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The Threshold Effect in the Relationship Between Inflation and Economic Growth in Ghana

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ABSTRACT

Sustainable growth of the economy and ensuring a stable price market are two major macroeconomic policy objectives of Ghana's economy, although policy makers find it tough in meeting these targets simultaneously. This is because high rate of inflation has adverse effect on economic growth, despite the fact that, a steady fall of the general price level for a continuous time period may be detrimental to the economy. Thus, the study sought to investigate the threshold effects of inflation on economic growth in Ghana. Annual time series data from 1980-2019 was used. The study found 10.70% as the inflation threshold value for Ghana. The results show that, anytime inflation is less than 10.70%, its negative effect on the economy is much less than when it increases beyond the threshold value of 10.70%. At the end, suggestions based on these findings are proffered to the relevant agencies, organizations, institutions, and stakeholders for necessary action.

Keywords: Threshold Effect, Relationship, Inflation, Economic Growth

CHAPTER ONE
INTRODUCTION
1.1 Background to the Study

The conventional macroeconomics view holds that, in fostering economic growth in a country, low inflation is very important (Majumder, 2016). The ultimate goal of every economy is to achieve continuous and sustainable economic growth as well as stabilizing the price level (Inglesi-lotz *et al.*, 2020). Hence, the fiscal policy with the major objective of promoting economic growth, and the monetary policy with the aim of stabilizing the price level must be properly coordinated for effective implementation (Tang, 2020). Effort to simultaneously sustain economic growth and price stability, may be difficult to policy makers (Bui, 2020). Notwithstanding, with the Keynesian theory, certain economic thoughts stressed moderate inflation is an impetus for economic growth (Khan and Senhadji, 2001). However, due to inflationary spiral and rational expectations, steadily increasing price level can transmute into high price level and uncertainty with the macroeconomic variables, which do not promote growth (Nicholas, 2019). Meanwhile, zero level of inflation also adversely influence economic growth as a result of continuous dwindling of producers' motivations (Sani, 2012).

Even though the exact relationship between inflation and growth remains open, the nature of the connection that exist between the two receives a lot of considerable interest and debate (Fei, Kun & Tahir, 2019). Based on this, various schools of thoughts offer diverse views about this relationship. The

Structuralists for example opine that inflation is very important for growth, while the monetarists argue that it retards growth (Ayyoub, 2011). Tobin, in 1965, introduced the asset alternative to capital into the Solow-Swan Model. That showed that the opportunity cost of money demand rises in the presence of high inflation, thus, consequentially improving accumulation of capital and enhancing growth (Mwakanemela, 2013).

On the contrary, when money is introduced into the budget constraint of the endogenous human capital accumulation model, high inflation would adversely impact labor supply and consumption resulting in lower growth rate (Eggoh & Khan, 2014). De Gregorio in 1993 proved that inflation may have important influence on physical capital accumulation. According to that model, money serves as a tool in reducing transaction cost transaction cost of firms and consumers, higher general price levels influences agents to decrease their demand for money, and hence transaction cost rises leading to adverse impacts on investment and growth (Leon-gonzalez, 2012).

Generally, economists are of a consensus that, high and variable inflation is detrimental to economic growth. There are however divided views on how low inflation should be. Ro put it another way, at what stage does inflation and growth relate negatively? The structure and nature of an economy determine the solution to this issue, however, these countries are not homogenous in nature and structures (Thanh, 2015). According to Asab and Al-tarawneh, (2020) when inflation rate is low, there exist insignificant or positive relationship, but a substantial negative bearing on economic growth where inflation is at a higher level. Therefore, estimating the threshold level (structural break point) if inflation and economic growth have such non-linear relationship and the turning point is possible (Rutayisire, 2015). This is generally attained by either by specifying beforehand the thresholds for varying inflation levels in *ad hoc* ways or directly estimating the threshold rate of inflation using a spline regression technique (Ndoricimpa & John, 2017).

In the 1970s, the Latin American economies faced higher rate of inflation which consequently resulted to decrease in economic growth, and hence ignite the views that there exists a negative force by inflation on growth instead of positive impacts (Mwakanemela, 2013). In India, the link between inflation and growth is positive, considering data on GDP growth and inflation rates (Hussain *et al.*, 2011).

In the 1990s, Rwanda adopted for a comprehensive economic adjustment and stabilization programs with technical and financial support from IMF and some development partners (Mwakanemela, 2013). The major aim of the policy was to achieve low inflation and stabilizing macroeconomic variables and speed up economic growth (Idris, 2018). In subsequent economic programs, a five percent inflation rate was employed as a policy target. Mostly this target was met, though it was missed in few circumstances due to internal and external supply shocks (Fei *et al.*, 2019). According to Khan & Senhadji (2001), the range of inflation threshold for developing countries is 11-12 percent and 1-3 percent for developed countries, though Kremer *et al.* (2009) in similar investigation, postulated that, the threshold for industrial economies is 2.5 percent and 17 percent for developing countries.

The Nigerian economy for the last two quarters in 2005 recorded over 8 percent in each of the quarters (Sani, 2012). The high GDP growth recorded in these quarters was as a result of successful implementation of economic reforms assisted by the National Economic and Development Strategy (NEEDS) (Chimobi, 2010). The major contributors of economic growth during the time were services, general commerce, and agriculture. Although the inflationary pressure during the first three quarters was very high, the significant growth rate recorded in the last quarter of 2005 strongly based on inflation declining from 24.3 percent in the third quarter to 11.3 percent (Idris, 2018).

In Ghana, just like any developing country, inflation has remained as a persistent problem to the economy. For instance, the average inflation rate between 1960-1970 was 5.5 percent, but however, jumped to 58 percent between 1971-1983 (Oteng-Abayie & Frimpong, 2010). This was as a result of major economic policies before the implementation of the Structural Adjustment Program (SAP). These regulations, which focused on consumer goods and services pricing, and that caused acute goods shortage and weakening various services at the time (Mohammed, 2016).
There is so much fluctuation in terms of inflationary rate in Ghana, and remained as an unsuccessful area after the Structural Adjustment Program implementation (Ahiakpor & Akapare, 2018). Also, the establishment of the Monetary Policy Committee (MPC) by Act 612, the Bank of Ghana is mandated to set an interest rate (policy rate) in achieving government inflationary target (Frimpong & Oteng-Abayie, 2010).

1.2 The Problem Statement

Growth sustainability of the economy and ensuring price stability are two major macroeconomic policy objectives of Ghana's economy, although policy makers find it tough in meeting these targets simultaneously. This is because high rate of inflation retard economic growth, despite the fact that, a steady fall of the general price level for a continuous time period may be detrimental to the economy (Frimpong & Oteng-Abayie, 2010). In Ghana, it is important for policy makers to know the appropriate inflationary rate target in an attempt to promote economic growth. This means that, the optimal target rate should be country specific and taking into consideration the structure of the economy, if the expected growth level is to be achieved (Mohammed, 2016). The assertion that, low and stable inflation create an enabling environment for businesses, and hence promote economic growth, has influenced the Bank of Ghana in making a single digit inflation rate mark as its short- and medium-term target. However, Ghana's economic performance over the twenty years has been inconsistent and failed woefully in a stride to achieve its target. For instance, according to World Bank (2003), while the projected GDP growth was 8% towards the achievement of the Millennium Development Goals (MDGs), the mean actual growth was approximately 5% (World Bank (2003). Example, the average inflationary rate from 1970s to 2019 is far above 13 percent. The motivation of this study is to investigate the ideal threshold level suitable for Ghana's economic growth.

1.3 Objectives to the Study

Generally, the study aims to investigate the threshold effects of inflation on economic growth in Ghana. This study basically focuses to empirically determine the optimal inflationary rate and its impact on economic growth in Ghana. The study seeks to achieve the overall objective through the specific objectives stated below;

1. To analyse the trends and performance of inflation and economic growth in Ghana.
2. To investigate the relationship between inflation and economic growth in Ghana.
3. To determine the threshold effects of inflation on economic growth in Ghana.

1.4 Research Questions

1. Are there significant trends of inflation and economic growth in Ghana?
2. What is the relationship between inflation and economic growth in Ghana?
3. What are the threshold effects of inflation on economic growth in Ghana?

1.5 Significance of the Study

The subject under examination is very important, since inflation and growth directly affects the lives of citizens, however there exist very scanty literature on the subject. Corporate investors and government would find the findings of this study useful in addressing related issues in the country. The Bank of Ghana would therefore be well informed in terms of monetary policy decision making. In addition to contributing to the existing scarce studies in this area, the study would serve as a reference copy for students and other researchers.

1.6 Scope of the Study

Annual data from World Development Indicators covering from 1980-2019 was used. Monetary Policy Rate, Money Supply (M2), Inflation, Foreign Direct Investment (FDI), Interest Rate, and Gross Capital Formation are the variables considered for this exercise.

1.7 Organization of the Study

The introduction of this research forms the first chapter which mainly covers the background, statement of the problem, and objectives. Literature review forms the second chapter and covers theoretical, empirical and conceptual reviews. The third chapter deals with the methodology used for the study whiles the fourth chapter presents, analyses and discusses the results. Summary of major findings, recommendations and conclusion are presented in the fifth chapter.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter reviews related previous studies. The chapter would be made up of four major sections. These includes definitions and conceptual review, review of theories, empirical review, and a conceptual framework.

2.2 Definitions and Conceptual Review

2.2.1 Economic Growth

Economic growth is viewed by different authors based on the conditions available to them at the time. Primarily, the concept of economic growth has to do with the long-run potential growth path or growth trend of the economy. Economic growth simply refers to the potential rise of the country's GDP, even though this can vary depending on how the GDP of the country is measured. According to Olaifa & Benjamin (2020), it refers to the rise of the net national product within a given period of time. Additionally, according to Omitogun (2018), economic growth is defined as a steady process by which the capacity to produce is appreciated for a given period of time to cause increase in national output and income. The rise in output is viewed as an economic growth, and therefore is associated with a sustained quantitative increase of the per capita income of a country or an increase in output matched by a rise in her labor force, trade volume, and consumption. The main features of economic growth have to do with increase in structural transformation, capital, labour, and international labour flows (Olaifa & Benjamin, 2020).

2.2.2 The Evolution of Ghana's Inflation Experiences

Ghana's inflation experience from independence can be grouped into four distinct episodes: that is the immediate post-independence era, which is up to 1966; immediate post-independence, 1966 to 1972; the deterioration period, 1972 to 1982; and the most recent period, 1982 to 2018, which is termed as the stabilization inflationary period. After the country exited from the West African Currency Board (WACB), it experienced its first inflation episode, and that continues until the overthrow of Dr. Kwame Nkrumah government in 1966. The period before the first episode was stable as far as inflation was concerned. This was due to the establishment of currency board in 1912. The first board's first notes and coins were issued in 1946 and that remained legal tender in Ghana, Nigeria, Sierra Leone and Gambia. However, Ghana exited the board in 1957 immediately after independence. The currency board had no powers over discretionary monetary policies and hence market forces determined the supply of money in Ghana and the other three colonies. Consequently, the government of Ghana had to finance its budget solely through borrowing or taxing but not printing of money to cause inflation.

During 1975, which is after independence, the government embarked on heavy industrialization projects in the history of Ghana. The government large expansionary and monetary polies were successful as a result of absence of the erstwhile West African Currency Board. In the period of the currency board, inflation was in single digit. The rate of inflation was estimated less than 1 percent at the time. However, between 1960 and 1963, the average rate of inflation was 8 percent per annum and rose to the tune of 23 percent (double) per annum between 1964 and 1966.

After Kwame Nkrumah government had been overthrown in 1966, the government then, which is the National Liberation Council (NLC) went into a new agreement with the IMF as measures to put forward to stabilize the economy. There was considerable measure with respect to Nkrumah's massive investment projects. The NLC government devaluated the Cedi by 30 percent against the US dollar and further undertook massive retrenchment exercise in the public sector, resulting 10 percent losing their jobs. The joint effect of both fiscal and monetary policies caused 8 percent deflation in 1967. Also, the average rate of inflation between 1967 and 1969 was 2.3 percent per annum.

In 1983, the country went into serious economic crisis since independence, the period recorded an inflation value of 122.8 percent. The highest figure ever in the country's history. A lot of policy measures were enrolled to put the economy back on track. The first stage was the Economic Recovery Program I (1983 - 1986) aimed at stabilizing inflation and increasing external balance. The second policy was determined at boosting production and restoring economic and social infrastructure. During the period, inflation reduced from 50 percent to 27 percent between 1987 and 1993. The acceleration growth period was attributed to the third stage of the reform period (1993-2000). The target growth within the period was 8 percent and 5 percent in reducing inflation. Furthermore, in 1986 and 2000, the end of year inflation recorded 24.6 percent and 40.5 percent respectively. The increased in inflation was caused by expansionary monetary policy carried out by the then government. The cedi depreciation against major trading currencies was another factor that fueled the inflationary instability. For instance, between 1999 and 2000, the Cedi depreciated from 33.0 percent to 49.5 percent, over 16.5 increase in 2000.

