to note that despite efforts to stabilise its macroeconomic variables, the poor monetary policy had made the country's flexible exchange rate regime incompatible with major global currencies. Although output growth was relatively steady at 9.0 per cent since the establishment of WAMZ in 2001, the path of growth, however, weakened with the 2008/2009 global financial crisis. Output growth fell to 5,3 per cent in 2009 before bouncing back to 6.1 per cent in 2010 and

further to 8.1 per cent and 8.7 per cent in 2011 and 2013, respectively. The major contributors of economic growth during this period were the resumption of iron ore production in 2011, coupled with the expansion of construction activities and the growth in the services sector. The shift in focus from agriculture towards service-led growth resulted in a rise in government revenue, which increased the fiscal space and enabled the Government to expand the provision of basic social services and fund public sector investment projects (especially infrastructure).

The country in 2011, benefited from debt relief under the Heavily Indebted Poor Countries (HIPC) initiatives, triggering additional relief from the Paris Club Creditors. This resulted in a fall in its public external debt (from US$4.6 billion in 2005 to US$115 million in 2011 (World Bank, 2013). Hence, inflation rate which was 17.5 per cent in 2008, fell to 8.5 per cent in 2011 and further to 7.6 per cent in 2013.

3.3.3.5 Nigeria

Nigeria, since the 70s has been majorly a mono-product economy relying heavily on oil as its major source of income. Nigeria is the largest oil producer in Africa and the tenth largest in the world, averaging about 2.3 million barrels per day, with 37.2 billion barrels of proven oil reserves (Agbaeze et al., 2014; OPEC, 2017). Despite these impressive oil resource endowments, an analysis of the contribution of the oil and non-oil sectors to the country's GDP showed that oil accounted for an average of 31.0 per cent of the Nigerian GDP in the 80s with the non-oil accounting for up to 69.0 per cent of the GDP. The adverse consequences of over-dependence on the oil trade heightened the need to diversify the Nigerian economy away from oil towards the non-oil export trade. Hence, government over the years in an effort to grow the non-oil export trade established supportive policies; this saw the contribution of non-oil GDP increasing from 68.7 per cent in 1989 to

70.8 per cent in 1999. The increase was not surprising with the trade liberalisation policy (this took the form of Structural Adjustment Programme) of the mid-1980s.

In terms of GDP growth, oil GDP has been increasing over the years from 12.5 per cent in 1984 to 26.4 per in 1990, with the non-oil GDP increasing from negative 5.9 per cent in 1984 to 4.9 per cent in 1990. Despite the various policies implemented by the government, the growth in non-oil GDP fell from 4.0.per cent in 1990 to 2.7 per cent in 1998, averaging 2.8 per cent within the same period.

However, the export promotion policy of the 1990s which was executed through intensified policy support to Small and Medium Scale Enterprises (SMEs) to enhance productivity and subsequently, export of local products saw the non-oil GDP growing from 2.7 per cent in 1998 to 10.7 per cent in 2007, peaking at 23.4 per cent in 2002. With the 2007/2008 global financial crisis, growth in non-oil GDP fell from 10.5 per cent in 2008 to as low as 5.8 per cent in 2012 and further to 3.8 per cent in 2015. Nonetheless, about 55.4 per cent of federally collected revenue is from the oil and gas industry (CBN, 2015). The major fallout of this fragile structure of the Nigerian economy was a situation where the economy had been growing without creating jobs and reducing poverty (Onodugo, 2013). Furthermore, the oil industry is a capital-intensive virtual enclave that generates very little employment.

The Agricultural sector, which dominated exports in the 1960s, gave way to the oil sector. Since 1996, the oil sector accounted for over 70 per cent of the total revenue and foreign exchange earnings. Generally, the significant increase in the international prices of oil from US$28.6/pbl in 2000 to US$113.4/pbl in 2012 could not result in the much fiscal buffer for the country despite the fiscal consolidation policy stance of the

government and the adoption of oil price rule to insulate the economy from oil price volatility.

Table 3.6: Nigerian Gross Domestic Product

Gross Domestic Product and Expenditure at 1990

	Constant Purchasers' Prices (N' billion)					Relative Weights					Contribution to Growth				
Components	Whole Sample	Average (1981 - 1990)	Average (1991 - 2000)	Average (2001 - 2010)	Average (2011- 2015)	Whole Sample	Average (1981 - 1990)	Average (1991 - 2000)	Average (2001 - 2010)	Average (2011- 2015)	Whole Sample	Average (1981 -1990)	Average (1991 -2000)	Average (2001 -2010)	Average (2011-2015)
Oil	6,783.8	4,953.4	6,629.1	8,406.4	7,503.8	0.26	0.32	0.32	0.23	0.12	0.44	1.26	0.19	0.45	-0.58
Non-Oil	23,939.8	10,700.5	14,422.6	30,776.4	55,863.4	0.74	0.68	0.68	0.77	0.88	4.19	1.54	1.89	8.29	5.38
Total GDP	30,723.6	15,653.9	21,051.7	39,182.8	63,367.3	1.00	1.00	1.00	1.00	1.00	4.63	2.80	2.08	8.74	4.80

Source: Author's computation based on data from the National Bureau of Statistics

This was because of the huge spending patterns of the three tiers of government which necessitated incessant drawdown of the crude oil savings account. As a result, the Central Bank's objective of maintaining the single digit inflation rate that was achieved in 1999 became a mirage for the most part of the period except in 2006 and 2007, and 2013 and 2014 as inflation averaged 12.2 per cent during the period. In addition, there was undue pressure on the exchange rate which depreciated from ₦102.1/US$ in 2000 to ₦158.2/US$ in 2011. The authorities in November 2011 adjusted the exchange rate band of the NGN-USD bilateral rate by ± 3% to accommodate continuing downward foreign exchange market pressures. With these, the Central Bank of Nigeria (CBN) limited the volatility in the exchange rate. The exchange rate appreciated to ₦157.3/US$ in 2012 and further to ₦157.3/US$ in 2013. Due to the slump in oil price in the latter part of 2014, the exchange rate depreciated to ₦169.7/US$ in 2014.

It has been noted that inflation was relatively modest in the 1960s. Relatively low inflation rate characterized the Period 1960 to 1973. Average annual inflation rate year-on-year during this period was 4.8 per cent. The inflationary spike of 33.3 per cent in 1963 was probably due to the implementation of the first national development plan, which was between 1962 and 1968. However, the period between 1973 and 1985 was marked by several developments that inflicted inflationary pressures on the economy. During the oil boom era, which was between 1970 and 1978, real GDP growth rate averaged 6.7 per cent annually, while inflation figures reached double-digit except for 1972 and 1973 when inflation rates were 3.2 per cent and 5.4 per cent respectively. Some of the reasons for the high inflation rate could be attributed to the drought in the Northern part of the country, which destroyed agricultural production and pushed up the cost of agricultural food items. The oil price shock in 1973, coupled with the promulgation of the Nigerian

Enterprises Promotion Decree (Indigenization Decree) of 1972, which enjoined government to control the 'commanding heights' of the economy, promoted fiscal expansion. The oil revenue windfall enabled the government to engage in huge fiscal expenditures to finance post-war reconstruction, huge infrastructural development projects, and the provision of basic social services. The huge public-sector expenditures which increased astronomically from ₦1,529.2 million in 1973 to ₦2,740.6 million in 1974 and further to ₦5,942.6 million in 1975, induced inflationary pressure on the economy. Consequently, inflation shot up from 18.5 per cent in 1973 to 43.5 per cent in 1975 before falling to 6.2 per cent as a result of various policies implemented to tame inflationary pressures.

Following the collapse of the international oil prices in the early 1980s, the weakness of the economy's dependence on oil revenue and exports became apparent hence the inflation rate rose from 16.1 per cent in 1980 to 38.8 per cent in 1983. The sharp increase in the inflation rate in 1983 was attributable to the austerity measures introduced in 1983 to stem the imminent collapse of the economy. Some of the factors adduced for this situation included import restriction and foreign exchange constraints, which led to severe shortages in the supply of goods and services.

This unhealthy macroeconomic development led to the introduction of the Structural Adjustment Programme (SAP) in 1986. The aim of SAP was to liberalise the economy and restructure the production and consumption patterns of Nigerians to reduce dependence on oil and achieve economic diversification. The resulting deregulation of key prices including the exchange rate and interest rates generated a pass-through to domestic prices, raising the rate of inflation from 13.7 per cent in 1986 to 61.2 per cent in 1988 and 48.8 per cent in 1992. The

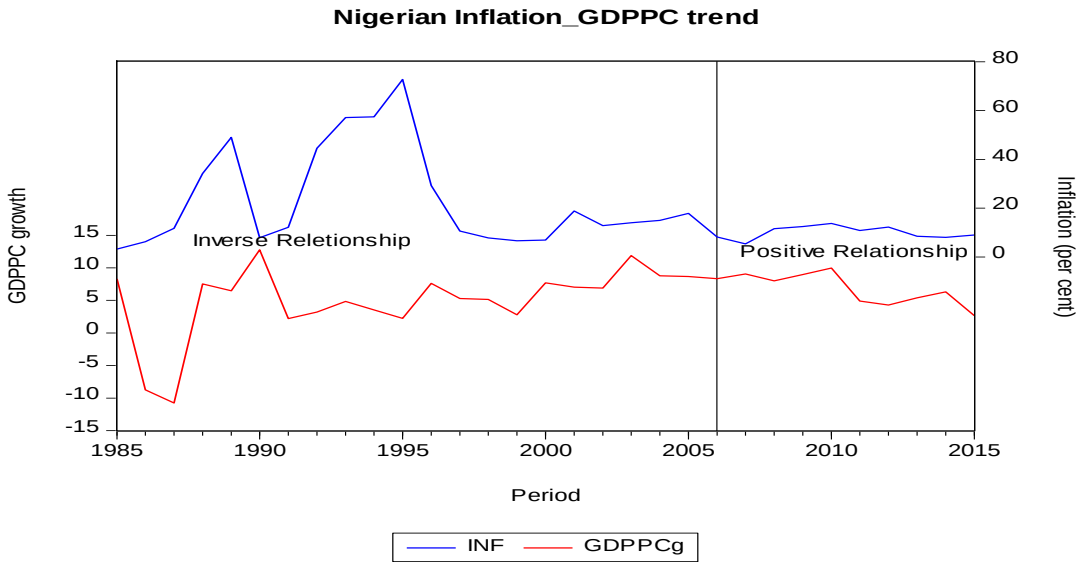
inflation rate rose further to 61.2 per cent in 1993 peaking at 76.7 per cent in 1994 before decelerating to 11.6 per cent in 1998. The average annual inflation rate during this period was 30.8 per cent. Olubusoye and Oyaromade (2008), observed that the main factors responsible for inflationary pressures during the SAP era were the wholesale depreciation of the naira exchange rate, which increased the price of imported goods, as well as, unprecedented growth in money supply with slow growth in output.

In 1999, the new civilian administration began to consolidate the gains of SAP by embarking on a series of institutional and economic reforms, including reform of the public sector, privatisation and commercialisation of public enterprises, fiscal and banking sector consolidation, and public debts management. The reforms included limiting government financing of deficits through ways and means advances by the Central Bank and the implementation of benchmark oil price rule with the creation of the excess crude account. Others include recapitalisation of the banking sector and further liberalisation of the foreign exchange market with the introduction of the wholesale Dutch auction system (wDAS), among others. The overall effect of these measures was to improve the macroeconomic environment, reduce inflationary pressures, and stabilise the exchange rate of the naira. Inflation dropped from 14.5 per cent in 2000 to 12.1 per cent in 2002 and 10.0 per cent in 2004.

Observing the inflation-GDP trend, real GDP growth was relatively stable until 2004, while the inflation rate was more volatile ranging from 5.4 to 18.9 per cent between 1999 and 2007. From 2005 to 2007 inflation hovered within the single digit range but shot up to 15.1 per cent in 2008 following the previous explosive credit growth while, GDP growth rate witnessed a sharp decline reflecting the effect of the global financial crisis, as inflation continued its upward trend.

Output growth rose towards the end of 2008 but suddenly dropped in 2009 indicating persisting global financial crisis. Inflation remained above 10.0 per cent between 2008 and 2012, while output growth averaged 6.0 per cent within the same period, showing signs of recovery from the effect of the global economic crisis. Following further weakening in the global economy, particularly the euro area, and the nationwide strike in Nigeria in January 2012, output growth declined by the end of 2012 to 4.3 per cent, before rising to 5.4 and 6.3 per cent in 2013 and 2014, respectively. On the other hand, inflation, which was 12.2 per cent in 2012, fell to 8.5 per cent in 2013 and further to 8.1 per cent in 2014.

Figure3.7: Inflation-growth in Nigeria



Source: World Bank Development Indicators& IFS CD-ROM

In the WAMZ period, the rate of inflation and value of the local currency has been consistent, and this serves as the global competitive measure of Nigeria. The macroeconomic progress of Nigeria is currently under threat due to the emergence of Islamic militant Boko Haram. This is

becoming a regional investment risk through security risks that need to be solved through collective efforts. Classifying the observed inflation rate into subgroups (depending on the severity) from minimum to maximum, we observe that within the WAMZ period (2000 to 2014), the inflation rate in Nigeria was below 20 per cent. Average inflation between 3.0 per and 10.0 per cent, corresponds with an average GDP of 6.5 within the same period, while average inflation rate between 10 and 20 per cent corresponds with an average GDP of 8.6 per cent. This implies that within the review period, the country witnessed walking, running and galloping inflation.

Table 3.7: Inflation classification in Nigeria based on speed (1984-2014)

Inflation Range	Frequency	Average Inflation	Average GDP
Walking Inflation (3<π<10)	10	7.05	6.5
Running Inflation (10≤π<20)	12	13.23	6.71
Galloping Inflation (20≤π<50)	8	37.24	6.01

Source: Author's computation based on data from World Bank Development Indicators and IFS CD-ROM .
Π signifies the inflation rate

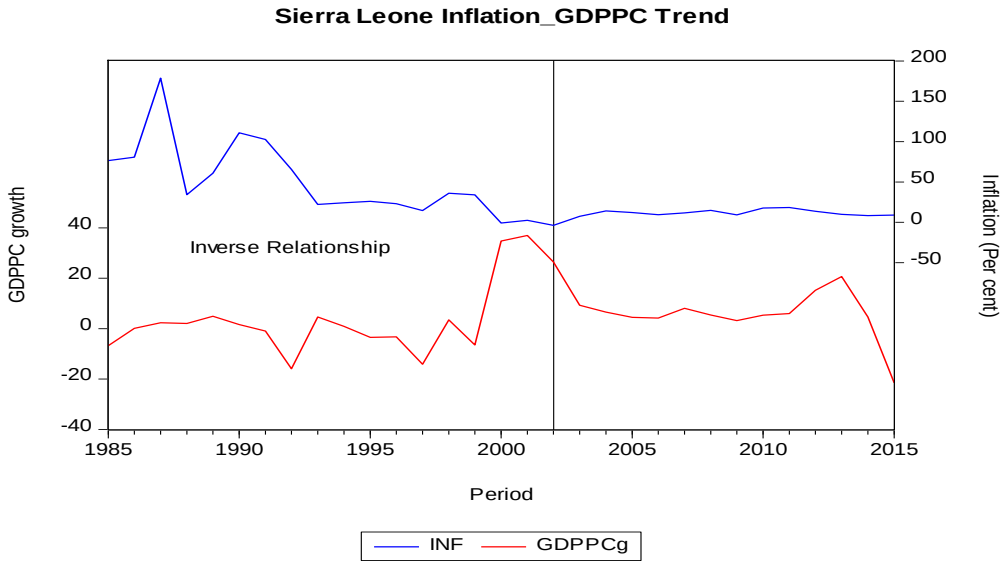
3.3.3.6 Sierra Leone

Sierra Leone's economic growth performance was moderate in the 70s, with average output growth of 2.7 per cent. Inflation in Sierra Leone was also moderate averaging 4.1 per cent between 1970 and 1973. However, between 1974 and 1979, the average inflation rate rose to 15.3 per cent and then galloped to 72.8 percent between 1980 and 1990. The upward movement of inflationary pressure was due to

government fiscal deficit monetisation and subsidy removal as a result of adopting a structural adjustment program. The consequences of the high inflation became counterproductive to the country's long-term social and economic interests as government officials resorted to bribery, institutionalising corruption in the economy (Ahortor et al., 2011). GDP growth on the other hand, at an average of 2.7 per cent in the 70s fell to 1.1 per cent in the 80s. The fall was as a result of the decline in corporate mining spread through the monetized economy (Kargbo et al., 2015). By the end of the 80s, the economy was almost collapsing, due to the declining GDP per capita, rapid inflation, and severe external imbalance. The trade balance as a percentage of GDP deteriorated from an average of -6.4 per cent between 1970 and 1975 to an average of -10.5 per cent between 1976 and 1979 but improved slightly to -9.8 per cent between 1980 and 1985. Also, Foreign reserves reduced from an average of US$43.2 million between 1970 and 1975 to US$35.0 million between 1976 and 1979 and further to US$ 14.9 million between 1980 and 1985. This was due to the poor export performance and low levels of capital inflow.

In a bid to rebuild the deteriorating economy, the government introduced the National Economic Emergency Program (NEEP) in 1987. The NEED comprised rigid currency holdings and control of cross-border trade and prices of staple products. However, these measures did not yield the expected result and were abolished in 1989 for the Economic Recovery Program (ERP). The key objective of the ERP was to restore economic growth in the country through structural reforms, including fiscal and monetary restraints.

Figure3.8: Inflation-growth in Sierra Leone



Source: World Bank Development Indicators& IFS CD-ROM

The civil war in the 1990s affected the economy severely leading to a reduction in productivity and local demand which culminated in relatively lower output growth. As the war intensified, output fell to negative 2.6 per cent in 1995, and the associated reduction in the domestic revenue base leading to a 56 per cent decline in revenue during the first half of 1999. The adoption of the IMF Structural Adjustment Program (SAP) and the World Bank Reconstruction Import Credit (RIC), resulted in a decline of the inflation rate. The end period inflation rate averaged 45.9 per cent between 1990 and 2000 when compared with an average of 72.8 per cent in the 80s (Bank of Sierra Leone Annual Report, 2000).

The end of the civil war in 2002 provided an ample business environment which yielded even lower inflation rates. The firms scaled up production and banks began to work with a flexible forex regime efficiently. This saw a reduction in unemployment, and inflation contained within a smaller percentage, with the growth in GDP rising to an average of 8.2 per cent during the WAMZ period (Akinyeye, 2010).

After successful post-conflict economic recovery, with growth rates averaging 6 per cent between 2002 and 2007, the post-2008 financial crises saw output growth rates slumping to 3.2 per cent in 2009 as demands for country's mineral export slowed down. The Ministry of Finance and Economic Development (MFED) with the support of the United Nations Development Programme (UNDP), designed a macro response program for the country. The policy package, which consists of fiscal stimulus, real depreciation of the country's currency and accommodating monetary policy, resulted in a rebound of output growth to 5.5 per cent in 2010.

3.3 Trend Analysis of the Inflation-Growth Nexus in the WAMZ countries

This particular sub-section provides a general discussion on the relationship between inflation and output growth in the WAMZ member countries and presents a descriptive analysis of important macro-variables in the countries. It further discusses the relationship between inflation and output growth in the WAMZ member countries with particular emphasis on the country-specific analysis and presents a descriptive analysis of important macro-variables in these countries.

Over the sample period, some countries like Ghana, Guinea, and Nigeria experienced high average inflation rates, while Gambia, Sierra Leone, and Liberia experienced relatively low average inflation rate.

An analysis of Inflation rate in the WAMZ shows the dispersion of the rate of inflation of the individual countries in the WAMZ. The dispersion of the Gambia rate of inflation away from its expected value at 3.1 per cent is the least followed by that of Liberia with 4.0 per cent, Nigeria with

6.04 per cent, Ghana with 8.3 per cent, Guinea with 9.4 per cent and lastly Sierra-Leone with 10.4 per cent rates of inflation.

Table 3.8 Descriptive Statistics of Inflation in the WAMZ countries

Descriptive Statistics of Inflation in the WAMZ countries 1995-2014							
	Gambia	*Ghana*	*Guinea*	*Liberia*	*Nigeria*	*Sierra Leone*	*WAMZ*
Mean (percent)	6.68	14.67	12.93	7.96	11.50	14.00	11.29
Standard Error (percent)	0.69	1.85	2.10	0.90	1.35	2.32	0.47
Median (percent)	5.54	13.62	12.40	7.50	11.19	12.44	10.30
Standard Deviation (percent)	3.10	8.27	9.38	4.03	6.04	10.40	7.83
Sample Variance (percent)	9.59	68.46	87.95	16.27	36.53	108.09	61.31
Kurtosis (percent)	0.35	0.41	0.28	0.11	3.22	0.96	0.28
Skewness (percent)	0.97	0.37	0.91	0.56	1.12	0.85	-0.27
Range (percent)	12.15	32.91	32.76	14.49	29.27	42.30	8.92
Minimum (percent)	2.06	0.00	1.94	3.00	0.00	-3.20	-3.20
Maximum (percent)	14.21	32.91	34.70	17.49	29.27	39.10	39.10

Source: Authors computations based on data from IMF CD-ROM.

However, the value of the degree of peaked-ness (kurtosis), as well as the normal distribution of the inflation rates, suggests that it is only in the case of Nigeria that the rate of inflation is normally distributed across the period of investigation with 3.2 per cent value. This kurtosis value of 3.2 per cent approximates the benchmark value of 3.0 per cent for the mesokurtic as well as the normal distribution of a series (Table 3.8). The inflation rate for all other member countries and the totality of the monetary union could be categorised as platykurtic.

Table 3.9 Descriptive Statistics of GDP growth in the WAMZ countries

Descriptive Statistics Of Per Capita GDP Growth Rate In The WAMZ Countries 1995-2014							
	Ghana	***Gambia***	***Guinea***	***Liberia***	***Nigeria***	***Sierra Leone***	***WAMZ***
Mean (percent)	3.29	0.35	0.77	7.47	3.72	2.74	2.87
Standard Error (percent)	0.56	0.74	0.33	5.02	1.50	1.69	0.60
Median (percent)	2.20	1.77	0.84	3.57	2.51	2.24	2.72
Standard Deviation (percent)	2.50	3.31	1.47	22.47	6.72	7.57	2.70
Sample Variance (per cent)	6.27	10.97	2.17	504.91	45.17	57.34	7.30
Kurtosis (percent)	4.54	0.26	0.08	11.37	14.40	1.31	7.54
Skewness (percent)	2.02	-1.09	-0.49	2.77	3.53	0.77	1.99
Range (percent)	10.10	10.95	5.74	50.99	33.12	31.28	14.11
Minimum (percent)	1.17	-7.30	-2.48	-31.34	-2.76	-10.57	-1.91
Maximum (percent)	11.28	3.65	3.25	19.65	30.36	20.71	12.20

Source: Author's computation based on data from World Bank WDI online database.

Concerning the descriptive statistics of GDP growth rate as detailed in Table 3.9 it is evident that Guinea; with 1.5 per cent standard deviation, is the least dispersed closely followed by Ghana, Gambia Nigeria, and Sierra Leone, with 2.5, 3.3, 6.7 and 7.6 per cents respectively. Liberia is the largest dispersed with 22.47 per cent (Table 3.9).

Basically, the summary of the descriptive statistics of GDP growth rates in the WAMZ member countries within the period under consideration is displayed in Table 3.9. In terms of the GDP growth in the WAMZ, it has been exceedingly strong in the review period with a regional average of 2.9 per cent between 1995 and 2014. The highest regional GDP growth of 12.2 per cent was recorded in 2013. In spite of the recent global financial and economic crisis, regional growth performance remained strong at almost 3.5 per cent, though with a slight drop to around 2.6 per cent in 2009, after the global financial crisis. Looking at the country-specific scorecard, it is evident that all the member countries have an average positive growth within the review period (Table 3.9).

The statistics of inflation rate in Table 3.8 and that of per capita GDP growth rate in Table 3.9; in terms of their dispersions away from their mean values, is highly revealing. It is only in Liberia that a noticeable trade-off of lowly dispersed inflation rate is accommodated with a highly dispersed GDP growth rate. For the other countries in the WAMZ, Nigeria and Gambia have a lowly dispersed rate of inflation which corresponds with a lowly dispersed GDP growth rate. More so, a lowly dispersed inflation rate of 2.1 per cent from its expected value for the whole monetary union of WAMZ is also accorded with a lowly dispersed GDP growth rate of 2.1 per cent away from its expected value. These outcomes portend possible implication for the threshold effect of inflation rate on economic growth within the monetary union.

A trend analysis of per capita GDP growth in the region shows that although the boom in commodity prices in the 1970s coupled with foreign aid in most of the countries in the region-accelerated growth. However it deteriorated in the early 80s. This continued into the early 1990s owing to a combination of adverse external developments, structural and institutional bottlenecks and policy errors (UN, 2001). In a bid to address some of this issue, some of the countries adopted the Structural adjustment Program supported by the Bretton Woods institutions which saw a slight increase in the region's growth. Per capita, GDP growth rate ranged from negative 31.3 per cent to 30.3 per cent within the review period. Guinea had the lowest average per capita GDP growth of 0.8 per cent. Guinea's poor performance could be explained by multiple crises, specifically, the 2007 and 2008 oil crisis, the 2008 food crisis, the global financial crisis as well as the socio-political crisis caused by the massacre of protesters in 2009. Liberia on the other hand, recorded the highest economic growth during the period under review, averaging 7.5 per cent. This impressive growth is not surprising as this is typical of post-crisis economies. As noted earlier, the end of civil war in 2002 provided an ample business environment as the country consolidated on its post-crisis performance by improving on its important sectors, which included agriculture production, services, and exports. Firms scaled up production and banks began to work effectively with a flexible forex regime. It is interesting to note that Macroeconomic management has also been extremely prudent in the country, proving as the necessary lever for managing shocks and keeping the economy on course.

The countries seem to have some advantages and challenges in the past that may help in the harmonization of macroeconomic practices to make WAMZ a success. Nigeria has a robust economy and attractive GDP growth accounting for over 87 per cent of the WAMZ GDP

between 1995 and 2014. Although Nigeria accounts for a significant share of the WAMZ GDP, this could be traceable to its large population which accounts for 77.1 per cent of the total WAMZ population. Ghana is the second largest economy in the WAMZ, with an average contribution of over 8.7 per cent of the WAMZ GDP within the same period. In the case of Ghana, more infrastructural and institutional strengthening program is critical in propelling it to a higher real GDP. Liberia, Guinea, and Sierra Leone show minimal GDP contribution within the reviewed period. The marginal contributions of some of these countries to the zone's GDP may be because these countries are still trying to recover from post-war destructions in the economy. Hence, they may still be exploring their resources in order to experience high and sustainable economic growth rates that may lead to higher contributions in the future.

Table 3.10: RELATIVE SHARE TO THE WAMZ GDP

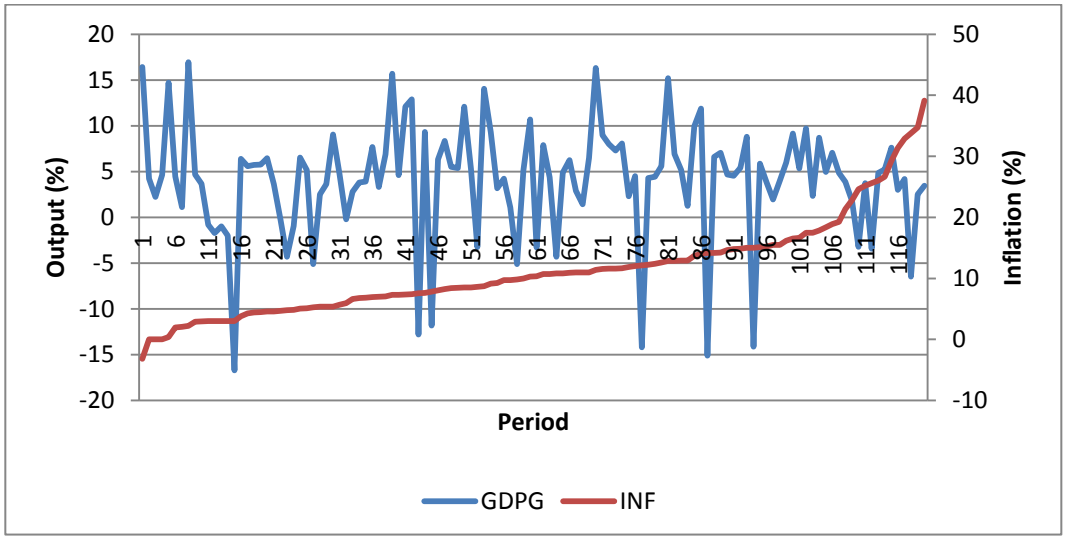
	Relative Share to the WAMZ GDP (%)					
	1995	**2000**	**2005**	**2010**	**2014**	**Average (1995-2014)**
GHANA	9.56	9.97	7.99	7.79	8.74	8.67
GAMBIA	0.34	0.35	0.26	0.23	0.20	0.26
GUINEA	2.73	2.80	2.04	1.69	1.65	2.01
LIBERIA	0.15	0.61	0.31	0.31	0.32	0.35
NIGERIA	86.3	85.5	88.7	89.4	88.3	87.93
SIERRA LEONE	0.9	0.8	0.7	0.6	0.8	0.72
TOTAL	100	100	100	100	100	100

Source: Author's computation based on data from World Bank WDI online database

An examination of the trend in Figure 3.9 (arranged from the lowest to the highest level of inflation) showed that there exists an absence of

correlation between inflation and output growth rate in the WAMZ countries, Except for some selected periods of noticeable inverse correlation between inflation and GDP per capita growth. For most of the periods, the scattered graph shows no sign of any particular relationship between the two variables. This position is corroborated by the trend depicted in Figure 3.9.

