THE INFLATION AND ECONOMIC GROWTH NEXUS IN GABON, KENYA, AND SOUTH AFRICA: AN EMPIRICAL ANALYSIS, 1961-2012

by

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Abstract

The main aim of this research is to investigate the nature of the relationship between inflation and economic growth. Over the years theoretical and empirical studies have presented different views about the relationship. Literatures on the topic have reported three types of results on the relationship between inflation and growth, positive relationship, negative relationship, and non-existence of any type of relationship between the two variables.

This study analyzes empirically the inflation and growth nexus using time series data from three countries in Sub-Saharan Africa, obtained from the World Bank database. The countries under study are Gabon, Kenya, and South Africa. The methodologies employed in the study are ADF Unit root test, Granger causality test, and OLS. The empirical results reveal that the relationship between inflation and economic growth is long run, nonlinear, negative, and significant for Kenya and South Africa, while it is found to be insignificant in Gabon. From the empirical results, the study has recommended some appropriate policies.

Key Words: Growth, Inflation, Long-run Relationship, Tradeoff, Causality

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CHAPTER ONE: INTRODUCTION

1.1   Introduction

The main objective of macroeconomic policy in all countries is to achieve sustainable economic growth with low inflation.[1] Inflation affects both the efficiency with which the economy operates and growth rate.

Inflation can be defined as, "the process of continuously rising prices, or equivalently, of continuously falling value of money."[2] Increase in prices is said to be inflation when it is irreversible.[3]

Inflation leads to inefficiency because increase in price of a commodity in an economy could signify shortage of a commodity or the effect of the ongoing inflation. For an economy to operate efficiently economic agents need to respond promptly to shortage in the economy. However in the case of continuing inflation economic agents cannot be sure whether the price movement is due to shortage or inflation which may lead to inefficiency.[4] Also inflation leads to the fall of purchasing power whereby buyers pay more to buy goods and services.[5] Other effects of inflation include inconvenience of holding less money to avoid erosion of the value of money. Menu costs and arbitrary

[1] Vikesh Gokal and Subrina Hanif. *Relationship between inflation and economic growth.* Economics Department, Reserve Bank of Fiji, 2004. (2)

[2] David Laidler, and Michael Parkin. "Inflation: a survey." *The Economic Journal*(1975): 741-809 as quoted in Helmut Frisch, *Theories of inflation.* Cambridge University Press, (1983),

[3] Helmut Frisch, *Theories of inflation.* Cambridge University Press, 1983. (9, 10)

[4] Manuel Guitián, and Robert Mundell, eds. *Inflation and Growth in China: Proceedings of a Conference Held in Beijing, China May 10-12, 1995.* DIANE Publishing, 1996. (46)

[5] Gregory N. Mankiw, Ronald D. Kneebone, Kenneth J. McKenzie, and Nicholas Rowe. "Principles of Macroeconomics (3rd Canadian Ed). South-Western USA " (2006), 267

redistribution of wealth among creditors and debtors are other effects of inflation.[6] The effects of inflation are highly dependable on the extent at which the inflation was anticipated and the institutional structure of the economy.[7]

1.2 The Origin Of The Debate

The studies on the relationship between inflation and economic growth has provided controversial findings over the years. Over the years there have been some studies that have reported the existence of a positive relationship, and some negative relationship. There have been few studies that found no conclusive evidence for the existence of neither a positive nor negative relationship.

Up until 1960s the view that inflation is harmful to the economy did not seem valid. This was because inflation and economic growth were positively correlated in the short run, this period was also known as the peak years of the Phillips curve. During this period most theories suggested the relationship to be positive in the short run but unclear in the long run. In the long run, Tobin (1965) among others suggested the relationship to be positive. However, most empirical studies did not find conclusive evidence during this period.[8]

In 1980s the view took a dramatic turn when most countries experienced a period of high inflation accompanied with high unemployment rates as well as decline in

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[6] Ibid, 267

[7] Stanley Fischer and Franco Modigliani. "Towards an understanding of the real effects and costs of inflation." *Weltwirtschaftliches Archiv* 114, no. 4 (1978): 810-833.

[8] Michael Bruno, and William Easterly. "Inflation crises and long-run growth. *"Journal of Monetary Economics* 41, no. 1 (1998): 3-26.

economic growth. The effects were more severe to developing countries than industrialized countries. During this period, most African countries experienced a decline in per capita output by 1.3 percent, which was equivalent to 5 percent below the average per capita output for all developing countries. During 1990s this decline accelerated to 1.8 percent, which widened the gap to 6.2 percent from 5 percent in the 1980s.[9] This period was known as the lost decade for most developing countries especially in Africa and Latin America. It was a decade of negative growth for many countries.[10]

As the decade progressed, the consequences of macroeconomic instability became stronger. This changed the view of most development economists and practitioners to believe that macroeconomic stability is crucial to attain sustainable economic growth.[11] Numerous studies were conducted to explain this tragedy and these studies found that macroeconomic instability was harmful for the economic growth.[12]

The view that economic growth requires low rate of inflation is contrary to the views presented in the business cycle. In the business cycle it is shown that inflation and economic growth move in the same direction. When an economy is in boom it is expected that both growth and inflation will be at their peaks.

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[9] Paul Collier, and Jan Willem Gunning. "Explaining African economic performance." *Journal of economic literature* (1999): 64-111.
[10] Stanley Fischer. "Growth, macroeconomics, and development." In *NBER Macroeconomics Annual 1991, Volume 6*, pp. 329-379. MIT Press, 1991.
[11] Ibid, 329
[12] Ibid, 331

1.3   Theories Of Inflation

Phillips curve

A Phillips curve is a curve showing a relationship between inflation and unemployment. The Phillips curve is divided into two time frames, a short-run and long run Phillips curve. The short-run Phillips curve depicts the tradeoff between inflation and unemployment holding constant the expected inflation rate and natural rate of unemployment. At any given time, unemployment will fall below/rise above its natural rate if inflation rate increases above/ falls below the expected rate. [13] In the long run there is no tradeoff between inflation and unemployment. Regardless of the inflation rate the unemployment rate will gravitate toward its natural rate. Thus the long-run Phillips curve is vertical showing the neutrality of money.[14]

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[13] Michael Parking, and Robin Bade. *Macroeconomics: Canada in the Global Environment, with MyEconLab*. Pearson Education Canada, 2009. (644)
[14] Mankiw et al, 408-412

Figure 1.3.1: A short run Phillips curve

A Short Run Phillips Curve
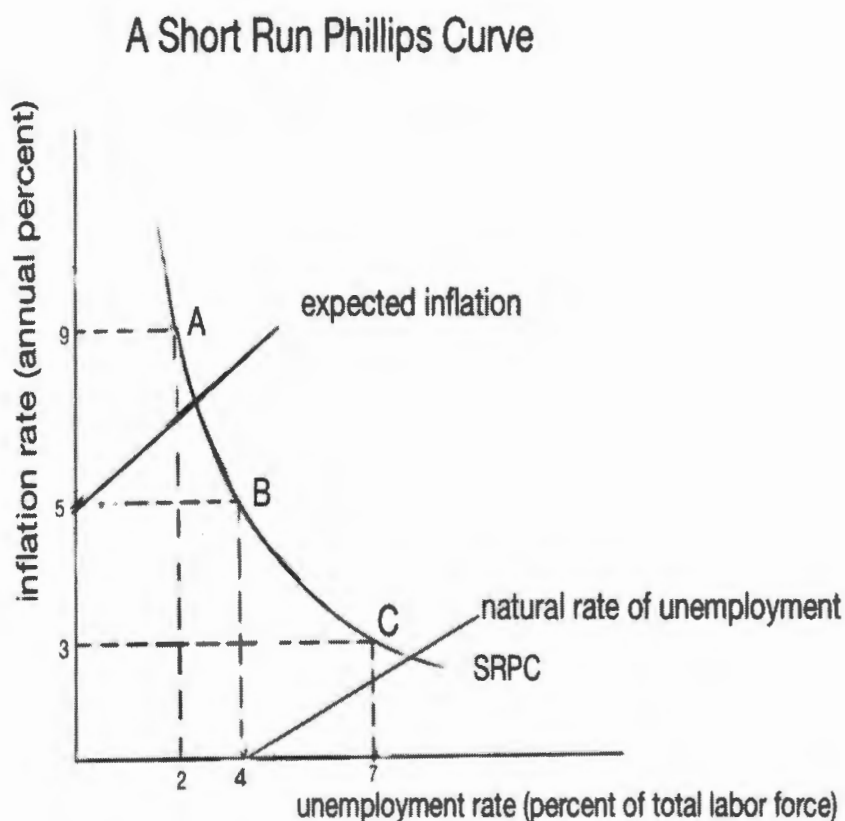
The short run Phillips curve (SRPC) shows the relationship between inflation and unemployment at a given expected rate and a given natural rate of unemployment. [15] Point B shows that the SRPC passes through when the expected inflation rate is given at 5 percent and the natural rate of unemployment of 4 percent. If an unanticipated event such as an increase in aggregate demand decreases unemployment from its natural rate to 2 percent, it will result into an increase in inflation rate from its expected rate to 9 percent. That will be a movement up the SRPC to point A. However, if the unanticipated decrease in aggregate demand increases unemployment rate to 7 percent then inflation

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[15] Parkin and Bade, 644

will fall to 3 percent. This will be a movement down the SRPC to point C. The movement occurs up or down along the short run Phillips curve (SRPC).