Additionally, in 2005, the inflationary figure rose from 11.8 percent in 2004 to 14.8 percent, but however could not meet the targeted 13.5 percent at the time. This resulted due to the increased in petroleum products by 50 percent alongside increased price level of goods and services. Between 2006 and 2010, the year-on-year inflationary rate was below 20 percent as inflation recorded a single digit figure of 8.6 percent. That was the second time in the country's history a single digit inflation had been recorded aside the 1971 9.2 percent figure. Also, the 2018 inflation rate was 9.84 as compared to 17.5 percent in 2016. The inflation rate in Ghana is predicted to decrease to 8.5 percent by 2021.

2.3 Theoretical Review

2.3.1 The Endogenous Growth Theory

Paul Romer and Robert Lucas (1990) are the chief originators of the endogenous theory of growth. The theory stressed the fact that, in stride to increase productivity, more resources should be supplied to the labour force continuously. In this situation, resources like physical capital, knowledge capital and human capital. Hence, the accumulation factors of production drive growth. This means that the sole means government can impact growth in the economy, at least in the long-run is through influence on education, research and development, and investment capital. This approach makes enhanced education important in achieving economic objectives (Rahman *et al.*, 2015).

Higher rate of investment by private sector or public, decreased government consumption spending, increased in school enrollment, and high political stability are strongly correlated with faster economic growth. Contrary to the neo-classical growth theory, changes in the form of technical does not premised on chance, but can be brought forth through appropriate policies. Furthermore, as the basis for technological innovativeness as well as entrepreneurship are achieved, the chances of further technical changes and accompanied growth in the economy is prominent. Changes as a result of technical is no longer considered as unexplainable and caused due to chance, as contained in the neo-classical theory, however, in endogenous growth theory it turns itself as a factor which policy decision can influence and should be included in a production functions vis-à-vis the conventional inputs of labor and capital. The level of growth can be influenced by taxing consumption, subsidizing investment, investing in research and development, and more importantly shifting resources from been consumed by government to area of investment. In this theory, decrease in growth occurs when government spending does not support investment through the creation of tax wedges above acceptable level to finance investments or discouraging saving to accumulate capital Forgha (2013).

2.3.2 The Structural Theory of Inflation

The structural theory of inflation postulates that, in developing countries, inflation occurs in a different way. The proponents advanced that, increase in money supply and expansion in investment expenditure are not the ultimate factor for inflation in developing countries (Chirinko & Fazzari, 2000). According to this theory, aggregate output has not been sufficiently increased in developing countries to match the rise in demand cause by increase investment expenditure as well as money supply. They added that, investment expenditure has not been sufficient by voluntary savings and that has resulted huge deficit financing in third world countries (Mission *et al.*, 2015). Economists like Myrdal and Straiten are the brain behind this theory. The duo argued that, it is not right to employ highly aggregate demand and supply model in explaining inflation in developing countries. That there exists unbalanced integrated structure in them due to possibilities of substitution between consumption and production and inter-sectoral flow of resources in the economy are not all that smooth and hence difficult in explaining inflation in them. The supporters of this theory viewed the prevalence of structural features in developing countries making the aggregate demand and supply inapplicable to them (Chirinko & Fazzari, 2000).

2.4 Empirical Review

Majumder (2016) studied how inflation drove growth in Bangladesh over the period of 1975 to 2013. The study employed Granger causality and an Error Correction Model (ECM) to evaluate the possible correlation between the two variables. The empirical findings from the study indicate inflation has a long run influence on growth and the effect is statistically significant.

Thanh (2015) investigated the threshold effect of inflation on the growth of the economy in ASEAN-5 countries. The panel data from 1980 to 2011 was used in the study, using Panel Smooth Transition regression (PSTR) technique of estimation to estimate the threshold of inflation and its impact on economic growth. The findings reveal that, the association between economic growth and inflation is significant and negative when inflation rates exceeds the 7.84% threshold. The findings further suggest that, central banks can improve the situation by decreasing inflation when it is above or near the estimated thresholds. Thus, the estimated threshold level may be regarded as an indicator for inflation targeting in conducting monetary policy exercises.

Bui (2020) evaluated the relationship between domestic credit and growth of the economy in ASEAN countries using nonlinear approach. The study employed secondary data from 2004 to 2017, sing Generalized Method of Moment (GMM). The findings successfully confirmed the inverted U-shaped nonlinear effect of domestic credit on economic growth. The findings further suggest that economic growth is enhanced by domestic credit, but should not exceed the optimal threshold of 75 percent, since at that level it exerts negative impact on economic growth.

Ahiakpor and Akapare (2014) assessed relationship between economic growth and inflation in Ghana. The research used quarterly data running from 1986 Q1 to 2012 Q4. The study used Johansen co-integration econometric method as its statistical tool. The findings show that, money supply, capital, expenditure of government, and labor force have a positive relationship with growth, with inflation and interest rates having negative influence on economic growth. The study therefore suggests inflating targeting as the most efficient monetary policy tool.

An empirical investigation by Khan & Senhadji (2001) on the threshold effects in the relationship between inflation and economic growth, through econometric methods provide procedures that are appropriate for inference and estimation. The findings of the study was that the threshold level at which growth is slow is projected in developing and industrious economies are 11% to 12% and 1% to 3%, respectively. The study also found that inflation negatively affects growth whenever inflation is greater than its threshold.

Mohammed (2016) examines the relationship between macroeconomic behavior and economic growth in Ghana from 1980 to 2013, using Johansen econometric estimation method. The study proved long-run relationship between macroeconomic variables considered and economic growth. The study results indicate that stock market prices, exchange rate, physical capital, and labor force have positive influence on economic growth in the long-run, although government expenditure, consumer price index, interest rate, and money supply have negative impact on economic growth. However, in the short-run, the findings reveal that, exchange rate, labor force, physical capital, labor force and stock market prices have positive effects on economic growth while consumer price index, money supply, government expenditure and interest ate have negative influence on real GDP growth.

Analysis on the threshold effect of inflation in Ghana from 1960 to 2008 was conducted by Frimpong & Oteng-Abayie (2010) by using threshold regression techniques. The results showed an evidence of threshold effect of inflation on Ghana's growth. The outcome further indicates that, the economy of Ghana is hurt when inflation threshold is around 11 percent, however, below 11 percent, inflation is more likely to have minimal influence on economic growth.

Sani (2012) determine the relationship between economic growth and inflation in Nigeria. The study employed quarterly data running from 2005Q1 to 2012Q1. The study adopted three variant methods that provide appropriate procedures in estimating the threshold level and inference. The empirical results suggest that, 10.5 to 12 percent is the estimated threshold level of inflation, above which negative influence is been exerted. However, the evidence of super-neutrality of money could not be confirmed, and hence concluded that, there is a considerable threshold level of inflation beyond which the super-neutrality does not work.

Fei *et al.*, (2019) evaluate the threshold effect of inflation on economic growth from 18 developed economies using static threshold analysis. The study adopted panel data consisting of the 18 developed countries considered from 1980 to 2016. The findings indicate that, higher inflation may cause higher growth up to the threshold level but when the value exceeds that estimated value, higher inflation may be inimical to the health of the economy.

Ahiabor (2013) investigates the influence of monetary policy on inflation in Ghana for the period 1985 to 2009 and employed Ordinary Least Squares (OLS) as its econometrics method in analyzing the data. The study finds a significant negative relationship between money supply and interest rate on inflation. However, a positive association was found between exchange rate and inflation.

Akarara and Azebi (2018) evaluate the effectiveness of monetary policy in controlling inflation in Nigeria. The study employs monthly time series dataset spanning from January 2009 to December 2016. While employing the Johansen cointegration technique and an error correction model, the study indicates the presence of a long-run relationship between selected monetary variables and inflation. The study finds that, in controlling inflation, Treasury Bill Rate (BR) is an effective tool in both short and long run, even though exchange rate and money supply are effective in controlling monetary policy in the short-run.

Anis *et al.* (2019) critically examine how effective monetary policy transmissions in Thailand and Indonesia through the channel of interest rate on inflation. The time series data covered from 2006Q1 to 2018Q4, using Vector Autoregressive (VAR) and Vector Error Correction models. The findings reveal that, inflation in Indonesia is significantly caused by interest rate, even though in Thailand, variability in inflation is attributed to private sector consumption and own shocks. Hence, the study concludes that, inflation is highly and significantly influence by central bank interest rate policy and own shocks.

Garriga and Rodriguez (2019) assess the influence of central bank independence on inflation in developing economies. The sample size for the study covered 118 developing countries, and a panel dataset starting from 1980 to 2013. The study used the fixed effect and random effect method in analyzing the data. The findings show that, inflation is lower in countries where independence of the central bank is very high. The findings also indicate that, the more democratic a country is, the more effective and positive influence that central bank exerts on inflation.

Ofori *et al.* (2019) critically assess the impact of money supply on inflation in Ghana. The study used time series data from 1967 to 2015, using Ordinary Least Square (OLS) as its estimation strategy. The study modeled inflation as a function of money supply in Ghana. The study findings as per the estimated empirical results reveal that, there exist a positive long-run relationship between inflation and money supply in Ghana.

Chimobi (2010) examine the relationship between economic growth and inflation in Nigeria. The study adopted time series data spanning from 1970 to 2005. The study employed the Johansen-Juselius co-

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integration estimation technique. The results reveal there exist no co-integration relationship between inflation and economic growth while suggesting that inflation exerts negatively on the growth of an economy.

Mwakanemela (2013) investigates how inflation rate of Tanzania affects its economic growth by using data covering from 1990 to 2011. The Johansen co-integration econometric method was used. The findings suggest that, inflation and growth were not cointegrated, however in the short run, they are negatively related.

Munir and Mansur (2009) investigate the relationship between economic growth and inflation in Malaysia. The study employed secondary data, covered from 1970 to 2005, using Hansen's (2000) newly threshold autoregressive (TAR) model and inference. The empirical results confirm that one inflation threshold value exists for inflation. The result also suggests positive association between inflation and economic growth. Lastly, the study findings reveal that, inflation will hurt the economy if the threshold value increases above 3.89 percent.

Adria (2009) considered the influence of inflation on Mexico's growth from 1970 to 2007. The study confirms the negative relationship between inflation and economic growth. The findings show 9 percent as the threshold level of inflation above which inflation weakens the growth of the economy.

Hasanov and Abdullah (2014) examine the relationship between threshold effects of inflation on economic growth in Azerbaijan. The study period covered 2000-2009. The threshold estimated indicate the existence of a nonlinear association between inflation and economic growth Azerbaijan and 13 percent threshold level. The finding demonstrate that below threshold level inflation exerts positive influence on economic growth, however the effects become negative when inflation increase beyond the threshold value.

2.5 Conceptual Framework

Based on the above related literature review, literature on inflation and how it impacts economic growth, the study employed the following conceptual framework.

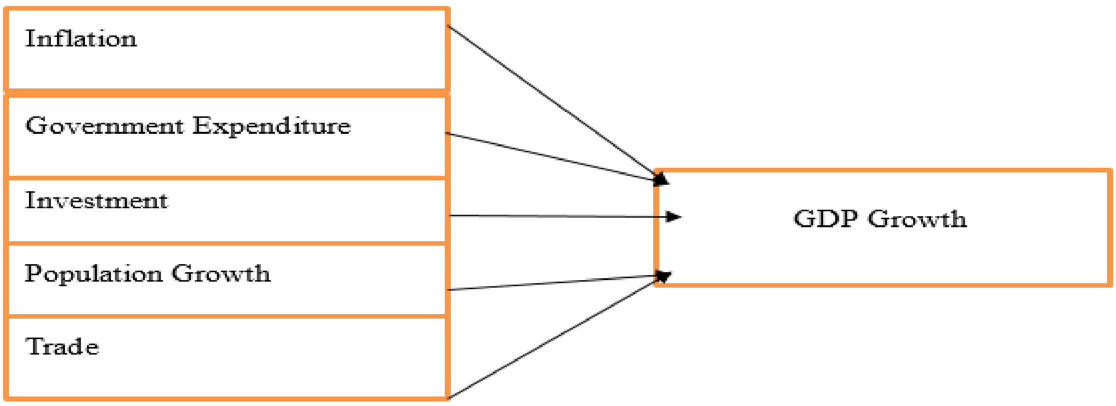

Figure 2.1: Conceptual Framework

CHAPTER THREE
METHODOLOGY

3.1 Introduction

The methodology employed in achieving the goals of this exercise is extensively dealt with in this chapter under three sub-sections. First, types and source of data are discussed; second, the model to be estimated is specified, description of variables and statement of a priori signs of the explanatory variables; and third, explanation of the estimation technique.