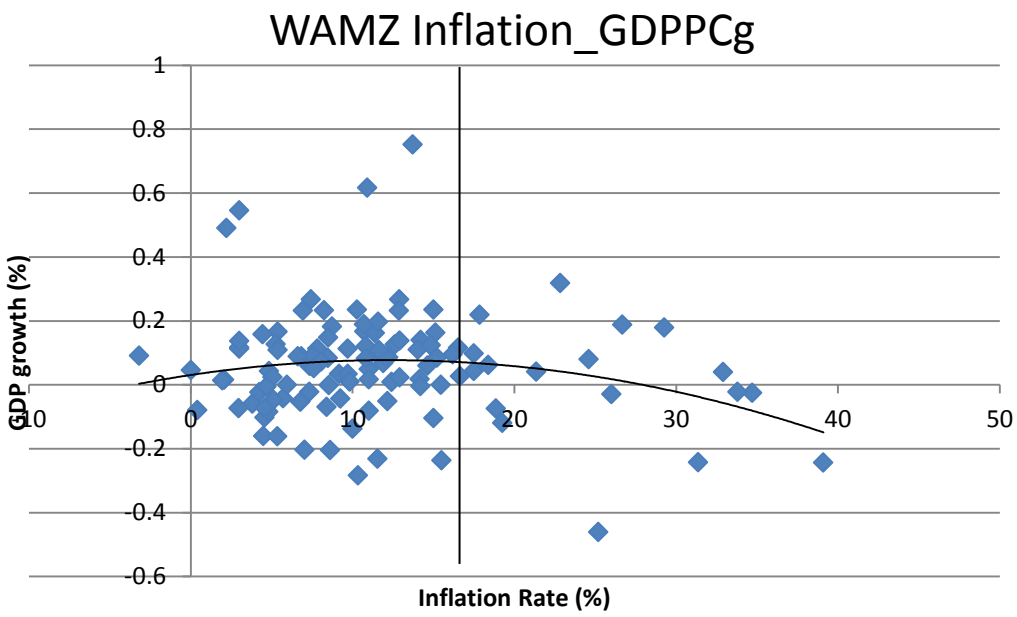
Figure 3.9: Average Inflation-growth in the WAMZ



Source: World Bank Development Indicators & IFS

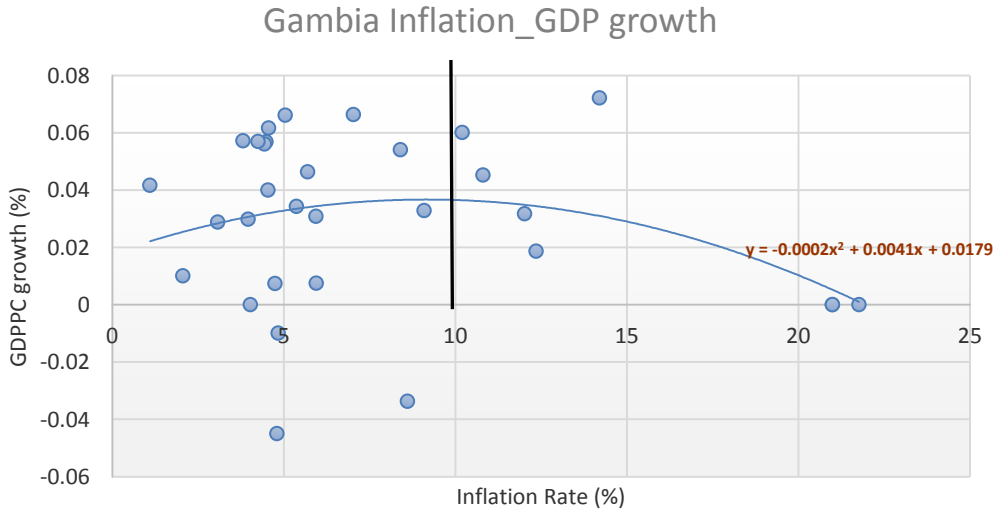
GDP is at 2005 constant market prices; inflation is percentage change in average consumer price index

Figure 3.10: Scatter plot of Inflation-GDP growth relationships in the WAMZ



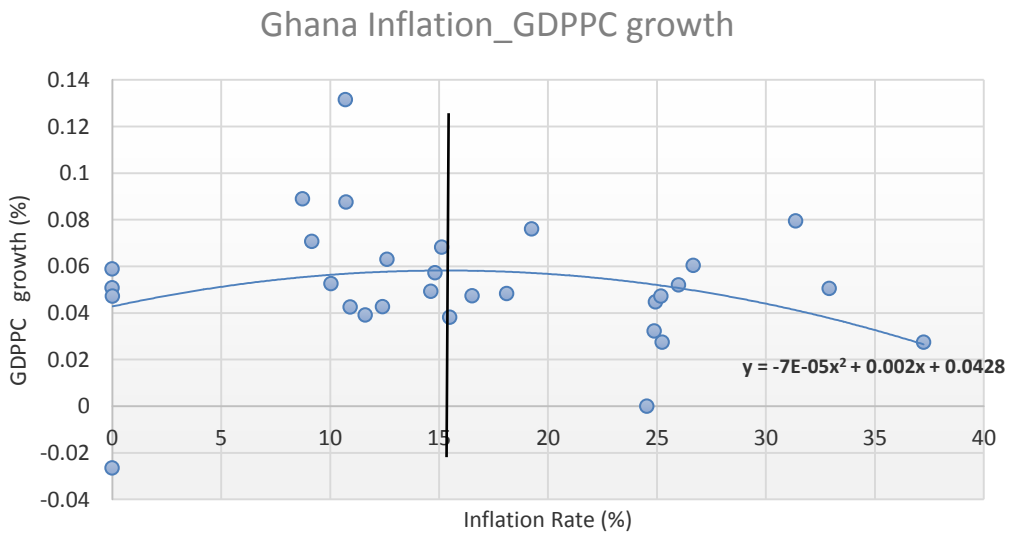
Source: World Bank Development Indicators & IFS

Figure 3.11: Scatter plot of Inflation-GDP growth relationships in the Gambia



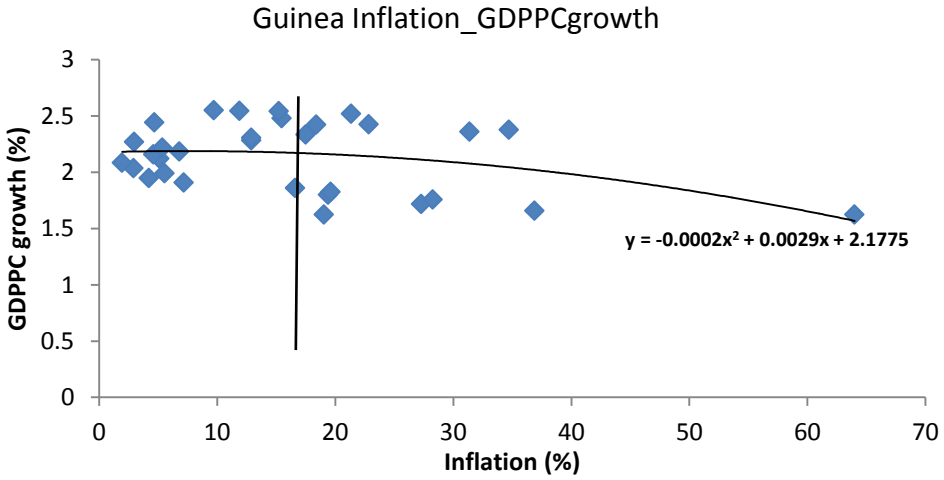
Source: World Bank Development Indicators & IFS

Figure 3.12: Scatter plot of Inflation-GDP growth relationships in Ghana



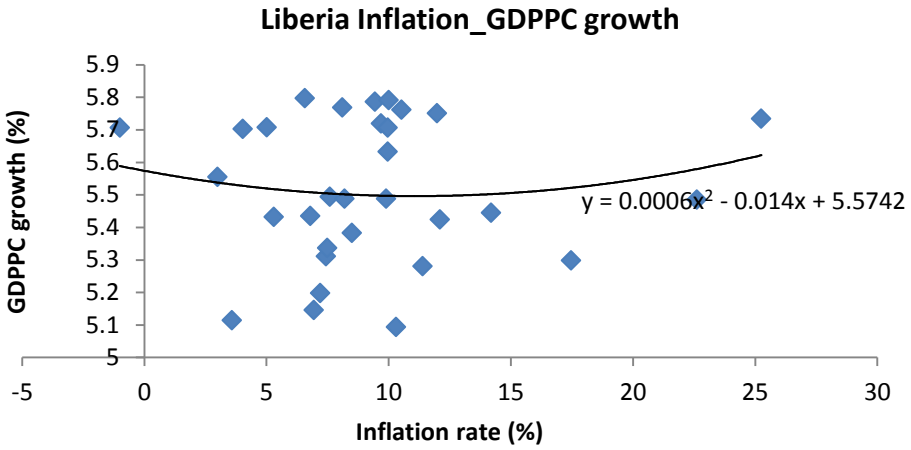
Source: World Bank Development Indicators & IFS

Figure 3.13: Scatter plot of Inflation-GDP growth relationships in Guinea



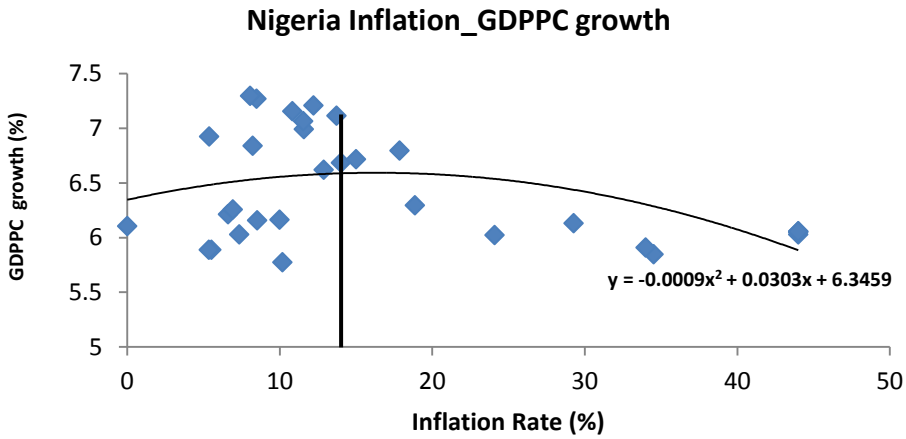
Source: World Bank Development Indicators & IFS

Figure 3.14: Scatter plot of Inflation-GDP growth relationships in Liberia



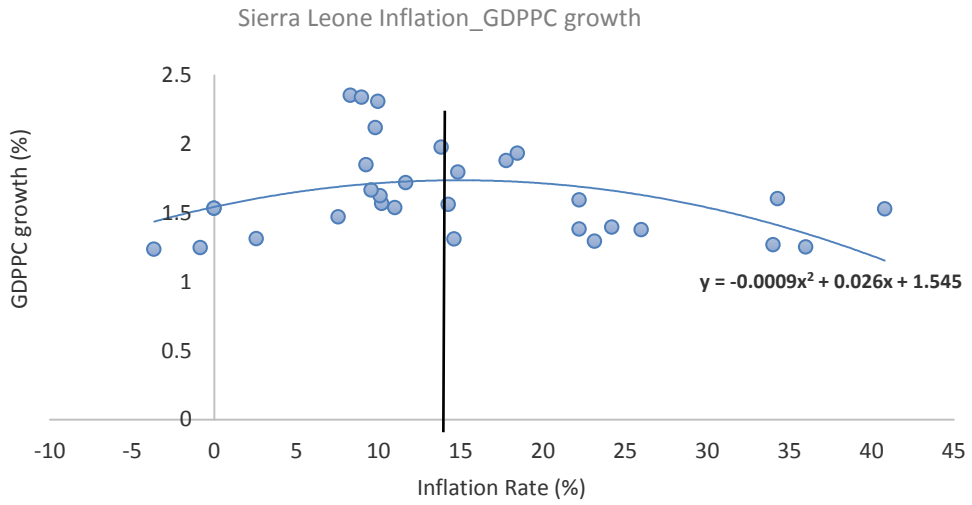
Source: World Bank Development Indicators & IFS

Figure 3.15: Scatter plot of Inflation-GDP growth relationships in Nigeria



Source: World Bank Development Indicators & IFS

Figure 3.16: Scatter plot of Inflation-GDP growth relationships in Sierra Leone



Source: World Bank WDI database and International Monetary Fund IFS

GDP is at 2005 constant market prices; inflation is percentage change in average consumer price index

As shown in figures 3.11 to 3.16, the relationship between inflation and economic growth seems to vary from country to country. For some countries such as Ghana, relatively low inflation is associated with high growth, while high inflation periods coincided with low growth; the Gambia had low inflation but also low growth; other countries such as Sierra Leone had relatively moderate inflation with high growth; Guinea and Nigeria have moderate inflation and low growth; Liberia had high inflation with low growth.

However, a few periods are identified with a marked inverse relationship where it was observed that a low rate of inflation is concomitantly accorded with high real GDP growth. In general, the figures seem to indicate that low inflation is associated with high economic growth while high inflation is associated with low growth in some periods. It can also be observed that the nature of the relationship varies from country to country. However, as no particular conclusion could be reached yet, a formal investigation would reveal the actual relationship between both

variables and at what point this relationship becomes beneficial and detrimental accordingly.

Several observations could be deduced from the stylized facts in the WAMZ countries. Firstly the member countries' seem to be working towards bringing down inflationary pressure (except Ghana, which has been registering consistently high inflation rates over recent years) in order to meet the convergence criteria for the WAMZ. Secondly, in terms of the distribution of the per capita GDP within the Zone, Nigeria dominates the WAMZ region, as it remains the largest contributor throughout the reviewed years. Hence, it is important to assess the inflation and economic growth relationship in Nigeria.

3.4 Conclusion

Discussing the information on inflation and GDP is important as these variables are considered necessary conditions for economic growth. A descriptive presentation of the macroeconomic variables with particular interest in inflation and GDP growth trend for the WAMZ countries reflects a lot about the relationship between the variables across the countries.

CHAPTER FOUR

"Once the true relationship between inflation and unemployment is understood, with luck and skill, a free lunch is possible"- Paul Ormerod

4.0 METHODOLOGY

4.1 Introduction

This chapter specifies and presents the methodological approach used in the analysis of the research work. Series of frameworks for tests and techniques of analysis, used to accomplish the empirical investigation were set up. This chapter begins by stating the research design, which stipulates the structure with which the estimations would be undertaken, followed by the statement of the hypothesis to be tested. Additionally, the theoretical framework and the model to be used for the analysis were developed.

4.2 Research Design

The empirical investigation of the inflation-growth nexus in the West African Monetary Zone (WAMZ) is undertaken in three phases. The study begins by considering a range of pre-estimation tests revolving around correlation, stationarity, and cointegration. It further considers the estimation of the empirical models specified for this study concerning the threshold levels at which inflation is beneficial and detrimental to the growth process of the monetary union and its individual countries. At this stage, the methodological framework adopted is be anchored on a theoretical framework upon which hypotheses will be tested for rejection or otherwise and the objectives of the study are therefore achieved.

To lend credence to the reliability of results and the validity of its outcomes, we proceed to consider several diagnostic tests and many

robustness checks. These diagnostic tests include a poolability test (which is a test to decide on the suitability of panel OLS or fixed-effect model), the Hausman test (which is a test to decide on the suitability of fixed-effect or random-effect panel model) and a range of stability and residual tests around the panel ARDL model. Aside from the panel models, the ARDL cointegration test will be carried out to serve as a robustness check.

4.3 Statement of Research Hypotheses

Statement of Research Hypotheses

From the stated objectives, the appropriate hypotheses for this study are;

(i) H_0: Inflation does not significantly Granger cause economic growth in WAMZ.

H_1: Inflation does significantly Granger cause economic growth in WAMZ.

(ii) H_0: Inflation does not significantly harm economic growth at any threshold point

H_1: Inflation does significantly harm economic growth at a threshold point.

(iii) H_0: The optimal inflation rate is not significantly different among the WAMZ countries

H_1: The optimal inflation rate is significantly different among the WAMZ countries.

(iv) H_0: The optimal inflation rate is not significantly different from the value before the establishment of the WAMZ.

H_1: The optimal inflation rate is significantly different since the establishment of the WAMZ.

4.4 Theoretical Framework and Model specification

A number of modeling frameworks have been used in the analysis of the inflation-growth relationship as discussed above in chapter three (3). The inflation and output growth relationship can be analysed using the augmented growth model, which has been used by many authors in empirical growth analysis (Devarajan, Swaroop, and Zhu, 1996; Younus, 2012). Hence, the study is anchored on the model enunciated by Mankiw, Romer, and Weil (1992). The Mankiw et al. (1992) model, which has gained popularity in the economic growth literature (Islam, 1995; Temple and Johnson, (1998); Jalilian and Odedokun, 2000) is an augmented Solow model. In the bid to capture the role of human capital in determining economic growth, Mankiw et al. (1992) augmented the Solow model by including accumulation of human capital as well as physical capital. Villavicencio and Mignon (2011) have adopted and modified this framework in the bid to capture the non-linear effect of inflation on economic growth. This research work is based on this modified framework in estimating the threshold level of inflation in the WAMZ.

Starting with the Cobb-Douglas production function with constant returns to scale which can be written as

$$Y_{it} = A_{it}K_{it}^{\alpha}L_{it}^{(1-\alpha)} \qquad 4.1$$

where Y is the total output level; A indicates Solow labor-augmenting technological process; K, is the stock of capital; and L is the quantum of labour - 'i' and 't' stand for country and time respectively; $\boldsymbol{\alpha}$ is the share of capital in total income. L and A are assumed to grow exogenously at

rates n and g, respectively such that the growth rate of the effective labour force is $n + g$ per annum so that

$$\mathrm{L(t)} = \mathrm{L(0)e^{nt}} \qquad 4.2$$

$$\mathrm{A(t)} = \mathrm{A(0)e^{gt}} \qquad 4.3$$

Assuming that s is the constant fraction of output that is saved and invested. If we denote output per effective labour unit as $\mathrm{y} = {}^{\mathrm{Y}}/_{\mathrm{AL}}$ and capital stock as $\mathrm{k} = {}^{\mathrm{K}}/_{\mathrm{AL}}$ the equation below can be derived:

$$\frac{\mathrm{dk_t}}{\mathrm{d_t}} = \mathrm{sy_t} - (\mathrm{n + g + \delta})\mathrm{k_t} \qquad 4.4$$

where δ is the rate of depreciation of capital stock per annum. $\frac{dk_t}{d_t}$ is the rate of change of the per capita capital stock, which is assumed to be equal to the flow of saving (equal to investment) minus capital depreciation and the growth of labour force (Jalilan et.al, 2006). By setting equation 4.4 equal to zero, we get the steady state solution of the stock of per capita capital. If we take the logarithm of both sides of equation 4.1 and replace the steady state value of output per effective worker, into equation 4.1 above, this gives the steady state solution for output per capita which is as follows:

$$\ln(\mathrm{y_{it}^*}) = \frac{1}{1-\alpha}[\ln\mathrm{A_{it}} + \alpha\ln(\mathrm{s_{it}})/(\mathrm{n_{it}} + \mathrm{g_{it}} + \delta_{\mathrm{it}})] \qquad 4.5$$

where (*) signifies the steady-state solution.

Adopting the assumptions of Mankiw et al. (1992) that economies move towards their steady-state solution, using a partial adjustment model in line Islam (1995) and Jalilan and Odedokun (2000), the adjustment towards a steady state can be specified thus:

$$\mathrm{lny_{it}} - \mathrm{lny_{i0}} = \varphi(\mathrm{lny_{it}^*} - \mathrm{lny_{i0}}) \qquad 4.6$$

where y_0 represents the initial level of per capita income, y^* is the steady state income per capita as earlier defined, y_t is the end of period income per capita $\varphi = \left(1 - e^{-\emptyset t}\right)$ is the adjustment dynamic towards the steady state and $\emptyset$ is an indicator of the annual speed of conditional convergence of income. Replacing $(\mathrm{lny}_{\mathrm{it}}^{*})$ by its equivalent from equation 4.5 gives a relationship defined thus:

$$\gamma_{\mathrm{it}} = \left({}^{\varphi}/_{\mathrm{t}}(1-\alpha)\right)[\mathrm{lnA_{it}} + \alpha\ln(\mathrm{s_{it}}/(\mathrm{n_{it}} + \mathrm{g_{it}} + \delta_{\mathrm{it}}))] - \left({}^{\varphi}/_{\mathrm{t}}\right)\mathrm{lny_{i0}} \qquad 4.7$$

Some empirical studies (Jalilan et al., 2006) assume that there is a fixed and equal $\mathrm{g} + \delta$ across countries, with g which is a proxy reflecting the rate of labour-augmenting technical progress and δ, the rate of depreciation of capital per annum. This study also assumes that $\mathrm{g} + \delta$ is equal for the six countries and is equal to 5 per cent in line with Mankiw et al. (1998)

Total factor productivity plays an important part in economic growth. Assuming its dynamics takes the following form (Jalilan and Odedokun, 2000):

$$\mathrm{A_{it}} = \mathrm{A_{i0}^{e^{\vartheta_i t}}} \qquad 4.8$$

where A_{i0} specifies the initial level of productivity, with ϑ_t as its rate of growth at the time t. Total productivity growth, 'ϑ', is expected to play an important role in total growth in any economy. Hence, in line with Temple and Johnson (1998) and drawing from the earlier reviewed literature relating to the relationship between inflation and output growth, an additional assumption is made. We assume that productivity growth 'ϑ' varies directly with the country's macroeconomic environment. In this study, inflation is used as a proxy for the macroeconomic environment in

line with Fisher (1993). Fisher argued that "a stable macroeconomic environment, meaning a reasonably low rate of inflation and a small budget deficit is conducive for sustained economic growth". Furthermore, some authors (Sala-i-Martin, 1997; Khan and Senhadji, 2001) have established the inclusion of inflation rate as a growth determinant empirically.

Hence, assuming a log-linear relationship between A and its determinants and substituting in 4.7, we will get the following representation for growth per capita:

$$\gamma_{it} = \left({}^{\varphi}/_{t}(1-\alpha)\right)\ln A_{i0} + \left(\frac{\varphi}{1-\alpha}\right)\ln\vartheta_i + \left({}^{\varphi\alpha}/_{t}(1-\alpha)\right)\ln\left[\frac{s_{it}}{(n_{it}+g_{it}+\delta_{it})}\right] - \frac{\varphi}{t}\ln y_{i0} \qquad 4.9$$

Equation 4.10 can be written as

$$\gamma_{it} = \beta_1\ln A_{i0} + \beta_2\ln\vartheta_i + \beta_3\ln\left[\frac{s_{it}}{(n_{it}+g_{it}+\delta_{it})}\right] - \beta_4\ln y_{i0} \qquad 4.10$$

where $\beta_1 = \left({}^{\varphi}/_{t}(1-\alpha)\right)$, $\beta_2 = {}^{\varphi}/_{(1-\alpha)}$, $\beta_3 = \left({}^{\varphi\alpha}/_{t}(1-\alpha)\right)$, $\beta_4 = \frac{\varphi}{t}$

Equation 4.10 above shows that income per capita is determined by population growth, physical capital and, human capital. Many cross-country regression studies have attempted to extend Mankiw, Romer and, Weil by adding additional control variables Z_i. This study also added some control variables in line with empirical literature on growth as well as a stochastic term to equation 4.10 in the model, which is used to examine the relationship between inflation and growth. Hence, the model to be specified is thus:

$$\gamma_{it} = \beta_1 \ln A_{i0} + \beta_2 \ln\left[\frac{s_{it}}{(n_{it} + g_{it} + \delta_{it})}\right] - \beta_3 \ln y_{i0} + \beta_4 \ln \vartheta_i + \beta_5 Z_{it} + \varepsilon_{it} \quad 4.11$$

where Z_i represents those growth determinants that lie outside Solow's original theory, ε_{it} is a white noise stochastic disturbance term that is cross and time variant. Equation 4.11 is regarded as a baseline growth model in modern empirical studies. This baseline model has been generalised in different dimensions, while some of these extensions reflect time series or panel data settings, others have introduced nonlinearity. As noted in Daulauf et.al (2005), the choices concerning which Z_i variables to include vary from study to study. The choice of the control variables added to equation 4.11 is based on the macroeconomic theoretical framework and on the basis of empirical growth literature. Amongst the control variables included in most empirical research are initial conditions (as proxied by GDP per capita). On the basis of a neo-classical model, variables such as investment should be included in the model (Cass, 1965). The endogenous growth model identified a measure for human capital development and government expenditure as fundamental growth determinants, these were added to the model. The justification for the inclusion of human capital in the growth model is as a result of non-homogeneity of labour in the production process due to different levels of education. In this research work, we make use of these control variables with the aim of ensuring that the model is appropriately specified. Hence, in addition to the baseline model in equation 4.11, and in line with Temple and Johnson (1998), the direct effect of inflation may be non-linear hence an interaction variable which is the square of inflation term is incorporated into the model as one of the control variables. The addition of the square of inflation gives a non-linear specification of the model. This specification allows us to appraise the threshold level of inflation. $\pi_{t,}$

which is inflation, is expected to have a positive sign, thereby reflecting beneficial effects of inflation on growth. The square of inflation, $\pi_t^{2,}$ on the other hand, is expected to have a negative sign, thereby reflecting adverse impact associated with higher inflation. Thus, the combination of positive and negative effects of inflation on output growth describes the inverted "U"-shape curve such that positive effects of inflation on growth turn negative at a particular level of inflation.

Also as earlier noted in the methodological review, a number of models (Khan and Senhadji, 2001; Sarel 1996) have been used to investigate the non-linear inflation-growth relationship. However, most of these models require a large amount of data in order to make valid inferences. Thus, in line with the works of Pollin & Zhu (2005), the research work adopted the quadratic function approach for the analysis of inflation threshold determination. Several authors have used this approach in threshold analysis (Devarajan, Swaroop, and Zhu, 1996; Hermaes and Lensink, 2001; Younus, 2012; Villavicencio and Mignon, 2011). The quadratic approach includes the square term of the inflation variable as an interaction variable to the growth model.

To calculate the critical point corresponding to the inflation threshold level, the equation is optimized by taking the partial derivative of equation (4.11) with respect to inflation, π_t. The derivative yields the following equation that is set equal to zero:

$$\delta Y_t/\delta \pi_t = \beta_1 + 2\beta_2 \pi_t = 0$$

$$\beta_1 + 2\beta_2 \pi_t = 0$$

Solving the above equation for π_t, the critical point of inflation beyond which the marginal impact of inflation becomes negative is thus obtained by setting:

$\pi_t^* = \beta_1 / -2\beta_2$ 4.12

The threshold point of inflation is then measured by$= ((\beta_1)/(-2 * \beta_2))$

In order to ascertain that this is the maximum (above which inflation is inimical to growth) and not the minimum point, the sign of β_2 must be negative.

