THE RELATIONSHIP BETWEEN INFLATION AND ECONOMIC GROWTH IN KENYA, 1963 – 2003

BY

KIGUME RUTH WANJIKU
DEPARTMENT OF ECONOMICS
KENYATTA UNIVERSITY

A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF ECONOMICS, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF ARTS DEGREE IN ECONOMETRICS OF KENYATTA UNIVERSITY

AUGUST 2005

DECLARATION

This research project is my original work and has not been presented for a degree in any other university.

Signature RKigume Date 01/08/05

Kigume Ruth Wanjiku

This research project has been submitted with our approval as university supervisors.

Signature Date 4/08/2005

Mr. Nelson Wawire

Department of Economics

Signature Date 10/08/2005

Mr. Obere Almadi

Department of Economics

DEDICATION

To my loving parents, James and Susan Kigume, who have brought me up to be the person that I am today.

ACKNOWLEDGEMENTS

First and foremost, I am eternally grateful to the Almighty God, to whom I owe my life. Thank you Lord for your wisdom, divine intervention and guidance throughout my study period.

I am greatly indebted to my two supervisors, Mr. Wawire and Mr. Obere, for their patience, guidance and input throughout the duration of the project, to making my work successful. I acknowledge Dr. Wambugu for his insight and direction especially at the beginning of this project. I also acknowledge the technical support of the Economics Department staff, Kenyatta University. I would like to thank my classmates: Mutai, Kananu, Tiriongo and Nyambura for their prayers, encouragement and friendship. My thanks also go to AERC and UON librarians for all the assistance I got from them.

Special thanks go to my family members; especially my siblings, Kigumz, Jose and Sarah for their prayers, love and support. I am also grateful to my best friend Beato, for her prayers and friendship, and to my wonderful niece Lexie, who adds so much joy to my life. I also wish to thank everyone else who contributed to my studies, through their prayers and/or support.

However, the views expressed in this study are not related in any way to the Economics Department of Kenyatta University or the University as a whole, they are solely mine.

Ruth Kigume

August, 2005

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS

AGOA	-	African Growth and Opportunity Act
COMESA	-	Common Market for East and Southern Africa
CPI	-	Consumer Price Index
EAC	-	East African Community
ECM	-	Error Correction Model
EU	-	European Union
GDP	-	Gross Domestic Product
IMF	-	International Monetary Fund
OECD	-	Organization for Economic Cooperation and Development
OLS	-	Ordinary Least Squares
LR	-	Levine and Renalt
LZ	-	Levine and Zervos
AERC	-	African Economics and Research Consortium
UON	-	University of Nairobi

DEFINITION OF OPERATIONAL TERMS

Inflation: a persistent rise in the general price level in an economy.

Economic growth: the rate of increase in an economy's employment, real output or income over time.

GDP: total value of all final goods and services produced in a country for a particular period, valued at prices in that period.

Phillips curve: implies a negative relationship between inflation and unemployment.

Balance of Payment: deficit when the sum of the capital account, the current account and net transfers equal a negative.

Terms of trade: the rate at which a country can trade domestic products for imported products.

Marginal benefits: amount by which an additional unit of an activity increases its total benefit.

Depreciation of a currency: a fall in the price of one currency relative to another, for example, a fall in the Kenya Shilling against the US dollar.

ABSTRACT

Low economic growth and fluctuating inflation rates have been experienced over the years in Kenya. The relationship between inflation and economic growth has brought a lot of controversy both in theory and empirical literature. This study sought to establish if there is significant causality between inflation and economic growth, the specific nature of this relationship and to determine whether there is a short run or long run relationship between these two variables. The study examined the relationship between these two variables using annual data covering the period 1963 to 2003. The Phillips curve approach was used in this study.

To undertake this study, published data was used. The data were tested for the presence of unit roots, which revealed that inflation was an I (1) and real GDP growth rate was an I (0). Granger causality tests revealed that there was no causality between inflation and economic growth rate. Estimations were done using OLS estimation technique. Various diagnostic tests were also carried out to confirm the statistical soundness of the models.

The study found that there was a negative short run relationship between inflation and economic growth. Further, this relationship was positive in the long run. These results showed that inflation was affected by its own first and second lags, economic growth, climatic shocks (for example drought), monetary policy interventions and external shocks like the oil price. On the other hand, economic growth was affected by its first and second lags only. In this case, the Phillips curve approach was not applicable since it presents a short run positive relationship between inflation and economic growth while the results presented an inverse short run relationship and a direct long run relationship between inflation and economic growth in Kenya.