3.2 Types and Sources of Data

Annual data covering from 1980-2019 was sourced from WDI. The study specified a model, where GDP growth is modeled as a function of inflation, population, and investment.

3.3 Model Specification

Based on the empirical review, the popular threshold model employed by Nasir & Nawaz (2010), Mubarik (2005), and Senhadji (2000) is adopted in this exercise. The present study first adopts and augments the model by concentrating on the variables of interest. This is simplified as follows;

$$lnRGDP_t = \alpha_0 + \beta_1 \ln(\pi_t) + \delta_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where $lnRGDP_t$ represents real GDP growth, π_t represents the inflation rate, δ_t represents the error term. In trying to estimate the threshold, the present study augmented equation (1) by adding an extra inflation variable (π^*), yielding equation (2);

$$lnRGDP_t = \alpha_0 + \beta_1 \ln(\pi_t) + \beta_2 D_i(\pi_t - \pi^*) + \delta_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

From equation (2) above, π^* is the expected inflation threshold and $\pi_t - \pi^*$ is the deviation of inflation from its threshold. For estimation purposes, the value of the expected inflation is selected arbitrarily in ascending order to estimate the model. The dummy variable (D) represents the extra inflation and it is defined as;

$$D_i = \begin{cases} 1, if\ \pi_t > \pi^* \\ 0,\ if\ \pi_t \leq \pi^* \end{cases} \quad i = 1 \ldots\ldots N; t = 1 \ldots\ldots T \ldots\ldots\ldots\ldots\ldots (3)$$

where $D_i = 1$, if inflation is greater than the threshold, while $D_i = 0$ shows otherwise. Given that $D_i = 1$, equation (2) could be re-specified as;

$$lnRGDP_t = \alpha_0 + \beta_1 \ln(\pi_t) + \beta_2(\pi_t - \pi^*) + \delta_t \ldots\ldots\ldots\ldots\ldots (4)$$

Hence from equation (4) above, the influence of inflation on output is β_1 that of extra inflation is β_2. The impact on growth by inflation is obtained by β_1+ β_2 if inflation exceeds the expected level, and it is $\beta 1$ if inflation equals the threshold level. By adding the control variables to equation (4), equation (5) is obtained as:

$$lnRGDP_t = \alpha_0 + \beta_1 \ln(\pi_t) + \beta_2(\pi_t - \pi^*) + \beta_3 X_t + \delta_t \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

From equation (5) X_t represents the control variables. The study employed population growth ($lnPOP$), Investment growth ($lnINV$), and trade (TD) as control variables. These control variables have been empirically proven to impact growth (Solow, 1956; Salai-i-Martin, 1997).

3.4 Description and Measurement of Variables

3.4.1 Gross Domestic Product (GDP) Growth

Gross domestic product (GDP) growth is the percentage increase or decrease in total monetary and/or market value of all finished goods and services produced within the borders of a country in a specific time period. Growth of GDP in real terms is employed in this study since it broadly measures the total domestic production of the economy – showing the economic status of the country (Mallett & Keen, 2012). This variable is measured in percentage of GDP and it is the dependent variable.

3.4.2 Inflation

Inflation is a quantitative measure of the rate at which the average price level of a basket of selected goods and services in an economy increases over some period of time. It is the consistent increase in the general price level where a same unit of currency effectively buys less than it did in previous periods. It is often expressed as a percentage, inflation that indicates a decrease in the purchasing power of a nation's currency (Bagus *et al.*, 2014). This variable is measured as Consumer Price Index (CPI) and is expected to have negative relationship with economic growth.

3.4.3 Population Growth

Population is the aggregate number of people in a specific area (country) at a particular time. Population growth on the other hand refers to the rate at which the number of people in a population increases in a given time period, which is expressed as a fraction over the initial population. This is an independent variable and is measured as percentage of the total population. The a priori expectation of this variable is positive relationship with GDP.

3.4.4 Investment

Investment simply refers to the production of goods that will be used to produce other goods. This is an independent variable and is measured in percentage of GDP. The a priori expectation of this variable is expected to have positive relationship with economic growth. The variable is a proxy for Gross Capital Formation.

3.5 Estimation Technique

In analyzing time series data, preliminary tests on the variables are very important to make sure the estimated parameters from the specified model are reliable. First the study examines the stationarity properties of all the variables in the study to ensure that the estimated results are not spurious. The study then examines the inflation threshold level of Ghana and the linear relationship between other non-threshold regressors and the dependent variable.

3.5.1 Augmented Dickey- Fuller (ADF) Test

The ADF test is the modified and improved version of the Dickey-Fuller test. Because the DF test assumed that the error terms should be uncorrelated and white noise, the ADF was developed for situations where the error terms may be correlated, this follows the idea that most macroeconomic variables may be correlated and also usually trended (Asteriou & Hall, 2011). The ADF test adds extra lagged term of the dependent variable to the equation and is able to do away with autocorrelation problem. A simple ADF stationarity test may be specified as;

$$\Delta \boldsymbol{X_t} = \boldsymbol{\alpha_1} + \boldsymbol{\alpha_2 t} + \boldsymbol{\alpha_3 X_{t-1}} + \sum_{i=1}^{p} \boldsymbol{\beta_1} \Delta \boldsymbol{X_{t-i}} + \boldsymbol{\varepsilon_t} \ldots\ldots\ldots\ldots\ldots\ldots.\ \mathbf{6.1}$$

From Equation (6.1) the time series variable represents $\boldsymbol{X}$, the trend factor is t, and the estimated parameters are α_1, α_2, and α_3. The first difference operator is represented by Δ, while β_1 is the various estimated parameters of the differenced value of the lagged variables and ε_t is the white noise error term. Based on Equation (6.1), the study tests the null hypothesis of the presence of unit root (α_3=0) against the alternative hypothesis of no unit root. If the series rejects the null hypothesis, the series is stationary, however, if the series do not reject the null hypothesis, it means the series is non-stationary and thus possesses a unit root.

3.5.2 Philips-Perron (PP) Test

In 1988, Philips-Perron advanced the Philips-Perron (PP) Test as more robust test for the stationarity of time series data. The PP Test improved the Augmented Dickey-Fuller (ADF) Test through a non-parametric modification of the Test Statistics which is able to solve the problem of autocorrelation and heteroscedasticity in the error terms. The PP Test ensures that there is white noise in the deviations in the regressions estimated. The Philips-Perron Test is illustrated in the Equation below;

$$\boldsymbol{\Delta X_{t-1} = \alpha_0 + \beta X_{t-1} + \varepsilon_t \ldots \ldots \ldots \ldots \ldots \ldots \ldots 6.2}$$

The study tests the null hypothesis from Equation (6.2) in the presence of the unit root ($\beta = 0$), the alternative hypothesis of no unit root. If the study fails to reject the null hypothesis, it means the series contains a unit root, thus the series is non-stationary. However, the series does not possess unit root if the study rejects the null hypothesis.

3.5.3 Hansen Estimation Strategy

Equation 6.3 below illustrates the Hansen's threshold estimation strategy for the study.

$$g_{yt} = \gamma_0 + \gamma_1 INF_{kt} + \gamma_2 i_t + \gamma_3 gGX_t + \gamma_4 GCF_t + \gamma_5 POP_t + \gamma_6 TD_t + g_{yt-1} + \varepsilon_t \ldots \ldots 6.3$$

Where g_{yt} represents economic growth over time, GX is Government Expenditure, GCF is Gross Capital Formation, POP is the level Population growth, and TD is Trade (another control variable) and *t*-represents the number of observations included in the study, that is from 1980-2019.

Theoretically and generally speaking, it is expected that an increasing inflation will exert significant effect on economic growth. However, Nguyen *et al.* (2017) suggest that the level of inflation of a country needs to be appropriate to its absorptive capacity. That is, a significant amount of inflation must be met to proffer the growth-enhancing benefits. This thesis therefore hypothesizes that there is a threshold level of inflation beyond which it would have a significant effect on the economic growth of Ghana. Thus, the study modifies the model by accounting for threshold effect of inflation on economic growth, by adjusting equation (6.3) to account for the threshold effect following the methodology of Hansen (2000). First, let the set of control variables to be denoted by X (X= GX, GCF, POP, TD). Thus,

$$g_{yt} = \gamma_0 + \gamma_1 X + \gamma_2 inf_{kt} + \gamma_3 i_t + \varepsilon_t \; q_i \leq \gamma \ldots \ldots \ldots . . 6.4$$

$$g_{yt} = \text{Ꝋ}_0 + \gamma_1 X + \text{Ꝋ}_2 inf_{kt} + \text{Ꝋ}_3 i_t + \varepsilon_t \; q_i > \gamma \ldots \ldots \ldots \; 6.5$$

where q_i is called the threshold variable, and is used to split the sample into two groups, which may be called "regimes".

To write the model in a single equation, define the dummy variable $d_i(\gamma) = \{q_i \leq \gamma\}$ where $\{.\}$ is the indicator function and set $inf_{kt}(\gamma) = inf_{kt} d_i(\gamma)$, so that equations 6.4 and 6.5 equal

$$g_t = \tau_0 + \tau_2 I(inf_{kt} \leq \gamma) + \tau_3 I(inf_{kt} > \gamma) + \tau_4 X + \tau_5 i_t + \varepsilon_t \ldots \ldots \ldots . . 6.6$$

where I is an indicator function for the two regimes related to level of inflation rate.

Equation (6.6) allows all of the regression parameters to switch between the regimes. The study also controls for government expenditure, gross capital formation, population growth, and trade. This is shown in equation 6.7 below;

$$g_t = \tau_0 + \tau_2 I(inf_{kt} \leq \gamma) + \tau_3 I(inf_{kt} > \gamma) + \tau_4 X + \tau_5 i_t + GX_t + GCF_t + POP_t + TD_t + \varepsilon_t \ldots \ldots \ldots \ldots 6.7$$

where GX represents government expenditure, GCF represents Gross Capital Formation (proxy for investment), POP represents Population growth, and TD represents Trade.
The procedure to estimate the non-linear relationship is to estimate equation (6.7) by Two Stage Least Square method and then computing the residual sum of squares (RSS), Alkaike Information Criteria (AIC) for the different or chosen threshold levels of the various control variables. The threshold estimate of the various control variables is found by selecting the one that minimizes the sequence of the RSS and AIC and therefore maximizing the R^2.

CHAPTER FOUR
DISCUSSION AND ANALYSIS OF RESULTS

4.1 Introduction

The chapter presents discussions and analysis of results. The chapter particularly focused on descriptive statistics, stationarity of variables employed, and the threshold results obtained.

4.2 Descriptive Statistics

Table 4.1 provides the statistical description the variables used in the model.

Table 4.1: Descriptive Statistics

Variable	Mean	Maximum	Minimum	Std. Dev	Observation
RGDP	1.575	2.642	-0.751	0.534	37
GX	2.523	3.039	1.982	0.264	37
INF	2.908	4.085	1.964	0.573	37
GCF	2.880	3.403	1.386	0.452	37
POP	0.952	1.129	0.784	0.099	37
TD	4.171	4.754	2.869	0.471	37

Source: Author's Construct (2020)

Table 4.1 above illustrates the descriptive statistics of the variables considered in the study. The data period covered from 1980 to 2019. GDP Growth (LNRGDP) as the dependent variable for this study recorded a mean figure of 1.575 and a maximum and minimum values of 2.642 and -0.751. The variable further recorded a standard deviation value of 0.534. Also, Government Expenditure (LNGX) recorded a deviation value of 0.264 while it's maximum and minimum values were 3.039 and 1.982 respectively. Its mean figure recorded 2.523. Additionally, the variable inflation (LNINF) indicated a mean value of 2.908 and a standard deviation value of 0.573. The variable's maximum and minimum values recorded 4.085 and 1.964 respectively. Gross Capital Formation (LNGCF) maximum and minimum values were 3.403 and 1.386, whiles 2.880 and 0.452 were the mean and standard deviation values. The Population growth (LNPOP) variable also indicated a standard deviation figure of 0.099 and a mean value of 0.952. The maximum and minimum values of this variable indicated 1.129 and 0.784 respectively. Lastly, the Trade variable indicated a mean figure of 4.171 and a standard deviation value of 0.471. This variable further recorded a maximum and minimum values of 4.754 and 2.869 respectively.