Taking the second derivative gives $\delta^2 Y_t / \delta \pi_t^2 = -2\beta_2$

As stated above, the dependent variable is the growth rate of GDP per capita. The n^{th} year's growth rate is calculated as the annual percentage change in GDP at purchasing power parity (PPP), divided by the population. It is in constant 2005 international dollars and was sourced from the World Bank World Development Indicators from the World Bank website.

In general, the explanatory variables include;

- The key variable in the model, which is a measure of inflation; this is measured as the annual percentage change in consumer price Index (CPI) over the preceding year. This was sourced from the IMF International Financial Statistics CD-ROM. It is expected that lower levels of inflation would exert a positive effect on output growth, while the higher value is expected to impact negatively on output growth (Egoh and Khan, 2014).

- Government expenditure, which is an indicator of macroeconomic stability is measured as a ratio of government consumption to GDP. It includes all current government expenditures for purchases of goods and services (including compensation of employees). This was sourced from the World Bank World Development Indicator statistics. A negative relationship is

expected between macroeconomic instability and economic activity based on theory and some empirical evidence (e.g., Easterly and Rebelo 1993; Fischer 1993; Bruno and Easterly, 1998 and Barro and Sala-i-Martin, 1995). They pointed out that government consumption is intended to capture public expenditures that do not directly affect productivity but will entail distortions on private decisions. Hence, a substantial percentage of public consumption would be likely contribute to slower growth. Thus, the coefficient associated with it is expected to have a negative effect on output. However, in some developing countries, government spending is seen as the major source of vigour for economic activities.

- The initial GDP is the log of real per capita GDP for 1994 in the panel analysis regression. Real GDP data are in constant 2005 international dollars and were sourced from the World Bank World Development Indicators from the World Bank website. This is expected to have a negative effect on growth (Barro,1991; Komendi and Meguire, 1985). The neoclassical model predicts a negative coefficient of initial GDP, which is a conditional rate of convergence. This is the rate it takes the economy to get to the steady-state level of output.

- Investment here is measured as the ratio of the gross capital formation to GDP. Gross capital formation (formerly reffered to as gross domestic investment) consists of expenses in addition to the fixed assets of the economy and net changes in the level of inventories. The role of capital accumulation as a vital component of sustained growth in developing countries has been extensively documented in the literature (Berthelemy and Soderling, 2001); hence it is expected to have a positive impact on output growth (Barro, 1991). The ratio of investment to GDP which was

conceived as a proxy for capital accumulation was also derived from World Development Indicators from the World Bank website.

- Human Capital Development is proxied by the ratio of primary and secondary school enrolment, irrespective of age, to the population that officially corresponds to the level of education shown. Ideally, secondary school completion rate would have been a better proxy for human capital development; however, because of availability of standardised data on secondary school completion for these countries, the enrolment rate will be used. It is expected human capital development will have a positive effect on output growth, because the more human knowledge there is, the more innovation, and hence a stronger TFP and economic growth (Sachs and Warner, 1995). For the developing countries, human capital aids effective adoption of new technologies from abroad (Benhabib and Spiegel, 1994). This was sourced from World Development Indicators from the World Bank website.

- As noted earlier and in empirical studies, there is an assumption of a fixed and equal $g + \delta$ across countries, where g is a proxy reflecting the rate of labour-augmenting technical progress and δ, the rate of depreciation of capital per annum. This study also assumes that $g + \delta$ is equal for the six countries and is equal to 5 per cent in line with some empirical studies on growth (Jalilan et al., 2006; Mankiw et al., 1992). Mankiw et al assumed $g + \delta$ to be constant across countries and set it equal to 5%, and that the country-specific shock is independent of the population growth rates (n). Hence, $n + g + \delta$ is the effective population growth plus 0.05. Data on population growth was sourced from United Nations World Population Prospects.

Table 4.1: Definition of Variables and their Statistical properties

Variable	Description	Apriori Expectation	No of Observation	Mean	Standard Deviation	Minimum	Maximum	Jarque-Bera
Inflation	Change in the consumer price index	**+/-**	120	11.29	7.83	-3.20	39.10	45.05***
Government Expenditure growth	Share of government consumption in GDP	**-**	120	10.99	4.27	3.54	28.13	121.76***
Investment	Measured as the ratio of gross capital formation to GDP	**+**	120	16.48	6.99	2.32	42.08	1.48
Human Capital Development	Measured as the percentage of primary school enrolment (gross)	**+**	120	61.11	15.07	29.10	92.29	3.14
$\mathbf{ln(n+g+\delta)}$	Measured as effective population growth plus 5%	**-**	120	0.983	-2.388	-1.135	2.065	758.99

Data Sourced from the IMF International Financial Statistics CD-ROM and World Development Indicators from the World Bank website

Ascertaining the statistical properties of the variables of interest is imperative to inform the choice of econometric methodology. Hence, looking at the univariate statistics of the variables, which include the mean, median, skewness, Jarque Bera, Kurtosis among others, were carried out for the WAMZ countries. The statistical properties of the variables reveal that the deviation from the mean is higher for inflation rate compared to the other variables. The Jarque-Bera (JB) test of normality is a test of the joint hypothesis that skewness and kurtosis are 0 and 3, respectively. From the result above, skewness and kurtosis for most of the variables were not satisfied (See Appendix 1). Based on these outcomes, it can then be deduced that most of the variables did not satisfy the standardised normal distribution. Hence we reject the null hypothesis that the variables (except Human capital Development and investment) are normally distributed.

4.5 Data and Sources

The study utilised annual time series data on the variables listed in equation 4.10. As earlier discussed, the choice of the explanatory variables in the model above is consistent with empirical works on inflation-growth relationships. The availability of data over a long period and across different countries offers the opportunity for cross-sectional and longitudinal analysis. The data were mainly sourced from the World Bank Development Indicators, the WAMI database and the International Monetary Fund IFS CD-ROM (International Financial Statistics). Secondary data were used in this research as they offer a lot of advantage for the research work, which includes among others; they are available without cost in public libraries or on the internet, thus, saving time and money. Furthermore, data on government official statistics allow researchers to examine high-quality data as they are collected by technical experts (Bryman and Bell, 2007).

This is not to say that secondary data has no limitation; however, despite its shortcomings, it is still more suitable for this type of research compared to other sources. This is so because the empirical analysis of this thesis rests upon macroeconomic variables which can only be sourced from official statistics, as only the government and international organisations (like the IMF and World Bank) have the capacity to collect such data. In addition, there are no ethical issues involved when using secondary data from official sources.

The period is between 1995 and 2014. The reason for the starting year of 1995 for the panel analysis is that the data for most of the variables of interest are only available for all the countries from 1995. The country sample includes six (6) West African Countries (Gambia, Ghana, Guinea, Liberia, Nigeria and Sierra Leone). As stated above, the dependent variable is the growth rate of GDP per capita. This is gross domestic product converted to international dollars using purchasing power parity rates. GDP per capita growth rate is calculated as the annual percentage change in the GDP at purchasing power parity (PPP) divided by the population. GDP data are in constant 2005 international dollars and were sourced from the World Bank World Development Indicators from the World Bank website.

4.6 Tests of Analyses

4.6.1 Framework for Panel Unit-Root Tests

In line with recent developments in time series econometrics, the possibility of a unit root in the time series data was examined. The time series data tend to exhibit a time trend which makes them non-stationary. Granger and Newbold (1974) argued that “the direct application of OLS to non-stationary data produces regressions that are

mis-specified or spurious" and could lead to Type I errors (Granger and Newbold, 1974, p117).

There are a variety of unit root tests for panel data, which differ in terms of the assumptions regarding the null hypothesis and how the autocorrelation is removed. They include the Levin, Lin, and Chu (2002), Breitung (2000), Hadri (1999), and Im, Pesaran, and Shin (2003), that developed panel-based unit root tests similar to the tests carried out on single series. They found panel unit root tests to be more powerful (less likely to commit a Type II error) than unit root tests applied to individual series because the information in the time series is enhanced by that contained in the cross-section data (Ramirez 2006). Levin, Lin, and Chu (LLC, 2002), Breitung (2000), and Hadri (2000) assume that there is a common unit root process in all series. The first two tests assume a null of a unit root while the Hadri test uses a null of no unit root.

For the individual unit root test, Im, Pesaran, and Shin (2003), and Fisher-ADF and PP test all allow for individual unit processes. The tests are characterised by combining individual unit root tests to derive a panel-specific result, under the null hypothesis of a unit root. Maddala and Wu (1999) and Choi (2001) proposed the Fisher-ADF and PP tests as an idea to group unit root tests as they use Fisher (1932) results to derive tests that combine the p-values from individual unit root tests. If the unit root is present in the variables, then it is necessary to check for the presence of a cointegrating relationship between the variables.

Levin et al. (2002), adopted an approach similar to the ADF test for a unit root, where the hypotheses are

H_0: each time series contains a unit root

H_1: each time series is stationary.

This entails carrying out ADF tests for each distinct unit in the panel and then adjusted to take into account any heteroskedasticity. When this is done, a pooled t-test is then produced to test the null, which is asymptotically distributed under the normal distribution allowing for different lags across different cross-sections. The model takes the following form:

$$\Delta y_{it} = \rho_i y_{i,t-1} + \delta_i z_{it}^{'} + \sum_{j=1}^{p_i} \theta_{ij} \Delta y_{i,t-j} + \varepsilon_{it}$$

4.13

i= 1,….., N

- The error terms across the cross-sections are assumed to be independent.
- ρi = 0 means they process has a unit root for individual i, while ρi < 0 means that the process is stationary around the deterministic part.
- z_{it}' are the deterministic components.
- The lag length for the lagged dependent variables is chosen in the usual way[7].

The Im, Pesaran, and Shin (2003) test is an alternative to the LLC test. It tests for individual unit root processes as against assuming a common unit root process like the LLC. This in effect tests for all i_s cross-sections to be stationary. The IPS test averages all the individual ADF test statistics. The null hypothesis, in this case, is that each series contains a unit root for all i cross-sections. The IPS test in effect follows the model below:

$$\Delta y_{it} = \alpha_i + \rho_i y_{i,t-1} + \sum_{j=1}^{pi} \beta_{ij} \Delta y_{i,t-j} + \varepsilon_{it} \qquad 4.14$$

where i = 1, . . .,N and t = 1, . . ., T

[7]The Akaike Information Criterion (AIC) and Schwartz Criterion (SC) are most commonly used approaches in choosing the appropriate lag length..

The main difference between these tests is that while one assumes a common unit root, the other assumes an individual unit root. In addition, the IPS has an alternative hypothesis stating that at least one of the cross-section series is stationary. Thus, while LLC requires that all cross-sections be stationary, IPS requires only some to be so. Depending on the different values of the N and T components, the two test statistics can give different results.

When the time dimension “T” is large, the Levin-Lin-Chu test is seen to have a higher test power. However, this can be problematic, as one might infer a whole panel is stationary, even if only a few individuals are actually stationary. On the other hand, when the time dimension is small, the LLC is seen to have low power. This implies that one can conclude that the variable is non-stationary when in fact most of the individual observations are actually stationary. Hence, it is always advisable to analyse both the outcome of the LLC and that of the IPS test. Overall, there is no dominant performance of one particular test.

4.6.2 Framework for Panel Data Correlation Test

Followed by the unit root test, the correlation matrix was used to detect the correlation between the variables. The correlation measures the strength of the linear relationship between the variables. The strength of the linear association between two numerical variables is determined by the correlation coefficient, *r*, whose range is −1 to +1. The negative or positive sign of the correlation coefficient is the sign of the straight line. This correlation coefficient r = ± $\sqrt{r^2}$ and it can be calculated by

$$r = \frac{\sum(x_i-\bar{x})(y_j-\bar{y})}{\sqrt{(x_i-\bar{x})^2}\sqrt{(y_j-\bar{y})^2}} \qquad 4.15$$

4.6.3 Framework for Granger Causality Test

In this section, a causality test was employed to examine whether inflation actually Granger-causes GDP growth and vice versa. This study seeks to conduct a pre-estimation Granger causality test to ascertain the level of exogeneity on the variables included in the model. The F-Test sets a null hypothesis that p lags are jointly equal to zero. The F-Test for the direction $x \rightarrow y$ indicates that the p lags of x in equation y jointly equal to zero. If accepted, it means x does not Granger cause y and if rejected, then, it does cause y. In effect, the VAR Granger causality test seeks to investigate the true direction of linkage among the variables; before estimations are done.

Betting on the null hypothesis that the parameters for all lags of X_t are equal to 0 and therefore that X_t does NOT Granger cause Y_t; Granger causality tests whether lagged values of one variable predict changes in another, or whether one variable in the system explains the time path of the other variables. Hence, a variable x is said to Granger-cause another variable y $(x \rightarrow y)$, if past values of x can predict present values of y.

Granger (1988) posits two cardinal principles namely the cause precedes the effect, and the causal series contains particular information about the series being caused that is not available in the other available series. Similarly, there is an instantaneous causality from x to y $(x \Rightarrow y)$ if present and past values of x predict the present value of y. If causality is in one direction, e.g., from x to y, we have uni-directional causality while if x Granger causes y and y Granger causes x, we have bi-directional or feedback causality $(y \Leftrightarrow x)$. There are two commonly used causality tests; one due to Granger (1969) and the other due to Sims (1972). The former is, however, more widely used in

applied econometrics, partly because of its simplicity and because it is less costly in terms of degrees of freedom (Charemza and Deadman, 1997).

If two-time series (Y_t) and (X_t) are considered, the series X_t failed to Granger-cause Y_t, if in a regression of Y_t on lagged Y's and lagged X's, the coefficients of the latter are zero. In particular, Hurlin and Venet (2001) proposed an extension of the Granger causality test to panel data models using the model below:

$$y_{i,t} = \sum_{k=1}^{p} \alpha^{k} y_{i,t-k} + \sum_{k=1}^{p} \beta_i^{k} x_{i,t-k} + v_{i,t} \qquad 4.14$$

with $p \varepsilon N^{*}$ and $v_{i,t} = \vartheta_i + \varepsilon_{i,t}$ where $\varepsilon_{i,t}$ are i.i.d. $(0, \sigma_{\epsilon}^2)$

Then if $\beta_i = 0 (i=1,2,\ldots\ldots,k)$, X_t fails to cause Y_t.

4.6.4 Framework for Cointegration Test

The existence of unit root in some of the variables necessitated the need for a cointegration test in order to ascertain if the variables that are integrated of order one would cointegrate in the long-run. In economics, two variables cointegrate if they have a long-run relationship between them. Since the variables are integrated of the same order (that is order one), the study employed the Johanssen (1991) method of cointegration. The Johannsen (1991) procedure for multivariate cointegration test was adopted for this purpose given its superiority over the Engle and Granger (1987) technique. The cointegrating series are per capita GDP, government expenditure and investment. A lag interval of 1 to 1 was used for the Johanssen cointegration rank test for both the trace and maximum Eigenvalue.

Cointegration test is to check the long run equilibrium condition among the variables included in a model. For a Vector Autoregression (VAR) model, we summarise the cointegration framework as enunciated by Johansen (1990) and Juselius (1990) and make it amenable to VAR framework as the case in this study.

Given a VAR (p) of $I(1)X's$ (ignoring constant and deterministic trends)

$$X_t = \emptyset_1 X_{t-1} + \cdots + \emptyset_p X_{t-p} + \varepsilon_t \qquad 4.15$$

Where X_t is an n × 1 vector of variables that are integrated of order one, $\emptyset_1$ through $\emptyset_p$ are m × m coefficient matrices. There always exists an error correction representation of the term; where;

$$X_t = X_{t-1} + \Delta X_t$$

$$\Delta X_t = \vartheta X_{t-1} + \sum_{i=1}^{p-1} \emptyset_1^* \Delta X_{t-1} + \varepsilon_t \qquad 4.16$$

where; ϑ and $\emptyset_1^*$ are functions of the $\phi's$

Specifically;

$$\emptyset_j^* = \sum_{i=j+1}^{p-1} \emptyset_j, j = 1, \ldots . p-1 \qquad 4.17$$

$$\vartheta = (I - \emptyset_i - \cdots \emptyset_p) = -\emptyset(1) \qquad 4.18$$

4.7 Techniques of Analyses

4.7.1 Procedure for Panel Data Analysis

Given the nature of the dataset, consisting of both cross-sectional (countries) and time series data, panel data regression was utilised. Before the estimation of the equation 4.11, the statistical properties of the variables in the model are identified and where the variables are of different orders of stationarity, (i.e., I(0) and I(1)), the conventional method of panel ARDL is considered more appropriate. The use of panel ARDL and its re-parameterisation was known as panel ARDL-ECM as against the traditional cointegration, and vector error correction model is preferred because the traditional methods are considered more appropriate only when the variables are of the same order of stationarity. Pesaran et al. (1999) popularise the technique known as Pooled Mean Group (PMG) to estimate non-stationary dynamic panels. The PMG estimator is based on a blend of combining and averaging of coefficients (Pesaran et al., 1999). This estimator permits short-run parameters intercepts terms and error variance to vary across groups. The general form of the empirical specification of the PMG model can be written as

$$y_{it} = \sum_{j=1}^{p} \tau_{ij}\, y_{i,t-j} + \sum_{j=0}^{q} \delta_{ij}\, X_{i,t-j} + \mu_t + \epsilon_{it} \qquad 4.20$$

Where number of cross sections i = 1, 2,….6 and time t = 1, 2, 3 …. T. X_{it} is a vector of K × 1 regressors, τ_{ij} is a scalar, μ i is a group specific effect. A major characteristic of co-integrated variables is their return to any deviation from long run equilibrium. This characteristic assumes that error correction dynamics of the variables in the system are swayed by their deviation from equilibrium. Therefore, it is common to re-parameterize the equation above into an error correction equation as

$$\Delta y_{it} = \emptyset_i y_{t-j} - \theta_i X_{t-j} \sum_{j=1}^{p-1} \tau_{ij} \Delta y_{i,t-j} + \sum_{j=0}^{q-1} \delta_{ij} \Delta X_{i,t-j} + \mu_t \epsilon_{it} \quad 4.21$$

If $\emptyset_i$ is equal to zero, then there is no evidence that the variables have a long run relationship. Thus, it is expected that $\emptyset_i$ should be negative and statistically significant under the former assumption that variables converge in the long run equilibrium in case of any disturbance. Where this is not the case the result of the ARDL cointegration test could be regarded as inconclusive and a panel cointegration test will be carried out and a panel OLS estimated.

In carrying out the panel OLS estimation, three different panel data techniques (pooled OLS, fixed effect, and random effect) were utilised. Although each of the panel data techniques has its strengths and weaknesses, the most appropriate technique for this research work was chosen through diagnostic tests employed.

In order to determine whether to use the fixed effect estimator or pooled OLS, an F-test is used to test the hypothesis that all constant terms are equal. The F-test is given as follows:

$$F(n-1, nT-n-k) = \frac{\left[\frac{R^2_{pooled} - R^2_{fe}}{n-1}\right]}{\left[\frac{(1-R^2_{fe})}{nT-n-k}\right]} \quad 4.22$$

where n and T indicate the number of observations from cross-country and time series dimensions of the panel while k is the number of regressors less the constant term.

The fixed-effects model controls for all time-invariant differences between the individuals, so the estimated coefficients of the fixed-effects models cannot be biased because of omitted time-invariant

characteristics (Kohler and Kreuter, 2009, p.245). It takes the country-specific effects as fixed and thus assumes the variance to be zero. The random effect estimator, on the other hand, addresses this fixed effect shortfall by assuming that the variance of the country-specific component is non-zero and thus increases the overall variance of the random disturbance.

In other words, the random effect estimator relaxes the implicit assumption that the error variances of the country-specific effects are homoscedastic. Unlike the fixed-effects model, the random effect model assumes that variations across entities are random and uncorrelated with the independent variables in the model. The random effect model is of the form:

$$\gamma_{it} = \rho \ln Y_{i0} + \beta X_{it} + \theta_{it} Z_i + \alpha_i + u_{it} + \varepsilon_{it}; \qquad \mathbf{4.23}$$

where U_{it} is between entity error and ε_{it} within-entity error.

In panel analysis, the effect of individual terms can be modeled either as a random effect or fixed effects. If the other regressors in the model are correlated with these individual effects, the fixed-effect model would be considered consistent and the random effects model inconsistent. However, if the other regressors in the model are not correlated with these individual effects, both random and fixed effects would be considered as consistent, but random effects would also be seen as efficient. The Hausman test is used to decide whether to use fixed or random effect model (Green, 2008). The null hypothesis of the Hausman test is that the unique errors (u_i) are not correlated with the regressors. A statistically significant difference is interpreted as evidence against the random effect assumption.

Since in both situations the fixed-effects model is seen as efficient, for us to conclude that the random effect is not efficient, the estimates from both models ought to be significantly different. Otherwise, both would be considered to be consistent. Therefore, if the difference in both models is significant, the null that individual effects are uncorrelated with the other regressors would be rejected. Conversely, if the difference is small, the null would not be rejected, and random effect would be preferred because it is more efficient.

Hausman and Taylor (1981) point out, however, that, though a better method, the GLS can also yield biased and inconsistent estimates if the regressors and country-specific effects are correlated hence emphasising the importance of taking country-specific effects into account when estimating the models.

4.8 Conclusion

This chapter discussed the empirical methodology for the study and the different estimation procedures to be followed in the analyses. It comprised of the model, the research methodology and analytical tool used in the analysis. The chapter detailed the empirical methodology used for the research study. Based on the augmented growth theory, the chapter developed the quadratic function approach, which is estimated as a second-degree polynomial. Furthermore, the data and the sources of the data used in the study where discussed, while presenting the descriptive statistics of the variables used in the analysis.

CHAPTER FIVE

"The basic facts are straightforward, but interpretations vary" - Bittlingmayer and Hazlett

5.0 PRE-ESTIMATION TESTS

5.1 Introduction

This chapter covers the pre-estimation analysis of the inflation-growth relationship using both the Panel data and country-specific data. The pre-estimation analysis starts with the descriptive discussion on the variables of interest in the six WAMZ countries. The theoretical background of the correlation analysis employed in estimating the correlation between the variables of interest as well as the empirical results of the correlation coefficient for all the variables used were discussed in the second sub-section. The third sub-section provides the unit root test and results on the variables used, while the last sub-section dealt with the cointegration test.

5.2 Descriptive Statistics

Table 5.1 shows the descriptive statistics of the series used for the analysis. There seems to be a large margin between the minimum and maximum values, especially for inflation. The skewness (which show how skewed/fat-tailed the distribution is) and the kurtosis (which measures the peakedness of the distribution) statistics show that most of the variables were not normal. The summary statistics show that most of the data skewness statistics are clearly different from "0", which implies that the distribution is asymmetrical (hence, non-normal). The kurtosis results confirm this too, as most of the distributions are different from "3" (some of them are less than "3" indicating that they are flatter than the normal distribution, while some are higher than "3" showing that

they are more peaked than the normal distribution). Apart from investment, whose kurtosis is almost “3”, those of other variables are slightly higher than “3” (Table 5.1).

Table 5.1 Summary Statistics

	PCGDP	INF	INV	GEXP	HCD	Ln(n+g+σ)
Mean	6.092540	11.29083	16.48267	2.334577	4.078447	0.982836
Median	6.059370	10.30000	17.26000	2.319934	4.130041	0.985591
Maximum	8.071937	39.10000	42.08000	3.336837	4.524997	2.065067
Minimum	4.171460	-3.200000	2.320000	1.264127	3.370609	-1.134910
Std. Dev.	0.716599	7.826196	6.994170	0.347669	0.272643	0.444428
Skewness	0.420894	1.224396	0.192704	0.349931	-0.790210	-2.387855
Kurtosis	3.776766	4.735768	3.383246	3.972623	2.903971	14.35743
Jarque-Bera	6.559853	45.04735	1.477082	7.179011	12.53475	758.9929
Probability	0.037631	0.000000	0.477811	0.027612	0.001897	0.000000
Observations	120	120	120	120	120	120
No of Countries	6	6	6	6	6	6

Source: Author’s computations. Normality tests include skewness statistic, kurtosis statistic and the Jarque-Bera statistic tests for normal distributed. The null hypothesis is that the errors are normally distributed. Note *** imply a rejection of the null hypothesis for normality at 1 per cent using Jarque Bera statistics.

This result is confirmed by the statistically significant Jarque-Bera statistics (which measure normality of the distribution). The Jarque-bera statistics show that we can reject the null hypothesis for normality for most of the country’s inflation and GDP data. A detailed table showing the summary statistics of the variables for each of the countries is shown in the appendix. A visual inspection of the graphical representations of the data suggests that some of the variables are not stationary, hence the need to perform a stationarity test.

5.3 Correlation Analysis

Before further analysis is carried out, it is useful to provide a descriptive diagnosis of variables used in the study to identify possible data problems. The data in Table 5.2 show the bivariate correlation coefficients between the proxy for output growth, which is GDP growth per capita, and possible explanatory variables. From the correlation matrix table, it can be seen that the correlation coefficients are all below 0.5; hence using the rule of thumb, the issue of multi-collinearity as noted in Gujarati et al. (2009) may not be a problem.

Table 5.2 shows inflation has the expected sign as the growth rate of GDP per capita was negatively correlated with the inflation rate. The negative relationship with inflation is consistent with the traditional Keynesian theory, neoclassical model, and some endogenous growth theories, which imply that higher inflation is negatively correlated with output growth.

Table 5.2: Correlation Analysis Result

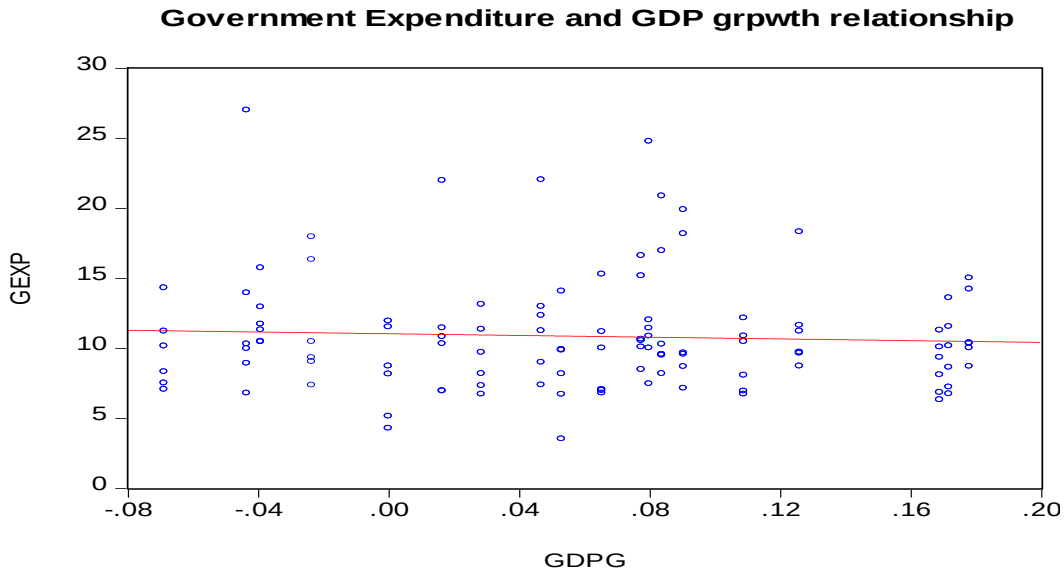
	PCGDPG	INF	INV	GEXP	Ln(n+g+ σ)	HCD	IGDP
PCGDPG	1.00						
INF	-0.123*	1.00					
INV	0.21*	-0.12	1.00				
GEXP	-0.004	0.378	-0.124	1.000			
Ln(n+g+ σ)	0.262	-0.416*	0.188*	-0.296	1.000		
HCD	0.202*	-0.002	0.309*	0.048*	0.001*	1.000	
IGDP	0.079	-0.088	-0.026	-0.069	0.020	-0.225*	1.000

Source: Author's computations based on data from World Bank Development Index.
Note: Econometric estimation was conducted using Eviews 9.0 software. All data are of annual frequency for the period 1995 to 2014. Coefficients are statistically significant at 5%.

Therefore, this preliminary inspection of data is an indication that there is a negative relationship between inflation and economic growth in the WAMZ region as expected. Although the research focuses on the relationship between economic growth and inflation, the influence of the other control variables cannot be completely ignored. Hence, from the result of the correlation test, it would be noted that not all the control variables have the expected signs.