Quantity theory of money

Also known as the classical theory of inflation, explains how the growth rate of money is correlated with the inflation rate. The theory shows that when the growth rate of money is greater than the growth rate of real GDP it creates inflation.[16]

The main components of the theory are: velocity of money (V), quantity of money (M), price of output (P), and amount of output (Y). The velocity of money, which is the measurement of the average circulation of money in the economy, is given by the equation below.

V= PY/M

From the equation of the velocity of money, the quantity equation can be obtained by multiplying (M) on both sides of the equation.

MV = PY   (The Quantity Equation)

The equation is called quantity equation because it associates the product of the quantity of money and the velocity of money to the nominal value of the economy's output of

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[16] Ibid, 638

goods and services.[17] Overtime the velocity of money (V) is relatively stable; hence a change in the quantity of money (M) results into proportionate changes in the nominal values of output (P X Y). Due to neutrality of money, changes in quantity of money do not affect output (Y). Therefore the changes in the nominal values of output are reflected in changes in the price level (P). Therefore a rapid increase in the money supply by the central bank will result in a high rate of inflation.[18]

Endogenous growth model

Endogenous growth theory suggests a negative relationship between inflation and economic growth. The key argument being inflation decreases returns, which reduces capital accumulation and decreases economic growth rate. Endogenous growth theory shows that steady-state growth rate is affected by economic behavior and economic policy in an economy. These can be factors such as; technological changes, rate of return, and economies of scale.[19] Inflation is considered to be a tax on capital (human capital and physical capital) and is said to lower returns. High tax on capital lowers the growth rate; this effect is direct for physical capital but indirect for human capital. High tax on human capital leads to low growth rate due to substitution of work for leisure.[20]

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[17] Mankiw et al, (2006), 255
[18] Ibid, 256
[19] Douglas Curtis, Ian Irvine, and David Begg. "Macroeconomics (2nd Canadian edition). Canada:McGraw-Hill Ryerson Ltd, (2010). 381
[20] Gokal and Hanif, (2004), 8

1.4 Research Objective

The key objective of this research is to find empirical evidence for inflation and growth nexus using data from Gabon, Kenya, and South Africa. These countries are used because of consistent and sufficient data availability to conduct research. Also, the macroeconomic performance of these countries is influential for other countries in the region. Should be noted that these countries are not at the same level of economic growth, however they are comparable because of their macroeconomic performance.

With this key research objective, this study attempts to answer the following two questions:

1. *What is the nature of the relationship between inflation and economic growth in the studied countries?*

This question is the main ground of the inflation-growth nexus. The results for this question have differed tremendously among studies and with time. There have been studies arguing for a negative relationship, some positive relationship and some argue against the existence of any type of relationship between inflation and growth. Answering this question is important, as it will contribute to the on-going debate regarding the relationship.

2. *If a relationship exists between inflation and economic growth, is it long run?*

This is another important question to answer; there have been many studies with alternating results. It is important to analyze if inflation affects growth, is the effect transitory or permanent (having a long-run equilibrium relationship). Obtaining empirical evidence which, clarifies the matter, will be important so as to develop appropriate policy recommendation. The long run relationship discussed in the study is the long-run

relationship between variables (inflation and growth), which will be analyzed by the long-run Phillips curve.

1.5   Significance Of The Research To Policy Implication

Most governments choose either unemployment or inflation due to the tradeoff between inflation and unemployment established in the Phillips curve. It is reported that some economists and policy makers opt for higher inflation to reduce unemployment rates in the economy. [21] This is because the Phillips curve argues that high rate of inflation will lower the unemployment rate in the economy.

Therefore results of this study may help policy makers, economists and monetary authorities to acknowledge the significance of inflation in attaining sustainable growth. Moreover, if inflation harms the economy then it will help the policy makers not to tradeoff.[22] Also, the study will contribute to the ongoing debate regarding the topic.

1.6   Structure Of The Study

This study is divided into five chapters. In chapter one, the introduction of the study, and the theoretical contributions towards the topic are discussed.   Also, the research questions, theories of inflation, the origin of the debate on inflation-growth nexus, and the significance of the research are presented. Chapter two reviews literatures from both theoretical studies and empirical studies and provides a brief reflection. Chapter three is

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[21] Roger LeRoy Miller, and Nancy W. Clegg. *Economics Today: The Micro View.* Addison-Wesley, 1999.
[22] Ibid, (1999)

a presentation of the methodology and analysis of the data used in the study. Chapter four is the presentation of the empirical findings and discussion of the results in detail. Chapter five gives the conclusion, limitation of the study, and the appropriate policy recommendations.

CHAPTER TWO: LITERATURE REVIEW AND REFLECTION

The view on the relationship between inflation and growth has been changing with time. In the 1960s most models of inflation and growth showed a positive correlation between the two variables. These models emphasized mostly on portfolio substitution mechanism where high inflation led to higher capital accumulation and low demand for money. However in 1980s after many countries experienced high inflation crises many development economists and policy makers agreed with the view that inflation was harmful to the economy.

Substantial theoretical and empirical studies have taken many forms in analyzing the relationship between inflation and economic growth. Some studies have found the relationship to be significant and positive, some significant and negative, and some insignificant. The relationship between inflation and growth remains debatable in theoretical and empirical findings.

2.1   Theoretical Studies

The following group of studies argues for the existence of a positive relationship between inflation and economic growth.

Mundell (1963) using the IS- LM curves finds for a positive relationship between inflation and growth. He argues that an increase in inflation leads to a decline in real money balances, which decreases the wealth of people. To accumulate the preferred wealth, people save more by switching from holding money to assets, which increases the

assets prices and decreases real interest rate, which stimulates savings in the economy. Greater savings leads to higher capital accumulation, which leads to rapid economic growth.

Tobin (1965) developed the Mundell (1963) model to make money the store of value in the economy; the model came to be known the Mundell-Tobin model. The study uses the portfolio substitution in the analysis of money and growth. The main assumption of the study is that individuals substitute current consumption for future consumption by either holding money or obtaining capital. The framework of the study shows that high rate of inflation permanently increases the levels of output. During high rates of inflation, people will tradeoff between holding money with acquiring more physical capital, as a result will increases capital intensity and in turn stimulated output growth. Output will grow until a new steady state capital stock is reached. Therefore the study concludes that inflation exhibits a positive relationship with output growth.

The view of the positive correlation between inflation and economics growth received challenges from various scholars. The following theoretical studies argue for a negative relationship between inflation and economic growth.

Stockman (1981) developed a model to account for the negative effect of high inflation on steady state level of output and wealth. The study argues that inflation lowers the steady state capital stock. Using the cash in advance constraint model the study argues that sometimes cash is used to finance investment projects of firms. Because increase in inflation reduces the purchasing power of money balances, people tend to reduce holding money as well as purchase of capital goods, which in return lowers the steady state level of output.

Lucas (1982) using the cash in advance constraint model to explain the relationship between inflation and output. The main assumption of the cash in advance model is that consumers must pay for the goods in cash before they can buy them. Therefore money is demanded because it is the only means of purchasing goods. The study assumes that consumers choose how much to hold after they know the current state (rational of the money supply or productivity stock). In the presence of inflation money loses value (earns a negative return). Since consumers earn interest on deposits not cash balances they will prefer to have most of their money in deposits during inflation. However they will hold just enough cash to pay for their consumption. This will eventually lower asset purchases, which lowers capital accumulation and hence reduces output growth.

Svensson (1985) amends the cash in advance constraint model proposed by Lucas (1982) by addressing how to price assets when faced with cash in advance constraint. The study assumes that consumers are ignorant and choose how much cash to hold before they know the current state (ignorant of the money supply or productivity stock). High inflation reduces the value of money. If cash is needed to finance consumption then high inflation will lead to less of the goods to be consumed. High inflation acts as a tax on goods that requires cash to be purchased because inflation reduces the value of money. Therefore high inflation affects real variables such as consumption and output.

Unlike the two groups that found the relationship to be positive or negative, the study below argues against the existence of any long run relationship between inflation and economic growth.

Sidrauski (1967) analyzes the super neutrality of money in optimal control framework considering real money balances in the utility function. Super neutrality holds when

growth of money supply in the long run does not affect real variables, including the growth rate of output. The study found that an increase in inflation has no effect on the steady state capital stock, output and growth.

2.2 Empirical Studies

The view that inflation and economic growth are positively correlated faced challenges in the 1980s when most countries were faced with high inflation crises accompanied with declining growth. Most researches were conducted to find the true nature of this relationship.

The following empirical study presents evidence for the existence of a positive relationship between inflation and economic growth.

Bullard and Keating (1995) analyze the long-run relationship between inflation and output in postwar economies based on the concept of permanent shocks to inflation. The main assumption of the study is the super neutrality of money in the long run. The study utilizes annual data on inflation and output from 58 countries. The study uses a bivariate vector auto regression with the variables output growth and change in inflation. The study imposes a restriction that inflation rate can only be temporarily affected by exogenous shocks to output. The restriction is aimed at detecting permanent and transitory components of inflation if they are not related. Permanent shocks are tested using the Augmented Dickey-Fuller test for unit roots. For each variable two sets of five regressions are run. The first set of five regressions is run with a constant allowing zero lags to 4 lags, and the second set is run with a constant and a deterministic trend allowing

for zero to 4 lags. The results are then analyzed commencing with the regressions with high lags while checking the adjusted Box-Ljung Q test statistics, which calculated for serial correlation of order 1, 2, 3 and 4 for each regression. Regressions are run for each of the 58 countries separate. The regression results were divided into two groups as follows: The relationship is statistically insignificant for 11 countries; there is an existence of a positive relationship in 5 countries; the relationship is negative and significant for 1 country; the effects of permanent inflation shocks led to a transitory effect to 10 countries; and the results were inconclusive for 31 countries. The general conclusion of the study is that there is enough evidence for the positive relationship between inflation and growth.