4.3 Trend Analyses of GDP Growth and Inflation in Ghana

The trends analysis of GDP growth and inflation is very important, as it helps us to know how these variables behave casually over the period under consideration. Figure 4.1 below illustrates the trends of GDP growth and Inflation in Ghana from 1980 to 2018.

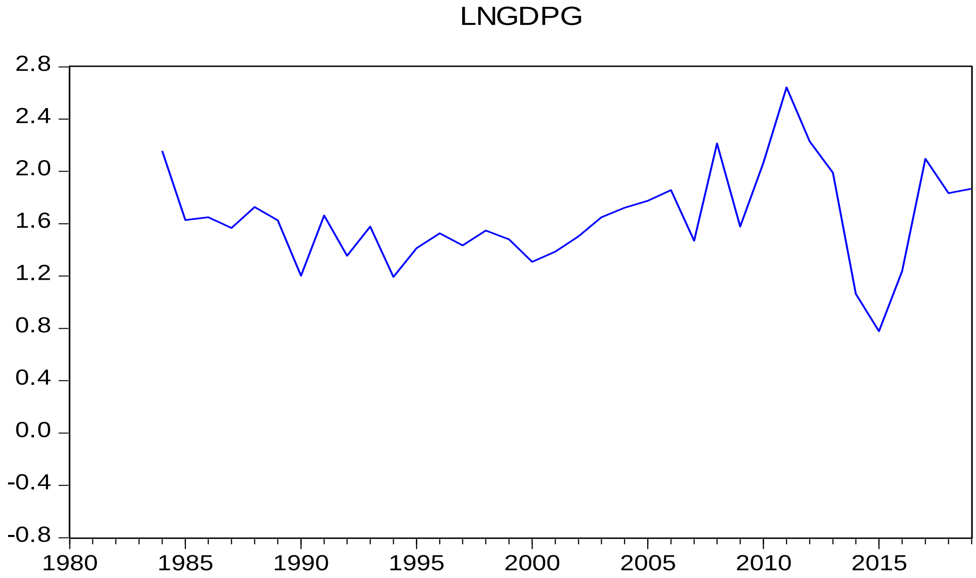

Figure 4.1: Trend of GDP growth

Figure 4.1 above indicates that, between 1980 and 1985, Ghana experienced a fall in economic growth. However, the country was able to stabilize the decreasing GDP growth between 1985 and 1988. From 1988 to 1990 the country witnessed slight growth and preceded with fluctuations from 1990 until 1995, where some sort of stability was maintained. The variable also portrays a long fall between 2010 and 2015. The country also enjoyed another rise in economic growth from 2015 to 2017. But from 2017 to 2019 the economic growth of the country is at a decreasing rate.

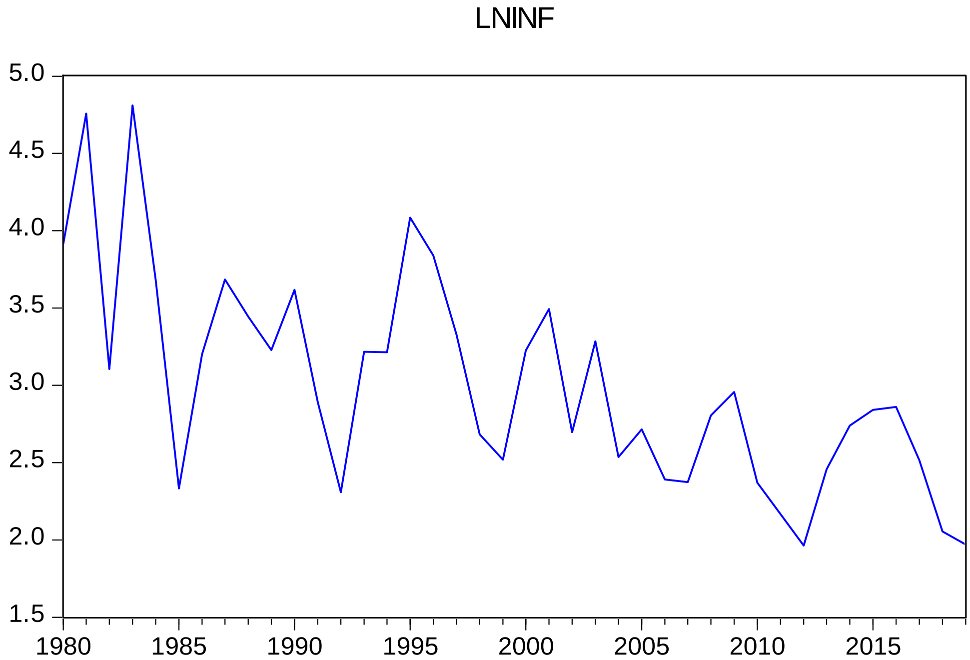

Figure 4.2: Trend of inflation rate

Figure 4.2 above shows the graphical behavior of inflation in Ghana. Between 1980 and 1985, the variable experienced severe fluctuations. Also, from 1989 to 1993 the country witnessed some level of decrease in the rate of inflation. The figure in general indicates that inflation in Ghana is unstable.

4.4 Stationarity Results

This study therefore used the ADF and Philips-Perron tests approach to determine whether the series at constant and constant with trend are stationary.

Table 4.2 Stationarity Results

Variable	ADF Test		Philips- Perron Test		Order of Integration
	Constant	Constant &Trend	Constant	Constant & Trend	
PANEL A: LEVELS					
LNGDPG	-3.715***	-3.900***	-3.646***	-3.745***	-
LNINF	-3.441**	-5.400***	-3.308**	-5.485***	-
LNGX	-1.254	-3.193	-1.010	-3.414	-
LNGCF	-2.379	-2.172	-2.763	-1.990	-
LNPOP	-0.086	-2.127	-1.288	-5.121***	-
LNTD	-1.613	-1.430	-1.624	-1.586	
PANEL B: FIRST DIFFERENCE					
ΔLNGX	-5.190***	-5.111***	-9.362***	-8.680***	I(1)
ΔLNGCF	-5.533***	-5.573***	-5.571***	-5.929***	I(1)
Δ LNPOP	-5.330***	-5.348***	-5.541***	-4.833***	I(1)
Δ LNTD	-5.078***	-8.110***	-5.075***	-5.414***	I(1)

*****, **, * indicates significance at 1%, 5% and 10% respectively**

Table 4.2 above illustrates the stationarity outcome of the series. The ADF Test and the Philips-Perron Test reveal that, GDP growth and inflation were stationary at level. This therefore rejects the Null Hypothesis of the presence of unit root at 5 percent level of significance. However, Government expenditure, Gross Capital Formation, population Growth, and Trade were not stationary at level, and hence could not reject the null hypothesis of the presence of unit root at 5 percent significance level. The series after first difference all became stationary. The results therefore integrated in order I(0) and I(1). This therefore informed that, the best estimation method to apply to this model is the ARDL econometric technique.

4.5 Threshold Results

Table 4.3 results below indicate 10.70% as inflation threshold value for Ghana. The results indicate that, if inflation is less than 10.70%, its impact on the economy of Ghana is less (0.254). However, the impact of inflation hurts (2.522) the economy when it rises beyond the threshold value, which is 10.70%.

Table 4.3: Threshold Results

Threshold Value: (2.370) 10.70%			
Variable	Coefficient	Standard Error	t-Statistic
LNINF<10.70%	-0.254***	0.118	-2.142
CONSTANT	4.036	0.638	6.321
LNINF ≥ 10.70%	-2.522***	0.568	-4.437

CONSTANT	8.677	1.475	5.884

4.6 Non-Threshold Results

The non-threshold regressors included in the study were population growth, government expenditure, trade and gross capital formation. Based on the estimation results in Table 4.4 below, gross capital formation was significant at 1% percent significance level, while government expenditure, and trade were also significant at 10% level of significance. However, population growth was insignificance.

Table 4.4: Non-Threshold Results

Variable	Coefficient	Standard Error	t-Statistic
D(LNPOP)	-3.144	3.968	-0.792
D(LNGX)	0.984*	0.493	1.993
D(LNTD)	-0.673*	0.392	-1.720
LNGCF	-0.567***	0.158	-3.592

Table 4.4 results above indicate the linear relationships between the non-threshold and the dependent variable, GDP Growth. The results show that, gross capital formation has a positive and significant association with GDP Growth. The result implies that, a 1% increase in gross capital formation leads to 0.567 percent increase in GDP growth. Additionally, the results indicate that, government expenditure and trade both have positive impact on GDP Growth. The results means that, a 1% increase in government expenditure causes GDP growth to increase by 0.984 percent Adria (2009). Furthermore, the results indicate that, there exist a positive relationship between trade and GDP growth. The results show that, a 1% increase in trade leads to 0.673 increase in Ghana's GDP growth. However, even though population growth indicates a negative association with GDP growth, it has an insignificant relationship with GDP growth. This finding is similar to investigations of Adria (2009).

CHAPTER FIVE
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents summary of major findings, and conclusion to the study. The chapter also presents recommendations based on the findings.

5.2 Summary of major findings

The fundamental aim of this study is to investigate the threshold effects in the relationship between inflation and economic growth in Ghana. The general objective for the study was further sub-divided into specific objectives in an attempt to achieve the purpose of this study. The study processes include; descriptive analysis, test for stationarities, and evaluating the threshold results, examining the linear relationships between the independent variables and the dependent variable. The study used secondary data and Hansen threshold estimation technique. The key findings from the study are as follows;

The study found 10.70% as the inflation threshold value for Ghana. The results show that, anytime inflation is less than 10.70%, its negative effect on the economy is much less than when it increases beyond the threshold value of 10.70%. The study also found that, gross capital formation was significant at 1% percent significance level, while government expenditure, and trade were also significant at 10% level of significance. However, population growth was insignificant. The results show that, gross capital formation has a positive and significant association with GDP Growth. Additionally, the results indicate that, government expenditure and trade both have positive impact on GDP Growth.

5.3 Conclusion

The overall aim of the study is to investigate the threshold effects in the relationship between inflation and economic growth in Ghana. Several theories and related literature were selected from the study area. The study employed economic growth (proxy for GDP growth) as the dependent variable while its other regressors include; inflation, government expenditure, gross capital formation, population growth, and trade. The study period spanned from 1980 to 2019. The study also used secondary data, sourced from World development Indicators (WDI, 2019). The estimation technique employed was the Hansen Threshold econometric method. It was found that; the inflation threshold value for Ghana is 10.70%. The results show that, anytime inflation is less than 10.70%, its negative effect on the economy is much less than when it increases beyond the threshold value, that is, 10.70%. The study also found that, gross capital formation was significant at 1% percent significance level, while government expenditure, and trade were also significant at 10% level of significance. However, population growth was insignificant. The results show that, gross capital formation has a positive and significant association with GDP Growth. Additionally, the results indicate that, government expenditure and trade both have positive impact on GDP Growth.

5.4 Recommendation

Based on the empirical analysis of the results, the study recommends government to team-up with the Bank of Ghana to ensure that Ghana's inflation does not increase above the threshold value. Since a rise beyond the threshold would impact the economy negatively. This can be done by adapting fiscal measures to control government expenditure and public and private investment. The study further recommends government to increase trade (export) while decreasing imports of goods and services in an attempt to promote economic growth in the country, since trade has a positive effect on economic growth. Additionally, the study recommends government to increase government expenditure in the area of capital goods to improve economic growth of the country.