Output growth was found to be negatively correlated with government expenditure in the WAMZ countries; this is in line with apriori expectation. The negative correlation suggests that unproductive government expenditure tends to reduce output growth. It also implies that expenditures that are not geared towards infrastructural development in the economy are associated with low growth.

Figure 5.1: Scatter plot of Government Expenditure-growth relationship in the WAMZ.



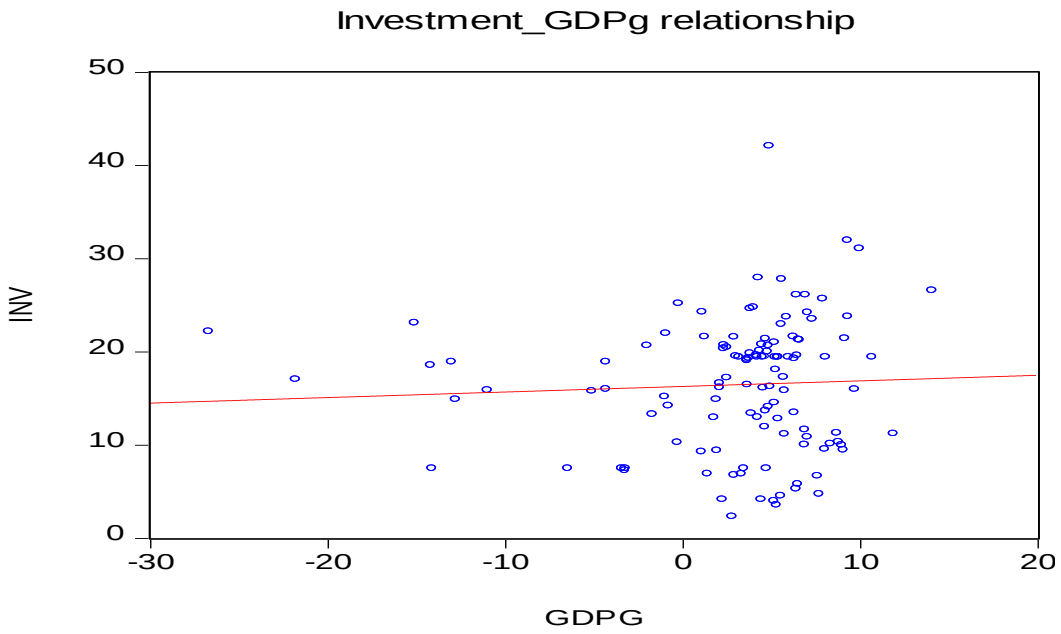
Source: World Bank Development Indicators & IFS

The diagram depicts the relationship between the growth rate of per capita GDP and the ratio of government expenditure. Although the

correlation appears not to be strong, one can see that there is a negative correlation between government expenditure and output growth although not significant. That means that as government expenditure increases, the output growth tends to decline and vice versa.

Per capita GDP growth was found to be positively and significantly correlated with human capital development and investment. The positive relationship between human capital development and economic growth as suggested by Becker (1994) indicates that education raises the productivity of workers by imparting useful knowledge and skills, hence raising workers' future income by increasing their lifetime earnings.

Figure 5.2: Scatter plot of Investment-growth relationship in the WAMZ

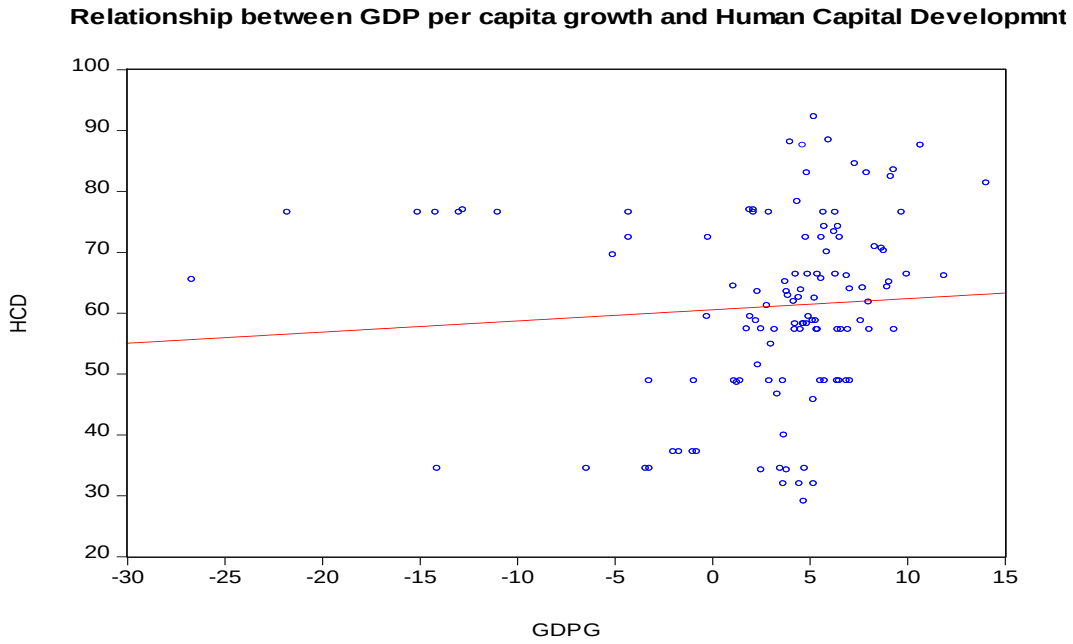


Source: World Bank Development Indicators & IFS

The above figure shows the relationship between the growth rate of per capita GDP and the ratio of investment to GDP. The figure clearly shows

that as investment increases, growth in per capita GDP also increases; showing a positive relationship.

Figure 5.3: Scatter plot of HCD-growth relationship in the WAMZ



Source: World Bank Development Indicators & IFS

An inspection of the relationship between human capital development and output growth indicates that they are positively correlated. This implies that a greater amount or level of government expenditure on education is expected to engender a higher level of output in the WAMZ.

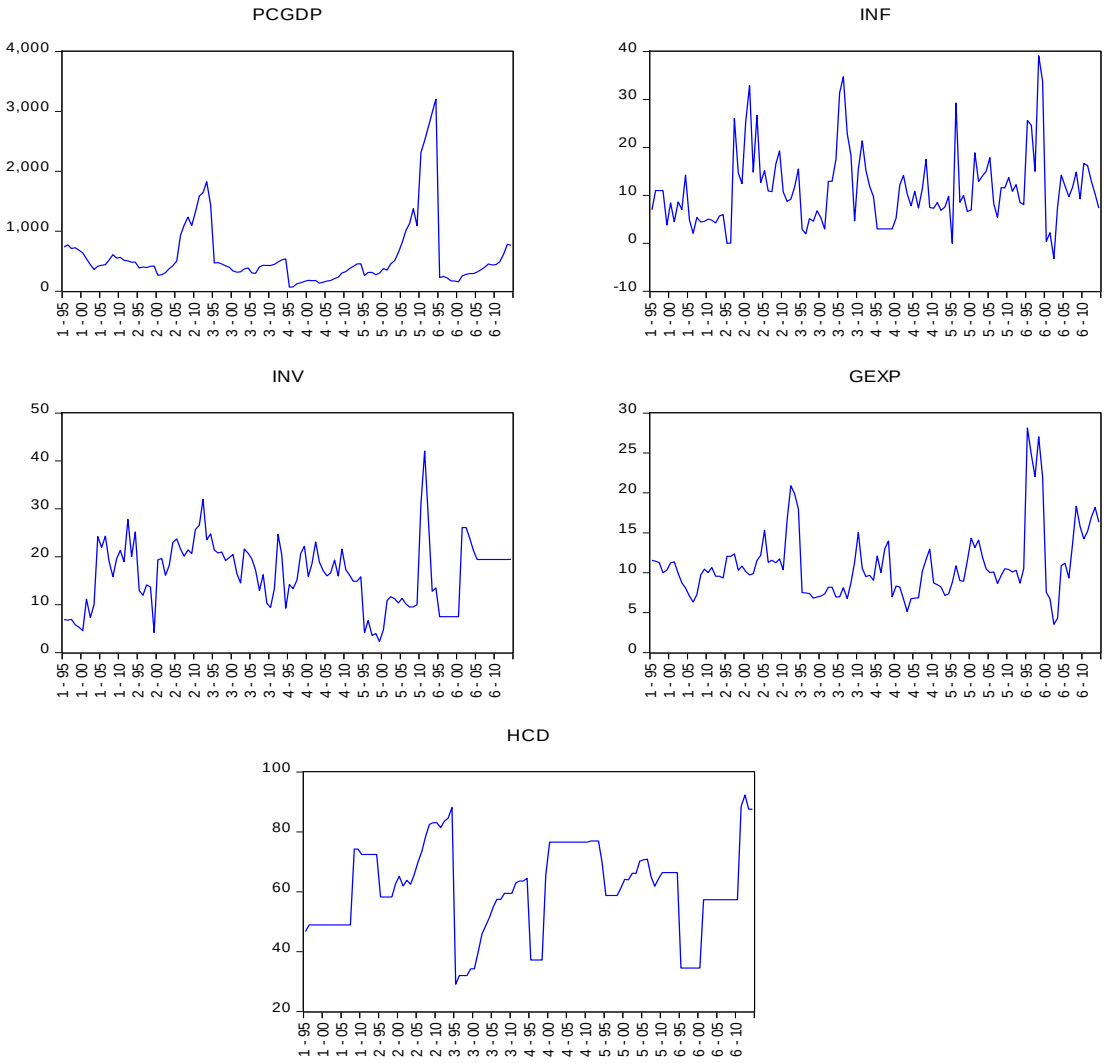
5.4 Analysis of Unit Root Test

A basic assumption of the Classical Linear Regression model is that variables should have a constant mean, variance and the covariance between the values of two periods should be zero. Violation of this assumption leads to spurious regression. To avoid this shortfall, the unit root test was conducted on the variables to ascertain their stationarity

properties. Where non-stationarity was detected, stationarity was induced by taking the first difference of the variable involved. This implies that in carrying out the unit root test; one must actively consider the merits and demerits of the different tests (and if possible compare the outcomes of the different tests). Hence, a stationarity test was carried out in order not to run a spurious regression.

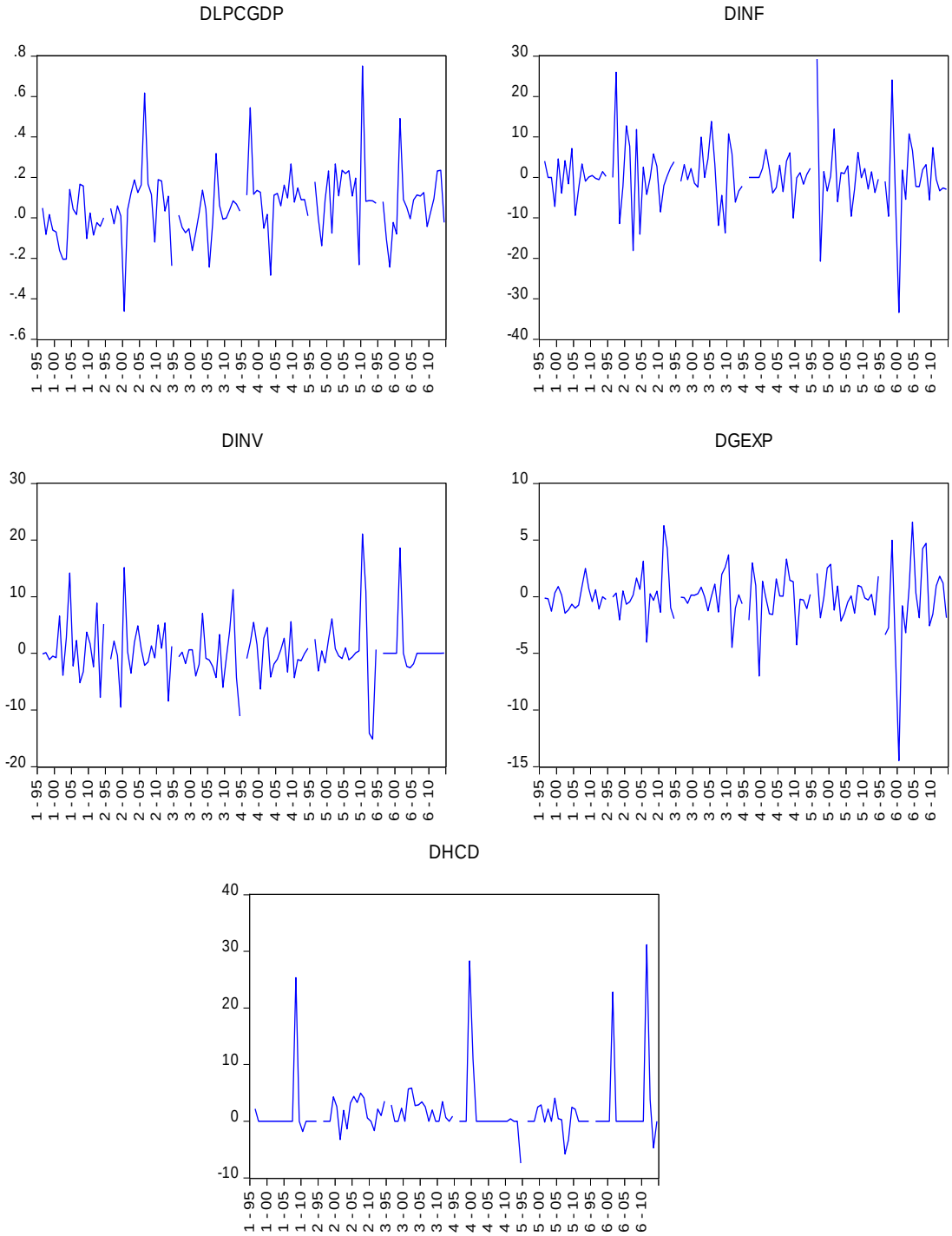
The graphical analysis of all the variables used in the model is seen in figure 5.4. The graphs show that all the variables tend to be trending, which indicates that the variables might not be stationary. The series were then differenced and charted. The differenced series indicate that the variables tend to be reverting back to the mean. Hence, in order to empirically test for the existence of unit root in the variables, unit root test was carried out on the variables, and the result is discussed in section 5.4.1.

Figure 5.4: Graphical Representation of the level series



Source: Data from World Bank Development Indicators & IFS CD-ROM

Figure 5.5: Graphical Representation of the differenced series



Source: World Bank Development Indicators & IFS CD-ROM

5.4.1 Results of the Panel Unit root test

The tests of the presence of unit root are based on the log transformation of the variables, and the result of the test is reported in Table 5.3. The unit root tests for various random walks reveal that most variables are non-stationary (Table 5.3). However, their first differences are stationary meaning that the series are integrated of order one, I (1) (Koop, 2013). Hence, the unit root test result for the WAMZ indicates that we fail to reject the null hypothesis of a unit root for per capita GDP, investment, and government expenditure. This implies that apart from inflation and population growth, the other variables were not stationary in the level form. A further test of the non-stationary variables in their differenced form showed that they are integrated of order one, that is they are I (1) series.

Table 5.3: Unit Root Results for the Panel date

Variable	Intercept		Intercept & Trend		Comment
	Levin, Lin & Chu (Assume Common unit root)	**Im, Pesaran & Shin W-stat (Assume Individual unit root)**	**Levin, Lin & Chu (Assume Common unit root)**	**Im, Pesaran & Shin W-stat (Assume Individual unit root)**	
LPCGDP	0.292	1.461	-1.950	-1.051	Not Stationary
INF	-3.165	-3.139	-2.792	-2.073	Stationary
GEXP	-1.483	-1.093	-1.379	-0.111	Not Stationary
INV	-2.751	-1.794	-4.164	-3.426	Stationary
HCD	-0.921	0.754	-0.063	0.369	Not Stationary
Ln(n+g+σ)	-6.441	-7.291	-5.090	-5.007	Stationary

First Differenced Series					
Variable	Intercept		Intercept & Trend		Comment
	Levin, Lin & Chu (Assume Common unit root)	**Im, Pesaran & Shin W-stat (Assume Individual unit root)**	**Levin, Lin & Chu (Assume Common unit root)**	**Im, Pesaran & Shin W-stat (Assume Individual unit root)**	
D(LPCGDP)	-3.450	-3.486	-2.682	-2.461	Stationary
D(GEXP)	-5.527	-4.244	-4.808	-2.771	Stationary
D(HCD)	-4.308	-3.149	-3.889	-2.039	Stationary

Source: Author's computations

Note: Estimation was conducted using EViews 9.0 software.

All data are of annual frequency for the period 1995 to 2014.

5.4.2 Results of the country-specific Analysis

A further test was carried out for the different countries time series data using the traditional Augmented Dickey-Fuller and Phillips-Perron tests. This was conducted with the trend and without trend as guided by the graphical analysis. The test was done with the following hypothesis:

Null hypothesis (H_0): Variable contains unit root and hence is non-stationary. **Alternative hypothesis (H_1):** Variable does not contain unit root and hence is stationary.

Decision rule: If the calculated ADF Test statistic is greater than the MacKinnon critical values (both in absolute terms) at the chosen level of significance, reject the null hypothesis of non-stationarity and accept the alternative hypothesis of stationarity, otherwise, do not reject the null hypothesis of non-stationarity. The ADF test result is summarized shown in Table 5.4 below (see the detailed result in appendix A13).

The reported results in Table 5.4 clearly demonstrate that the null hypothesis of each of the time series has a unit root that cannot be rejected for most of the levels country-specific variables since their ADF values are less than critical values at the 1 per cent, 5 per cent and 10 per cent levels of significance. Therefore, most explanatory variables (with the exception of inflation) and the proxy for economic growth are non-stationary in their levels. However, the results indicate that the null hypothesis is rejected for the first differences; hence making most of the variables stationary in their first differences. Although non-stationarity in the variables brings about spurious regressions (Sjo, 2008), cointegration tests for all the models (both panel and country-specific) demonstrate that the variables cointegrate (see chapter 6), thereby hinting that the regressions are non-spurious.

Table 5.4 Unit Root Tests for Country-Specific Variables

Variable	The Gambia	Ghana	Guinea	Liberia	Nigeria	Sierra Leone
GDPPC	-5.9071	-3.0916	-5.3234	-4.1609	-3.8685	-3.2190
Order of Integration	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
INF	-4.3589	-5.2897	-3.6854	-5.6450	-4.1330	-2.4858
Order of Integration	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)
INF2	-5.5454	-5.6958	-2.7511	-5.6250	-2.2708	-4.0607
Order of Integration	I(0)	I(0)	I(0)	I(0)	I(0)	I(0)
HCD	-5.266	-4.055	-3.822	-2.81	-4.161	-5.013
Order of Integration	I (1)	I (1)	I (1)	I (0)	I (1)	I (1)
GEXP	-4.4933	-4.9632	-5.1602	-3.8105	-6.3641	-7.5310
Order of Integration	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
INV	-7.5787	-7.6274	-5.6567	-4.0901	-6.5675	-5.6956
Order of Integration	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
Ln(n+g+σ)	-4.485	-3.420	-2.950	-3.492	-3.423	-3.267
Order of Integration	I(0)	I(1)	I(1)	I(0)	I(0)	I(1)

Source: Author's computations. Note: the ADF-test was conducted under the null hypothesis of unit root using MacKinnon critical values of -3.68, -2.97 and -2.62 for the 1%, 5%, and 10% significance level, respectively.

Based on the fact that the variables in the model are of mixed orders of integration and none of the variables is of order higher than the order I (1), a panel ARDL approach rather than the traditional panel

cointegration test is considered more appropriate. This is because, according to Johansen (1995) and Philipps and Hansen (1990), the long-run relationships exist only in the context of cointegration among variables with the same order of integration. Nevertheless, Pesaran and Shin (1999) argue that panel ARDL can be used even with variables with a different order of integration irrespective of whether the variables under study are I (0) or I (1). Furthermore, using the Pooled Mean Group (PMG) ARDL allows short-run coefficients, including the intercepts, the speed of adjustment to the long-run equilibrium values, and the error variances to be heterogeneous country by country, while the long-run slope coefficients are restricted to be homogeneous across countries. This is quite useful if we have reasons to expect that the long-run equilibrium relationship between the variables is similar across countries, the short-run adjustment is allowed to be country-specific as a result of individual country differences. However, this should be taken with caution as the existence of a long-run relationship between the variables of interest requires the coefficient on the error–correction term in the Panel ARDL to be negative, statistically significant and not lower than -2. Also, the relative size of T and N is crucial, since when both of them are large, it allows us to use the dynamic panel technique, which helps to avoid bias in the average estimators and resolves the issue of heterogeneity. Where the above conditions are violated, a panel cointegration analysis (see chapter 4) could be used to ascertain if the I (1) variables have a long run relationship, and where a long run relationship is established, we can go ahead with the analysis.

5.5 Conclusion

The chapter dwelled on the pre-estimation analysis for both the panel data analysis and the country-specific analysis. Firstly, the summary statistics of the variables of interest were explored, with emphasis on the skewness and the kurtosis of the distributions. Secondly, correlation

analysis was used to identify the relationship between the dependent variable and the explanatory variables. Scatter plots of the other explanatory variables were also carried out. Thirdly, a unit root test was used to identify the stationarity property of the time series data used for both the panel and country-specific analysis. Admittedly, descriptive analysis though useful is inadequate (Koop, 2013); hence, a more profound diagnosis is subsequently obtained through OLS estimations.

CHAPTER SIX

"Theory and introspection have their proper place in economic analysis, but at some point, they must be tested by the actual reactions of the marketplace" - Blank, David M

6.0 Model Estimations and Analysis of Results

6.1 Introduction

The research question posed in the introductory chapter is premised on the hypothesis that inflation has a significant non-linear relationship with output growth. Hence, in line with recent literature on optimal inflation, this chapter investigates the inflation-output relationship for both the WAMZ and the individual countries in the WAMZ. To execute this, we adopt a deductive reasoning approach where a research strategy is designed to test the developed hypothesis. The analysis was carried out to determine if there is any significant difference in the inflation threshold of the various WAMZ countries. Although there are a lot of methodologies for estimating inflation threshold, as earlier discussed, the quadratic approach would be used to determine the inflation thresholds. This chapter covers the presentation and discussion of the empirical results for the panel regression analysis. The chapter dwelt on the research objective and testing of the research hypothesis. It started with the discussion of the test result of the Granger causality between economic growth and inflation while the second sub-section provided a detailed discussion of the data estimation technique for the panel analysis, pointing out the various steps employed in panel analysis regression as well as the main empirical results with regard to the panel analysis. The analysis started with the estimation of the panel ARDL analysis, followed by the pooled analysis and the fixed effect model, upon carrying out the fixed effect redundancy test. Furthermore,

following the post-estimation diagnostics, the most suitable model was adopted and discussed. Section 6.5 concludes the chapter.

6.2 Research Objectives and Hypothesis Testing

This section seeks to address each of the stated objectives by testing the attendant research hypotheses earlier posited (see chapter 4). There are four research hypotheses directed at answering each of the research questions as well as addressing each of the research objectives.

6.2.1 Objective One: Determine the direction of causality between Economic growth and inflation

This objective seeks to ascertain the direction of causality between inflation and output growth. In doing so, it tends to answer the first research question as to "What is the causality between inflation and economic growth?" The direction of causality between inflation and economic growth is highly imperative as it helps to underscore which of the variables is an independent variable and which is a dependent variable in a case where a univariate causality is found. More so, it helps to underscore whether inflation and economic growth are endogenous in nature in a case where bi-causal causality exists between the two variables.

Table 6.1 provides the F-test statistics of the causality tests conducted for inflation and economic growth across countries and over time. Table 6.1 presents the results of panel homogeneous causality tests, which reveals that there is uni-directional causality between inflation and Economic growth. The causality runs from inflation to economic growth, which means that change in inflation leads to a change in economic growth, but a change in economic growth, in turn, does not necessarily

lead to a change in inflation. The results of the F-test statistics as shown in Table 6.1 reveal that the null hypothesis that the F-test statistical result for inflation Granger-causing economic growth is statistically significant at lag 1 to 2. This implies that we fail to accept the null hypothesis that inflation does not Granger-cause economic growth for the given lag lengths and that the alternative hypothesis that inflation Granger-causes economic growth is accepted.

Table 6.1: Granger Causality test

Lags	F-test
Inflation does not Granger-cause Economic growth	
1	0.1411
2	1.5733
Economic growth does not Granger-cause inflation	
1	4.5422**
2	3.4879**

Source: Author's computations based on data from World Bank Development Index and IFS. Note: Econometric estimation was conducted using EViews 9.5 software. All data are of annual frequency for the period 1995 to 2014. *** is significant at 1%, ** is significant at 5% and * is significant at 10%.

Furthermore, the null hypothesis that economic growth does not Granger-cause inflation is accepted. The result of the Granger causality test shows that there is unidirectional causality from inflation to economic growth. This implies that inflation Granger-causes economic growth. In this case, the null hypothesis that inflation does not significantly Granger cause economic growth has been rejected at the 5 percent level of significance.

Although some authors (Datta, 2011; Chuan Yeh, 2009) have established that there seem to be two way relationships between

inflation and economic growth, the result of the causality test tends to align with the empirical findings of Erybaykal and Okuyan, (2008); Chimaobi, (2010); Mubarik, (2005); Friedman (1977), Dotsey and Sarte (2000) that there is a unidirectional causality from inflation to economic growth. The rejection of this hypothesis has implications for model estimations in this section. First, it suggests that the empirical investigation is to consider the impact of inflation on economic growth as supported by the theoretical literature and as suggested by the rejection of the null hypothesis of uni-directional causality from inflation to economic growth only. Specifically, the results of the analysis using the Engle and Granger causality test showed the existence of a unidirectional causality that runs from inflation to output growth. The decision on the direction of causality was made from the F-statistics and probability values of the tests.

6.2.2 Objective Two: Investigating the Inflation and Economic growth Relationship in the WAMZ.

6.2.2.1 Estimation for the Dynamic Panel (Panel ARDL) Model

The estimation procedure for this study is executed scientifically. Generally, a dynamic model, the panel autoregressive distributed lag method (PARDL) proposed by Pesaran, Shin & Smith (1999) was first estimated. As earlier stated, considering that the variables in the model are of different orders of stationarity, (i.e., I (0) and I(1)), the conventional method of panel ARDL is considered more appropriate. The result of the ARDL cointegration test was inconclusive at 5 per cent level of significance; however, the PARDL result of the short run PARDL analysis showed that the adjustment coefficient from the Error Correction Model (ECM) is negative and statistically significant at 1 per cent level of significance (see appendix A4). This is a sign that the

model converges towards equilibrium. The speed of adjustment is more than ninety per cent.

The main explanatory variables have the desired sign. The coefficient of β_1 is positive while the coefficient of β_2 is negative, (showing the maximum inflation conducive for growth). Hence, from the regression results, the threshold level of inflation was obtained by estimating the marginal effect of inflation rate on economic growth, holding other factors constant, the threshold level of inflation for the WAMZ was estimated at 12.4 per cent (see the detailed result in appendix A4).

In a bid to carry out a more conclusive result and to serve as a robustness check, a panel cointegration test was also carried out, and a panel OLS estimated. The results of the panel cointegration and the panel OLS are discussed in the sections 6.2.2.2 and 6.2.2.3.

6.2.2.2 Panel Cointegration Test

The existence of unit root in some of the variables necessitated the need for a cointegration test in order to ascertain if the I (1) variables would cointegrate in the long run. In economics, two variables cointegrate if they have a long-running relationship between them. Since the variables are integrated of the same order (that is order one), the study employed the Johanssen (1991) method of cointegration in order to provide evidence for the existence of a long-run relationship between the variables. The Johannsen (1991) procedure for a multivariate cointegration test was adopted for this purpose given its superiority over the Engle and Granger (1987) technique. The cointegrating series are per capita GDP, government expenditure and investment. A lag interval of 1 to 1 was used for the Johanssen cointegration rank test for both the trace and maximum Eigenvalue. The result is summarised in Table 6.2.

Table 6.2: Panel cointegration result

Unrestricted Cointegration Rank Test (Trace and Maximum Eigenvalue)

Hypothesised. No. of CE(s)	Fisher Stat.* (from trace test)	Prob.	Fisher Stat.* (from max-eigen test)	Prob.
None*	37.66	0.0002	37.05	0.0000
At most 1	11.09	0.5208	8.954	0.7068
At most 2	9.034	0.7001	9.034	0.7001

* denotes rejection of the hypothesis at the 0.05 level
Source: Author's estimation from Eviews

Table 6.2 shows the result of an unrestricted cointegration rank test trace and Maximum Eigenvalue. The results reveal that the null hypothesis for no cointegrating relationship among the variables was rejected at 5 per cent significant level indicating the existence of at most one cointegrating relationships among the variables. Table 6.2 indicates that there exists a unique cointegrating vector among per capita GDP, government expenditure and investment at 5 per cent significance level. On the basis of these results, a long-run equation can be estimated in order to assess the relationship between inflation and economic growth.