The following group of empirical studies presents evidence for the existence of a tradeoff between inflation and economic growth.

Fischer (1983) investigates the reasons for negative correlation between inflation and economic growth. The results are expressed in a simple monetary maximizing model. The study uses the Sidrauski's optimizing model to study the relationship between inflation, output, and growth under the assumption that money enters the production function, and printing money finances government spending. The study uses mathematical formulas and calculations to obtain the empirical evidence. The study finds that a negative relationship exists between inflation and economic growth.

Gylfason (1991) analyses the relationship between endogenous growth and inflation in Latin America. In the analysis a simple model of simultaneous determination and interaction of inflation and economic growth is constructed by including money into an optimal growth framework with constant returns to capital. The study also examines the

potential effects of inflation on savings through real interest rate (or uncertainty), income velocity of money and on government budget deficit through inflation tax and tax erosion. The study uses a numerical analysis of the model using reduced form solutions to obtain the results. The results show that inflation and growth are negatively correlated in the long run.

Fischer (1991) reestablishes that macroeconomics policies stability is crucial in achieving economic growth and development. The macroeconomics policies discussed in the study are monetary, fiscal, and exchange rate policies that assist in determining inflation rate, the budget deficit, and the balance of payment. The study specifically analyzes partial correlation between growth and inflation, and growth and budget deficit. The expected result being countries with high rates of inflation and high budget deficit will have a slow growth. The study uses evidence from cross-sectional studies that were published since 1980 to1991. From these analyses the study concludes that macroeconomic policies are crucial for long run growth.

Fischer (1993) argues for the existence of a non-linear relationship between inflation and economic growth. The study develops a framework to identify the channels through which inflation harms economic growth. In the analysis the study uses dataset for 93 countries in the analysis. The study used simple panel regression to test if inflation is correlated with economic growth. Also, a regression analogue of growth accounts (a production function based approach initiated by Victor Elias in 1992) is used to identify the main channels of transmission. The results show that indeed inflation and economic growth are correlated and that high inflation is does not foster sustainable growth.

Moreover this study also established that inflation non-linearly affects growth mainly by reducing investment and by lowering the rate growth of productivity.

Barro (1995) analyzes the relationship between inflation and economic growth using annual data covering over 100 countries from 1960 to 1990. To assess the effects of inflation on economic growth the study employs a system of regression equations that allows for other determinants of growth to be held constant. Inflation rate over each period was included as explanatory variable along with other determinants of growth. The study finds empirical evidence indicating that an increase in inflation reduces economic growth. The study finds that an annual increase in inflation by 10 percent leads to annual decrease of growth rate by 0.2 to 0.3 and decline in the annual investment to GDP ratio by 0.4 to 0.6 percent.

Christoffersen and Doyle (1998) analyze the inflation- growth relationship by focusing on the role of export market growth and structural reforms. The study uses unbalanced panel data with the longest series being from 1990 to 1997. The data used was for 7 variables: annual real GDP data, population, the share of exports, transition reform index, the direction of trade to 1996, war dummy, and export market growth rates. In their analysis they examined how inflation affects growth and conducted robustness test. Also they tested how parameter estimates were affected by inflation outlier and excluding countries one at a time from the panel analysis. The results of the study suggest that high inflation does not boost economic growth therefore the study advised countries to maintain low inflation rates.

Gokal and Hanif (2004) analyzed if the relationship between inflation and economic growth exists in Fiji. The study also tests for the existence of threshold. The study

employs annual data over the period 1970 - 2003. In the analysis the study explores a bivariate relationship between inflation and economic growth. In this analysis the study analyses the time series data by applying preliminary analysis first before testing for causal relationship. The study finds empirical evidence for the existence of negative relationship between inflation and economic growth although the relationship found was weak. The Granger causality test found that causality in Fiji is uni-directional meaning causality runs from economic growth to inflation. The findings of the study suggest that output gap influences inflation outcome. If output gap rose by 18% inflation will increase by 1% in the following year.

Ahmed and Mortaza (2005) analyses the relationship between inflation and economic growth in Bangladesh. The study also examines the presence of a threshold effect. The dataset used covers the period 1981 to 2005, for the variables CPI and real GDP. In the analysis the cointegration and error correction models have been used to seek for the empirical evidence. The empirical results show that there is a long-run negative relationship between inflation and economic growth. Also the threshold analysis show suggests the threshold level to be 6%. Therefore above 6% inflation harms economic growth.

Espinoza, Ananthakrishnan, and Leon (2010) examine the existence of threshold levels in the inflation –growth nexus. Data used is panel for 165 countries over the period 1960 -2007. A smooth transition model is used to investigate the rate at which if inflation increases beyond the estimated threshold negatively affect growth. The estimation results indicate that for all countries with the exception of countries with advanced economies, the threshold level is 10%, and if inflation rises above this level it immediately becomes

harmful to the economy. However the effects are not so rapid for the case of developed countries. The results for the developed economies indicated that the threshold was smaller than that for developing economies. Another finding is that higher effect of inflation for oil exporting countries is found to be stronger but the estimates are less robust.

Jalali-Naini and Naderian (2011) discuss the relationship between inflation using the cash in advance constraint model and in connection with super neutrality of money in Islamic Republic of Iran. In their study they extended the cash constraint model to include consumption and investment. The study found empirical evidence for the existence of a negative relationship between inflation and economic growth. It was found that because of high growth rate of money supply, high inflation leads to lower steady state output and consumption. The study argues that unanticipated inflation rate affects only the current inflation rate but has no effect on the output. However an anticipated increase in inflation significantly affects output due to its upward revision of inflationary expectation. The study proposes policy implications that anchor inflationary expectation. This is because unanticipated inflation does have long run impacts to the economy.

Salian and Gopakumar (2012) examine the inflation- growth nexus in India. The study uses a bivariate model composed of growth rate of GDP calculated at 1993-94 prices and inflation given by the average Wholesale Price Index (WPI). The data used are annual data collected from the Reserve Bank of India over the period 1972-73 to 2007-08. The methodologies employed in the study are the cointegration and error correction model. The Estimation results indicate that there is a long- run, and negative relationship between Inflation and Economic growth.

Inyiama (2013) analyzes the inflation-growth link in Nigeria. The study uses annual time series data from 1970 to 2010 for variables real GDP, inflation, interest rate, and exchange rate. Ordinary Least Square and Granger causality test are employed in the analysis. In the study inflation is the dependent variable and interest rate, exchange rate and real GDP are the exogenous variables. The estimation results reveal the existence of a negative relationship between inflation and economic growth. Exchange rate and interest showed a positive correlation with inflation. However the causality test revealed there is no causality between the variables.

Several studies have focused on non-linearity and threshold effects of inflation on growth. A threshold effect of inflation means inflation rate has to reach a certain level before it has negative effects on growth. These studies include the works of Gosh and Phillips (1998), Khan and Senhadji (2001), Sarel (1995), and Li (2005).

Sarel (1995) examines the existence of non-linear effects of inflation on economic growth and the presence of thresholds. The dataset is composed of annual data on population, GDP, consumer price indices, terms of trade, real exchange rates, government expenditures and investment rates. CPI and terms of trade were included in the study to reduce the effect of negative correlation between inflation and growth. In the analysis, the study uses data from 87 countries over the period 1970-1990. Data is divided into 12 equal groups and dummy variables were assigned for each group. Thereafter OLS regression was estimated for the growth rate on inflation dummies and others. The test discovered the presence of structural breaks, which occurs when inflation rate is 8

percent. Above 8 percent inflation has a negative, significant and robust impact on economic growth.

In their analysis of the relationship between inflation and economic growth Ghosh and Phillips (1998) also addressed various methodological problems in past studies. The study argues that the inflation and growth relationship cannot be simple or linear. However the study discourages the estimation of a multivariate relationship, as it will get very complicated. This is because the other determinants of growth included could be functions of inflation therefore reduce the apparent effect of growth. The study used data from 145 countries over the period 1960 to 1996. The data set consists of 3603 observations of real per capita GDP growth and period average CPI, and panel regression was used in the analysis. The main contribution from the study is the combination of non-linear treatment of the relation with a broad test of robustness. The results found the relationship to be negative, convex, and statistically significant. The results also revealed the existence of threshold effects at 2.5 percent and a negative effect above the level.

Khan and Senhadji (2001) examine the inflation growth relationship for industrial and developing countries separately. The main objectives of the study were to test for the existence of the threshold effect, and test if the threshold effect is similar across developing countries and industrial countries. The study used data from 140 countries (industrial and developing countries) for the period 1960 to 1998. Data was mainly collected from the World Economic Outlook (WEO) database. Data collected was for two variables: growth rate measured in GDP and inflation rate measured by the percentage change in Consumer Price (CPI) Index. To test for the existence of the threshold effects, a log model of inflation was estimated. Threshold level was estimated along with other

regression parameters since it was unknown. Estimation was conducted with the conditional least square because the conventional gradient search technique the study intended to use for estimation (Non-Linear least square) was inappropriate. The empirical results found the empirical evidence for the threshold effects; they also found that the threshold is more in developing countries (11-12 percent) compared to industrialized countries (1-3 percent).