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APPENDIX
DESCRIPTIVE STATISTICS

	LNGDPG	LNINF	LNGX	LNGCF	LNPOP	LNTD
Mean	1.574979	2.908318	2.522861	2.879662	0.951596	4.171061
Median	1.578979	2.841996	2.447471	3.044548	0.936093	4.322513
Maximum	2.642418	4.085330	3.039173	3.402838	1.128171	4.754008
Minimum	-0.751421	1.963799	1.982292	1.386294	0.783902	2.869098
Std. Dev.	0.534301	0.572720	0.263830	0.451737	0.098546	0.470903
Skewness	-2.040445	0.228360	0.462479	-1.256515	0.173171	-1.252936
Kurtosis	11.12987	2.111578	2.281218	4.591183	1.928756	3.973812
Jarque-Bera	127.5704	1.538410	2.115469	13.63941	1.954087	11.14271
Probability	0.000000	0.463381	0.347242	0.001092	0.376422	0.003805

Sum	58.27424	107.6078	93.34585	106.5475	35.20905	154.3293
Sum Sq. Dev.	10.27720	11.80830	2.505825	7.346384	0.349609	7.982991
Observations	37	37	37	37	37	37

STATIONARITY TEST
ADF – LEVEL
GDPG

Null Hypothesis: LNGDPG has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.714977	0.0081
Test critical values:	1% level	-3.632900	
	5% level	-2.948404	
	10% level	-2.612874	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNGDPG)
Method: Least Squares
Date: 01/03/21 Time: 13:16
Sample (adjusted): 1985 2019
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGDPG(-1)	-0.564939	0.152071	-3.714977	0.0007
C	0.914329	0.254466	3.593134	0.0011

R-squared	0.294888	Mean dependent var	-0.008252
Adjusted R-squared	0.273521	S.D. dependent var	0.385182
S.E. of regression	0.328305	Akaike info criterion	0.665699
Sum squared resid	3.556883	Schwarz criterion	0.754576
Log likelihood	-9.649740	Hannan-Quinn criter.	0.696380
F-statistic	13.80105	Durbin-Watson stat	1.849014
Prob(F-statistic)	0.000750		

Null Hypothesis: LNGDPG has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.899843	0.0227
Test critical values:	1% level	-4.243644	
	5% level	-3.544284	
	10% level	-3.204699	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNGDPG)
Method: Least Squares
Date: 01/03/21 Time: 13:16
Sample (adjusted): 1985 2019
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGDPG(-1)	-0.594385	0.152412	-3.899843	0.0005
C	0.807989	0.265537	3.042845	0.0047
@TREND("1980")	0.007019	0.005507	1.274619	0.2116

R-squared	0.328957	Mean dependent var	-0.008252
Adjusted R-squared	0.287017	S.D. dependent var	0.385182
S.E. of regression	0.325241	Akaike info criterion	0.673319
Sum squared resid	3.385024	Schwarz criterion	0.806634
Log likelihood	-8.783077	Hannan-Quinn criter.	0.719339
F-statistic	7.843471	Durbin-Watson stat	1.887840
Prob(F-statistic)	0.001690		

INF

Null Hypothesis: LNINF has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.441036	0.0153
Test critical values:	1% level	-3.610453	

	5% level	-2.938987
	10% level	-2.607932

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNINF)
Method: Least Squares
Date: 01/03/21 Time: 13:18
Sample (adjusted): 1981 2019
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNINF(-1)	-0.492199	0.143038	-3.441036	0.0015
C	1.443325	0.444313	3.248440	0.0025

R-squared	0.242436	Mean dependent var	-0.049813
Adjusted R-squared	0.221961	S.D. dependent var	0.676384
S.E. of regression	0.596614	Akaike info criterion	1.854829
Sum squared resid	13.17011	Schwarz criterion	1.940140
Log likelihood	-34.16917	Hannan-Quinn criter.	1.885438
F-statistic	11.84073	Durbin-Watson stat	2.110176
Prob(F-statistic)	0.001452		

Null Hypothesis: LNINF has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.400082	0.0004
Test critical values:	1% level	-4.211868	
	5% level	-3.529758	
	10% level	-3.196411	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNINF)
Method: Least Squares
Date: 01/03/21 Time: 13:18

Sample (adjusted): 1981 2019
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNINF(-1)	-0.897714	0.166241	-5.400082	0.0000
C	3.394887	0.657932	5.159939	0.0000
@TREND("1980")	-0.036070	0.009865	-3.656152	0.0008

R-squared	0.447565	Mean dependent var	-0.049813
Adjusted R-squared	0.416874	S.D. dependent var	0.676384
S.E. of regression	0.516505	Akaike info criterion	1.590339
Sum squared resid	9.603977	Schwarz criterion	1.718305
Log likelihood	-28.01161	Hannan-Quinn criter.	1.636252
F-statistic	14.58300	Durbin-Watson stat	1.887342
Prob(F-statistic)	0.000023		

GCF

Null Hypothesis: LNGCF has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.378657	0.1541
Test critical values:	1% level	-3.610453	
	5% level	-2.938987	
	10% level	-2.607932	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNGCF)
Method: Least Squares
Date: 01/03/21 Time: 13:19
Sample (adjusted): 1981 2019
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGCF(-1)	-0.135978	0.057166	-2.378657	0.0226
C	0.423547	0.161093	2.629215	0.0124

R-squared	0.132637	Mean dependent var	0.048422

Adjusted R-squared	0.109194	S.D. dependent var	0.217462
S.E. of regression	0.205246	Akaike info criterion	-0.279296
Sum squared resid	1.558657	Schwarz criterion	-0.193985
Log likelihood	7.446271	Hannan-Quinn criter.	-0.248687
F-statistic	5.658010	Durbin-Watson stat	1.815037
Prob(F-statistic)	0.022650		

Null Hypothesis: LNGCF has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.172311	0.4910
Test critical values:	1% level	-4.211868	
	5% level	-3.529758	
	10% level	-3.196411	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNGCF)
Method: Least Squares
Date: 01/03/21 Time: 13:19
Sample (adjusted): 1981 2019
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGCF(-1)	-0.184460	0.084914	-2.172311	0.0365
C	0.490006	0.183234	2.674211	0.0112
@TREND("1980")	0.003364	0.004338	0.775646	0.4430

R-squared	0.146894	Mean dependent var	0.048422
Adjusted R-squared	0.099499	S.D. dependent var	0.217462
S.E. of regression	0.206360	Akaike info criterion	-0.244588
Sum squared resid	1.533037	Schwarz criterion	-0.116621
Log likelihood	7.769459	Hannan-Quinn criter.	-0.198674
F-statistic	3.099359	Durbin-Watson stat	1.760022
Prob(F-statistic)	0.057287		

POP

Null Hypothesis: LNPOP has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.086426	0.9436
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNPOP)
Method: Least Squares
Date: 01/03/21 Time: 13:20
Sample (adjusted): 1983 2019
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNPOP(-1)	-0.000999	0.011563	-0.086426	0.9317
D(LNPOP(-1))	1.294539	0.115023	11.25460	0.0000
D(LNPOP(-2))	-0.535339	0.089438	-5.985563	0.0000
C	-0.001004	0.011096	-0.090513	0.9284

R-squared	0.892607	Mean dependent var	-0.007589
Adjusted R-squared	0.882844	S.D. dependent var	0.016963
S.E. of regression	0.005806	Akaike info criterion	-7.358030
Sum squared resid	0.001112	Schwarz criterion	-7.183877
Log likelihood	140.1236	Hannan-Quinn criter.	-7.296633
F-statistic	91.42795	Durbin-Watson stat	2.181998
Prob(F-statistic)	0.000000		

Null Hypothesis: LNPOP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 2 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-2.126698	0.5146

Test critical values:	1% level	-4.226815	
	5% level	-3.536601	
	10% level	-3.200320	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNPOP)
Method: Least Squares
Date: 01/03/21 Time: 13:20
Sample (adjusted): 1983 2019
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNPOP(-1)	-0.059534	0.027994	-2.126698	0.0413
D(LNPOP(-1))	1.221718	0.113050	10.80685	0.0000
D(LNPOP(-2))	-0.488472	0.086783	-5.628678	0.0000
C	0.066861	0.031672	2.111048	0.0427
@TREND("1980")	-0.000552	0.000243	-2.270069	0.0301

R-squared	0.907503	Mean dependent var	-0.007589
Adjusted R-squared	0.895941	S.D. dependent var	0.016963
S.E. of regression	0.005472	Akaike info criterion	-7.453290
Sum squared resid	0.000958	Schwarz criterion	-7.235599
Log likelihood	142.8859	Hannan-Quinn criter.	-7.376544
F-statistic	78.48925	Durbin-Watson stat	2.215385
Prob(F-statistic)	0.000000		

GX

Null Hypothesis: LNGX has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.253639	0.6411
Test critical values:	1% level	-3.610453	
	5% level	-2.938987	
	10% level	-2.607932	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNGX)
Method: Least Squares
Date: 01/03/21 Time: 13:21
Sample (adjusted): 1981 2019
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGX(-1)	-0.108537	0.086578	-1.253639	0.2178
C	0.281871	0.215022	1.310892	0.1980

R-squared	0.040745	Mean dependent var	0.014169
Adjusted R-squared	0.014819	S.D. dependent var	0.158572
S.E. of regression	0.157392	Akaike info criterion	-0.810228
Sum squared resid	0.916578	Schwarz criterion	-0.724917
Log likelihood	17.79945	Hannan-Quinn criter.	-0.779619
F-statistic	1.571612	Durbin-Watson stat	1.469903
Prob(F-statistic)	0.217837		

Null Hypothesis: LNGX has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.192559	0.1008
Test critical values:	1% level	-4.211868	
	5% level	-3.529758	
	10% level	-3.196411	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNGX)
Method: Least Squares
Date: 01/03/21 Time: 13:21
Sample (adjusted): 1981 2019
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGX(-1)	-0.394454	0.123554	-3.192559	0.0029

C	0.795505	0.259610	3.064226	0.0041
@TREND("1980")	0.009578	0.003196	2.997191	0.0049

R-squared	0.232309	Mean dependent var	0.014169
Adjusted R-squared	0.189659	S.D. dependent var	0.158572
S.E. of regression	0.142745	Akaike info criterion	-0.981715
Sum squared resid	0.733537	Schwarz criterion	-0.853749
Log likelihood	22.14344	Hannan-Quinn criter.	-0.935802
F-statistic	5.446929	Durbin-Watson stat	1.409414
Prob(F-statistic)	0.008577		

TD

Null Hypothesis: LNTD has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.612990	0.4666
Test critical values:	1% level	-3.610453	
	5% level	-2.938987	
	10% level	-2.607932	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNTD)
Method: Least Squares
Date: 01/03/21 Time: 13:22
Sample (adjusted): 1981 2019
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNTD(-1)	-0.081384	0.050456	-1.612990	0.1152
C	0.367531	0.205420	1.789163	0.0818

R-squared	0.065698	Mean dependent var	0.041032
Adjusted R-squared	0.040446	S.D. dependent var	0.223084
S.E. of regression	0.218526	Akaike info criterion	-0.153905
Sum squared resid	1.766881	Schwarz criterion	-0.068594
Log likelihood	5.001141	Hannan-Quinn criter.	-0.123296
F-statistic	2.601737	Durbin-Watson stat	1.225745

Prob(F-statistic)	0.115245

Null Hypothesis: LNTD has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.429838	0.8361
Test critical values:	1% level	-4.211868	
	5% level	-3.529758	
	10% level	-3.196411	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNTD)
Method: Least Squares
Date: 01/03/21 Time: 13:23
Sample (adjusted): 1981 2019
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNTD(-1)	-0.118791	0.083080	-1.429838	0.1614
C	0.459253	0.262471	1.749727	0.0887
@TREND("1980")	0.002917	0.005119	0.569836	0.5723

R-squared	0.074049	Mean dependent var	0.041032
Adjusted R-squared	0.022608	S.D. dependent var	0.223084
S.E. of regression	0.220548	Akaike info criterion	-0.111602
Sum squared resid	1.751087	Schwarz criterion	0.016364
Log likelihood	5.176238	Hannan-Quinn criter.	-0.065689
F-statistic	1.439483	Durbin-Watson stat	1.185587
Prob(F-statistic)	0.250369		

AFTER FIRST DIFFERENCE
GX

Null Hypothesis: D(LNGX) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

	t-Statistic	Prob.*

Augmented Dickey-Fuller test statistic		-5.188960	0.0001
Test critical values:	1% level	-3.615588	
	5% level	-2.941145	
	10% level	-2.609066	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNGX,2)
Method: Least Squares
Date: 01/03/21 Time: 13:57
Sample (adjusted): 1982 2019
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGX(-1))	-0.821857	0.158386	-5.188960	0.0000
C	0.018593	0.025145	0.739444	0.4644

R-squared	0.427893	Mean dependent var	0.008262
Adjusted R-squared	0.412001	S.D. dependent var	0.201504
S.E. of regression	0.154515	Akaike info criterion	-0.845851
Sum squared resid	0.859499	Schwarz criterion	-0.759662
Log likelihood	18.07117	Hannan-Quinn criter.	-0.815186
F-statistic	26.92530	Durbin-Watson stat	2.009269
Prob(F-statistic)	0.000008		

Null Hypothesis: D(LNGX) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.111420	0.0009
Test critical values:	1% level	-4.219126	
	5% level	-3.533083	
	10% level	-3.198312	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(LNGX,2)
Method: Least Squares
Date: 01/03/21 Time: 13:58
Sample (adjusted): 1982 2019
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGX(-1))	-0.825517	0.161504	-5.111420	0.0000
C	0.008745	0.053957	0.162081	0.8722
@TREND("1980")	0.000483	0.002331	0.207059	0.8372