6.2.2.3 Estimation for the Static Panel (Panel OLS Analysis) Model

Based on the result of the panel cointegration test, a panel OLS was then estimated. We begin with estimating the pooled OLS, then fixed-effect and random-effect panel models. In order to ascertain which of the panel models the analyses for our model would be based upon, poolability test and Hausman test were conducted. The former is to ascertain the preference of the fixed-effect panel model to the pooled

OLS model while the latter is to consider which is preferred between the fixed-effect and random-effect static model.

6.2.2.3.1 Estimations for the Panel Model

6.2.2.3.1.1 Regression Result

In order to empirically determine the threshold level of inflation in the WAMZ, pooled, fixed effect and random effect regressions were estimated using the data earlier mentioned and the model discussed in chapter 4 (see equation 4.11).

Regression number one in Table 6.3 includes each of the variables in the dataset and the interaction term as earlier discussed in Chapter 4. As can be seen in the table, the result of this pooled OLS regression shows that the coefficients of inflation and inflation squared are positive and negative respectively, as expected. This is in line with apriori expectation (see the detailed result in appendix A4). The F-test for the pool regression produces a statistically significant F-value of 1.82.

The result of the pool regression does not control for country-specific effects thereby assuming that all parameters are constant across cross-sectional units (pooled OLS). To test for the significance of the fixed effect (F-ratio test), the pool regression and the fixed effect regression (see appendix) were used. As earlier stated in equation 4.22, the F-ratio was used to test for the significance of the fixed effect model. Since the F-ratio (of 12.14) is greater than the critical value for F-ratio (which is equal to 2.1), the null hypothesis that there is no country or period-specific effects is rejected. We conclude that the fixed effects model is a better fit as compared to the model without fixed effects.

Therefore, the next OLS regression is a fixed effect analysis, and it includes all the previous variables. The adjusted R-square increased from 0.0483 to 0.3173. Again, the variables of interest have the apriori

sign. The t-value and the probability value of the regression result show that both variables are statistically significant. This thus supports the finding that inflation up to a particular level is necessary for growth.

Further analysis to check if fixed cross-section effects alone are necessary for the panel regression, a redundant fixed-cross section effect test was employed. The null hypothesis is that the fixed effects are redundant and thus unnecessary. The result of the redundant test is shown in Table 6.5 below.

Table 6.3 Redundant Fixed Cross-section Effect Tests

Redundant Fixed Effects Tests

Equation: FIXED_MODEL

Test cross-section fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	4.9439	(5,101)	0.0004

Source: Author's computations based on data from World Bank Development Index and IFS.

Note: Econometric estimation was conducted using EViews 9.5 software. All data are of annual frequency for the period 1995 to 2014.

The likelihood ratio test of the redundant fixed effect for cross-sectional effect shows that the use of fixed-effects estimation is adequate as the null hypothesis of redundant fixed effect was rejected at 1 per cent level of significance. This implies that the effect of the individual countries cannot be ignored.

Additionally, testing using the significance of the period effects showed that we fail to reject the null hypothesis of fixed-period effect (Table 6.4). The essence of the test is to know whether to include time effect or not. Ideally, if the F-statistic is significant, the null hypothesis would be rejected and the alternative accepted. This will imply that the fixed-effect regression should include period dummies.

Table 6.4: Redundant Fixed Period Effect Tests

Redundant Fixed Effects Tests

Equation: FIXED_MODEL

Test period fixed effects

Effects Test	Statistic	d.f.	Prob.
Period F	1.1051	(18,90)	0.3608

Source: Author's computations based on data from World Bank Development Index and IFS. Note: Econometric estimation was conducted using EViews 9.5 software. All data are of annual frequency for the period 1995 to 2014.

Since Table 6.4 above shows that the F-value is insignificant, we, therefore, fail to reject the null hypothesis and conclude that no time effect is needed in the fixed-effect regression. Judging from the result of the pre-estimation test above, the regression was then estimated using cross-section fixed effects, by including dummy variables for each of the countries. The result, which is shown in Table 6.3, reports the fixed-effects estimates that account for country-specific effects by allowing the constant term to differ across the cross-sectional units systematically.

Table 6.5 Regression Result

Variable	Pooled OLS		Fixed Effect		Random Effect		Fixed Effect Model During the WAMZ period	
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
INF	0.00726	0.2504	0.0130	0.0013	0.0075	0.2006	0.01119	0.0189
INF2	-0.00028	0.1155	-0.0005	0.0000	-0.0002	0.0814	-0.000482	0.0003
GEXP	0.058661	0.4101	-0.0056	0.8859	0.0586	0.3847	0.00044	0.9306
INV	0.00378	0.1145	0.0037	0.0273	0.0039	0.0706	0.00278	0.1668
HCD	0.29388	0.0820	0.2994	0.0014	0.2897	0.0676	0.00146	0.2110
Ln (n+g+σ)	-0.00201	0.9610	-0.0397	0.1123			-0.0691	0.0823
IGDPPC	0.000006	0.8330	-0.0101	0.6924			-0.0421	0.0982
$Dummy_{WAMZ\ Period}$							0.0135	0.7098
Obs.	114		114		114		114	
Adjusted R^2	0.0483		0.3173		0.0655		0.3046	
Serial correlation test								
Breusch-Pagan LM	0.5651	0.5651	9.98E-09	1.000	11.88	0.6883	1.19E-09	
Pesaran CD	0.4736	0.4736	6.77E-06	1.000	0.69	0.4854	-8.17E-06	
Durban Watson	1.84		1.93		1.83		1.95	

Source: Author's computations based on data from World Bank Development Index and IFS.

Note: Econometric estimation was conducted using EViews 9.5 software. All data are of annual frequency for the period 1995 to 2014

In addition, equation 4.11 was re-estimated using the random effect model in order to find the most robust and best fitting results. Because we have only six cross-sections, the number of the control variables to be included in the random model was limited so that we do not violate the rules when running a random effect model. The results are shown in Tables 6.3 and 6.4. The result of the regression analysis shows that the variables of interest like the other regressions had the desired sign. The adjusted R-squared was lower than that of the fixed effect. A decreased adjusted R-square does suggest a small amount of explanatory power has been lost in the model, probably because some of the variables were dropped because of the limited cross-section. The last regression (fixed effect with a dummy variable for the WAMZ) like all the other regressions had apriori signs for the variables of interest.

6.2.2.3.1.2 Diagnostic Tests

In order to ascertain the appropriateness of the random effect model, it is necessary to test if the individual effects are correlated with the other regressors in the model or not. To decide between fixed or random effects a Hausman test was carried out with the null hypothesis that the preferred model is random effects as against the alternative that the fixed effect model was preferred (Green, 2008). Hausman (1978) proposed a test for this based on the difference between the random and fixed-effects estimates. Hausman's test was applied to the estimated random effect model to determine whether the random effect estimator would be preferred to the fixed-effect estimator. Under this test, the assumption is that, if the differences in the random effect and fixed-effect coefficients are random, then the country-specific effects are correlated with the regressors, and hence the random effect estimates are consistent and efficient. Table 6.6 below shows the result of the Hausman test.

Table 6.6: Correlated Random Effects - Hausman Test

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	14.479	5	0.0128

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
INF	0.002798	0.007530	0.000004	0.0170
INF2	-0.000170	-0.000292	0.000000	0.0059
INV	0.004780	0.003891	0.000001	0.2563
GEXP	0.069863	0.058574	0.000020	0.0125
HCD	0.305321	0.289767	0.000442	0.4596

Source: Author's computations based on data from World Bank Development Index and IFS.

Note: Econometric estimation was conducted using EViews 9.5 software. All data are of annual frequency for the period 1995 to 2014. The Hausman test shows Chi2(5)=14.48, with the Prob>Chi2=0.0.012, When P-value is insignificant, i.e., Prob>chi2 larger than 0.05, random effects are chosen but when it is not the significant fixed effect is selected. Based on Hausman test, the fixed effect in is chosen for this analysis.

The Hausman Wald-ratio is 14.5 and significant at the conventional 5 per cent level of significance. This then leads to rejecting the null hypothesis assumption of a random effects model, implying that country-specific effects are uncorrelated with the regressors. Besides, a key assumption in regression is that the error terms are independent of each other. Testing for cross-sectional dependence is an important factor in estimating panel data models. When the time dimension of the panel is larger than the cross-sectional dimension (T > N), one may use the LM test, developed by Breusch and Pagan (1980). On the other hand, when the time dimension of the panel is less than the cross-sectional dimension (T < N), the LM test statistic does not enjoy any desirable statistical properties in that it exhibits substantial size distortions. Thus, there is clearly a need for testing for cross-sectional dependence where N is large, and T is small. Since in our analysis above, the time dimension (20) is larger than the cross-sectional dimension (6), the Breusch-Pagan Lagrange Multiplier (LM) statistic test would be

appropriate. The null hypothesis of Breusch-Pagan LM test of independence is that residuals across entities are not correlated.

Table 6.7: Cross-Section Dependence Test

Residual Cross-Section Dependence Test

Null hypothesis: No cross-section dependence (correlation) in weighted residuals

Test	Statistic	d.f.	Prob.
Breusch-Pagan LM	8.92E-09	15	1.0000
Pesaran CD	6.28E-06		0.9997

Source: Author's computations based on data from World Bank Development Index and IFS. Note: Econometric estimation was conducted using EViews 9.5 software. All data are of annual frequency for the period 1995 to 2014.

Based on the above diagnostic tests, we can conclude that there is no cross-sectional dependence. Thus, inferences from the model are assumed valid.

6.2.2.3 Discussion of Results

It is obvious from all the regression results in Table 6.6 and 6,7, that the relationship between inflation and per capita GDP growth is non-linear, indicating that a higher level of inflation rates is inimical to growth. The F-test for all the regressions produced statistically significant F-values. Table 6.5 reports the regression results of the different panel analyses, based on the various diagnostic test (redundant fixed and Hausman test) above, the regression was estimated as a fixed-effect model using country dummies. Hence, the results discussed below are based on the fixed effect model using cross-country effect (see the detailed result in appendix A6). The threshold result of the fixed panel regression using the quadratic model is thus discussed in this section.

The economic variables in the analysed regressions include all the variables derived from the model as specified in equation 4.11. In addition, country dummies were used to test the hypothesis that

different countries may have a different inflation-growth relationship. From the result, it would be observed that the dummy variables for Gambia and Sierra Leone were found to be statistically insignificant; while those of the other countries were significant at 5 per cent level of significance.

The effect of our variables of interest (which is inflation and the square of inflation) on economic growth are statistically significant and showed a strong non-linear relationship. The fact that the p-value for the inflation squared variable is close to zero also confirms that the quadratic coefficient is significant. The impacts of the variables of interest indicate a significant positive (for inflation) and negative (for inflation squared) relationship with economic growth depending on the level of the inflation rate. This agrees with the economic theory that low inflation rate induces growth (especially in developing countries), while high inflation is detrimental to growth. Also, the signs of the variables of interest satisfy the stipulated conditions (for the quadratic model) discussed in chapter 4.

Incorporating a set of other explanatory variables in the fixed-effect model specification to test if there is any significant change in the model produced the results seen in Table 6.9. The result of the fixed-effect model showed that all estimated parameters of our regression had the apriori signs. Investment and human capital development exhibited a positive relationship with output growth, while government expenditure, initial GDP, and population growth showed a negative relationship with output growth. All the estimated parameters with the exception of government expenditure, population growth, and initial GDP were statistically significant at 5 per cent level of significance.

Economic theory and empirical research suggest that investment in economic infrastructure spurs economic growth as an investment is expected to generate employment not only directly through the actual construction, operation and maintenance requirements but also through indirect multiplier effects across the economy (Kumo, 2012). Hence, it is not surprising from the empirical analysis that the estimated coefficient for investment is statistically significant at 5 per cent level of significance. This implies that a one standard deviation increase in the investment ratio would raise the growth rate of per capita GDP by 0.004 percentage point, thus, suggesting that countries should encourage the inward flow of finance to meet the investment requirements of the economy. This is in line with the views of Euractiv (2010) that infrastructure development is a prerequisite for poverty alleviation and employment creation in developing countries.

The result of the analysis showed that secondary school enrolment has also been a driver of output growth in the WAMZ. The estimated coefficient of 0.2994 means that a one percentage point increase in enrolment is associated with a rise in GDP per capita growth by 0.2994 percentage point. This implies that the benefits from education are more likely to accrue as better educated school leavers enter the workforce.

Government expenditure decisions in the region were highly influenced by several factors, which vary from country to country. In some countries, government expenditure was seen as a burden to the economy. The coefficient of government expenditure on the fixed panel regression showed a negative effect on output growth in the WAMZ within the estimated period thus, supporting the ideas of Barro and Sala-i-Martin (1995) and a host of others (Miller and Russek, 1997; Barro, 1991) that argued that government expenditure is a burden to the economy. They argued that high government expenditure (especially on

unproductive projects) crowds out the most efficient private investment and inhibits growth. The estimated coefficient for government expenditure is in line with apriori expectations. This implies that a one standard deviation decline in the ratio would raise output growth by 0.0056.

6.2.3 Objective Three: Estimating the threshold level at which inflation is harmful to output growth for the WAMZ countries.

To explore this further, however, it is useful to look in more detail at what was driving growth in the different WAMZ countries. Some authors have also argued that the threshold level of inflation varies among countries (especially developing countries) depending on the country-specific and time-specific characteristics (Eggoh & Khan, 2014; and Baglan & Yoldas, 2014). The earlier analysis as in other studies, suggests that a low level of inflation induces growth, while higher levels tend to be detrimental to growth. Hence, this particular objective seeks to answer the question of "what level of inflation is detrimental to growth in the WAMZ and should the target inflation for the WAMZ countries be the same or vary across countries?" This analysis was carried out by taking a partial differential of the growth equation with respect to inflation and equating to zero.

From the results above, the threshold level of inflation was obtained by estimating the marginal effect of inflation rate on economic growth, holding other factors constant,

$$\delta \ln Y_t / \delta \pi_t = \beta_1 + 2\beta_2 \pi_t = 0$$

Equating to zero and solving the above equation for π_t, the inverted curve is thus obtained using

$$\boldsymbol{\pi_t^* = -\beta_1 / 2\beta_2}$$

$$\textbf{That is, } (\delta \ln Y_t / \delta \pi_t) = =- [0.0130/2*(-0.0005)]$$

The threshold level of inflation = **12.9%**

Consequently, the estimated quadratic equation for the sample data between 1995 and 2014 provided a threshold inflation rate of 12.9 per cent.

Table 6.8: Country-Specific Regression result

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	Gambia	Ghana	Guinea	Liberia	Nigeria	S/Leone
C	-0.032	0.101	0.132	-0.062	0.181	0.117
INF	0.009***	0.014***	0.014***	0.012***	0.012***	0.018***
INF2	-0.000***	-0.000***	-0.000***	-0.004***	-0.000***	-0.000***
INV	0.004**	0.003**	0.004**	0.003**	0.006**	0.003**
GEXP	0.037	0.028	0.026	0.037	0.039	-0.008
Ln(n+g+σ)	-0.011	-0.020	-0.027	-0.032	-0.037	-0.040
HCD	0.292***	0.299**	0.298**	0.313*	0.327***	0.285***
IGDP	0.002	-0.026	-0.032	0.001	-0.046*	-0.032
R2	0.35	0.21	0.23	0.25	0.31	0.31
D/W Stat	1.84	1.74	1.75	1.79	1.81	1.72
Inflation Threshold	11.84	14.21	14.46	14.16	13.94	14.21

Source: Author's computations based on data from World Bank Development Index and IFS. Note: Econometric estimation was conducted using EViews 9.5 software. All data are of annual frequency for the period 1995 to 2014. Other variables include investment, government expenditure, and human capital development. Note**:** *** = 1% level of significance; ** = 5% level of significance: *=10% level of significance. Econometric estimation was conducted using EViews 9.5 software. All data are of annual frequency for the period 1995 to 2014. DW is the Durbin Watson statistics.

This implies that the impact of inflation rates up to 12.9 per cent on economic growth remains positive, but any increase beyond this level tends to hurt growth. The estimated threshold for the different WAMZ countries ranged from 11.8 per cent for the Gambia to 14.5 per cent for Guinea. Although, the estimated inflation threshold value of 12.9 per cent for the WAMZ countries is lower than the 17.0 per cent obtained by Lopez and Mignon (2011) for emerging countries, It is, however, not significantly different from the 10 to 12.95 per cent range identified by Eggoh and Khan (2014) for developing countries.

6.2.4 Objective Four: Is the Estimated threshold level significantly different from the level before the Establishment of the WAMI.

Further analysis to examine if the obtained level of inflation threshold is significantly different from its level after the establishment of the WAMI, a dummy was constructed to capture only the period of WAMI establishment. Pre WAMI covers from 1995 to 2000, while the WAMI period covers from 2000 to 2014. This was incorporated into the estimated growth model in equation 4.11. The result showed that the dummy variable for the WAMZ period was statistically not significant at the 5 per cent level. The t value obtained for the coefficient of the dummy variable from the regression equation is found to be insignificant when viewed in relation to its computed p-value of 0.005; hence, the formulated null hypothesis is not rejected. The statistically insignificant coefficient of the dummy variable (0.0135) with a p-value of 0.71 at the 5 per cent level indicates that the threshold level of inflation was not statistically different from the level after the establishment of WAMZ (see the detailed result in appendix A4).

6.3 Conclusion

The objective of price stability usually defined as an inflation rate of close to zero has been criticized by several authors, especially for developing countries. While the proponents of this objective argue that this level of inflation is optimal since it simultaneously averts the adverse consequences of inflation, researchers like Khan and Senhadji (2001) and Pollin and Zhu (2006) argued that for developing countries, moderate level of inflation is beneficial to growth. This chapter discussed the estimation and analysis of the panel data. A Granger causality test was first employed to determine whether the time series data used are useful in forecasting one another. The model reported evidence of a causal link from inflation to economic growth. The result of the panel Granger causality test showed that there is unidirectional causality from inflation to economic growth. This implies that inflation Granger causes economic growth. Secondly, in investigating the exact relationship between inflation and economic growth in the WAMZ, a model was specified by including some determinants of output growth. As a result of data availability, some explanatory variables (government expenditure, investment and a proxy for human capital development) were included in the model together with inflation. Also, an interaction variable which is the square of inflation was included in the growth model.

Both static and dynamic model were used for the analysis. A panel ARDL was first estimated, however, with the inconclusive bound testing result (although significant coefficient of the error correction term), a panel cointegration test was carried out and a panel static (pool, fixed, and random) model estimated. The relationship between inflation and economic growth was examined for the group country analysis using three different models (pool, fixed and random effect) after ascertaining the long run relationship in the variables using a panel cointegration

analysis. The result further showed the existence of a threshold level of inflation for the WAMZ member countries. The findings of the analysis showed that all the estimated parameters had the expected signs, although some were not significant. The empirical results in addition to identifying the determinants of growth in the WAMZ countries, strongly suggest the existence of threshold levels for all the countries, beyond which inflation exerts a negative effect on growth. Based on the series of diagnostics tests employed in the panel data analysis, the cross-sectional fixed-effect model was chosen over the other models. Further analysis to ascertain if there is a significant difference in the level of inflation after the commencement of the WAMZ, showed that there is no significant difference prior to and after the establishment of the WAMZ. The estimated inflation level based on the fixed effect model was found to be within the 10 per cent and 12.95 per cent range identified by Eggoh and Khan (2014) for developing countries. It is important to note that the first two hypotheses have been tested in this chapter. The conclusion reached for the first hypothesis is that there is unidirectional causality from inflation to economic growth while the test of the hypothesis using the second methodology showed a threshold level ranging from 11.84 per cent to 14.46 per cent, thus, the level of inflation that is harmful to output growth for the WAMZ countries is apparently more than 10 per cent. In examining if the obtained level of inflation threshold is significantly different from its level after the establishment of the WAMZ, the estimated result showed that the dummy variable for the WAMZ period was not different from the level after the establishment of the WAMZ.

CHAPTER SEVEN

"Growing inequality is one of the biggest social, economic and political challenges of our time. But it is not inevitable"- Zanny Beddoes

7.0 OPTIMAL INFLATION RATE FOR THE WAMZ: THE CASE OF NIGERIA.

7.1 Introduction

Within the WAMZ and sub-Saharan African as a whole, Nigeria is the largest economy with substantial resources, both natural and human; a well-developed financial system, a well-developed stock exchange; and a modern infrastructure supporting the major areas in the region. Nigeria, with a population of about 176 million people in 2014 (NBS, 2015) and a land area of 923,768 km^2, is the largest economy in West Africa region and the second largest in the whole of Sub-Saharan Africa. As at 2014, Nigeria contributed over 88.3 per cent to the WAMZ's GDP, and 77.2 per cent of its total population. It is an oil-based economy with the oil sector contributing about 10 per cent of its GDP, over 80 per cent of total government revenue and about 90 per cent of the country's foreign exchange earnings (CBN, 2014). It is the highest exporter of crude oil in West Africa and richly endowed with huge agricultural resources. A lot of West African countries depend on the Nigerian market and population for its trade. Hence these countries benefit from its relatively huge population amongst other things, rather than countries further away. Given the relative importance of the country in the WAMZ region, it is, therefore, imperative to further examine the level of inflation that would be detrimental to output in Nigeria. This is because it is expected that movements in Nigerian inflation are likely to have economic implications on inflation and economic growth in the rest of the region.

The issue of the relationship between inflation and output growth in Nigeria may differ from that of the other WAMZ countries with food constituting over 60 per cent of the CPI basket, while both food and energy (non-core CPI) comprise almost 70 per cent of the CPI basket. Furthermore, the Nigerian economy is largely dependent on the agricultural sector and imports for consumption, while depending largely on the oil sector for government revenue and investment. It can be seen from chapter 3 that, although oil is a major aspect of the Nigerian economy, it is the Non-oil sector that drives the changes in GDP. Hence, the analysis will pay attention to the inflation threshold on the non-oil GDP in Nigeria.

This chapter will focus on the key determinants of output growth in Nigeria by incorporating relevant variables that explain the growth in Nigeria in addition to the earlier ones in the previous chapter. This chapter will look at Non-oil GDP growth in Nigeria and estimate the optimal inflation conducive for growth in the non-oil sector. Given that other works on the inflation threshold in Nigeria have focused on the overall GDP, this chapter hopes to contribute to the literature by investigating the relationship between inflation and output growth using non-oil GDP. Econometric estimations are conducted using the Pesaran and Shin et al. (1998) and Greenwood-Nimmo et al. (2011) Auto Regressive Distributive Lag (ARDL) cointegration framework given the possible non-stationarity inherent in the macroeconomic variables. The analysis is conducted using a dataset spanning from 1985 to 2014.

7.2 Empirical Analysis

7.2.1 The Data

Macroeconomic theory has identified various factors that influence the growth of a country as mentioned in the earlier chapters. Some empirical findings suggested that these factors include investment, human capital development, inflation, political factors, socio-cultural factors, and many others (Antwi et al., 2013). Hence, in order to examine the empirical evidence of the optimal inflation in Nigeria, the study considers some of these factors. The empirical analysis in this chapter is conducted using the model earlier specified in equation 4.11 and data spanning from1984 to 2014. The dataset includes the log of real GDP (Y_t) defined as gross domestic product at constant 2005 prices to capture the structure of the Nigerian economy. Oil revenue was added to the earlier estimated model to estimate its impact on non-oil GDP in Nigeria. All domestic datasets are sourced from the CBN and the NBS database.

7.2.2 The Data

Parameters in the above equations are estimated by applying the OLS procedure to the ARDL model. Given its time-series nature, and the fact that output growth is affected by an array of factors, OLS estimation of the model can be subjected to a number of problems like endogeneity bias, autocorrelation, and non-stationary of variables (as explained in earlier chapters). Nonetheless, according to Pesaran and Shin (1998), the ARDL modeling approach has the advantage of producing consistent parameter estimates even in the presence of these problems. From the preceding chapters, we noted that the non-stationarity of most economic variables affects the validity of inferences made with such variables. Hence, to avert the problem of spurious regression as well as enable us to capture both long-run relationships and short-run dynamics

we, again, conduct a cointegration analysis using the ARDL model *à la* Pesaran and Shin (2001). Pesaran and Shin also indicated that the OLS estimators of the cointegrating parameters of the ARDL are Gaussian and efficient. Test of cointegration is conducted using the PSS bounds F-test which are performed under the (joint) null of no cointegration.

7.2.3 Unit Root test

The first step of the analysis is to check the unit root properties of the variables involved. A stationarity test was conducted to examine the time-series properties of the variables.

The tests are conducted using both the ADF test with the null hypothesis of a unit root and the KPSS test with a null hypothesis of stationarity. The results contained in Table 7.1, as expected showed a mixture of I(0) and I(1) properties among the variables. While government expenditure and inflation are I(0), all the other variables are I(1). However, as observed earlier, the combination of I(0) and I(1) variables in the model would not affect the validity of our analysis based on the ARDL model.

Table 7.1: Stationarity Test for the Variables

	ADF			KPSS		
	Levels	1st diff.	Decision	Levels	1st diff.	Decision
Government Expenditure (Gexp)	-3.174**	-	I (0)	0.3222	-	I (0)
Human Capital Development (HCD)	-2.9065	-5.416**	I (1)	0.267	-	I (0)
Inflation (Inf)	-4.1330**	-	I (0)	0.35779	-	I (0)
Investment (inv)	-3.0081	-4.241**	I (1)	0.1656**	-	I (0)
Oil revenue (Oir)	-1.3199	-5.884**	I (1)	0.1808**		I (0)
Population (Ln(n+g+σ))	-3.436**	-	I(0)	0.3030	-	I(0)
Non-Oil GDP (Y_N_G)	-0.6612	-4.5852**	I (1)	0.7010**	-	I (0)

Source: Author's computation based on data from the Central Bank of Nigeria database and National Bureau of Statistics database. Note: the ADF-test was conducted under the null hypothesis of unit root using MacKinnon critical values of -3.68, -2.97 and -2.62 for the 1%, 5% and 10% significance level, respectively, while the KPSS-test was performed under the null hypothesis of stationarity with corresponding asymptotic critical values of 0.74, 0.46 and 0.11

7.2.4 ARDL Model and Cointegration Test

The validity of the estimated equations is confirmed by employing relevant diagnostic tests such as the Ramsey reset test, Jarque–Bera normality test, the Breusch–Godfrey serial correlation LM test, the ARCH test for heteroskedasticity and stability tests such as the CUSUM test. This study uses F-test statistic in bounds test to determine if the variables cointegrate in the long run. That is, the joint significance of the coefficients tested with F-statistic at one period of lag as shown in equation 7.2. The result of the regression analysis shows that the models satisfied most of the diagnostic tests.

The F-statistic is compared with the asymptotic critical values provided in Pesaran et al. (2001) as discussed in the preceding chapters. Robust OLS estimators are derived using the Newey-West method to produce HAC standard errors which ensure the validity of our inferences even in the presence of the classical problems. All restrictions and model evaluations are conducted at the 5 per cent level of significance. We further evaluate the correctness of our model specification using Ramsey's RESET with the null of no specification error. All the models passed the functional forms test of Ramsey's RESET showing that the models were well specified.

The Jarque-Bera statistics show that the error terms are non-normally distributed except for the non-oil GDP where the hypothesis of normal distribution could not be rejected. The Durbin-Watson statistics do not indicate the presence of autocorrelation in any of the models.