Li (2005) analyzes if the relationship between inflation and economic growth is negative and non-linear, and if there is a threshold effect of inflation and economic growth. Also the study examines the channels through which inflation affects growth in the long run. The study used data from 90 developing countries and 28 developed countries covering the period of 1961 to 2004 using simple linear regression and fixed-effect estimation. The empirical results show that the relationship is certainly negative and there is a threshold effect. Further investigation indicated that there are different forms of non-linearity in the inflation-growth relationship between developing and developed countries. Also the study finds that Total Factor Productivity (TFP) is the main channel through which inflation affects growth.

Unlike the two groups that found the relationship to be significant but either positive or negative: the following studies did not find empirical evidence for the existence of a relationship between inflation and growth in the long run.

Bruno and Easterly (1996) analyze the relationship between inflation and economic growth in their study, which was initially conducted to examine the key determinants of growth. The study defines high inflation to be when annual inflation is above 40 percent. Data used in the study is for 31 countries that were once affected by inflation crisis over

the period 1961 to 1992. The results of study found the relationship to be non-existent in the long run when inflation is above 40 percent. However the study finds empirical support for the negative relationship in the short and medium run, when inflation is below 40 percent. The study provides a reason for their findings being countries tends to recover from discrete high inflation crises. In the study the risks of using cross section pooled data are also outlined, the main problem being the relationship becomes very sensitive to large outliers and change in sample period.

Jha and Dand (2011) analyze the effect of inflation variability on economic growth when inflation is high. The study uses panel data from 31 developed countries for the period over 1961-2009. The data used is composed of the following variables: Growth rate of real GDP per capita, inflation given by the growth rate of the CPI index, terms of trade, initial income level measured as the five-year average of GDP per capita in 2000 constant US dollars, government consumption expenditure over GDP, gross capital formation over GDP, the growth rate of money and quasi money (M2). The analysis first examines for the existence of threshold level in inflation using the Hansen (1990) method. The method is applied to detect threshold levels in inflation variability as measured by the coefficient of variation. The estimation uses five-year averages to eliminate multicollinearity. The estimation results reveal that there is no significant finding that inflation variability affects economic growth when inflation is high.

Faria and Carneiro (2001) analyses the relationship between inflation and economic growth by analyzing an economy with persistent high inflation and inflation shocks using a bivariate time series model. The main objective of the study was to estimate the long-run response of output to permanent inflation shock. The study uses monthly inflation

rate and real output data of Brazil over the period of January 1980 to July 1995. The Blanchard and Quay (1989) decomposition is used for estimation. The method is useful as it allows the assessment of temporary and permanent shocks on a variable in bivariate Vector Autoregression (VAR). The results found no long-run relationship between inflation and economic growth in Brazil. However in the short run the results indicate the existence of a negative relationship.

2.3   Reflection

Most of the studies in this topic were conducted in 1980s and 1990s; very few studies have been conducted in 2000s. This study will make its contribution to research by providing new empirical evidence because the study uses data over the period 1961 to 2012. Also the study area (sub-Saharan Africa) covered in this research has little research conducted on it. The empirical findings of this study are expected to contribute to the ongoing debate on the inflation-growth relationship.

CHAPTER THREE: METHODOLOGY AND DATA ANALYSIS

The methodologies employed in this study are Granger Causality test, Unit Root Test, and OLS. OLS will be performed on the variables that have already been tested for stationarity using ADF unit root tests and prove to be stationary at level (integrated of order zero).

3.1 Model Specification and Methodology Used

The model is a multivariate model with three common macroeconomic variables: annual growth rate, inflation rate, and growth rate of gross capital formation.

Analyzing multivariate relationship is preferred because the relationship between inflation and economic growth is not simple and a bivariate model could be misleading. Two models will be estimated, the first model for the short run relationship and a second model for the dynamic relationship which captures the long run relationship between inflation and economic growth.

The short-run relationship model estimated which is a short run Phillips curve:

$$Y(t) = a + \beta 1 * \pi(t) + \beta 2 * \pi^2(t) + \beta 3 * K(t) + \mu(t)$$

The second model estimates the dynamic relationship between inflation and growth, which can also be viewed as the expectations-augmented Phillips curve, or the long run Phillips curve where the expectations are assumed to be adaptively formed.

$$Y(t) = a + \beta 1*Y(t-1) + \beta 2*\pi (t) + \beta 3*K (t) + \mu(t)$$

Where:

Y is the annual growth rate of real GDP,

Y(t-1) captures the long-run properties of the relationship between inflation and economic growth.

π is the annual inflation rate constructed from the GDP deflator,

π^2 captures the non-linear effect of inflation on GDP growth,

K is the annual growth rate of gross capital formation, and

the intercept **a** is the shift parameter which captures the technological progress. Finally, $\beta 1$, $\beta 2$, and $\beta 3$ are parameters for inflation, inflation squared, and capital respectively.

This model is a supply-side model in which GDP growth is determined by inflation, growth of capital accumulation, and the technological progress whose growth rate is assumed to be exogenous and is represented by the intercept of the model.

Granger causality test

The Granger causality test is used to analyze the ability of one variable to predict another variable. There can be bi-directional causality (causality among variables), uni-directional (causality running from one variable to the other), and no causality meaning the two variables are independent.

Therefore a variable X_t is said to granger cause variable Y_t if and only if, using past values of Y_t can lead to a greater accuracy in prediction in variable X_t than if the past values were not used, holding other terms unchanged.[23]

Preliminary analysis

Because the data used is time series data, precaution is taken before making any meaningful inferences of the causal relationship between inflation and economic growth. Asteriou and Hall (2011) among others argue that precaution has to be taken when interpreting results derived from Ordinary Least Square (OLS) estimated with time series data because the results could be misleading. This is due to the fact that most macroeconomic time series are trended thus making them non-stationary. Therefore, if not addressed non-stationary data may cause the standard OLS procedures to lead to incorrect conclusion. A spurious regression is one of the main effects of using non-stationary data. It provides high R^2 and the test statistics will appear to provide significant estimates but the results may not have economic meaning. This is caused by the fact that the ordinary Least Square estimates may be inconsistent, and therefore the statistical tests are invalid.[24]

In order to address this problem the empirical analysis starts by testing all the variables for unit root and then examining if the variables are stationary. Determining the

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[23] Dimitrios Asteriou, and Stephen G. Hall. "*Applied Econometrics,* second edition". New York: Palgrave Macmillan, 2011. 322
[24] Ibid, 338

existence of the cointegrating relationship among the variables is important because if the variables are cointegrated then the estimated results are more effective.[25]

The Augmented Dickey-Fuller (ADF) test of unit root has been used. In conducting unit root tests to establish the order of integration of each variable, the hypotheses are as follows:

Hypotheses:

H_0: the variable have a unit root

H_1: the variable does not have a unit root (this is the alternative hypothesis that will be accepted when the null hypothesis is rejected)

If the ADF test statistic is less than the test critical value, then the null hypothesis of a unit root is rejected and we conclude that the series is stationary.

3.2 Data Analysis

The dataset used is for three sub-Saharan African countries, Gabon, Kenya, and South Africa. The data is for the period over 1961-2012, for the three macroeconomic variables: the growth rate of GDP as the dependent variable, and the independent variables used are inflation rate measured by the percentage change of GDP deflator index, and growth rate of gross capital formation. Data used are collected mainly from the publicly available World Bank database in the World Development Indicators. The study has focused on Gabon, Kenya, and South Africa because there are limited researches on the topic. The countries under observation were selected because of the availability of consistent data on

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[25] Ibid, 356

the selected variables. Most Sub-Saharan African countries are lacking data for most

variables, and for some there is a problem of missing data in the sample to be used in

research.

Descriptive statistics

Table 3.2.1: Summary statistics for Gabon

	GROWTH_GABON	INFLATION_GABON	CAPITAL_GABON
Mean	4.492410	8.073670	7.885349
Median	4.531229	5.106717	5.012122
Maximum	39.48710	65.41047	180.9974
Minimum	-24.04921	-20.80981	-61.96591
Std. Dev.	9.836005	16.05190	34.97773
Skewness	0.744912	1.065854	2.373245
Kurtosis	7.525286	5.241850	13.50110
Jarque-Bera	49.17855	20.73515	287.7382
Probability	0.000000	0.000031	0.000000
Sum	233.6053	419.8308	410.0382
Sum Sq. Dev.	4934.096	13140.84	62395.52
Observations	52	52	52

Table 3.2.1 above indicates that from 1961 to 2012 GDP grew at an average of 4.49

percent annually in Gabon. However, the average of inflation is at 8.07, which is almost

double the average growth of GDP. The deviation of inflation from the mean is higher

than the deviation of GDP from the mean as shown by their Standard Deviations.

Table 3.2.2: Summary statistics for Kenya

	GROWTH_KENYA	INFLATION_KENYA	CAPITAL_KENYA
Mean	6.557898	7.837155	5.890064
Median	4.353389	8.508753	8.817365
Maximum	90.79044	41.98877	49.21908
Minimum	-4.655447	-47.47426	-35.18791
Std. Dev.	12.69951	11.29466	17.84879
Skewness	5.790248	-1.696249	-0.098447
Kurtosis	38.77625	13.59249	3.036536
Jarque-Bera	3063.770	268.0381	0.086888
Probability	0.000000	0.000000	0.957486
Sum	341.0107	407.5320	306.2833
Sum Sq. Dev.	8225.152	6506.038	16247.55
Observations	52	52	52

Table 3.2.2 above shows that from 1961 to 2012 GDP grew at an average of 6.56 percent annually in Kenya. However, the average growth of inflation is at 7.84. The deviation of inflation from the mean is lower than that of GDP as shown by their Standard Deviation. The Jarque-Bera normality test shows that the null hypothesis only for capital formation is normally distributed cannot be rejected. However it should be noted that Jarque-Bera test is mainly for high volume data while the study uses data with a life span of 52.