R-squared	0.428593	Mean dependent var	0.008262
Adjusted R-squared	0.395941	S.D. dependent var	0.201504
S.E. of regression	0.156611	Akaike info criterion	-0.794444
Sum squared resid	0.858448	Schwarz criterion	-0.665161
Log likelihood	18.09443	Hannan-Quinn criter.	-0.748446
F-statistic	13.12616	Durbin-Watson stat	2.004832
Prob(F-statistic)	0.000056		

GCF

Null Hypothesis: D(LNGCF) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.532618	0.0000
Test critical values:	1% level	-3.615588	
	5% level	-2.941145	
	10% level	-2.609066	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNGCF,2)
Method: Least Squares
Date: 01/03/21 Time: 13:58
Sample (adjusted): 1982 2019
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGCF(-1))	-0.910465	0.164563	-5.532618	0.0000

C	0.039549	0.036632	1.079635	0.2875

R-squared	0.459539	Mean dependent var	-0.003924
Adjusted R-squared	0.444527	S.D. dependent var	0.295934
S.E. of regression	0.220560	Akaike info criterion	-0.134102
Sum squared resid	1.751274	Schwarz criterion	-0.047914
Log likelihood	4.547943	Hannan-Quinn criter.	-0.103437
F-statistic	30.60986	Durbin-Watson stat	1.834400
Prob(F-statistic)	0.000003		

Null Hypothesis: D(LNGCF) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.573222	0.0003
Test critical values:	1% level	-4.219126	
	5% level	-3.533083	
	10% level	-3.198312	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNGCF,2)
Method: Least Squares
Date: 01/03/21 Time: 13:59
Sample (adjusted): 1982 2019
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGCF(-1))	-0.939506	0.168575	-5.573222	0.0000
C	0.099881	0.079183	1.261401	0.2155
@TREND("1980")	-0.002875	0.003342	-0.860284	0.3955

R-squared	0.470731	Mean dependent var	-0.003924
Adjusted R-squared	0.440487	S.D. dependent var	0.295934
S.E. of regression	0.221360	Akaike info criterion	-0.102396
Sum squared resid	1.715010	Schwarz criterion	0.026888
Log likelihood	4.945517	Hannan-Quinn criter.	-0.056398
F-statistic	15.56448	Durbin-Watson stat	1.838770
Prob(F-statistic)	0.000015		

POP

Null Hypothesis: D(LNPOP) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.330211	0.0001
Test critical values:	1% level	-3.621023	
	5% level	-2.943427	
	10% level	-2.610263	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNPOP,2)
Method: Least Squares
Date: 01/03/21 Time: 13:59
Sample (adjusted): 1983 2019
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNPOP(-1))	-0.241136	0.045240	-5.330211	0.0000
D(LNPOP(-1),2)	0.538706	0.079323	6.791259	0.0000
C	-0.001959	0.001041	-1.882682	0.0683

R-squared	0.801335	Mean dependent var	-0.002906
Adjusted R-squared	0.789649	S.D. dependent var	0.012473
S.E. of regression	0.005721	Akaike info criterion	-7.411858
Sum squared resid	0.001113	Schwarz criterion	-7.281243
Log likelihood	140.1194	Hannan-Quinn criter.	-7.365810
F-statistic	68.57127	Durbin-Watson stat	2.190802
Prob(F-statistic)	0.000000		

Null Hypothesis: D(LNPOP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.347572	0.0005
Test critical values:	1% level	-4.226815	

	5% level	-3.536601
	10% level	-3.200320

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNPOP,2)
Method: Least Squares
Date: 01/03/21 Time: 14:00
Sample (adjusted): 1983 2019
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNPOP(-1))	-0.247398	0.046264	-5.347572	0.0000
D(LNPOP(-1),2)	0.559313	0.084304	6.634458	0.0000
C	-0.000321	0.002397	-0.134022	0.8942
@TREND("1980")	-7.56E-05	9.95E-05	-0.759713	0.4528

R-squared	0.804750	Mean dependent var	-0.002906
Adjusted R-squared	0.787000	S.D. dependent var	0.012473
S.E. of regression	0.005757	Akaike info criterion	-7.375142
Sum squared resid	0.001094	Schwarz criterion	-7.200989
Log likelihood	140.4401	Hannan-Quinn criter.	-7.313745
F-statistic	45.33805	Durbin-Watson stat	2.264101
Prob(F-statistic)	0.000000		

TD

Null Hypothesis: D(LNTD) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.078114	0.0002
Test critical values:	1% level	-3.615588	
	5% level	-2.941145	
	10% level	-2.609066	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(LNTD,2)
Method: Least Squares
Date: 01/03/21 Time: 14:01
Sample (adjusted): 1982 2019
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNTD(-1))	-0.722812	0.142339	-5.078114	0.0000
C	0.045032	0.032298	1.394264	0.1718

R-squared	0.417355	Mean dependent var	0.014312
Adjusted R-squared	0.401171	S.D. dependent var	0.252734
S.E. of regression	0.195576	Akaike info criterion	-0.374541
Sum squared resid	1.376997	Schwarz criterion	-0.288352
Log likelihood	9.116276	Hannan-Quinn criter.	-0.343876
F-statistic	25.78724	Durbin-Watson stat	1.984623
Prob(F-statistic)	0.000012		

Null Hypothesis: D(LNTD) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.110017	0.0000
Test critical values:	1% level	-4.226815	
	5% level	-3.536601	
	10% level	-3.200320	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNTD,2)
Method: Least Squares
Date: 01/03/21 Time: 14:01
Sample (adjusted): 1983 2019
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNTD(-1))	-1.224596	0.150998	-8.110017	0.0000
D(LNTD(-1),2)	0.324890	0.116038	2.799866	0.0085
C	0.265499	0.059937	4.429620	0.0001

@TREND("1980")	-0.008877	0.002453	-3.618879	0.0010

R-squared	0.678899	Mean dependent var	0.012214
Adjusted R-squared	0.649708	S.D. dependent var	0.255884
S.E. of regression	0.151446	Akaike info criterion	-0.835365
Sum squared resid	0.756888	Schwarz criterion	-0.661212
Log likelihood	19.45425	Hannan-Quinn criter.	-0.773968
F-statistic	23.25716	Durbin-Watson stat	1.430351
Prob(F-statistic)	0.000000		

PHILIPS-PERRON TEST – LEVEL

Null Hypothesis: LNGDPG has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.646311	0.0097
Test critical values:	1% level	-3.632900	
	5% level	-2.948404	
	10% level	-2.612874	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.101625
HAC corrected variance (Bartlett kernel)	0.091864

Phillips-Perron Test Equation
Dependent Variable: D(LNGDPG)
Method: Least Squares
Date: 01/03/21 Time: 14:04
Sample (adjusted): 1985 2019
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGDPG(-1)	-0.564939	0.152071	-3.714977	0.0007
C	0.914329	0.254466	3.593134	0.0011

R-squared	0.294888	Mean dependent var	-0.008252
Adjusted R-squared	0.273521	S.D. dependent var	0.385182
S.E. of regression	0.328305	Akaike info criterion	0.665699

Sum squared resid	3.556883	Schwarz criterion	0.754576
Log likelihood	-9.649740	Hannan-Quinn criter.	0.696380
F-statistic	13.80105	Durbin-Watson stat	1.849014
Prob(F-statistic)	0.000750		

Null Hypothesis: LNGDPG has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 5 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.745204	0.0322
Test critical values:	1% level	-4.243644	
	5% level	-3.544284	
	10% level	-3.204699	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.096715
HAC corrected variance (Bartlett kernel)	0.067301

Phillips-Perron Test Equation
Dependent Variable: D(LNGDPG)
Method: Least Squares
Date: 01/03/21 Time: 14:04
Sample (adjusted): 1985 2019
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGDPG(-1)	-0.594385	0.152412	-3.899843	0.0005
C	0.807989	0.265537	3.042845	0.0047
@TREND("1980")	0.007019	0.005507	1.274619	0.2116

R-squared	0.328957	Mean dependent var	-0.008252
Adjusted R-squared	0.287017	S.D. dependent var	0.385182
S.E. of regression	0.325241	Akaike info criterion	0.673319
Sum squared resid	3.385024	Schwarz criterion	0.806634
Log likelihood	-8.783077	Hannan-Quinn criter.	0.719339
F-statistic	7.843471	Durbin-Watson stat	1.887840
Prob(F-statistic)	0.001690		

INF

Null Hypothesis: LNINF has a unit root
Exogenous: Constant
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.308411	0.0213
Test critical values:	1% level	-3.610453	
	5% level	-2.938987	
	10% level	-2.607932	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.337695
HAC corrected variance (Bartlett kernel)	0.293087

Phillips-Perron Test Equation
Dependent Variable: D(LNINF)
Method: Least Squares
Date: 01/03/21 Time: 14:05
Sample (adjusted): 1981 2019
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNINF(-1)	-0.492199	0.143038	-3.441036	0.0015
C	1.443325	0.444313	3.248440	0.0025

R-squared	0.242436	Mean dependent var	-0.049813
Adjusted R-squared	0.221961	S.D. dependent var	0.676384
S.E. of regression	0.596614	Akaike info criterion	1.854829
Sum squared resid	13.17011	Schwarz criterion	1.940140
Log likelihood	-34.16917	Hannan-Quinn criter.	1.885438
F-statistic	11.84073	Durbin-Watson stat	2.110176
Prob(F-statistic)	0.001452		

Null Hypothesis: LNINF has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 7 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*

Phillips-Perron test statistic		-5.484949	0.0003
Test critical values:	1% level	-4.211868	
	5% level	-3.529758	
	10% level	-3.196411	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.246256
HAC corrected variance (Bartlett kernel)	0.112794

Phillips-Perron Test Equation
Dependent Variable: D(LNINF)
Method: Least Squares
Date: 01/03/21 Time: 14:05
Sample (adjusted): 1981 2019
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNINF(-1)	-0.897714	0.166241	-5.400082	0.0000
C	3.394887	0.657932	5.159939	0.0000
@TREND("1980")	-0.036070	0.009865	-3.656152	0.0008

R-squared	0.447565	Mean dependent var	-0.049813
Adjusted R-squared	0.416874	S.D. dependent var	0.676384
S.E. of regression	0.516505	Akaike info criterion	1.590339
Sum squared resid	9.603977	Schwarz criterion	1.718305
Log likelihood	-28.01161	Hannan-Quinn criter.	1.636252
F-statistic	14.58300	Durbin-Watson stat	1.887342
Prob(F-statistic)	0.000023		

GX

Null Hypothesis: LNGX has a unit root
Exogenous: Constant
Bandwidth: 6 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.010128	0.7402
Test critical values:	1% level	-3.610453	
	5% level	-2.938987	

	10% level	-2.607932

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.023502
HAC corrected variance (Bartlett kernel)	0.018337

Phillips-Perron Test Equation
Dependent Variable: D(LNGX)
Method: Least Squares
Date: 01/03/21 Time: 14:07
Sample (adjusted): 1981 2019
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGX(-1)	-0.108537	0.086578	-1.253639	0.2178
C	0.281871	0.215022	1.310892	0.1980

R-squared	0.040745	Mean dependent var	0.014169
Adjusted R-squared	0.014819	S.D. dependent var	0.158572
S.E. of regression	0.157392	Akaike info criterion	-0.810228
Sum squared resid	0.916578	Schwarz criterion	-0.724917
Log likelihood	17.79945	Hannan-Quinn criter.	-0.779619
F-statistic	1.571612	Durbin-Watson stat	1.469903
Prob(F-statistic)	0.217837		

Null Hypothesis: LNGX has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.414243	0.0641
Test critical values:	1% level	-4.211868	
	5% level	-3.529758	
	10% level	-3.196411	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.018809

HAC corrected variance (Bartlett kernel)	0.024585

Phillips-Perron Test Equation
Dependent Variable: D(LNGX)
Method: Least Squares
Date: 01/03/21 Time: 14:07
Sample (adjusted): 1981 2019
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGX(-1)	-0.394454	0.123554	-3.192559	0.0029
C	0.795505	0.259610	3.064226	0.0041
@TREND("1980")	0.009578	0.003196	2.997191	0.0049

R-squared	0.232309	Mean dependent var	0.014169
Adjusted R-squared	0.189659	S.D. dependent var	0.158572
S.E. of regression	0.142745	Akaike info criterion	-0.981715
Sum squared resid	0.733537	Schwarz criterion	-0.853749
Log likelihood	22.14344	Hannan-Quinn criter.	-0.935802
F-statistic	5.446929	Durbin-Watson stat	1.409414
Prob(F-statistic)	0.008577		