Table 7.2: ARDL Model Result for Non-Oil GDP

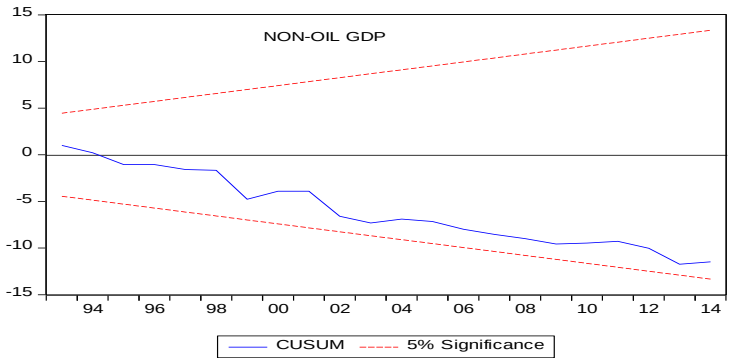
Regressors	Non-Oil Output
Y (-1)	-0.322***
INF	0.531***
INF2	-0.016***
INV	0.416***
GEXP	0.468***
HCD	0.191
OIr	-0.002***
Ln(n+g+σ)	-2.630***
F-Stat$_{BT}$	3.95***
DW	1.92
Ramsey	1.693
Jarque-Bera	3.003
B-G LM Test	3.40
ARCH_LM	0.086
Inflation Threshold	16.44

Source: Author's computation based on data from the Central Bank of Nigeria database and National Bureau of Statistics database. Note: Diagnostic tests results are based on F-statistic, and the asterisks represent the level of significance. Note: *** = 1% level of significance; ** = 5% level of significance: *=10% level of significance. Models 1and 2, is the corresponding regressions for Oil and Non-Oil regressions, respectively. The Breusch-Godfrey Serial correlations LM test the null hypothesis that there is no serial correlation in the residuals. Breusch-Godfrey LM serial autocorrelation of residuals test (H0: no autocorrelation), The ARCH LM test the null hypothesis that there is no ARCH up to order q in the residuals. ARCH Test for autocorrelation conditional heteroskedasticity (H0: no heteroskedasticity), The Normality tests the null hypothesis that the errors are normally distributed. Jacque-Bera normality test for distribution of residual term (H0: normality).

Furthermore, the Bruesch-Geoffrey LM test statistics do not show that there is the presence of serial autocorrelation in the error terms. The heteroskedasticity test statistics indicate that there is no

heteroskedasticity problem, which implies that the residuals are homoscedastic in all equations.

Figure 7.1 Cusum Test (Recursive OLS Estimate) stability test.



The plots of the cumulative sum of recursive residuals (CUSUM) stability tests for the regression as shown in figure 7.1 indicate that all the coefficients of the estimated model are stable over the study period as they fall within the critical bounds. Hence, we find little or no evidence of serial correlation, autoregressive conditional heteroskedasticity, and white heteroskedasticity. The residual terms are normally distributed, and the functional form of the model appears well specified. With all this in mind, we can safely argue that our model is not plagued by any issue. This implies that our model is reliable for making inferences.

7.3 Discussion of the Regression Results

In order to ascertain the presence of a long run relationship among the variables in the above equations; a 'Bounds tests' approach was conducted. The results of the 'Bounds tests' are presented in Table 7.2. Table 7.2 reveals that the computed F-statistics based on the Wald tests is 3.95. All the above statistics clearly exceeded the upper bound of 3.9 for the equations at the 1% significance level, suggesting that the null hypothesis of no cointegrating relation is rejected for those equations.

From the empirical analysis, the various ARDL models are estimated for non-oil (y_n) output. The impact of inflation on non-oil output growth in the models shows that lower levels of inflation were found to impact positively on growth, while higher levels of inflation were found to impact negatively on output growth just like in the earlier models. This further shows that the relationship between inflation and growth is non-linear. Based on the model, the estimated threshold for inflation rate is estimated at 16.44 per cent for the Non-Oil GDP model, (see the detailed result in appendix A7).

The signs of some of the variables were in line with apriori expectation, while the sign of others were in contrast to expectation. All things being equal, oil revenue is expected to have a positive effect on output growth (Non-oil GDP), which implies that the higher the level of revenue generated from oil the higher the economic growth. However, the estimated result showed that the increase in oil revenue has a negative impact on non-oil GDP. The negative effect of oil revenue on Nigerian output growth is in line with Sachs and Warner (2001) whose research works suggested that resource-rich countries generally grow more slowly than resource-poor countries and that any relative price shock which increases the value of these resources would most likely hamper development. Their assertion is also in line with Hadass and Williamson (2001) who argued that the issue of “resource curse” is mostly because of government mismanagement of resources rather than being endowed with the natural resource. Nweze and Edame (2016) also noted that, although the oil sector has contributed to over 80 per cent of government revenue in Nigeria since its discovery, this has led to the neglect of other sectors especially the agricultural sector. Okonjo-Iweala (2004), in her presentation as the then finance minister, posited that Nigeria goes through fiscal recklessness when there is increased revenue from oil price rise. She noted that the Nigerian government

tends to implement loose fiscal policy with its flawed attendant pattern of borrowing whenever there is a boom in the oil sector.

Although this is in contrast to the theoretical expectation, government expenditure was found to impact positively on non-oil GDP. This implies that government expenditure had the potential to stimulate growth in the non-oil sector implying that expenditure on social development has improved human capital thus contributing to higher productivity. The possible explanation could be that increases in government expenditures helped to improve the macroeconomic environment and the general security conditions, hence, attracting foreign investment and supports' into the country. A similar result has also been found for Nigeria by Mbutor et al. (2013), who argued that government spending is the major source of vigour for economic activities in Nigeria. Some other authors (Lin, 1994, Kweka and Morrissey, 2000) also found a positive impact of government spending on output growth in some developing countries,

In line with apriori expectation, the effect of investment on output growth was significantly positive in the regression. The result is an indication that investments had been shown as one of the most significant determinants of output performance as in a simple Keynesian model. Hence countries that invest more tend to grow faster than those countries that save and invest less.

7.4 Conclusion

Nigeria is the largest economy in the West African zone both in terms of population and its contribution to the zone's GDP. Hence, the focus of this chapter was to empirically estimate the optimal inflation threshold for the WAMZ using Nigeria as a case study. The estimated result using non-oil GDP showed that the optimal inflation for Nigeria is approximately 16 per cent. It is also noteworthy that the estimated

threshold level of inflation is based on the period used for the analysis. With the recent decline in inflation rate in Nigeria, there may be need for continuous analysis of the threshold level. The analysis also revealed that other drivers of output growth in Nigeria include investment, government expenditure, and human capital development. Furthermore, the chapter generally discussed the result of the estimated model and based on the findings of the study appropriate policies were recommended.

CHAPTER EIGHT

8.0 SUMMARY, CONCLUSION, AND RECOMMENDATION

8.1 Introduction

This chapter concludes the study by first presenting a summary, focusing on the findings in each chapter and their implications. It also presents the conclusion of the research study on the inflation threshold for the second WAMZ member countries. Arising from the findings of the research study, some policy lessons supported by the empirical findings were drawn as well as the limitations of the study. Finally, the areas for further research are suggested.

8.2 Summary

The study sets out to empirically investigate the relationship between output growth and inflation in the second West African Monetary Zone. The results of the hypothesis were evaluated in relation to the objectives of the study and the theoretical and empirical literature. In order to promote a clearer synthesis of the discussion, each of the objectives was situated within the findings of other studies.

The study provided both theoretical and empirical analysis of the inflation-output growth relation for the second West African Monetary Zone, with a view to finding the optimal inflation necessary for growth in the zone. A body of theoretical and empirical analysis on inflation threshold in developed and developing countries, both on cross-country and country-specific analysis demonstrates the strong tide and emphasis on the non-linearity of the inflation-output growth relationship. Although inflation is seen as being inimical to output growth, a major question that still arises is “is the single digit inflation target for the zone

ideal?", "should this target be the same for all the countries?" In answering these questions, there is a preponderance of evidence in the literature; with different estimation methodologies on cross-country analysis. However, empirical studies on WAMZ countries (with the exception of Nigeria and Ghana) analysis are still limited. Moreover, methodological issues for the available literature tend to blur any chance of convergence of opinions. This has continued to pose a problem to the determination of the actual inflation rate to be targeted by the zone in order to achieve one of the convergence criteria of the second WAMZ countries, hence, delaying the full implementation of the second West African monetary union. This serves as a motivation for this study.

A quadratic regression model was used to estimate the inflation threshold for the zone. This implies that the regression equation was estimated as a second-degree polynomial. The panel least square technique was used to estimate the zone-wide inflation threshold, while the ordinary Least Square technique was used for the individual country estimates. Annual time series data spanning from 1995 to 2014 were utilised for the analysis. The study was structured into eight chapters. The introductory chapter set the agenda for the research, by articulating the problem statement, objective, hypothesis for the research study as well as the justification and scope of the study.

In the second chapter, a review of the related literature involving both the theoretical and empirical issues was carried out. The theoretical framework for the study was also expounded in this chapter. There was evidence of conflicting theoretical ideas on the inflation-output relationship in the literature. While some were of the view that inflation is harmful to output growth at all levels, others were of the view that inflation is needed for growth and yet others provided evidence that a certain level of inflation is required for growth, especially in developing

countries. Furthermore, a comprehensive review of the different methodologies used in literature for the estimation of threshold analysis was carried out in this chapter ranging from the popular Khan and Senhadji approach to the logistic approach and then to the quadratic function approach. The empirical evidence in the literature showed different threshold levels for the WAMZ countries using different time span and methodologies. Although most of these studies favoured an inflation level of less than 10.0 per cent for the WAMZ, some of the studies provided evidence for a higher inflation level; some results were not statistically significant, while, others were inconclusive. Thus, the critical assessment of the literature enhanced the identification of these gaps.

The third chapter explored the background and the establishment of the second West African Monetary Zone. The macroeconomic background and overview of the economies of the WAMZ countries were examined with the aim of providing clearer insights on the key issues relating to historical performance and assessment of economic management. This provided a deeper understanding of the similarities and peculiarities of these countries.

Chapter four discussed the empirical methodology for the study and the different estimation procedures to be followed in the analyses. Furthermore, the control variables were briefly discussed, while presenting the descriptive statistics of the variables used in the analysis.

Chapter Five comprises the pre-empirical analysis for the study analysis. The chapter investigated the relationship between inflation and economic growth in the WAMZ. The stationarity properties of the panel data were examined using the Levin-Lin-Chu and Im, Pesaran & Shin W-stat unit roots tests while the ADF stationarity test was used to

examine the unit root test for the country-specific data. A detailed trend of inflation and output growth in the six WAMZ countries was discussed while graphically presenting the variables used for the growth model.

The sixth chapter estimated, presented and discussed both the panel data analysis and the country-specific model. The Granger causality test was first utilised to test the causal relationship between inflation and growth. The objective was to ascertain the direction of causality between inflation and output growth. In doing so, it tends to answer the first research question of "What is the causality between inflation and economic growth?" The results of the analysis using the Engle and Granger causality test showed the existence of a unidirectional causality that runs from inflation to output growth. This confirms the results of Friedman (1977), Dotsey and Sarte (2000), thus, implying that inflation in the WAMZ Granger-causes economic growth, but not vice versa. The decision on the direction of causality was made from the F-statistics and probability values of the tests.

Secondly, to ascertain the exact relationship between inflation and output growth in the WAMZ, both panel, and country-specific analysis were estimated. The empirical analysis used both static and dynamic models in the analysis. The static model used three different panel models (pool, fixed and random effect), while the dynamic model used the panel ARDL model developed by Peasaran and Shin (2001). Based on the result of the diagnostics tests, the pool and random effect methods were not tenable; hence, the fixed-effect method was used to test the hypothesis with a good measure of the degree of freedom. The result of the model showed significant positive and negative coefficients of inflation and inflation squared respectively, suggesting an inverted U-shaped relationship between inflation and per capita GDP in the WAMZ and concluding that the relationship between inflation and output growth

in the WAMZ within the analysed period is non-linear. The result showed that low inflation rate exerts a significant positive impact on output growth, while high values of inflation negatively affect output growth significantly, showing the non-linearity of inflation on output growth of the selected countries.

Thirdly, the research further examined if there is a threshold inflation rate for the WAMZ countries and to know if the single digit inflation being targeted by the WAMZ is ideal or not. Both panel time-series analysis and country-specific analysis were used to answer the questions of "Does an Inflation threshold level exist for the WAMZ member countries?" and "Should the target inflation rate be the same for all WAMZ countries or country specific?" Both models adopted the quadratic approach to threshold regression technique to examine the existence of optimal inflation. Estimations from the static regression equation showed the turning point to be at 12.9 per cent; this result is not different from 12.4 per cent obtained from the dynamic model. The estimated result of the analysis is not significantly different from the result of studies by Eggoh and Khan (2014) and that of Balogun and Yoldas (2014). Moreover, the study found no significant difference in the inflation threshold for the WAMZ since the establishment of the West African Monetary Institute in 2001. Further analysis to answer the question of "whether the target inflation for the WAMZ countries should be the same or vary across countries" was carried out using dummies to account for the country-specific effects. The result showed that although there are significant variations in the optimal inflation for the different countries, the average inflation threshold was not statistically different from the panel result.

Chapter seven examined the optimal inflation for Nigeria as a case study. The macroeconomic background and overview of the Nigerian

economy were examined with the aim of providing clearer insights on the key issues relating to historical performance and assessment of economic management in the country. Furthermore, an inflation-growth model was carried out using the non-oil GDP and the results presented and discussed.

The empirical result based on country-specific analysis suggests that there are significant differences in the inflation threshold levels in various WAMZ countries as they ranged from 11.8 percent for the Gambia, which was the least to 14.5 percent for Guinea, which was the highest. A panel data analysis of the optimal inflation rate for the WAMZ suggests that inflation is significantly associated with lower growth only after it reaches about 12.9 percent. Further analysis using Nigeria, which is the most significant economy in the WAMZ in terms of its contribution to the zone's GDP, as a case study showed that the optimal inflation for the WAMZ is around 16.00 percent, which is higher than the 10.00 percent currently being targeted in the WAMZ countries.

8.4 Recommendations

From the study, some findings are discernible. It was evident based on the analysis that the threshold for the WAMZ countries is undoubtedly above 10.0 per cent. Findings of the regression analysis revealed that the optimal inflation threshold for the WAMZ is between 12.00 per cent and 13.00 per cent implying that the single digit target for the WAMZ might be a bit restrictive. Based on the results obtained from the regression analysis in the sixth and seventh chapter and based on the findings, appropriate policies were recommended. Output growth in the WAMZ was found to be determined by a multitude of factors, but investment and education are critical. Based on the findings of this research study, some useful policy lessons can be drawn for the second West African Monetary Zone member countries. Inflation rate between

12.00 and 13.00 per cent might not hurt the WAMZ economic growth. Hence, it is thus recommended that,

- The policy against inflation needs to be tighter at levels of inflation above 13.00 per cent and not below as currently being targeted. This implies that although low inflation is advocated, targeting single-digit inflation in the WAMZ may not be in the interest of the countries. This is because there is likely to be positive growth benefits in these countries if inflation is allowed to move to 13.00 per cent. It should also be noted that some of the WAMZ countries, inflation should actually be allowed to edge up to more than 13.00 per cent. Thus, rather than suppressing inflationary pressures through the continuous increase in its short-term rates, it might be necessary to look closely at the sources of the inflationary pressures.
- Human capital development was found to have a significant positive effect on most of the WAMZ countries, hence, the need for government to promote skill-intensive productive activities and invest in infrastructural developments and other developmental activities for more revenue generation.
- There is also a need to restructure resource allocation to tackle basic education and health to ensure that the majority of the populace becomes a useful part of the labour force, thus increasing productivity and growth.
- The study showed that government expenditure in most of the examined countries impacted negatively on output growth, thus the need to reallocate expenditures to ensure that basic needs are met.
- Although the WAMZ countries belong to the same geographical area, which could enhance group formation; there could be other sources of heterogeneity such as different political, legal, economic, national policies and interactive forces that drive the

individual growth processes in this region. Hence, if policy needs are implemented along country-specific characteristics, it could serve as a better pathway to economic growth in the zone.

- Additionally, monetary authorities should focus more on policy measures for lowering inflation at levels that are close to the threshold point rather than targeting inflation above 10 per cent.

8.4 Conclusion

Determining the threshold level of inflation is very important for monetary policy makers. In the WAMZ countries, like in many developing countries, what constitutes an optimal inflation level is yet to be fully appreciated. Although there have been several studies to ascertain the inflexion point of inflation for the developing countries like the WAMZ member countries, the WAMZ average inflation rate has hovered around 11.84 and 14.46 per cent since the establishment of WAMI. Efforts are continually being directed at lowering this rate further (irrespective of its associated costs) given that one of the convergence criteria requires that the inflation rate should be below 10 per cent. In order to achieve this desired aim, some of the countries have migrated to a full-fledged inflation targeting framework[8], while some are earnestly preparing to migrate to the framework. However, the lack of consensus among researchers and the regularly changing structure of the economies, and varying inflationary patterns make the discussion about the threshold level of inflation a burning issue at all times. Hence, the study has evaluated the inflation threshold for the second West African Monetary Zone (WAMZ).

[8] This entrenches the interest rate and the inflation rate, respectively, as the sole instrument and objective of monetary policy. This would entail the announcement of a specific inflation target around which the effectiveness of the Bank's policy actions would be judged. Adopting IT entails credibility of the monetary authority, an adequate understanding of the transmission mechanism of monetary policy and the willingness to sacrifice other objectives (such as economic growth and employment) for the attainment of price-stability.

The empirical analyses are based on both group panel data and individual countries' time series techniques. From the analysis, using both the dynamic and static panel model, the results provide evidence that there actually exists a level of inflation above which inflation becomes worrisome to output growth, showing the non-linearity of inflation. The individual country analysis showed varying inflation rates for the different countries. Moreover, the result of the analysis provided strong evidence that the level of inflation for the WAMZ is above the 10 per cent currently being targeted. The analysis showed that the main variables of interest, which are inflation, and the square of inflation, were all statistically significant. The sign of the coefficients of both inflation and square of inflation was positive and negative, respectively as expected to indicate the non-linear relationship between inflation and output growth.

8.5 Limitation and Agenda for Future Research

Although a lot of studies and research work have made important advances in estimating the inflation threshold of the WAMZ countries, it is difficult to claim that one piece of work such as this has the answer to the inflation-growth debate. Although the analysis in general and the empirical model have been constructed as complete and as comprehensive as possible, there are, however, some limitations causing suggestions for further research and improvements to the existing research I have done in this thesis.

The panel analysis conducted in this paper is based on data from six (6) WAMZ countries over a 20-year period only, comprising/summing up to 120 observations. This might not matter so much for the panel analysis; however, the data limitation posed a challenge (especially for countries like Liberia) in carrying out the specific country analysis. This may be

one of the reasons why some of the variables showed different signs from a priori expectation. Perhaps if the dataset covered more years, we would find better results. Ideally, this time-series should be expanded, and for further study, data on some country-specific growth determinants should be included.

Furthermore, the limited time series also restrict the possible choices of an econometric model. Within the panel data econometrics, there exist many possibilities regarding the choice of model. Ordinary least squares (OLS), as used here, may not be the optimal choice, although there was no evidence of heteroscedasticity and/or autocorrelation in the data, the results from the analysis should be taken with caution. It is also noteworthy to know that there is a possibility that the estimated threshold numbers may change over time, reflecting the changing structure of the economies and the sources of inflationary pressures. Given that in the recent times, with the different macroeconomic policies being implemented in these WAMZ countries, inflation rate has generally been decreasing. It is expected that the inflation threshold for the region could reduce over time. Hence, the need for continued study of this nature in order to guide the monetary authorities better.

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APPENDIX

A1. DESCRIPTIVE STATISTICS

	DLPCGDP	INF	INV	GEXP	HCD	Ln(n+g+σ)
Mean	0.058829	11.29083	16.48267	10.99492	61.11053	0.9828
Median	0.060575	10.30000	17.26000	10.17500	62.18111	0.98559
Maximum	0.751409	39.10000	42.08000	28.13000	92.29563	2.06507
Minimum	-0.461396	-3.200000	2.320000	3.540000	29.09623	-1.13471
Std. Dev.	0.166693	7.826196	6.994170	4.274162	15.07198	0.44443
Skewness	0.754519	1.224396	0.192704	1.695091	-0.264217	-2.35786
Kurtosis	6.635906	4.735768	3.383246	6.585909	2.410023	14.3574
Jarque-Bera	73.61078	45.04735	1.477082	121.7604	3.136577	758.9928
Probability	0.000000	0.000000	0.477811	0.000000	0.208402	0.00000
Sum	6.706524	1354.900	1977.920	1319.390	7333.264	117.9408
Sum Sq. Dev.	3.139866	7288.672	5821.292	2173.946	27032.58	23.5045
Observations	114	120	120	120	120	120

A2. PANEL UNIT ROOT TEST

A1. Panel unit root test: Summary

Series: LPCGDP

Time: 13:14

Sample: 1995 2014

Exogenous variables: Individual effects

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	0.29204	0.6149	6	108
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	1.46120	0.9280	6	108
ADF - Fisher Chi-square	6.95592	0.8605	6	108
PP - Fisher Chi-square	4.02811	0.9829	6	114

** Probabilities for Fisher tests are computed using an asymptotic Chi - Square distribution. All other tests assume asymptotic normality.

A2. Panel unit root test: Summary

Series: D(LPCGDP)

Time: 13:15

Sample: 1995 2014

Exogenous variables: Individual effects

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				

Levin, Lin & Chu t*	-3.45003	0.0003	6	102
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.48634	0.0002	6	102
ADF - Fisher Chi-square	33.6306	0.0008	6	102
PP - Fisher Chi-square	51.8828	0.0000	6	108

** Probabilities for Fisher tests are computed using an asymptotic Chi

- Square distribution. All other tests assume asymptotic normality.

B. Panel unit root test: Summary

Series: INF

Time: 12:51

Sample: 1995 2014

Exogenous variables: Individual effects

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-3.16459	0.0008	6	108
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.13882	0.0008	6	108
ADF - Fisher Chi-square	30.5707	0.0023	6	108
PP - Fisher Chi-square	43.6565	0.0000	6	114

** Probabilities for Fisher tests are computed using an asymptotic Chi

- Square distribution. All other tests assume asymptotic normality.

C. Panel unit root test: Summary

Series: INV

Time: 12:54

Sample: 1995 2014

Exogenous variables: Individual effects

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-2.75178	0.0030	6	108
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-1.79482	0.0363	6	108
ADF - Fisher Chi-square	21.6234	0.0420	6	108
PP - Fisher Chi-square	16.3552	0.1755	6	114

** Probabilities for Fisher tests are computed using an asymptotic Chi
- Square distribution. All other tests assume asymptotic normality.

D1. Panel unit root test: Summary

Series: GEXP
Time: 13:06
Sample: 1995 2014
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-1.48318	0.0690	6	108
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-1.09344	0.1371	6	108
ADF - Fisher Chi-square	14.7708	0.2542	6	108
PP - Fisher Chi-square	14.9561	0.2438	6	114

** Probabilities for Fisher tests are computed using an asymptotic Chi
-square distribution. All other tests assume asymptotic normality.

D2. Panel unit root test: Summary

Series: D(GEXP)
Time: 13:06
Sample: 1995 2014
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-5.52732	0.0000	6	102
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-4.24354	0.0000	6	102
ADF - Fisher Chi-square	39.8042	0.0001	6	102
PP - Fisher Chi-square	57.6386	0.0000	6	108

** Probabilities for Fisher tests are computed using an asymptotic Chi
- Square distribution. All other tests assume asymptotic normality.

E1. Panel unit root test: Summary

Panel unit root test: Summary
Series: HCD
Time: 12:51
Sample: 1995 2014
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-0.92061	0.1786	6	108
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	0.74152	0.7708	6	108
ADF - Fisher Chi-square	8.82467	0.7178	6	108
PP - Fisher Chi-square	6.09051	0.9115	6	114

** Probabilities for Fisher tests are computed using an asymptotic Chi
-square distribution. All other tests assume asymptotic normality.

E2. Panel unit root test: Summary

Panel unit root test: Summary
Series: D(HCD)
Time: 12:39
Sample: 1995 2014
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-4.30757	0.0000	6	102
Null: Unit root (assumes individual unit root process)				

Im, Pesaran and Shin W-stat	-3.14990	0.0008	6	102
ADF - Fisher Chi-square	30.2788	0.0025	6	102
PP - Fisher Chi-square	47.6710	0.0000	6	108

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

F. Panel unit root test: Summary

Panel unit root test: Summary
Series: LPOPG
Time: 14:20
Sample: 1995 2014
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-6.44068	0.0000	6	108
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-7.29154	0.0000	6	108
ADF - Fisher Chi-square	68.8470	0.0000	6	108
PP - Fisher Chi-square	26.9951	0.0077	6	114

** Probabilities for Fisher tests are computed using an asymptotic Chi - Square distribution. All other tests assume asymptotic normality.

A3. Panel Cointegration Result

Johansen Fisher Panel Cointegration Test
Series: PCGDP GEXP HCD
Time: 07:20
Sample: 1995 2014
Included observations: 120
Trend assumption: Linear deterministic trend (restricted)
Lags interval (in first differences): 1 1

Unrestricted Cointegration Rank Test (Trace and Maximum Eigenvalue)

Hypothesized No. of CE(s)	Fisher Stat.* (from trace test)	Prob.	Fisher Stat.* (from max-eigen test)	Prob.
None	37.66	0.0002	37.05	0.0002
At most 1	11.09	0.5208	8.954	0.7068
At most 2	9.034	0.7001	9.034	0.7001

* Probabilities are computed using asymptotic Chi-square distribution.

Individual cross-section results

Cross Section	Trace Test Statistics	Prob.**	Max-Eign Test Statistics	Prob.**
Hypothesis of no cointegration				
1	42.2954	0.0576	25.8743	0.0492
2	36.4657	0.1898	19.9960	0.2433
3	33.8550	0.2952	20.7195	0.2045
4	52.4951	0.0042	30.7968	0.0101
5	33.5695	0.3086	19.6078	0.2663
6	55.9307	0.0016	36.4907	0.0014
Hypothesis of at most 1 cointegration relationship				
1	16.4210	0.4592	9.7448	0.6461
2	16.4697	0.4554	11.0257	0.5107
3	13.1355	0.7276	8.5954	0.7653
4	21.6983	0.1517	16.2870	0.1334
5	13.9616	0.6608	9.6791	0.6531
6	19.4401	0.2556	10.9664	0.5168
Hypothesis of at most 2 cointegration relationship				
1	6.6762	0.3795	6.6762	0.3795
2	5.4440	0.5339	5.4440	0.5339
3	4.5401	0.6632	4.5401	0.6632
4	5.4113	0.5384	5.4113	0.5384
5	4.2825	0.7010	4.2825	0.7010
6	8.4737	0.2154	8.4737	0.2154

**MacKinnon-Haug-Michelis (1999) p-values

Panel ARDL Bounds Test

Included observations: 118
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	2.994558	6

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	1.99	2.94
5%	2.27	3.28
2.5%	2.55	3.61
1%	2.88	3.99

Test Equation:
Dependent Variable: D(LPCGDP)
Method: Least Squares
Included observations: 118

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INF)	-0.005114	0.003540	-1.444754	0.1514
D(LHCD)	1.458069	0.151983	9.593606	0.0000
D(LPOPG)	0.556516	0.104826	5.308938	0.0000
D(LPOPG(-1))	-0.337902	0.100283	-3.369499	0.0010
C	-0.846103	0.399665	-2.117031	0.0366
INF	0.003108	0.004018	0.773570	0.4409
INV(-1)	0.003419	0.003570	0.957591	0.3404
LGEXP(-1)	0.087735	0.091605	0.957759	0.3403
LHCD(-1)	0.113553	0.116075	0.978270	0.3301
LPOPG(-1)	0.228767	0.092987	2.460197	0.0155
LPCGDP(-1)	-0.023845	0.038204	-0.624161	0.5339

R-squared	0.613142	Mean dependent var	-8.90E-05
Adjusted R-squared	0.576987	S.D. dependent var	0.377216
S.E. of regression	0.245339	Akaike info criterion	0.116235
Sum squared resid	6.440475	Schwarz criterion	0.374520
Log-likelihood	4.142111	Hannan-Quinn criteria.	0.221106
F-statistic	16.95871	Durbin-Watson stat	2.031132
Prob(F-statistic)	0.000000		

A4. Panel estimation Results

A. PANEL ARDL

Dependent Variable: D(LPCGDP)
Method: ARDL
Time: 13:36
Sample: 1997 2014
Included observations: 108
Maximum dependent lags: 1 (Automatic selection)
Model selection method: Hannan-Quinn criterion (HQ)
Dynamic regressors (2 lags, automatic): INF INF*INF INV LGEXP LHCD LPOPG
Fixed regressors: C
Number of models evaluated: 2
Selected Model: ARDL(1, 2, 2, 2, 2, 2, 2)
Note: final equation sample is larger than selection sample

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Long Run Equation				
INF	0.037909	0.016296	2.326312	0.0243
INF*INF	-0.001534	0.000398	-3.857090	0.0003
INV	0.081402	0.003116	26.12291	0.0000
LGEXP	-1.293151	0.166224	-7.779569	0.0000
LHCD	2.792008	0.302366	9.233858	0.0000
LPOPG	0.240149	0.434756	0.552377	0.5833
Short Run Equation				
COINTEQ01	-0.311902	0.162522	-1.919140	0.0609
D(INF)	-0.000477	0.003124	-0.152720	0.8793
D(INV)	-0.007298	0.011140	-0.655086	0.5155
D(INV(-1))	-0.013144	0.008281	-1.587271	0.1190

D(LGEXP)	0.486723	0.222116	2.191299	0.0333
D(LGEXP(-1))	0.214719	0.186033	1.154198	0.2541
D(LHCD)	-0.502514	0.634400	-0.792110	0.4322
D(LHCD(-1))	-0.616636	0.538225	-1.145685	0.2576
D(LPOPG)	1.700354	1.044873	1.627331	0.1102
D(LPOPG(-1))	-3.394956	2.321943	-1.462118	0.1502
C	-1.087854	0.604355	-1.800025	0.0781

Mean dependent var	0.057665	S.D. dependent var	0.170753
S.E. of regression	0.088141	Akaike info criterion	-1.515833
Sum squared resid	0.372904	Schwarz criterion	0.156662
Log likelihood	162.9500	Hannan-Quinn criter.	-0.836625

*Note: p-values and any subsequent tests do not account for model selection.