Table 3.2.3: Descriptive Statistics for South Africa

	GROWTH_SA	INFLATION_SA	CAPITAL_SA
Mean	3.256577	9.667067	4.422035
Median	3.610691	8.590734	3.803242
Maximum	8.896031	24.91463	32.85031
Minimum	-2.137042	0.318915	-23.28707
Std. Dev.	2.579776	5.225254	12.03882
Skewness	-0.234565	0.413104	0.035964
Kurtosis	2.650314	2.928881	2.761726
Jarque-Bera	0.741786	1.489966	0.134221
Probability	0.690118	0.474742	0.935092
Sum	169.3420	502.6875	229.9458
Sum Sq. Dev.	339.4175	1392.467	7391.593
Observations	52	52	52

Table 3.2.3 above indicates that from 1961 to 2012 GDP grew at an average of 3.26 percent annually in South Africa. However, the average growth of inflation is at 9.67. This is approximately 3 times more than the average growth of GDP. The deviation of inflation from the mean is higher than that of GDP as shown by their Standard Deviations. In South Africa Jarque-Bera test indicates that the null hypothesis for all variables cannot be rejected because the p-value is greater than 1, 2, and 10 percent significance level. Therefore, we conclude that the sample is normally distributed.

Trends of inflation and growth

Figure 3.2.1: trends of inflation and economic growth in Gabon
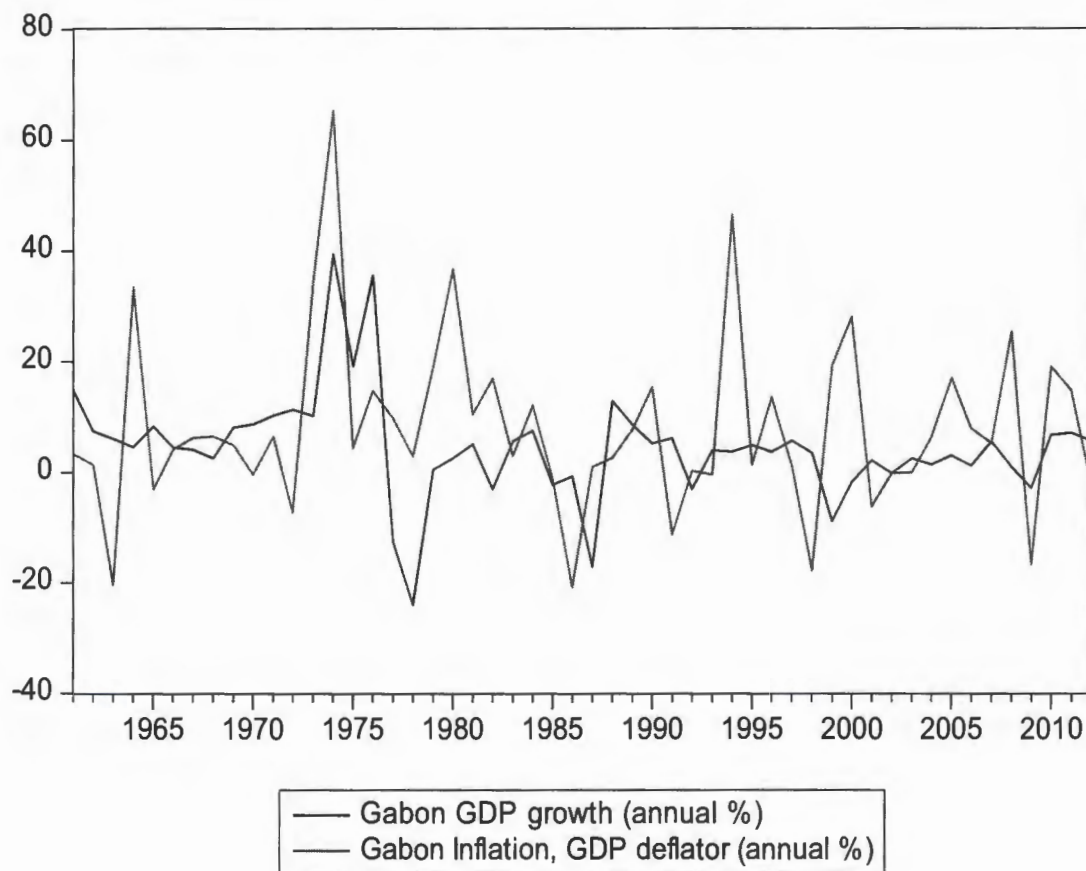
Inflation and growth rate has shown major spikes in Gabon than other countries under study. The variables exhibit an inverse relationship in 1967 and 1968. In 1967 when inflation increased from 4.13 percent to 6.23 percent growth fell from 4.51 percent to 4.12 percent. In 1968 when inflation increased to 6.46 percent, growth fell to 2.51 percent. However from the graph the relationship appears to be weak. Very large changes of inflation have resulted to a small change in growth rate. In 1993 inflation rose rapidly from negative 0.51 percent to 46.55 percent but this change led to a decline of growth

rate from 3.95 to 3.71 percent. This means a 47.06 percent led to a 0.24 percent decline in growth rate.

Figure 3.2.2: trend of inflation and economic growth in Kenya
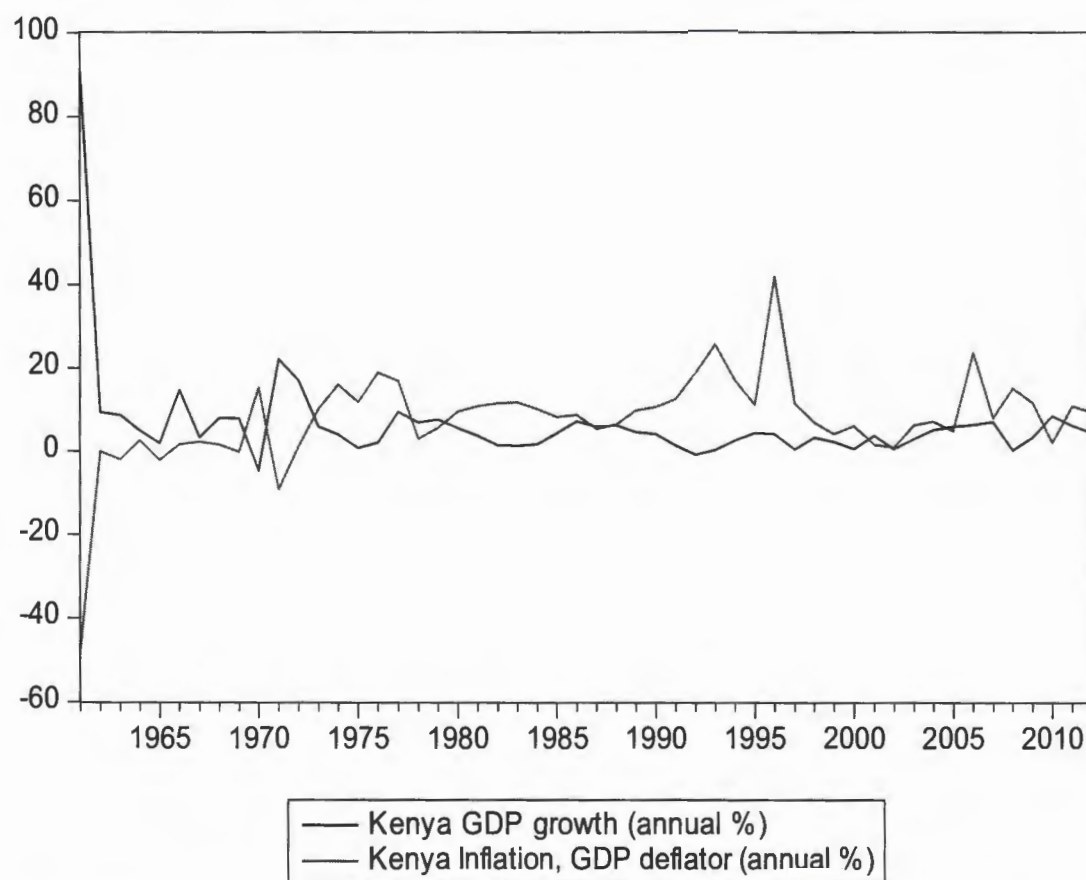
The graph above shows the trends of inflation and growth in Kenya. From 1961 to 2012 there were few periods of rapid increase or decrease in inflation and economic growth rate. In 1970 inflation increase rapidly from -0.18 percent to 15.32 percent, during the same period growth rate declined sharply from 7.96 percent to -4.66 percent. However, in 1971 there was turn in events where inflation fell to -9.22 percent and growth rate increased to 22.17 percent. Another spike in the trend was experienced in 1992 and 1993;

during the period inflation rose to 18.9 percent in 1992 and reached its peak on 1993 at 25.70 percent. It was a wrath for the economic growth rate, 1992 growth rate was recorded at negative 0.8 percent and went to 0.35 percent in 1993. The highest spike of inflation was experienced in 1996 when inflation rose to 41.99 percent, but there was no great effect to growth rate as growth rate reduced from 4.41 to 4.15 percent. However in 1997 despite the fall in inflation to 11.44 percent growth rate fell to 0.47 percent. In general, an inverse relationship is observed between inflation and growth rate.