GCF

Null Hypothesis: LNGCF has a unit root
Exogenous: Constant
Bandwidth: 11 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.762697	0.0730
Test critical values:	1% level	-3.610453	
	5% level	-2.938987	
	10% level	-2.607932	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.039966
HAC corrected variance (Bartlett kernel)	0.015271

Phillips-Perron Test Equation
Dependent Variable: D(LNGCF)
Method: Least Squares
Date: 01/03/21 Time: 14:09
Sample (adjusted): 1981 2019
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGCF(-1)	-0.135978	0.057166	-2.378657	0.0226
C	0.423547	0.161093	2.629215	0.0124

R-squared	0.132637	Mean dependent var	0.048422
Adjusted R-squared	0.109194	S.D. dependent var	0.217462
S.E. of regression	0.205246	Akaike info criterion	-0.279296
Sum squared resid	1.558657	Schwarz criterion	-0.193985
Log likelihood	7.446271	Hannan-Quinn criter.	-0.248687
F-statistic	5.658010	Durbin-Watson stat	1.815037
Prob(F-statistic)	0.022650		

Null Hypothesis: LNGCF has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 7 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.990113	0.5884
Test critical values:	1% level	-4.211868	
	5% level	-3.529758	
	10% level	-3.196411	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.039309
HAC corrected variance (Bartlett kernel)	0.024279

Phillips-Perron Test Equation
Dependent Variable: D(LNGCF)
Method: Least Squares
Date: 01/03/21 Time: 14:10
Sample (adjusted): 1981 2019
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGCF(-1)	-0.184460	0.084914	-2.172311	0.0365
C	0.490006	0.183234	2.674211	0.0112
@TREND("1980")	0.003364	0.004338	0.775646	0.4430

R-squared	0.146894	Mean dependent var	0.048422
Adjusted R-squared	0.099499	S.D. dependent var	0.217462
S.E. of regression	0.206360	Akaike info criterion	-0.244588
Sum squared resid	1.533037	Schwarz criterion	-0.116621
Log likelihood	7.769459	Hannan-Quinn criter.	-0.198674
F-statistic	3.099359	Durbin-Watson stat	1.760022
Prob(F-statistic)	0.057287		

POP

Null Hypothesis: LNPOP has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.288341	0.6254
Test critical values:	1% level	-3.610453	
	5% level	-2.938987	
	10% level	-2.607932	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000965
HAC corrected variance (Bartlett kernel)	0.002372

Phillips-Perron Test Equation
Dependent Variable: D(LNPOP)
Method: Least Squares
Date: 01/03/21 Time: 14:10
Sample (adjusted): 1981 2019
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNPOP(-1)	-0.028879	0.053379	-0.541007	0.5917

C	0.026348	0.051687	0.509754	0.6133

R-squared	0.007848	Mean dependent var	-0.001479
Adjusted R-squared	-0.018966	S.D. dependent var	0.031591
S.E. of regression	0.031889	Akaike info criterion	-4.003188
Sum squared resid	0.037626	Schwarz criterion	-3.917877
Log likelihood	80.06217	Hannan-Quinn criter.	-3.972579
F-statistic	0.292689	Durbin-Watson stat	0.172915
Prob(F-statistic)	0.591745		

Null Hypothesis: LNPOP has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.120575	0.0009
Test critical values:	1% level	-4.211868	
	5% level	-3.529758	
	10% level	-3.196411	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000331
HAC corrected variance (Bartlett kernel)	0.001104

Phillips-Perron Test Equation
Dependent Variable: D(LNPOP)
Method: Least Squares
Date: 01/03/21 Time: 14:11
Sample (adjusted): 1981 2019
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNPOP(-1)	-0.365298	0.051441	-7.101290	0.0000
C	0.423120	0.056792	7.450339	0.0000
@TREND("1980")	-0.003630	0.000437	-8.303255	0.0000

R-squared	0.659652	Mean dependent var	-0.001479
Adjusted R-squared	0.640744	S.D. dependent var	0.031591
S.E. of regression	0.018935	Akaike info criterion	-5.021814

Sum squared resid	0.012907	Schwarz criterion	-4.893848
Log likelihood	100.9254	Hannan-Quinn criter.	-4.975901
F-statistic	34.88710	Durbin-Watson stat	0.225164
Prob(F-statistic)	0.000000		

TD

Null Hypothesis: LNTD has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.623563	0.4613
Test critical values:	1% level	-3.610453	
	5% level	-2.938987	
	10% level	-2.607932	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.045305
HAC corrected variance (Bartlett kernel)	0.048307

Phillips-Perron Test Equation
Dependent Variable: D(LNTD)
Method: Least Squares
Date: 01/03/21 Time: 14:12
Sample (adjusted): 1981 2019
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNTD(-1)	-0.081384	0.050456	-1.612990	0.1152
C	0.367531	0.205420	1.789163	0.0818

R-squared	0.065698	Mean dependent var	0.041032
Adjusted R-squared	0.040446	S.D. dependent var	0.223084
S.E. of regression	0.218526	Akaike info criterion	-0.153905
Sum squared resid	1.766881	Schwarz criterion	-0.068594
Log likelihood	5.001141	Hannan-Quinn criter.	-0.123296
F-statistic	2.601737	Durbin-Watson stat	1.225745
Prob(F-statistic)	0.115245		

Null Hypothesis: LNTD has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.585804	0.7804
Test critical values:	1% level	-4.211868	
	5% level	-3.529758	
	10% level	-3.196411	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.044900
HAC corrected variance (Bartlett kernel)	0.053665

Phillips-Perron Test Equation
Dependent Variable: D(LNTD)
Method: Least Squares
Date: 01/03/21 Time: 14:12
Sample (adjusted): 1981 2019
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNTD(-1)	-0.118791	0.083080	-1.429838	0.1614
C	0.459253	0.262471	1.749727	0.0887
@TREND("1980")	0.002917	0.005119	0.569836	0.5723

R-squared	0.074049	Mean dependent var	0.041032
Adjusted R-squared	0.022608	S.D. dependent var	0.223084
S.E. of regression	0.220548	Akaike info criterion	-0.111602
Sum squared resid	1.751087	Schwarz criterion	0.016364
Log likelihood	5.176238	Hannan-Quinn criter.	-0.065689
F-statistic	1.439483	Durbin-Watson stat	1.185587
Prob(F-statistic)	0.250369		

AFTER FIRST DIFFERENCE
GX

Null Hypothesis: D(LNGX) has a unit root
Exogenous: Constant
Bandwidth: 36 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-9.361715	0.0000
Test critical values:	1% level	-3.615588	
	5% level	-2.941145	
	10% level	-2.609066	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.022618
HAC corrected variance (Bartlett kernel)	0.001565

Phillips-Perron Test Equation
Dependent Variable: D(LNGX,2)
Method: Least Squares
Date: 01/03/21 Time: 14:13
Sample (adjusted): 1982 2019
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGX(-1))	-0.821857	0.158386	-5.188960	0.0000
C	0.018593	0.025145	0.739444	0.4644

R-squared	0.427893	Mean dependent var	0.008262
Adjusted R-squared	0.412001	S.D. dependent var	0.201504
S.E. of regression	0.154515	Akaike info criterion	-0.845851
Sum squared resid	0.859499	Schwarz criterion	-0.759662
Log likelihood	18.07117	Hannan-Quinn criter.	-0.815186
F-statistic	26.92530	Durbin-Watson stat	2.009269
Prob(F-statistic)	0.000008		

Null Hypothesis: D(LNGX) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 31 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-8.679463	0.0000
Test critical values:	1% level	-4.219126	
	5% level	-3.533083	

	10% level	-3.198312	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.022591
HAC corrected variance (Bartlett kernel)	0.001713

Phillips-Perron Test Equation
Dependent Variable: D(LNGX,2)
Method: Least Squares
Date: 01/03/21 Time: 14:14
Sample (adjusted): 1982 2019
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGX(-1))	-0.825517	0.161504	-5.111420	0.0000
C	0.008745	0.053957	0.162081	0.8722
@TREND("1980")	0.000483	0.002331	0.207059	0.8372

R-squared	0.428593	Mean dependent var	0.008262
Adjusted R-squared	0.395941	S.D. dependent var	0.201504
S.E. of regression	0.156611	Akaike info criterion	-0.794444
Sum squared resid	0.858448	Schwarz criterion	-0.665161
Log likelihood	18.09443	Hannan-Quinn criter.	-0.748446
F-statistic	13.12616	Durbin-Watson stat	2.004832
Prob(F-statistic)	0.000056		

GCF

Null Hypothesis: D(LNGCF) has a unit root
Exogenous: Constant
Bandwidth: 7 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.571427	0.0000
Test critical values:	1% level	-3.615588	
	5% level	-2.941145	
	10% level	-2.609066	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.046086
HAC corrected variance (Bartlett kernel)	0.027626

Phillips-Perron Test Equation
Dependent Variable: D(LNGCF,2)
Method: Least Squares
Date: 01/03/21 Time: 14:14
Sample (adjusted): 1982 2019
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGCF(-1))	-0.910465	0.164563	-5.532618	0.0000
C	0.039549	0.036632	1.079635	0.2875

R-squared	0.459539	Mean dependent var	-0.003924
Adjusted R-squared	0.444527	S.D. dependent var	0.295934
S.E. of regression	0.220560	Akaike info criterion	-0.134102
Sum squared resid	1.751274	Schwarz criterion	-0.047914
Log likelihood	4.547943	Hannan-Quinn criter.	-0.103437
F-statistic	30.60986	Durbin-Watson stat	1.834400
Prob(F-statistic)	0.000003		

Null Hypothesis: D(LNGCF) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 12 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.928832	0.0001
Test critical values:	1% level	-4.219126	
	5% level	-3.533083	
	10% level	-3.198312	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.045132
HAC corrected variance (Bartlett kernel)	0.017483

Phillips-Perron Test Equation
Dependent Variable: D(LNGCF,2)
Method: Least Squares
Date: 01/03/21 Time: 14:15
Sample (adjusted): 1982 2019
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGCF(-1))	-0.939506	0.168575	-5.573222	0.0000
C	0.099881	0.079183	1.261401	0.2155
@TREND("1980")	-0.002875	0.003342	-0.860284	0.3955

R-squared	0.470731	Mean dependent var	-0.003924
Adjusted R-squared	0.440487	S.D. dependent var	0.295934
S.E. of regression	0.221360	Akaike info criterion	-0.102396
Sum squared resid	1.715010	Schwarz criterion	0.026888
Log likelihood	4.945517	Hannan-Quinn criter.	-0.056398
F-statistic	15.56448	Durbin-Watson stat	1.838770
Prob(F-statistic)	0.000015		

POP

Null Hypothesis: D(LNPOP) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.541442	0.0000
Test critical values:	1% level	-3.615588	
	5% level	-2.941145	
	10% level	-2.609066	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	7.39E-05
HAC corrected variance (Bartlett kernel)	0.000147

Phillips-Perron Test Equation
Dependent Variable: D(LNPOP,2)
Method: Least Squares
Date: 01/03/21 Time: 14:15

Sample (adjusted): 1982 2019
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNPOP(-1))	-0.317689	0.045451	-6.989756	0.0000
C	-0.004127	0.001434	-2.877887	0.0067

R-squared	0.575755	Mean dependent var	-0.003758
Adjusted R-squared	0.563971	S.D. dependent var	0.013377
S.E. of regression	0.008833	Akaike info criterion	-6.569357
Sum squared resid	0.002809	Schwarz criterion	-6.483169
Log likelihood	126.8178	Hannan-Quinn criter.	-6.538692
F-statistic	48.85669	Durbin-Watson stat	0.734349
Prob(F-statistic)	0.000000		

Null Hypothesis: D(LNPOP) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.832657	0.0020
Test critical values:	1% level	-4.219126	
	5% level	-3.533083	
	10% level	-3.198312	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	7.20E-05
HAC corrected variance (Bartlett kernel)	0.000142

Phillips-Perron Test Equation
Dependent Variable: D(LNPOP,2)
Method: Least Squares
Date: 01/03/21 Time: 14:16
Sample (adjusted): 1982 2019
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNPOP(-1))	-0.296683	0.050310	-5.897065	0.0000