A.POOL REGRESSION

Dependent Variable: D(LOG(PCGDP))
Method: Panel Least Squares
Time: 13:16
Sample (adjusted): 1996 2014
Periods included: 19
Cross-sections included: 6
Total panel (balanced) observations: 114

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.043909	0.071530	-0.613846	0.5406
INF	0.007257	0.006279	1.155766	0.2504
INF2	-0.000284	0.000179	-1.586880	0.1155
INV	0.003779	0.002375	1.591401	0.1145
D(LOG(GEXP))	0.058661	0.070940	0.826910	0.4101
D(LOG(HCD))	0.293875	0.167387	1.755660	0.0820
LPOPG	-0.002008	0.040974	-0.049006	0.9610
IIGDP	6.47E-06	3.06E-05	0.211326	0.8330

R-squared	0.107254	Mean dependent var	0.058829
Adjusted R-squared	0.048299	S.D. dependent var	0.166693
S.E. of regression	0.162617	Akaike info criterion	-0.727243
Sum squared resid	2.803104	Schwarz criterion	-0.535229
Log likelihood	49.45285	Hannan-Quinn criter.	-0.649315
F-statistic	1.819246	Durbin-Watson stat	1.838749
Prob(F-statistic)	0.090965		

4B.FIXED REGRESSION

Dependent Variable: D(LOG(PCGDP))
Method: Panel EGLS (Cross-section SUR)
Time: 14:16
Sample (adjusted): 1996 2014
Periods included: 19
Cross-sections included: 6
Total panel (balanced) observations: 114
Iterate weights to convergence

White cross-section standard errors & covariance (no d.f. correction)
Convergence achieved after 22 weight iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.035944	0.155584	0.231028	0.8178
INF	0.013043	0.003945	3.306374	0.0013
INF*INF	-0.000507	0.000107	-4.746741	0.0000
INV	0.003689	0.001647	2.239137	0.0273
D(LOG(GEXP))	-0.005553	0.038602	-0.143865	0.8859
D(LOG(HCD))	0.299378	0.091156	3.284250	0.0014
LPOPG	-0.039728	0.024801	-1.601859	0.1123
LIGDP	-0.010106	0.025471	-0.396756	0.6924

Effects Specification

Cross-section fixed (dummy variables)

Weighted Statistics

R-squared	0.442443	Mean dependent var	0.571629
Adjusted R-squared	0.376199	S.D. dependent var	1.325599
S.E. of regression	1.062409	Akaike info criterion	-1.095244
Sum squared resid	114.0000	Schwarz criterion	-0.783221
Log-likelihood	75.42890	Hannan-Quinn criter.	-0.968611
F-statistic	6.678955	Durbin-Watson stat	1.937332
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.180061	Mean dependent var	0.058829
Sum squared resid	2.574498	Durbin-Watson stat	2.094435

4C.RANDOM REGRESSION

Dependent Variable: D(LOG(PCGDP))
Method: Panel EGLS (Cross-section random effects)
Time: 20:54
Sample (adjusted): 1996 2014
Periods included: 19
Cross-sections included: 6
Total panel (balanced) observations: 114
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.045558	0.055241	-0.824704	0.4114
INF	0.007530	0.005848	1.287588	0.2006
INF*INF	-0.000292	0.000166	-1.759242	0.0814
INV	0.003891	0.002131	1.825993	0.0706
D(LOG(GEXP))	0.058574	0.067115	0.872740	0.3847
D(LOG(HCD))	0.289767	0.156975	1.845942	0.0676

Effects Specification

	S.D.	Rho

Cross-section random	6.34E-08	0.0000
Idiosyncratic random	0.154504	1.0000

Weighted Statistics

R-squared	0.106831	Mean dependent var	0.058829
Adjusted R-squared	0.065481	S.D. dependent var	0.166693
S.E. of regression	0.161143	Sum squared resid	2.804431
F-statistic	2.583559	Durbin-Watson stat	1.836935
Prob(F-statistic)	0.030070		

Unweighted Statistics

R-squared	0.106831	Mean dependent var	0.058829
Sum squared resid	2.804431	Durbin-Watson stat	1.836935

4D.FIXED WITH DUMMY REGRESSION

Dependent Variable: D(LOG(PCGDP))
Method: Panel EGLS (Cross-section SUR)
Time: 13:15
Sample (adjusted): 1996 2014
Periods included: 19
Cross-sections included: 6
Total panel (balanced) observations: 114
Iterate weights to convergence
White cross-section standard errors & covariance (d.f. corrected)
Convergence achieved after 23 weight iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.190113	0.174885	1.087071	0.2796
INF	0.011199	0.004693	2.386072	0.0189
INF2	-0.000482	0.000127	-3.787395	0.0003
INV	0.002775	0.001993	1.392582	0.1668
GEXP	0.000437	0.005011	0.087307	0.9306
HCD	0.001459	0.001158	1.259008	0.2110
DUMMY	0.013515	0.036218	0.373141	0.7098
LPOPG	-0.069084	0.039367	-1.754854	0.0823
LIGDP	-0.041242	0.024704	-1.669456	0.0982

Effects Specification

Cross-section fixed (dummy variables)

Weighted Statistics

R-squared	0.384590	Mean dependent var	0.564480
Adjusted R-squared	0.304587	S.D. dependent var	1.291558
S.E. of regression	1.067708	Akaike info criterion	-1.027549
Sum squared resid	114.0000	Schwarz criterion	-0.691524
Log likelihood	72.57028	Hannan-Quinn criter.	-0.891175
F-statistic	4.807180	Durbin-Watson stat	1.959975
Prob(F-statistic)	0.000002		

Unweighted Statistics

R-squared	0.148721	Mean dependent var	0.058829
Sum squared resid	2.672903	Durbin-Watson stat	2.070299

A5. Panel Post Estimation Diagnostics

5.A Hausman Test

Correlated Random Effects - Hausman Test
Equation: RANDOMED
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	14.479811	5	0.0128

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
INF	0.002798	0.007530	0.000004	0.0170
INF*INF	-0.000170	-0.000292	0.000000	0.0059
INV	0.004780	0.003891	0.000001	0.2563
D(LOG(GEXP))	0.069863	0.058574	0.000020	0.0125
D(LOG(HCD))	0.305321	0.289767	0.000442	0.4596

Cross-section random effects test equation:
Dependent Variable: D(LOG(PCGDP))
Method: Panel Least Squares
Time: 12:15
Sample (adjusted): 1996 2014
Periods included: 19
Cross-sections included: 6
Total panel (balanced) observations: 114

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.029576	0.060150	-0.491711	0.6240
INF	0.002798	0.006175	0.453052	0.6515
INF*INF	-0.000170	0.000172	-0.990339	0.3243
INV	0.004780	0.002270	2.105364	0.0377
D(LOG(GEXP))	0.069863	0.067267	1.038592	0.3014
D(LOG(HCD))	0.305321	0.158378	1.927797	0.0566

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.216917	Mean dependent var	0.058829
Adjusted R-squared	0.140890	S.D. dependent var	0.166693
S.E. of regression	0.154504	Akaike info criterion	-0.805676
Sum squared resid	2.458774	Schwarz criterion	-0.541657

Log likelihood	56.92353	Hannan-Quinn criter.	-0.698525
F-statistic	2.853148	Durbin-Watson stat	2.089478
Prob(F-statistic)	0.003564		

5B Redundant Fixed Effects Tests

Redundant Fixed Effects Tests
Equation: FIXED_MODEL
Test cross-section fixed effects

Effects Test	Statistic	d.f.	Prob.	Prob.
Cross-section F	4.943940	(5,101)	0.0004	0.0004

Cross-section fixed effects test equation:
Dependent Variable: D(LOG(PCGDP))
Method: Panel EGLS (Cross-section SUR)
Date: 05/30/17 Time: 14:28
Sample (adjusted): 1996 2014
Periods included: 19
Cross-sections included: 6
Total panel (balanced) observations: 114
Use pre-specified GLS weights
White cross-section standard errors & covariance (no d.f. correction)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.216576	0.145488	1.488621	0.1396
INF	0.020590	0.002639	7.801839	0.0000
INF*INF	-0.000689	8.12E-05	-8.480269	0.0000
INV	0.004198	0.002191	1.915893	0.0581
D(LOG(GEXP))	-0.018475	0.032681	-0.565311	0.5731
D(LOG(HCD))	0.294206	0.091295	3.222571	0.0017
LPOPG	-0.044569	0.025321	-1.760174	0.0813
LIGDP	-0.050159	0.024268	-2.066837	0.0412

Weighted Statistics

R-squared	0.305981	Mean dependent var	0.571629
Adjusted R-squared	0.260150	S.D. dependent var	1.325599
S.E. of regression	1.157019	Sum squared resid	141.9014
F-statistic	6.676238	Durbin-Watson stat	1.593173
Prob(F-statistic)	0.000002		

Unweighted Statistics

R-squared	0.043872	Mean dependent var	0.058829
Sum squared resid	3.002113	Durbin-Watson stat	1.839648

5C Redundant Fixed Effects Tests

Equation: FIXED_MODEL

Test period fixed effects

Effects Test	Statistic	d.f.	Prob.
Period F	1.105073	(18,90)	0.3608
Period Chi-square	22.763765	18	0.1998

Period fixed effects test equation:

Dependent Variable: D(LOG(PCGDP))

Method: Panel Least Squares

Time: 12:11

Sample (adjusted): 1996 2014

Periods included: 19

Cross-sections included: 6

Total panel (balanced) observations: 114

White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.045558	0.061050	-0.746242	0.4571
INF	0.007530	0.005654	1.331719	0.1858
INF*INF	-0.000292	0.000157	-1.854661	0.0664
INV	0.003891	0.002653	1.467056	0.1453
D(LOG(GEXP))	0.058574	0.067544	0.867194	0.3878
D(LOG(HCD))	0.289767	0.133982	2.162732	0.0328

R-squared	0.106831	Mean dependent var	0.058829
Adjusted R-squared	0.065481	S.D. dependent var	0.166693
S.E. of regression	0.161143	Akaike info criterion	-0.761858
Sum squared resid	2.804431	Schwarz criterion	-0.617847
Log likelihood	49.42589	Hannan-Quinn criter.	-0.703412
F-statistic	2.583559	Durbin-Watson stat	1.836935
Prob(F-statistic)	0.030070		

5.D Lagrange Multiplier Tests for Random Effects

Null hypotheses: No effects
Alternative hypotheses: Two-sided (Breusch-Pagan) and one-sided (all others) alternatives

	Test Hypothesis		
	Cross-section	Time	Both
Breusch-Pagan	2.226621 (0.1357)	0.089391 (0.7650)	2.316011 (0.1280)
Honda	1.492186 (0.0678)	0.298983 (0.3825)	1.266548 (0.1027)
King-Wu	1.492186 (0.0678)	0.298983 (0.3825)	1.459467 (0.0722)
Standardized Honda	2.420201 (0.0078)	0.458365 (0.3233)	-2.250004 (0.9878)
Standardized King-Wu	2.420201 (0.0078)	0.458365 (0.3233)	-1.470590 (0.9293)
Gourieroux, et al.*	--	--	2.316011 (0.1426)

A6. COUNTRY-SPECIFIC REGRESSIONS

6A. Gambia

Dependent Variable: D(LOG(PCGDP))
Method: Panel EGLS (Cross-section SUR)
Time: 16:40
Sample (adjusted): 1996 2014
Periods included: 19
Cross-sections included: 6
Total panel (balanced) observations: 114
Linear estimation after one-step weighting matrix
White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.031626	0.167582	-0.188719	0.8507
INF	0.008693	0.004759	1.826683	0.0706
INF*INF	-0.000367	0.000131	-2.802070	0.0060
INV	0.003568	0.001635	2.182370	0.0313
D(LOG(GEXP))	0.036505	0.049420	0.738667	0.4618
D(LOG(HCD))	0.292228	0.109240	2.675109	0.0087
LPOPG	-0.011168	0.028308	-0.394501	0.6940
LIGDP	0.002309	0.027683	0.083418	0.9337
D1	-0.095985	0.024814	-3.868247	0.0002

Weighted Statistics

R-squared	0.351696	Mean dependent var	0.463843
Adjusted R-squared	0.302301	S.D. dependent var	1.201280
S.E. of regression	1.031304	Sum squared resid	111.6767

F-statistic	7.120122	Durbin-Watson stat	1.845466
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.147611	Mean dependent var	0.058829
Sum squared resid	2.676388	Durbin-Watson stat	1.949964

6B. Ghana

Dependent Variable: D(LOG(PCGDP))
Method: Panel EGLS (Cross-section SUR)
Time: 16:42
Sample (adjusted): 1996 2014
Periods included: 19
Cross-sections included: 6
Total panel (balanced) observations: 114
Linear estimation after one-step weighting matrix
White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.101278	0.162447	0.623449	0.5343
INF	0.013783	0.003553	3.879025	0.0002
INF*INF	-0.000485	0.000103	-4.688732	0.0000
INV	0.003339	0.001812	1.842523	0.0682
D(LOG(GEXP))	0.028457	0.041218	0.690398	0.4915
D(LOG(HCD))	0.299882	0.130348	2.300624	0.0234
LPOPG	-0.020394	0.028934	-0.704849	0.4825
LIGDP	-0.026497	0.026908	-0.984717	0.3270
D2	0.012111	0.042559	0.284567	0.7765

Weighted Statistics

R-squared	0.218974	Mean dependent var	0.412786
Adjusted R-squared	0.159467	S.D. dependent var	1.130526
S.E. of regression	1.027376	Sum squared resid	110.8276
F-statistic	3.679808	Durbin-Watson stat	1.741608
Prob(F-statistic)	0.000806		

Unweighted Statistics

R-squared	0.092724	Mean dependent var	0.058829
Sum squared resid	2.848725	Durbin-Watson stat	1.850459

6C.Guinea

Dependent Variable: D(LOG(PCGDP))
Method: Panel EGLS (Cross-section SUR)
Time: 16:42
Sample (adjusted): 1996 2014
Periods included: 19
Cross-sections included: 6
Total panel (balanced) observations: 114

Linear estimation after one-step weighting matrix
White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.131523	0.155176	0.847572	0.3986
INF	0.014019	0.003745	3.743609	0.0003
INF*INF	-0.000484	0.000107	-4.540752	0.0000
INV	0.004127	0.002107	1.958346	0.0528
D(LOG(GEXP))	0.026215	0.043916	0.596945	0.5518
D(LOG(HCD))	0.297781	0.135556	2.196730	0.0302
LPOPG	-0.027108	0.027325	-0.992058	0.3235
LIGDP	-0.031927	0.026060	-1.225139	0.2233
D3	-0.044870	0.024143	-1.858462	0.0659

Weighted Statistics

R-squared	0.225176	Mean dependent var	0.412812
Adjusted R-squared	0.166142	S.D. dependent var	1.129564
S.E. of regression	1.024322	Sum squared resid	110.1698
F-statistic	3.814333	Durbin-Watson stat	1.754455
Prob(F-statistic)	0.000572		

Unweighted Statistics

R-squared	0.108856	Mean dependent var	0.058829
Sum squared resid	2.798073	Durbin-Watson stat	1.881278

6D. Liberia

Dependent Variable: D(LOG(PCGDP))
Method: Panel EGLS (Cross-section SUR)
Time: 16:43
Sample (adjusted): 1996 2014
Periods included: 19
Cross-sections included: 6
Total panel (balanced) observations: 114
Linear estimation after one-step weighting matrix
White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.062136	0.158841	-0.391185	0.6965
INF	0.011869	0.004070	2.916626	0.0043
INF*INF	-0.000419	0.000117	-3.573965	0.0005
INV	0.003262	0.001799	1.812543	0.0728
D(LOG(GEXP))	0.036949	0.040061	0.922327	0.3585
D(LOG(HCD))	0.312804	0.132761	2.356147	0.0203
LPOPG	-0.031557	0.028327	-1.114053	0.2678
LIGDP	0.001145	0.025948	0.044135	0.9649
D4	0.096064	0.035846	2.679941	0.0086

Weighted Statistics

R-squared	0.251150	Mean dependent var	0.437457

Adjusted R-squared	0.194095	S.D. dependent var	1.142512
S.E. of regression	1.023474	Sum squared resid	109.9874
F-statistic	4.401882	Durbin-Watson stat	1.787349
Prob(F-statistic)	0.000129		

Unweighted Statistics

R-squared	0.096554	Mean dependent var	0.058829
Sum squared resid	2.836700	Durbin-Watson stat	1.844862

6E. Nigeria

Dependent Variable: D(LOG(PCGDP))
Method: Panel EGLS (Cross-section SUR)
Time: 17:06
Sample (adjusted): 1996 2014
Periods included: 19
Cross-sections included: 6
Total panel (balanced) observations: 114
Linear estimation after one-step weighting matrix
White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.181317	0.156133	1.161297	0.2482
INF	0.012042	0.004101	2.936017	0.0041
INF*INF	-0.000432	0.000120	-3.594983	0.0005
INV	0.005534	0.002057	2.689952	0.0083
D(LOG(GEXP))	0.039843	0.043932	0.906932	0.3665
D(LOG(HCD))	0.326866	0.116722	2.800389	0.0061
LPOPG	-0.026983	0.028909	-0.933372	0.3528
LIGDP	-0.046278	0.024444	-1.893175	0.0611
D5	0.156068	0.046399	3.363591	0.0011

Weighted Statistics

R-squared	0.314942	Mean dependent var	0.413106
Adjusted R-squared	0.262747	S.D. dependent var	1.170976
S.E. of regression	1.027600	Sum squared resid	110.8759
F-statistic	6.033957	Durbin-Watson stat	1.813254
Prob(F-statistic)	0.000002		

Unweighted Statistics

R-squared	0.175930	Mean dependent var	0.058829
Sum squared resid	2.587471	Durbin-Watson stat	2.016423

6F. Sierra Leone

Dependent Variable: D(LOG(PCGDP))
Method: Panel EGLS (Cross-section SUR)
Time: 16:48
Sample (adjusted): 1996 2014
Periods included: 19
Cross-sections included: 6
Total panel (balanced) observations: 114
Iterate weights to convergence
White cross-section standard errors & covariance (d.f. corrected)
Convergence achieved after 29 weight iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.116675	0.166703	0.699897	0.4855
INF	0.018053	0.002806	6.434463	0.0000
INF*INF	-0.000635	8.50E-05	-7.462637	0.0000
INV	0.003177	0.001906	1.666956	0.0985
D(LOG(GEXP))	-0.007534	0.036407	-0.206944	0.8365
D(LOG(HCD))	0.285277	0.092616	3.080216	0.0026
LPOPG	-0.040396	0.028856	-1.399906	0.1645
LIGDP	-0.031729	0.027081	-1.171615	0.2440
D6	0.065941	0.042941	1.535607	0.1276

Weighted Statistics

R-squared	0.314475	Mean dependent var	0.469169
Adjusted R-squared	0.262244	S.D. dependent var	1.237319
S.E. of regression	1.041976	Akaike info criterion	-1.018250
Sum squared resid	114.0000	Schwarz criterion	-0.802234
Log likelihood	67.04023	Hannan-Quinn criter.	-0.930581
F-statistic	6.020900	Durbin-Watson stat	1.722306
Prob(F-statistic)	0.000002		

Unweighted Statistics

R-squared	0.036581	Mean dependent var	0.058829
Sum squared resid	3.025008	Durbin-Watson stat	1.810058

A7. Nigerian Non-Oil Gdp Country-Specific

Dependent Variable: Y_N_G
Method: ARDL
Time: 14:05
Sample (adjusted): 1985 2014
Included observations: 30 after adjustments
Maximum dependent lags: 1 (Automatic selection)
Model selection method: Hannan-Quinn criterion (HQ)
Dynamic regressors (0 lag, automatic): INF INF*INF INV GEXP D(HCD) LPOPG OIR
Fixed regressors:
HAC standard errors & covariance (Prewhitening with lags = 3, Bartlett kernel, Newey-West fixed bandwidth = 3.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Y_N_G(-1)	-0.321527	0.049221	-6.532279	0.0000
INF	0.530550	0.128896	4.116111	0.0005
INF*INF	-0.016140	0.001510	-10.68866	0.0000
INV	0.416100	0.117464	3.542361	0.0018
GEXP	0.468477	0.197124	2.376562	0.0266
D(HCD)	0.190860	0.113554	1.680785	0.1069
LPOPG	-2.630423	0.564081	-4.663198	0.0001
OIR	-0.001940	0.000365	-5.319880	0.0000

R-squared	0.450459	Mean dependent var	0.439000
Adjusted R-squared	0.275605	S.D. dependent var	5.839364
S.E. of regression	4.969966	Akaike info criterion	6.267881
Sum squared resid	543.4123	Schwarz criterion	6.641534
Log likelihood	-86.01822	Hannan-Quinn criter.	6.387416
Durbin-Watson stat	1.915656		

*Note: p-values and any subsequent tests do not account for model selection.

POST DIAGNOSTIC TESTS

Ramsey RESET Test
Equation: MODEL_O
Specification: Y_O_G Y_O_G(-1) INF INF*INF D(INV) D(GEXP) D(HCD) LPOPG OIR
Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	0.154243	21	0.8789
F-statistic	0.023791	(1, 21)	0.8789

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	0.503448	1	0.503448
Restricted SSR	444.8902	22	20.22228
Unrestricted SSR	444.3867	21	21.16127

Ramsey RESET Test
Equation: MODEL_N
Specification: Y_N_G Y_N_G(-1) INF INF*INF INV GEXP D(HCD) LPOPG OIR
Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	1.301046	21	0.2073
F-statistic	1.692721	(1, 21)	0.2073

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	40.53482	1	40.53482
Restricted SSR	543.4123	22	24.70056

Unrestricted SSR	502.8775	21	23.94655

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	3.476977	Prob. F(2,20)	0.0506
Obs*R-squared	7.739815	Prob. Chi-Square(2)	0.0209

Test Equation:
Dependent Variable: RESID
Method: ARDL
Time: 13:57
Sample: 1985 2014
Included observations: 30
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Y_N_G(-1)	-0.215882	0.325728	-0.662767	0.5150
INF	-0.156940	0.357797	-0.438629	0.6656
INF*INF	0.002973	0.007729	0.384596	0.7046
INV	0.018699	0.167145	0.111875	0.9120
GEXP	0.016680	0.326987	0.051012	0.9598
D(HCD)	-0.020428	0.400225	-0.051040	0.9598
LPOPG	0.619550	1.979875	0.312924	0.7576
OIR	-0.000176	0.000569	-0.309918	0.7598
RESID(-1)	0.291145	0.368507	0.790067	0.4388
RESID(-2)	-0.574043	0.220045	-2.608756	0.0168

R-squared	0.257970	Mean dependent var	0.024358
Adjusted R-squared	-0.075944	S.D. dependent var	4.328711
S.E. of regression	4.490074	Akaike info criterion	6.102817
Sum squared resid	403.2153	Schwarz criterion	6.569883
Log-likelihood	-81.54226	Hannan-Quinn criteria.	6.252235
Durbin-Watson stat	2.155932		

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.123183	Prob. F(2,20)	0.8848
Obs*R-squared	0.365052	Prob. Chi-Square(2)	0.8332

Test Equation:
Dependent Variable: RESID
Method: ARDL
Time: 13:50
Sample: 1985 2014
Included observations: 30
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Y_O_G(-1)	-0.059649	0.392351	-0.152031	0.8807
INF	0.003502	0.372855	0.009391	0.9926
INF*INF	-0.000156	0.007657	-0.020362	0.9840
D(INV)	-0.007006	0.146798	-0.047726	0.9624

D(GEXP)	0.010166	0.321018	0.031668	0.9751
D(HCD)	0.000358	0.433423	0.000825	0.9994
LPOPG	0.128126	1.236648	0.103607	0.9185
OIR	1.30E-05	0.000439	0.029576	0.9767
RESID(-1)	0.087737	0.463295	0.189376	0.8517
RESID(-2)	0.098083	0.238361	0.411489	0.6851

R-squared	0.012164	Mean dependent var	-0.008056
Adjusted R-squared	-0.432362	S.D. dependent var	3.916755
S.E. of regression	4.687625	Akaike info criterion	6.188931
Sum squared resid	439.4766	Schwarz criterion	6.655997
Log-likelihood	-82.83396	Hannan-Quinn criteria.	6.338349
Durbin-Watson stat	1.979258		

Heteroskedasticity Test: ARCH

F-statistic	0.139826	Prob. F(1,26)	0.7115
Obs*R-squared	0.149776	Prob. Chi-Square(1)	0.6987

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Time: 10:54
Sample (adjusted): 1987 2014
Included observations: 28 after adjustments
HAC standard errors & covariance (Prewhitening with lags = 2, Bartlett kernel, Newey-West fixed bandwidth = 3.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	16.29756	4.091390	3.983379	0.0005
RESID^2(-1)	0.072689	0.152326	0.477194	0.6372

R-squared	0.005349	Mean dependent var	17.55316
Adjusted R-squared	-0.032907	S.D. dependent var	24.50937
S.E. of regression	24.90936	Akaike info criterion	9.337114
Sum squared resid	16132.39	Schwarz criterion	9.432271
Log-likelihood	-128.7196	Hannan-Quinn criteria.	9.366204
F-statistic	0.139826	Durbin-Watson stat	1.981711
Prob(F-statistic)	0.711486		