Figure 3.2.3: trend of inflation and economic growth in South Africa
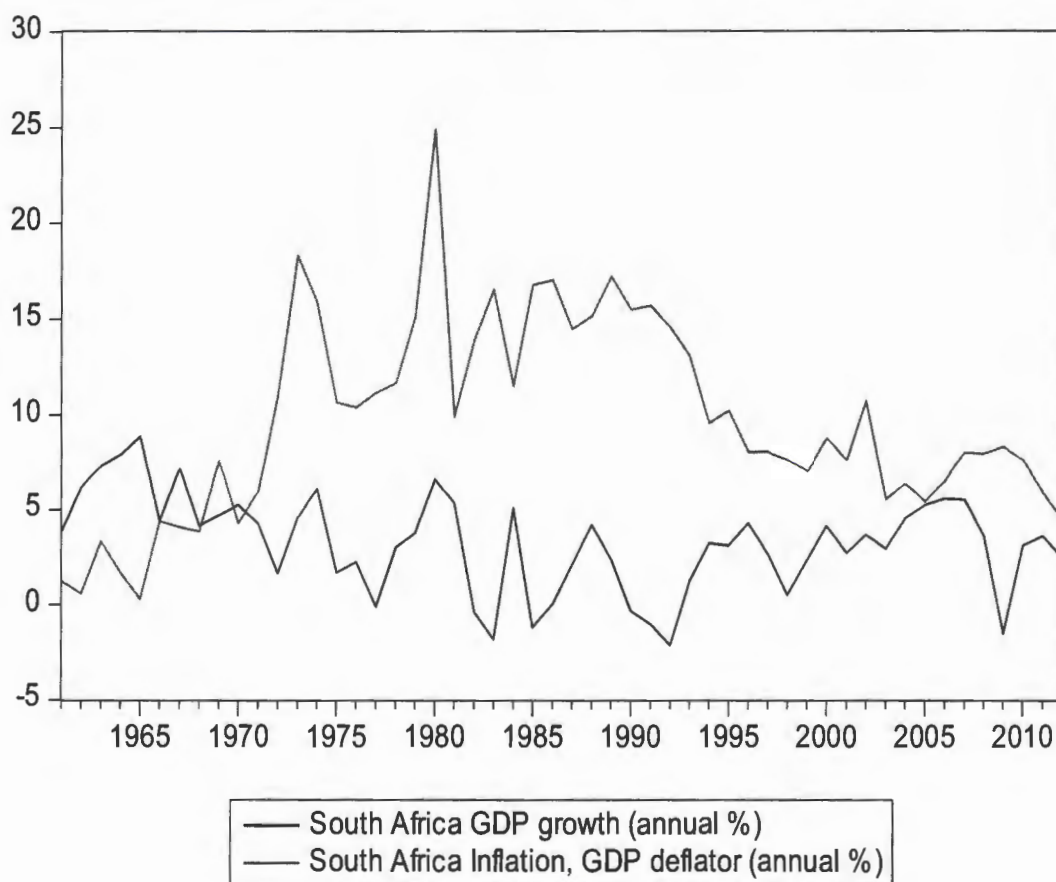
The graph above shows the trend of inflation and growth in South Africa from 1961 to 2012. Growth rate shows the presence of many spikes, which are not very severe. There are some few cases where inflation and growth were both rising. In 1980 inflation reached its peak at 24.92 percent and growth had also increased from 3.79 percent in 1979. This suggests the possibility of other factors that drove inflation that high. In overall inflation and growth have exhibited an inverse relationship in South Africa. In 1985 when inflation rose from 11.52 percent to 16.8 percent, the country experienced a negative growth rate; growth rate fell from 5.1 percent to negative 1.85 percent.

CHAPTER FOUR: ESTIMATION AND RESULTS

4.1 Summary of the Augmented Dickey Fuller (ADF) Unit root test

Table 4.1: Summary results of the Augmented Dickey Fuller (ADF) Unit root test

	Constant only		constant and trend	
	Levels	1st differences	levels	1st differences
GABON				
GROWTH	-5.1489*** [0]	-10.0528*** [0]	-5.2662*** [0]	-9.9552*** [0]
CAPITAL	-7.4662*** [0]	-12.9364*** [0]	-7.4359*** [0]	-12.8006*** [0]
INFLATION	-7.1590*** [0]	-6.2642*** [4]	-7.0973*** [0]	-6.2041*** [4]
KENYA				
GROWTH	-5.7513*** [1]	-4.2327*** [6]	-6.0305*** [1]	-4.2235*** [6]
CAPITAL	-7.6146*** [0]	-6.6776*** [2]	-7.5178*** [0]	-6.6136*** [2]
INFLATION	-7.7556*** [0]	-8.2318*** [1]	-7.7729*** [0]	-8.1957*** [1]
SOUTH AFRICA				
GROWTH	-4.0934*** [0]	-7.3047*** [1]	-4.3742*** [0]	-7.2561*** [1]
CAPITAL	-6.3168*** [1]	-9.0965*** [1]	-6.3082*** [1]	-8.9895*** [1]
INFLATION	-2.8115* [0]	-9.6478*** [1]	-2.6859 [0]	-9.8169*** [0]

Notes: *, **, and *** symbolizes significance at 10 percent, 5 percent, and 1 percent respectively and the rejection of the null hypothesis of non-stationarity. The optimal lags are given in the brackets [], and are automatically selected by Schwarz selection criterion.

The ADF test results show that for all the three countries all the three variables used, inflation, growth and capital formation are stationary, $I(0)$ when the test includes constant only. For all the three countries all variables are stationary at 1 percent significance level except for inflation in South Africa, which is stationary at 10 percent

significance level. When time trend is included, all variables for Gabon and Kenya are found to be stationary at 1 percent significance level. However, for the case of South Africa when time trend is include growth and capital are found to be stationary but inflation is found to be $I(1)$.

4.2 Summary results of Granger causality test

Table 4.2.1: Summary results of Granger Causality test in Gabon

Null Hypothesis:				Obs	F-Statistic	Prob.
CAPITAL_GABON does not Granger Cause GROWTH_GABON				50	1.60678	0.2118
GROWTH_GABON does not Granger Cause CAPITAL_GABON					0.37285	0.6909
INFLATION_GABON does not Granger Cause GROWTH_GABON				50	1.49046	0.2362
GROWTH_GABON does not Granger Cause INFLATION_GABON					0.51466	0.6012

In Gabon the granger causality test shows that there is no causality between inflation and growth. The null hypotheses of inflation does not granger cause growth (p-value=0.2362), and growth does not granger cause inflation (0.6012) were accepted. There is no causality between capital formation and growth.

Table 4.2.2: Summary results of Granger Causality test in Kenya

Null Hypothesis:	Obs	F-Statistic	Prob.
CAPITAL_KENYA does not Granger Cause GROWTH_KENYA	50	3.17856	0.0511
GROWTH_KENYA does not Granger Cause CAPITAL_KENYA		0.39264	0.6776
INFLATION_KENYA does not Granger Cause GROWTH_KENYA	50	0.65160	0.5261
GROWTH_KENYA does not Granger Cause INFLATION_KENYA		0.20306	0.8170

In Kenya, inflation and growth are found to have no causality. The null hypothesis of inflation does not granger cause growth (p-value=0.5261) was accepted. The null hypothesis for growth does not granger cause inflation (p-value=0.8170) was also accepted. Also, the results show the existence of a uni-directional causality between capital formation and growth, running from capital formation to growth.

Table 4.2.3: Summary results of Granger Causality test in South Africa

Null Hypothesis:	Obs	F-Statistic	Prob.
CAPITAL_SA does not Granger Cause GROWTH_SA	50	5.13717	0.0098
GROWTH_SA does not Granger Cause CAPITAL_SA		2.59448	0.0858
INFLATION_SA does not Granger Cause GROWTH_SA	50	7.95245	0.0011
GROWTH_SA does not Granger Cause INFLATION_SA		0.94400	0.3966

In South Africa the Granger causality test show that between inflation and economic growth the causality is unidirectional running from inflation to growth. The null hypothesis for growth does not granger cause inflation was accepted at p-value= 0.3966. The null hypothesis for inflation does not granger cause growth (p--value=0.0011) was rejected at 1 percent significance level. This implies that it is possible to make accurate predictions about the values of growth using only the past data of inflation. The results also show that there is a bi-directional causality between capital formation and growth.

4.3 Summary results of OLS short-run relationship

Table 4.3.1: Summary results of OLS short-run relationship in Gabon

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.746329	1.049343	2.617188	0.0118
INFLATION	0.028430	0.091177	0.311814	0.7565
INFLATION SQUARED	-0.000463	0.002329	-0.198752	0.8433
CAPITAL	0.210987	0.031896	6.614899	0.0000
R-squared	0.561731			
Adjusted R-squared	0.534340			
F-statistic	20.50730			
Durbin-Watson stat	1.645352			

For Gabon, the OLS results indicate that there is a positive and significant technological progress. The adjusted R^2 is not very high but it is acceptable. The F-statistics rejects the null hypothesis that all independent variables jointly have no effect on growth, and it can be concluded that independent variables jointly have effect on growth. The Durbin-Watson statistics shows that there is no serious problem of autocorrelation. However the

effects of inflation on grow is found to be insignificant. Also the nonlinear effects of inflation to growth are found to be insignificant.