C	-0.006998	0.003272	-2.138977	0.0395
@TREND("1980")	0.000141	0.000145	0.976587	0.3355

R-squared	0.587009	Mean dependent var	-0.003758
Adjusted R-squared	0.563409	S.D. dependent var	0.013377
S.E. of regression	0.008839	Akaike info criterion	-6.543610
Sum squared resid	0.002735	Schwarz criterion	-6.414327
Log likelihood	127.3286	Hannan-Quinn criter.	-6.497613
F-statistic	24.87380	Durbin-Watson stat	0.750696
Prob(F-statistic)	0.000000		

TD

Null Hypothesis: D(LNTD) has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.074894	0.0002
Test critical values:	1% level	-3.615588	
	5% level	-2.941145	
	10% level	-2.609066	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.036237
HAC corrected variance (Bartlett kernel)	0.033069

Phillips-Perron Test Equation
Dependent Variable: D(LNTD,2)
Method: Least Squares
Date: 01/03/21 Time: 14:17
Sample (adjusted): 1982 2019
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNTD(-1))	-0.722812	0.142339	-5.078114	0.0000
C	0.045032	0.032298	1.394264	0.1718

R-squared	0.417355	Mean dependent var	0.014312
Adjusted R-squared	0.401171	S.D. dependent var	0.252734

S.E. of regression	0.195576	Akaike info criterion	-0.374541
Sum squared resid	1.376997	Schwarz criterion	-0.288352
Log likelihood	9.116276	Hannan-Quinn criter.	-0.343876
F-statistic	25.78724	Durbin-Watson stat	1.984623
Prob(F-statistic)	0.000012		

Null Hypothesis: D(LNTD) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.414410	0.0004
Test critical values:	1% level	-4.219126	
	5% level	-3.533083	
	10% level	-3.198312	

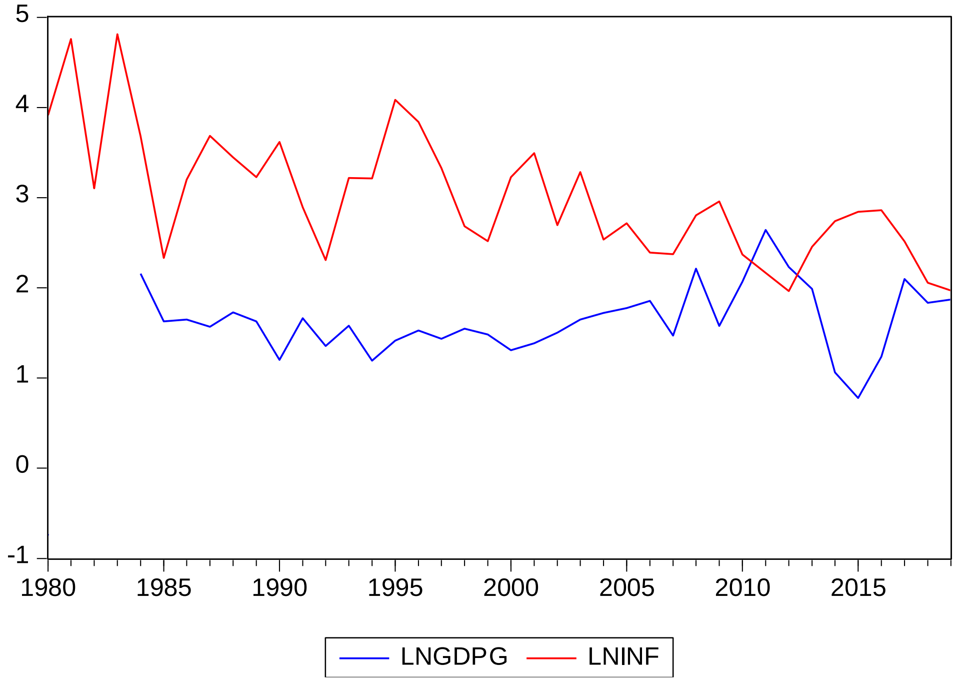
*MacKinnon (1996) one-sided p-values.

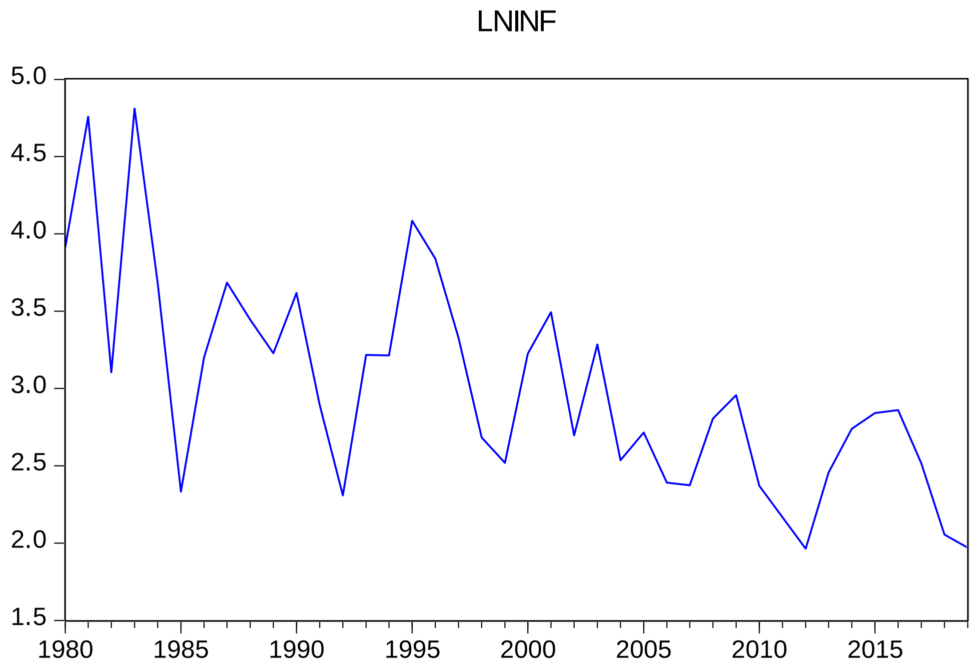
Residual variance (no correction)	0.033333
HAC corrected variance (Bartlett kernel)	0.033333

Phillips-Perron Test Equation
Dependent Variable: D(LNTD,2)
Method: Least Squares
Date: 01/03/21 Time: 14:18
Sample (adjusted): 1982 2019
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNTD(-1))	-0.757179	0.139845	-5.414410	0.0000
C	0.148242	0.066939	2.214588	0.0334
@TREND("1980")	-0.004963	0.002843	-1.746108	0.0896

R-squared	0.464043	Mean dependent var	0.014312
Adjusted R-squared	0.433417	S.D. dependent var	0.252734
S.E. of regression	0.190237	Akaike info criterion	-0.405433
Sum squared resid	1.266657	Schwarz criterion	-0.276150
Log likelihood	10.70323	Hannan-Quinn criter.	-0.359435
F-statistic	15.15189	Durbin-Watson stat	2.108824
Prob(F-statistic)	0.000018		


5
4
3
2
1
0
-1
1980
1985
1990
1995
2000
2005
2010
2015
LNGDPG
LNINF


LNINF
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1980
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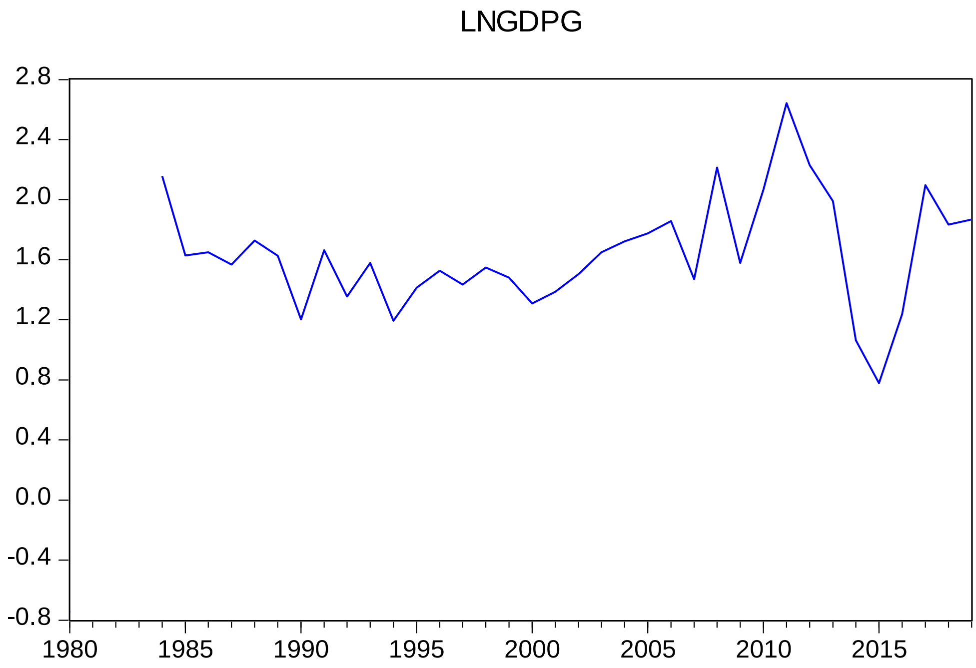

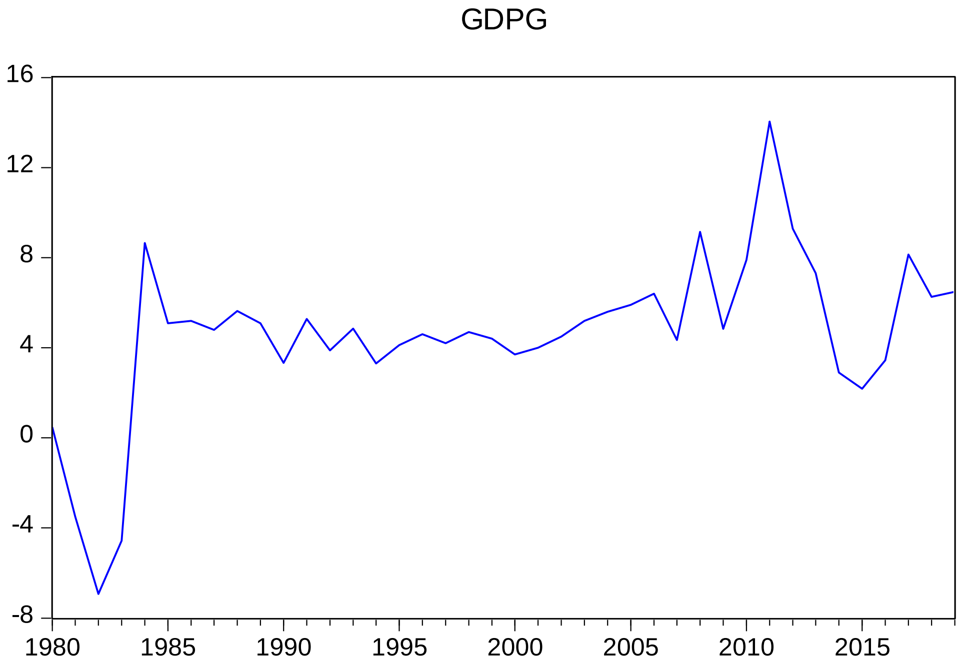

Dependent Variable: LNGDPG
Method: Threshold Regression
Date: 12/21/20 Time: 11:01
Sample (adjusted): 1984 2019
Included observations: 36 after adjustments
Threshold type: Bai-Perron tests of L+1 vs. L sequentially determined
thresholds

Threshold variable: LNINF
Threshold selection: Trimming 0.15, , Sig. level 0.05
Threshold value used: 2.37095
White heteroskedasticity-consistent standard errors & covariances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNINF < 2.37095 -- 6 obs				
LNINF	-0.253539	0.118392	-2.141524	0.0411
C	4.035900	0.638452	6.321385	0.0000
2.37095 <= LNINF -- 30 obs				
LNINF	-2.521696	0.568350	-4.436869	0.0001
C	8.676524	1.474587	5.884037	0.0000
Non-Threshold Variables				
D(LNPOP)	-3.144251	3.967694	-0.792463	0.4348
D(LNGX)	0.983607	0.493421	1.993442	0.0560
D(LNTD)	0.673375	0.391593	1.719578	0.0965
LNGCF	0.567329	0.157941	3.592028	0.0012

R-squared	0.501195	Mean dependent var	1.639602
Adjusted R-squared	0.376494	S.D. dependent var	0.367024
S.E. of regression	0.289811	Akaike info criterion	0.553954
Sum squared resid	2.351729	Schwarz criterion	0.905847
Log likelihood	-1.971163	Hannan-Quinn criter.	0.676774
F-statistic	4.019164	Durbin-Watson stat	2.158095
Prob(F-statistic)	0.003667		