Heteroskedasticity Test: ARCH

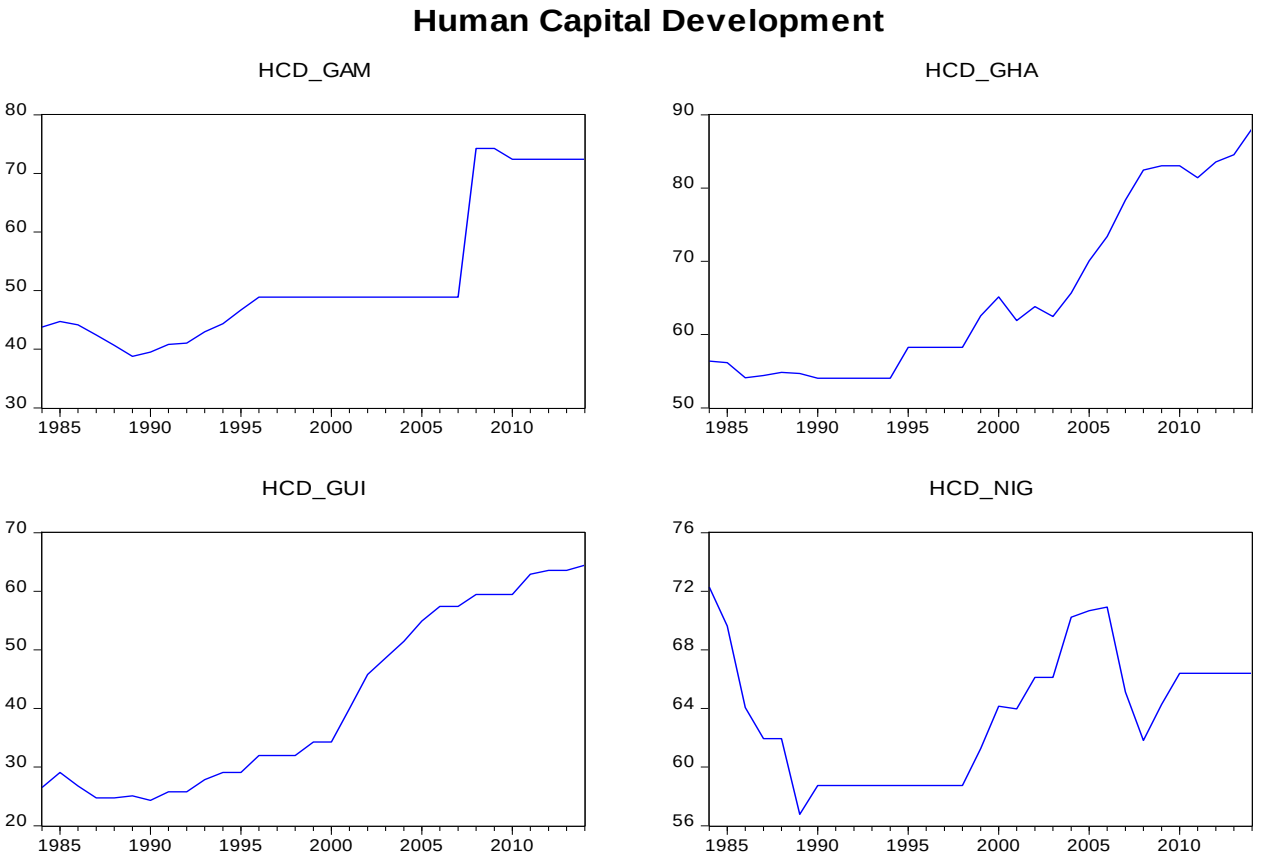
F-statistic	0.088430	Prob. F(1,27)	0.7685
Obs*R-squared	0.094671	Prob. Chi-Square(1)	0.7583

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Time: 10:42
Sample (adjusted): 1986 2014
Included observations: 29 after adjustments
HAC standard errors & covariance (Prewhitening with lags = 3, Bartlett kernel, Newey-West fixed bandwidth = 3.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	15.73916	7.642227	2.059500	0.0492
RESID^2(-1)	-0.057242	0.037817	-1.513675	0.1417

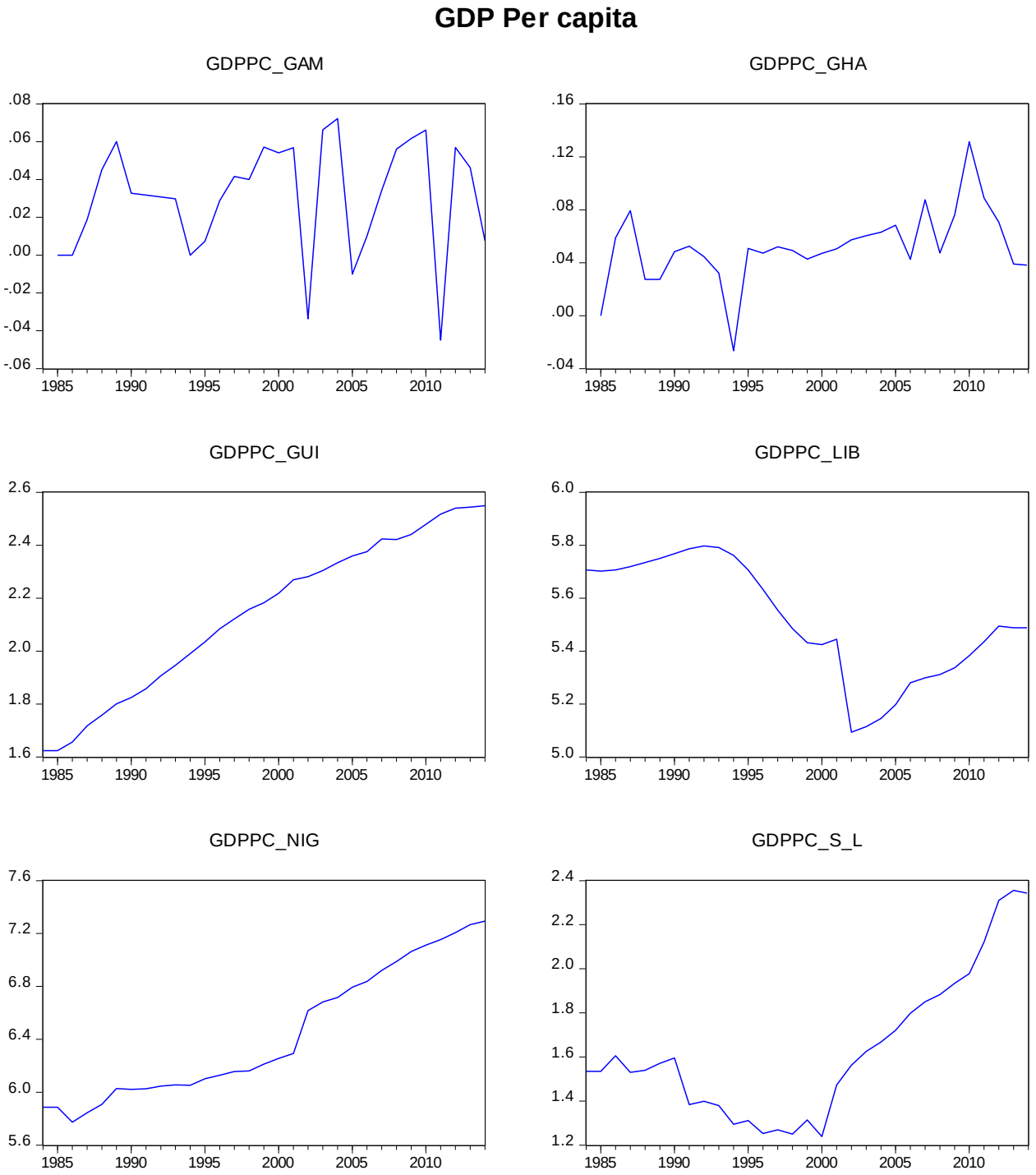
R-squared	0.003265	Mean dependent var	14.86633
Adjusted R-squared	-0.033652	S.D. dependent var	43.43926
S.E. of regression	44.16411	Akaike info criterion	10.48017
Sum squared resid	52662.65	Schwarz criterion	10.57447
Log-likelihood	-149.9625	Hannan-Quinn criteria.	10.50971
F-statistic	0.088430	Durbin-Watson stat	1.986964
Prob(F-statistic)	0.768458		

A8.Graph of Country-Specific Human Capital Development



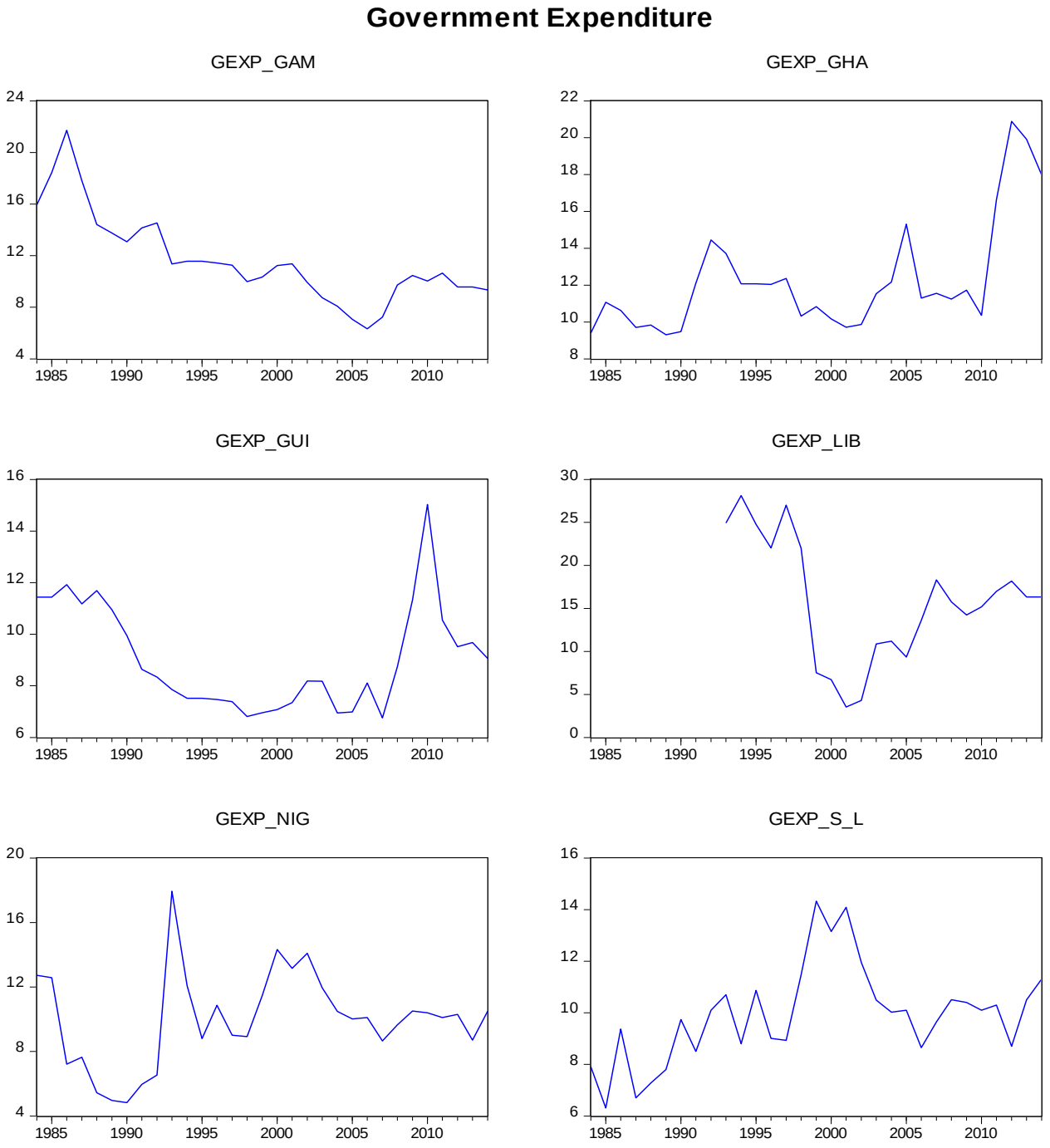
Source: From World Development Indicators from the World Bank website. It is proxied by the secondary school enrolment

A9. Graph of Country-Specific GDP Per Capita



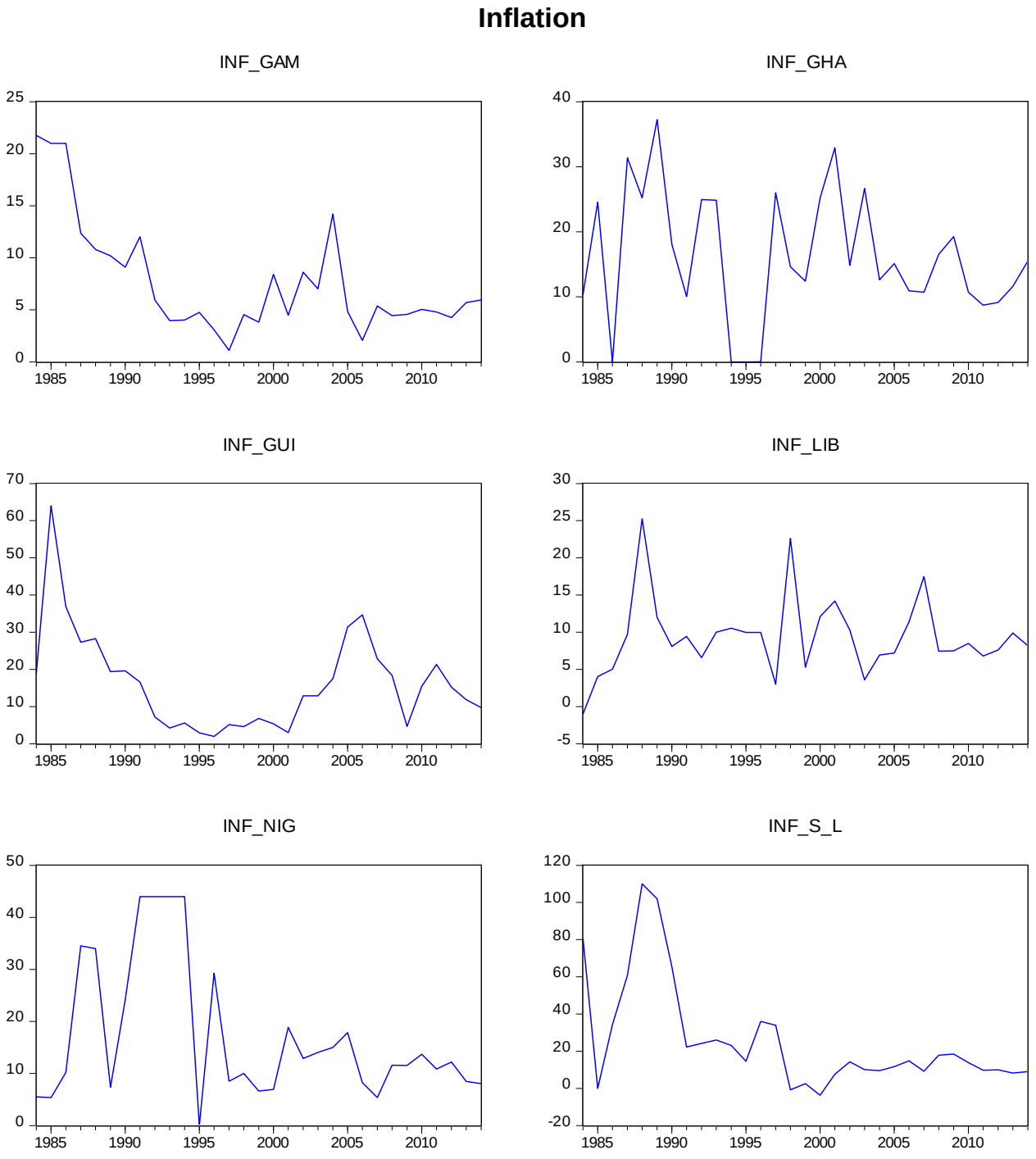
Source: From the World Bank World Development Indicators from the World Bank website. GDP data are in constant 2005 US$

A10. Graph of Country-Specific Government Expenditure



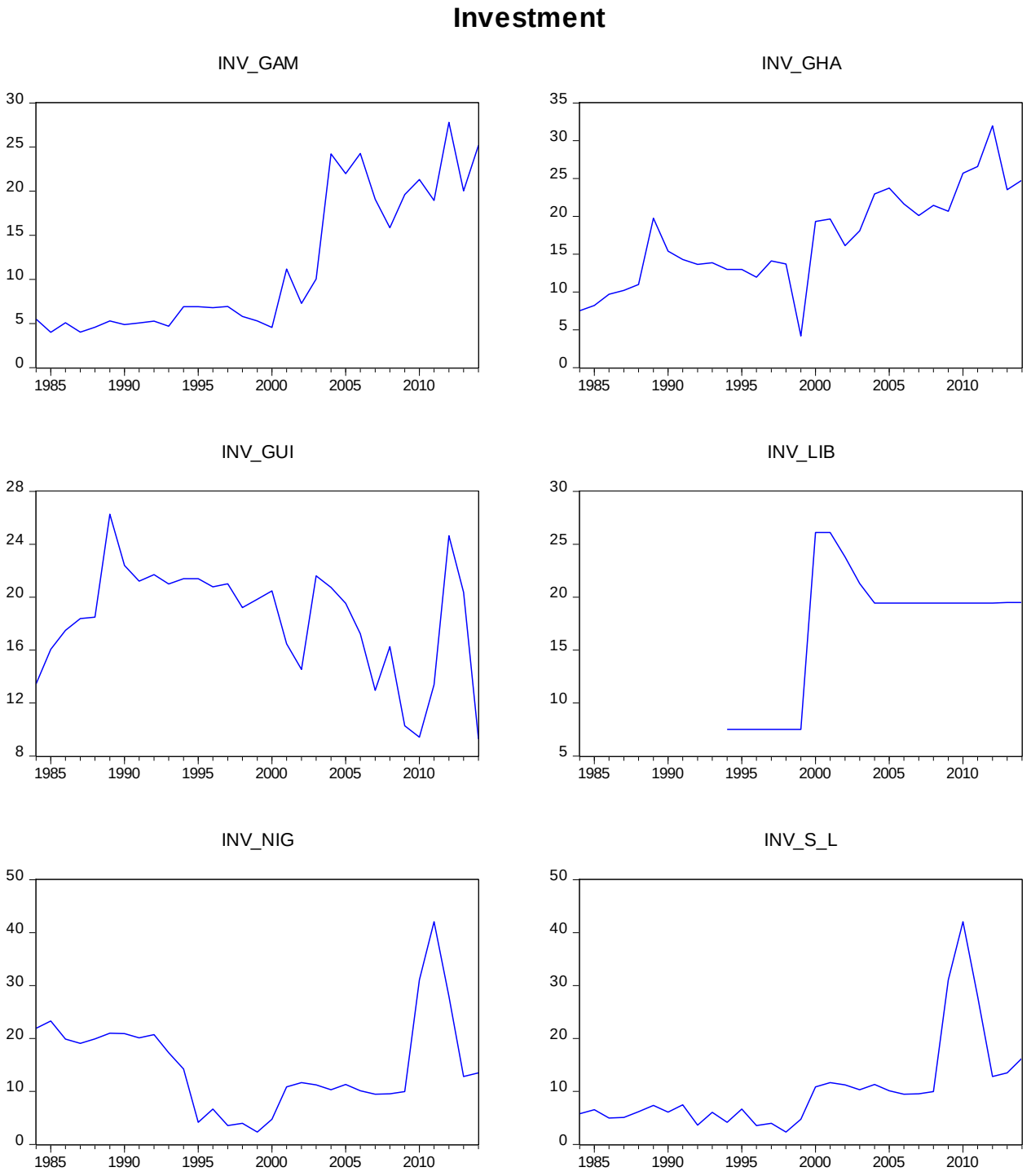
Source: From the World Bank World Development Indicator statistic.

A11. Graph of Country-Specific Inflation



Source: From the IMF International Financial Statistics CD-ROM

A12. Graph of Country-Specific Investment



Source: World Development Indicators from the World Bank website

A13. Country-specific Descriptive Analysis.

		GDPPC	INF	HCD	GEXP	INV	Ln(n+g+σ)
Gambia	Mean	1.733	8.792	51.84	11.639	11.715	1.211752
	Maximum	2.670	35.010	74.24	21.710	27.800	1.574846
	Minimum	1.060	0.190	38.79	6.330	3.990	1.036737
	Std. Dev.	0.511	8.580	12.02	3.490	8.102	0.163224
	Skewness	0.396	2.018	1.06	1.050	0.650	1.101527
	Kurtosis	1.907	6.552	2.51	3.938	1.774	3.11733
	Jarque-Bera	2.2757	36.14***	6.07**	6.610**	3.9928	6.286814
	Observations	31	31	31	31	31	31
Ghana	Mean	71.724	16.395	65.27	12.440	17.445	0.968217
	Maximum	154.400	37.240	88.11	20.890	31.970	1.20896
	Minimum	32.650	0.000	54.04	9.310	4.180	0.834479
	Std. dev.	36.620	9.569	11.77	3.180	6.488	0.080554
	Skewness	0.970	0.198	0.698	1.328	0.028	0.749905
	Kurtosis	2.758	2.470	1.9115	3.722	2.403	4.018615
	Jarque-Bera	4.941	0.566	4.04	9.782**	0.465	4.245719
	Observations	31	31	31	31	31	31
Guinea	Mean	8.868	16.090	41.027	9.084	17.939	1.074
	Maximum	12.800	64.000	64.44	15.030	26.270	1.777
	Minimum	5.070	1.900	24.312	6.760	9.280	0.583
	Std. dev.	2.537	13.292	15.12	2.016	4.446	0.361
	Skewness	0.019	1.651	0.368	0.928	-0.485	0.489
	Kurtosis	1.702	6.496	1.436	3.448	2.458	2.315
	Jarque-Bera	2.177	29.875***	3.86	4.706	1.593	1.7436
	Observations	31	31	31	31	31	31
Liberia	Mean	254.147	9.341		15.792	16.967	1.280636
	Maximum	329.430	25.250		28.130	26.100	2.065067
	Minimum	163.000	-1.000		3.540	7.500	0.575969
	Std. dev.	53.759	5.239		7.109	6.473	0.429833
	Skewness	-0.096	1.210		0.019	-0.566	0.339953

	Kurtosis	1.684	5.299		2.145	1.945	2.219513
	Jarque-Bera	2.284	14.39***		0.671	2.096	0.89286
	Observations	31	31		22	21	21
Nigeria	Mean	706.471	17.326	63.62	8.836	18.272	0.96741
	Maximum	1471.000	44.000	72.29	17.940	23.300	1.008937
	Minimum	321.300	5.360	56.78	4.830	13.310	0.934132
	Std. dev.	372.147	12.945	4.42	3.135	2.862	0.026639
	Skewness	0.774	1.158	0.258	0.991	0.076	0.132171
	Kurtosis	2.135	2.880	1.967	3.482	1.800	1.509453
	Jarque-Bera	4.064	6.950**	1.722	5.377	1.888	2.959992
	Observations	31	31	31	31	31	31
Sierra Leone	Mean	5.418	25.675	50.71	9.927	10.420	0.501556
	Maximum	10.550	70.000	92.29	14.330	42.080	1.614341
	Minimum	3.450	-3.660	34.52	6.310	2.320	-1.13491
	Std. dev.	2.034	28.771	17.76	1.882	8.650	0.904314
	Skewness	1.373	1.711	1.09	0.407	2.279	-0.715266
	Kurtosis	3.962	5.052	3.280	3.269	7.996	1.961682
	Jarque-Bera	10.93***	20.55***	6.250**	0.950	59.06***	4.035844
	Observations	31	31	31	31	31	31

Source: Author's computations. Normality tests include skewness statistic, kurtosis statistic and the Jarque-Bera statistic tests for normal distributed. The null hypothesis is that the errors are normally distributed. Note * imply a rejection of the null hypothesis for normality at 1 per cent using Jarque Bera statistics**

A14 Panel ARDL Country-Specific short-run model

The Gambia

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
COINTEQ01	-0.420394	0.011397	-36.88712	0.0000
D(INF)	0.011349	8.15E-06	1392.910	0.0000
D(INV)	0.012081	8.43E-06	1433.925	0.0000
D(INV(-1))	0.006853	6.02E-06	1139.121	0.0000
DLOG(GEXP,2)	0.361972	0.010318	35.08061	0.0001
DLOG(GEXP(-1),2)	0.179903	0.019760	9.104512	0.0028
DLOG(HCD,2)	0.260318	0.016815	15.48102	0.0006
DLOG(HCD(-1),2)	-0.198588	0.015788	-12.57874	0.0011
D(LPOPG)	1.576168	4.338024	0.363338	0.7404
D(LPOPG(-1))	-6.661681	5.624903	-1.184319	0.3216

Ghana

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
COINTEQ01	-0.465100	0.043098	-10.79181	0.0017
D(INF)	-0.017481	4.25E-05	-411.0874	0.0000
D(INV)	-0.018062	5.70E-05	-316.6813	0.0000
D(INV(-1))	0.012575	5.30E-05	237.3762	0.0000
DLOG(GEXP,2)	-0.001687	0.028032	-0.060186	0.9558
DLOG(GEXP(-1),2)	0.290070	0.025586	11.33696	0.0015
DLOG(HCD,2)	-2.366179	1.281158	-1.846906	0.1619
DLOG(HCD(-1),2)	1.494577	0.943119	1.584717	0.2112
D(LPOPG)	-2.359903	9.379998	-0.251589	0.8176
D(LPOPG(-1))	4.560306	6.689803	0.681680	0.5444

Guinea

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
COINTEQ01	-1.347541	0.043059	-31.29529	0.0001
D(INF)	-0.004605	6.28E-06	-733.2947	0.0000
D(INV)	0.011011	2.63E-05	418.8623	0.0000
D(INV(-1))	-0.010153	1.96E-05	-517.6405	0.0000
DLOG(GEXP,2)	0.278928	0.023995	11.62424	0.0014
DLOG(GEXP(-1),2)	0.301007	0.020469	14.70514	0.0007
DLOG(HCD,2)	-0.034014	0.131452	-0.258754	0.8126
DLOG(HCD(-1),2)	-0.466832	0.114193	-4.088093	0.0265
D(LPOPG)	-0.865872	0.301736	-2.869638	0.0641
D(LPOPG(-1))	1.471256	0.209834	7.011523	0.0060

Liberia

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
COINTEQ01	-1.091477	0.004295	-254.1327	0.0000
D(INF)	0.000136	5.29E-06	25.71400	0.0001
D(INV)	0.017566	1.12E-05	1567.748	0.0000
D(INV(-1))	-0.020069	8.06E-06	-2489.522	0.0000
DLOG(GEXP,2)	0.301545	0.007039	42.83955	0.0000
DLOG(GEXP(-1),2)	0.292006	0.002669	109.4204	0.0000
DLOG(HCD,2)	0.773364	0.005796	133.4205	0.0000
DLOG(HCD(-1),2)	1.097695	0.010637	103.2002	0.0000
D(LPOPG)	0.225002	0.002556	88.03869	0.0000
D(LPOPG(-1))	-0.533980	0.003076	-173.5958	0.0000

Nigeria

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
COINTEQ01	-1.762925	0.045904	-38.40485	0.0000
D(INF)	-0.025573	0.000129	-198.3881	0.0000
D(INV)	0.011221	3.51E-05	319.5118	0.0000
D(INV(-1))	0.007344	3.17E-05	231.9027	0.0000
DLOG(GEXP,2)	0.723005	0.099021	7.301562	0.0053
DLOG(GEXP(-1),2)	0.054711	0.077706	0.704077	0.5321
DLOG(HCD,2)	-0.866680	0.824963	-1.050569	0.3706
DLOG(HCD(-1),2)	1.119638	1.832083	0.611128	0.5843
D(LPOPG)	5.189607	8.676071	0.598152	0.5919
D(LPOPG(-1))	-2.239943	3.471928	-0.645158	0.5648

Sierra Leone

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
COINTEQ01	-0.357949	0.075365	-4.749508	0.0177
D(INF)	0.007440	1.12E-05	663.7526	0.0000
D(INV)	0.029822	4.44E-05	671.8781	0.0000
D(INV(-1))	-0.023431	6.14E-05	-381.3992	0.0000
DLOG(GEXP,2)	0.037320	0.007046	5.296454	0.0131
DLOG(GEXP(-1),2)	0.057697	0.005113	11.28323	0.0015
DLOG(HCD,2)	-0.055413	0.017378	-3.188639	0.0498
DLOG(HCD(-1),2)	0.138845	0.014521	9.561626	0.0024
D(LPOPG)	-0.051977	0.003621	-14.35262	0.0007
D(LPOPG(-1))	0.180040	0.006974	25.81603	0.0001

A15. The West African Monetary Zone (WAMZ) region.

Country	Demographic weight	Geographic weight	Economic weight
Benin	3,0%	2,2%	1,9%
Burkina Faso	5,5%	5,4%	,6%
Cote d'Ivoire	7,4%	6,3%	6,2%
Guinea Bissau	0,5%	0,7%	0,2%
Mali	5,2%	24,2%	2,6%
Niger	5,1%	24,8%	1,6%
Senegal	4,2%	3,8%	3,5%
Togo	2,0%	1,1%	0,9%
UEMOA	**32,7%**	**68,6%**	**19,5%**
Gambia	0,6%	0,2%	0,2%
Ghana	7,9%	4,7%	9,7%
Guinea	3,4%	4,8%	1,4%
Liberia	1,3%	2,2%	0,4%
Nigeria	52,0%	18,1%	67,3%
Sierra Leone	1,9%	1,4%	0,9%
ZMAO	**67,1%**	**31,3%**	**80,0%**
Cap Vert	**0,2%**	**0,1%**	**0,5%**
CEDEAO	**100%**	**100%**	**100%**

Source: http://en.reingex.com/WAMZ-Monetary-Zone.shtml