CHAPTER ONE

INTRODUCTION

1.1 Background

1.1.1 Debate between the structuralists and the monetarists

Rapid economic growth and low inflation rates are common objectives of macroeconomic policy (Ghosh and Phillips, 1998). In economic literature, the relationship between inflation and economic growth has been discussed in different ways with respect to the development stages of the world economy. According to the Washington consensus view, there is a negative relationship between growth and inflation (Ercel, 1999). The current view on this relationship in contemporary literature is that high inflation affects economic growth positively in the short run, while it leads to a reduction in the growth potential in the long run (Ercel, 1999).

Understanding the interaction between inflation and economic growth is one of the main issues in macroeconomics. The relationship between inflation and economic growth remains a controversial one and there is no clear theory linking these two variables (Mallik, 2001). Originating from Latin American context in the 1950s, the issue has generated an enduring debate between the structuralists and the monetarists. The structuralists, like Campos (1964), believe that inflation is essential for growth whereas the monetarists, like Friedman (1973), think that inflation is detrimental to economic progress. There are two aspects to this debate, the nature of the relationship, if one exists and the direction of causality (Mallik, 2001).

The monetarists hold that inflation has ceased to promote development and has become incompatible with it. They argue that even countries that managed to keep inflation low and high economic growth are now facing an acceleration of inflation and a deceleration of growth. They recommend that inflation should be stopped before it degenerates into explosive tensions and the only effective method seems to be the curbing of excess demand.

Structuralists on the other hand hold that inflation is a natural accompaniment of growth and cannot be curbed through monetary and fiscal means without provoking unemployment or stagnation of growth because of supply rigidities. They claim that the instability of export proceeds renders it impossible to curb inflation in the short run. It infact renders desirable a gradual attack on inflation, except to the extent that foreign assistance becomes available to render the supply of imports more elastic (Campos, 1964).

Higgins (1969) claims that inflation seems to have been justified as a lubricant to economic growth, while in others, rampant inflation has disrupted the economy and retarded economic growth. This has given rise to considerable controversy about the relationship between inflation and economic growth.

1.1.2 Kenya's inflation and economic growth rates

Given the above background information, it would be important to examine if such a relationship exists in the Kenyan context. To explain the trend of the inflation and economic growth rates over the years, it may be helpful to divide the period under study into four phases. The first phase, which runs from 1963 to 1973, captures the period before the first oil shock and when there was remarkable growth in the economy. The

second phase, 1974 to 1984, considers the contractionary policy measures that were put in place. The third phase, 1985 to 1990, considers the period when the government published a sessional paper on economic management for renewed growth and the fourth phase, which runs from 1991 to 2003, captures the liberalization period.

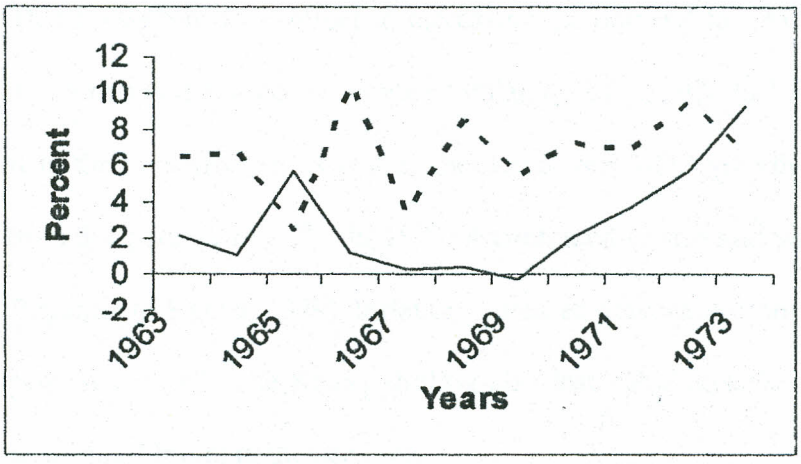
a) Phase one: 1963 - 1973

In this phase, Kenya's first decade after independence, beginning in 1963, was one of remarkable growth and structural change. The government adopted macroeconomic policies after independence based on the Sessional Paper Number 10 of 1965 on African Socialism and its application to planning in Kenya. The policies documented were to promote wealth distribution, create employment opportunities, bring about faster economic growth and promote self-reliance on essential commodities.