Table 4.3.2: Summary results of OLS short-run relationship in Kenya

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.191563	0.670730	13.70382	0.0000
INFLATION	-0.812624	0.045532	-17.84720	0.0000
INFLATION SQUARED	0.018981	0.001284	14.78733	0.0000
CAPITAL	0.032984	0.029278	1.126579	0.2655
R-squared	0.926512			
Adjusted R-squared	0.921919			
F-statistic	201.7219			
Durbin-Watson stat	1.577245			

For Kenya, the coefficients of all variables except capital are significant at 1 percent significance level. The results indicate that there is a positive and significant technology progress. Inflation is found to have negative and significant effect on growth, with a percentage increase in inflation resulting into 0.8126 decrease of growth rate. The results also indicate that the relationship between inflation and growth could be non-linear. The results from OLS are inconsistent with those obtained form Granger causality test. The Granger causality indicated that there was no causality between inflation and growth. It should be noted that the Granger causality test is not powerful enough to investigate the true nature of the relationship between variables.

Inflation squared that captures the non-linear effects is found to be significant at 1 percent significance level. This suggests that there are other channels through which high

inflation affects growth. The adjusted R^2 is very high and the F-statistics rejects the null hypothesis that all independent variables jointly have no effect on growth, and it can be concluded that independent variables jointly have effect on growth. The Durbin-Watson statistics shows that there is no serious problem of autocorrelation.

Table 4.3.3: Summary results of OLS short-run relationship in South Africa

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.281850	0.739557	8.494070	0.0000
INFLATION	-0.592932	0.140570	-4.218045	0.0001
INFLATION SQUARED	0.018116	0.006207	2.918683	0.0053
CAPITAL	0.119538	0.018572	6.436333	0.0000
R-squared	0.679572			
Adjusted R-squared	0.659545			
F-statistic	33.93317			
Durbin-Watson stat	1.913641			

The regression results show that technology progress in South Africa is positive and significant. Also, inflation is shown to have a negative and significant effect on growth. Inflation is found significant at 1 percent significance level. A percentage increase in inflation will lower growth rate by 0.5926. The results also indicate that the relationship between inflation and growth could be non-linear. Inflation squared that captures the non-linear effects is found to be significant at 1 percent significance levels. The adjusted R^2 is not very high but it is acceptable. The F-statistics rejects the null hypothesis that all independent variables jointly have no effect on growth, and it can be concluded that

independent variables jointly have effect on growth. The Durbin-Watson statistics shows that there is no serious problem of autocorrelation.

In general, the OLS results for the short run relationship from Kenya and South Africa provide evidence for the existence of a negative, non-linear, and significant relationship between inflation and economic growth. However, in Gabon the relationship between inflation and growth is found to be insignificant. The magnitude of the impact of inflation on growth differs among countries. From the above results, a percent increase in inflation has more effect on growth rate in Kenya (0.8126) than in South Africa (0.5926). The OLS results are robust and significant therefore the study concludes that inflation has a negative effect on economic growth. This is supported by the results presented above which are significant.

Granger causality test shows that there is a unidirectional causality between inflation and growth in South Africa running from inflation to growth. For the case of Gabon and Kenya no causality was found between inflation and growth.

4.4 Summary results of OLS dynamic relationship

Table 4.4.1: Summary results of OLS dynamic relationship in Gabon

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.337699	1.019948	1.311536	0.1960
GROWTH_GABON (t-1)	0.286346	0.086014	3.329077	0.0017
INFLATION_GABON	0.016710	0.056246	0.297079	0.7677
CAPITAL_GABON	0.203606	0.025856	7.874738	0.0000

R-squared	0.645027
Adjusted R-squared	0.622369
F-statistic	28.46813
Durbin-Watson stat	2.329821

In the long run the coefficient for technology progress is found to be positive but insignificant in Gabon. Also the effect of inflation on growth is found to be insignificant. Due to the insignificance of the findings from Gabon cannot be used to make any conclusions regarding the relationship between inflation and economic growth. The adjusted R^2 is not very high but it is acceptable. The F-statistics rejects the null hypothesis that all independent variables jointly have no effect on growth, and it can be concluded that independent variables jointly have effect on growth. The Durbin-Watson statistics shows that there is no problem of autocorrelation.

Table 4.4.2: Summary results of OLS dynamic relationship in Kenya

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.465363	0.947029	6.826998	0.0000
GROWTH_KENYA (t-1)	0.044563	0.044577	0.999679	0.3226
INFLATION_KENYA	-0.244118	0.068991	-3.538420	0.0009
CAPITAL_KENYA	0.048508	0.032931	1.473003	0.1474

R-squared	0.264181
Adjusted R-squared	0.217214
F-statistic	5.624809
Durbin-Watson stat	2.001435

For Kenya, the results of the dynamic relationship reveal that inflation has a negative and significant impact on growth. Inflation is found to be significant at 1 percent significance level. An increase in inflation will lead into a decrease in growth rate by 0.2441. The Granger Causality test did not show this negative relationship between inflation and growth. This is because Granger test cannot investigate the true nature of the relationship but rather just the ability of one variable to predict the other. Capital formation is shown to have a positive impact on growth but the impact is insignificant. These results are consistent with those found in the short-run. For Kenya, results for both short-run and long run relationship found inflation to have a negative and significant impact on growth rate. Also, capital formation is found to have a positive impact on growth but the impact is insignificant. The adjusted R^2 is low, and the F-statistics rejects the null hypothesis that all independent variables jointly have no effect on growth, and it can be concluded that

independent variables jointly have an impact on growth. The Durbin-Watson statistics shows that there is no problem of autocorrelation.

Table 4.4.3: Summary results of OLS dynamic relationship in South Africa

Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	3.173688	0.711696	4.459333	0.0001
GROWTH_SA (-1)	0.250049	0.095594	2.615751	0.0119
INFLATION_SA	-0.138430	0.048036	-2.881821	0.0059
CAPITAL_SA	0.131613	0.018448	7.134260	0.0000

R-squared	0.671389
Adjusted R-squared	0.650413
F-statistic	32.00870
Durbin-Watson stat	2.162497

For South Africa, the results show a positive and significant technology progress. Technology progress is vital in fostering economic growth in the country. Inflation has negative impact on growth rate and the impact is significant at 1 percent significance level. An increase in inflation will lead into a decrease 0.1316 decrease in growth rate. Capital formation and the value of the previous growth rate are found to have a positive and significant influence on current growth rate. Capital formation is significant at 1 percent significance levels and the lagged value of growth is significant at 5 percent significance level. The adjusted R^2 is fairly high showing that the model is a good fit. The F-statistics rejects the null hypothesis that all independent variables jointly have no effect on growth, and it can be concluded that independent variables jointly have effect on growth. The Durbin-Watson statistics shows that there is no problem of autocorrelation.

In Kenya and South Africa the results for the short-run and long-run relationship between inflation and growth show that inflation has a negative and significant impact on growth rate. Some studies presented in literature review suggest that inflation non-linearly lowers growth by lowering investment and total factor productivity. The relationship was found to be insignificant in Gabon for both short-run and long-run. Therefore policy recommendations and further discussions will be based on significant results from Kenya and South Africa.

The short-run results showed the presence of non-linearity of the impact of inflation to growth rate. These results suggest that there are other channels through which inflation harm economic growth. These channels have not been analyzed in the study. Fischer (1993) is among the few reputable scholars who analyzed the non-linear channels of transmissions and suggest that inflation has a non-linear effect on growth through investment and lowering rate of productivity.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATION

5.1 Conclusion

There is no consensus in both the theoretical and empirical studies on the relationship between inflation and economic growth. This study has analyzed the short run and long-run relationship between inflation and economic growth. Annual time series data from Gabon, Kenya, and South Africa over the period 1961 to 2012 are used in the analysis. Data used is publicly available and was obtained from the World Bank database. The variables used in the study are: the growth rate of GDP as the dependent variable, and the independent variables used are inflation measured by the growth rate of GDP deflator index and gross capital formation. Because the data used is time series, preliminary analysis was conducted by testing all variables for unit root, and Augmented Dickey-Fuller test of unit root is used. For all the three countries, all data is tested with constant only, and constant and time trend. The variables are found to be stationary as they are integrated of order zero $I(0)$. Granger causality test shows that there is a unidirectional causality between inflation and growth in South Africa running from inflation to growth. For the case of Gabon and Kenya no causality was found between inflation and growth.

The empirical findings for Kenya and South Africa are consistent with the theoretical views that argued for the existence of a negative relationship between inflation and economic growth. With this empirical evidence that inflation lowers economic growth, the study has suggested some appropriate policies.

The main contribution of this study is the use of recent data set, which makes it contribution to the inflation and growth nexus by providing the most recent findings.

Also the study has analyzed in detail both the short-run and long-run relationship between inflation and economic growth. The empirical results show that in the long-run inflation has a negative and significant impact on growth rate in Kenya and South Africa. Also results suggest the existence of a non-linear relationship between inflation and economic growth in the short-run.

5.2 Policy suggestion

The empirical results for Kenya and South Africa in both short-run and long-run have provided the evidence for the existence of a negative relationship between inflation and economic growth. To address this issue the study has provided the following policy recommendations.

First, as empirical results have shown that inflation has a negative impact on economic growth, the government through the central bank should assess the possible benefits of adopting inflation-targeting regime. There have been literatures that have advocated for the success of an inflation-targeting regime in the past 20 years. IMF among others has shown that there is high success rate for most countries that have adopted the inflation-targeting regime.

Second, as empirical results have shown that capital formation is crucial for economic growth, the government should consider developing policies that will focus on improving education and developing training programs and ensuring equal accessibility for all citizens so as to help workers become more skilled and increase the capital stock. Short-run and long-run results for South Africa suggest that increase in capital formation

has a positive and a significant effect on growth rate. Although South Africa is known for offering quality education and training, all citizens do not enjoy these services equally. Some reports have provided the statistics that the quality of education and training differs among the ethnic groups. White South Africans are reported to receive quality schooling, while it is not the same for other ethnic groups. Therefore amending this crooked system will help ensure that all citizen regardless of their ethnic groups they receive quality education and training necessary to increase the nation's human capital stock. This inequality in the quality of education hinders massive capital formation because population data show that white South Africans account for 8.4 percent of the total population according to the census data of 2014.

Third, as empirical results have shown that capital formation is crucial for economic growth, the government should develop some policies to stimulate the net business investments which will help increase the capital formation and lead to economic growth. Also, Net business investment will stimulate economic growth by increasing productivity of labor and capital through investment in capital assets.

As empirical results have shown that technological progress plays an important role for economic growth, the government should consider developing policies that will foster technological progress such as investing in Research and Development. Results for both short-run and long-run relationship in Kenya and South Africa found that technology progress has a positive and significant influence on growth rate. Data from World Bank show that in 2009 Kenya spent 0.98 percent of the GDP on research and development. Also, out of 1 million people there are 228 researchers. For South Africa 0.76 percent of the GDP was spent on research and development in 2009. In the same

year there were 369 researchers in 1 million people. When data from Canada (a developed country) are studied, they shows that in 2009 spending on R&D as a percent of the GDP was 1.97 percent and there were 4451 researchers in 1 million people. Kenya and South Africa should develop policies that will address the shortage of researchers and increase spending on Research and Development. Investing in Research and Development may help increase economic growth in the country.

5.3 Future research

The topic on inflation and growth nexus is broad, thus this study has focused mainly in analyzing if (or not) a long run, significant and negative relationship exists between inflation and economic growth. In the short run the study has established that there is an existence of a non-linear relationship between inflation and economic growth. The main channels of transmissions are not analyzed; therefore it is important for future research on the topic to analyze the main channels of transmission.

Also, the data used in the study has 52 observations covering the period from 1961 to 2012. Further research should look into using data that covers a longer period of time. It should be duly noted that the findings from this study aim at contributing to the on going research by no means should they be taken as conclusive evidence.

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Appendix:

Table 6: Data used in Empirical Analysis

	Gabon	Gabon	Gabon	Kenya	Kenya	Kenya	South Africa	South Africa	South Africa
Series Name	GDP growth (annual percent)	Inflation, GDP deflator (annual percent)	Gross capital formation (annual percent growth)	GDP growth (annual percent)	Inflation, GDP deflator (annual percent)	Gross capital formation (annual percent growth)	GDP growth (annual percent)	Inflation, GDP deflator (annual percent)	Gross capital formation (annual percent growth)
1961	14.7668	3.2784	25.1428	-7.7746	8.6622	-35.1879	3.8454	1.2607	-8.0567
1962	7.4492	1.3809	0.9132	9.4574	0.0183	-7.4765	6.1773	0.5934	-3.1588
1963	6.0924	-20.3428	-17.1946	8.7783	-1.8773	19.4757	7.3736	3.3268	22.8396
1964	4.5545	33.5406	-10.9290	4.9645	2.6907	-15.8241	7.9398	1.6975	27.1194
1965	8.3333	-3.0591	-2.4540	2.0091	-2.0520	7.6388	8.8960	0.3189	8.2834
1966	4.5080	4.1344	41.9355	14.7286	1.7138	49.2191	4.4384	4.3883	-7.0241
1967	4.1152	6.2247	-30.1435	3.3612	2.4008	6.7517	7.1965	4.0764	21.6563
1968	2.5088	6.4609	3.5959	7.9827	1.6788	40.4223	4.1534	3.8568	-4.2687
1969	8.0829	4.9591	9.5868	7.9592	-0.1799	2.5098	4.7160	7.6320	12.2718
1970	8.6793	-0.4202	11.3122	-4.6554	15.3157	37.7489	5.2485	4.2830	17.5287
1971	10.2587	6.5042	14.3631	22.1739	-9.2192	1.4076	4.2790	5.9803	11.4958
1972	11.3370	-7.2770	19.5498	17.0824	1.2052	-8.1652	1.6548	11.0166	-14.2969
1973	10.1824	34.7577	15.2626	5.8966	10.2038	20.9390	4.5720	18.3285	14.2840
1974	39.4871	65.4105	180.9974	4.0656	16.0493	-5.3839	6.1111	15.9010	17.9938
1975	19.1901	4.3722	23.6842	0.8822	11.8351	-31.5018	1.6954	10.6706	0.2995
1976	35.6253	14.6649	43.0723	2.1540	18.9062	11.9337	2.2500	10.4169	-12.0541
1977	-12.5821	9.7957	-21.8915	9.4538	16.8998	35.8392	-0.0941	11.1685	-5.9242
1978	-24.0492	2.8591	-61.9659	6.9125	3.0810	23.8618	3.0145	11.6797	-3.9915
1979	0.4744	18.9830	23.5157	7.6152	5.6386	-24.4937	3.7905	15.1305	10.9978
1980	2.5529	36.7811	2.6165	5.5920	9.5507	13.6531	6.6206	24.9146	32.8503
1981	5.0953	10.4421	46.1765	3.7735	10.8531	-4.7232	5.3607	9.9273	11.6408

1982	-3.0975	16.9036	-6.7877	1.5065	11.5926	-22.7208	-0.3834	13.9364	-23.2871
1983	5.6082	2.9248	-4.5764	1.3091	11.8380	-9.9474	-1.8465	16.5688	3.3483
1984	7.5089	12.0102	5.2171	1.7552	10.1907	0.7170	5.0991	11.5197	0.7599
1985	-2.3329	-1.2761	9.6089	4.3006	8.3058	28.0278	-1.2114	16.8006	-19.9163
1986	-0.8036	-20.8098	-16.3670	7.1776	8.7117	-18.3595	0.0178	17.0617	-10.7138
1987	-17.1460	0.9933	-53.0993	5.9371	5.4020	22.2414	2.1008	14.4975	-2.1338
1988	12.8454	2.6151	94.6633	6.2032	6.4556	1.7644	4.2000	15.1832	19.2579
1989	8.5453	7.7280	-35.3634	4.6903	9.7690	10.1332	2.3949	17.2588	4.5143
1990	5.1922	15.3581	0.0000	4.1921	10.6372	-6.9949	-0.3178	15.5215	-13.5701
1991	6.1125	-11.3661	18.2482	1.4383	12.5320	-7.8451	-1.0183	15.7270	1.6671
1992	-3.0901	0.2139	-12.5901	-0.7995	18.8972	-18.2237	-2.1370	14.5712	-6.9950
1993	3.9466	-0.5095	1.5651	0.3532	25.6985	14.9691	1.2336	13.0876	-0.6562
1994	3.7128	46.5514	-0.1253	2.6328	17.0164	9.0874	3.2341	9.5940	25.2779
1995	4.9738	1.3391	4.8071	4.4062	11.2211	8.4041	3.1157	10.2503	13.7990
1996	3.6250	13.5627	16.9072	4.1468	41.9888	9.9831	4.3067	8.0897	0.2365
1997	5.7384	0.9465	29.4998	0.4749	11.4352	8.5473	2.6468	8.1065	2.0527
1998	3.4778	-17.7864	14.2969	3.2902	6.9314	20.7832	0.5174	7.7104	3.1062
1999	-8.9326	19.1913	-38.7608	2.3054	4.1939	-8.1343	2.3581	7.0732	-2.1052
2000	-1.8830	28.0893	-8.2703	0.5997	6.0798	11.1141	4.1546	8.8095	3.3093
2001	2.1317	-6.2526	10.7302	3.7799	1.5731	12.1214	2.7354	7.6669	-0.0912
2002	-0.2672	-0.2400	-6.9230	0.5469	0.9332	-20.3742	3.6678	10.7495	10.8770
2003	2.4752	-0.0902	-1.1816	2.9325	6.1973	10.0056	2.9491	5.5502	11.0067
2004	1.3460	6.3265	34.2291	5.1043	7.1268	7.6275	4.5545	6.3719	17.1072
2005	3.0216	17.0021	-6.7636	5.9067	4.8996	13.2405	5.2771	5.4447	5.7067
2006	1.1812	7.9269	7.4545	6.3306	23.6949	22.4524	5.6037	6.5276	12.9426
2007	5.5534	5.2543	7.8148	6.9933	7.9854	16.1270	5.5478	8.0789	12.0105
2008	0.9998	25.4068	6.1682	0.2323	15.1512	14.1362	3.6221	8.0064	4.4167
2009	-2.9000	-16.7046	7.5950	3.3069	11.6373	11.0929	-1.5262	8.3719	-8.5977
2010	6.7000	19.0432	10.7979	8.4057	2.0917	11.3719	3.1400	7.6533	4.2582
2011	7.1000	14.7640	-0.4645	6.1221	10.7835	6.5667	3.5993	5.8744	6.9963
2012	5.6000	-2.7356	4.5613	4.4523	9.3225	9.7245	2.4669	4.4559	4.8751