During this period, economic growth averaged 6 percent per annum, the rate of inflation, on Less Developed Countries' standards, was on average 3 percent per annum, the exchange rate was fixed and there were positive real interest rates (World Bank, 1984). The economy enjoyed a relative degree of stability in prices. The growth rates experienced in the early 1970s were the result of a combination of favourable factors in agriculture and industry. During this period, there was a land redistribution policy that led to high agricultural output.

Further, sustained commodity exports provided foreign exchange earnings, which favoured investment and capital imports (World Bank, 1984) and this is shown in the graph below:

Figure 1.1 Average annual inflation and real GDP growth rates, 1963 – 1973



where - - - - - - - is real GDP growth rate

_____is inflation rate

Source of basic data: *Economic Surveys* (various issues), *International Financial Statistics* (various issues)

b) Phase two: 1974 - 1984

In the second phase, the country encountered many destabilizing shocks. The first oil shock in 1973/1974 was a major crisis in Kenya, which turned the trend of economic growth. There was a balance of payments crisis in 1974 and the inflation rate shot up from 9.3 percent in 1973 to 17.8 percent in 1974 (World Bank, 1985). This led the government to adopt contractionary monetary policy measures to alleviate these problems in early 1975. These measures included the introduction of a 10 percent export subsidy, restriction of the import control system and the devaluation of the Kenya shilling by 14 percent in order to improve the external balance (World Bank, 1985).

The 1976-1978 coffee booms, due to a 400 percent increase in world prices of coffee, salvaged the situation and hence the stabilization measures adopted in 1975 were

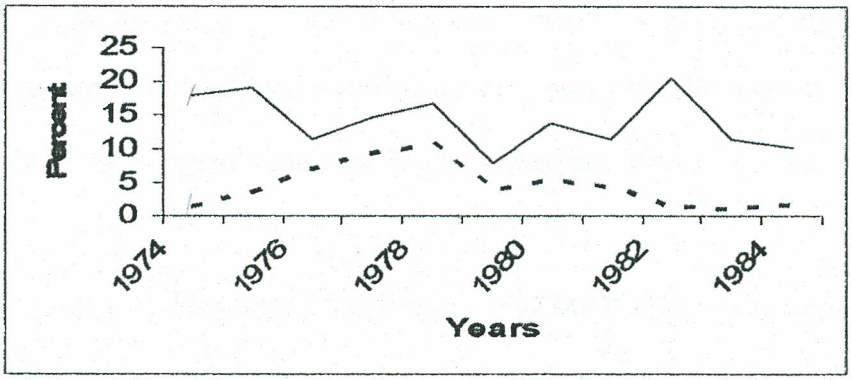
abandoned prematurely. The increased revenue from the commodity boom was passed over to farmers. This revenue had the effect of increasing the demand for real domestic assets and this led to a rise in the prices. The rate of inflation fell in 1976 to 11.4 percent from 19.1 percent in the previous year. On the other hand, real GDP growth rose to 7 percent in 1976 from 3.4 percent in 1975. In 1977, it continued to rise and was at 10.8 percent in 1978 (Republic of Kenya, 1979). Inflation increased drastically from 8 percent in 1979 to 20.7 percent in 1982. The Kenya shilling also lost value equally drastically leading to a serious disequilibrium in the economy.

The economy was also hit by the decline in coffee prices and the second oil price shock in 1979. Between 1980/82, the world economy experienced recession caused by the depression in the major western industrialized economies. This was transmitted through external shocks leading to a rise in international interest rate and a fall in demand for exports. The Kenyan economy as a result, experienced sluggish growth. The GDP growth rate decreased from 5.6 percent in 1980 to a mere 1.5 percent in 1982. The attempted coup *detat* 1982 worsened the situation because it led to a massive capital flight (Republic of Kenya, 1983). Some foreign investors pulled their investment out of the country citing insecurity.

In 1984, there was a severe drought that made the government to import substantial amount of food, which decreased foreign reserves. This resulted into a worsening balance of payment and high inflation rate. GDP growth was still low at 1.8 percent in 1984 (Republic of Kenya, 1985). The rate of inflation fell from 20.7 percent in 1982 to 11.5 percent in 1983 and further down to 10.3 percent in 1984 (World Bank, 1990).

In figure 1.2 below, the annual inflation is plotted against real GDP growth rates for the period 1974 – 1984.

Figure 1.2 Average annual inflation and real GDP growth rates, 1974 – 1984



where - - - - - - - is real GDP growth rate

_____ is inflation rate

Source of basic data: *Economic Surveys* (various issues), *International Financial Statistics* (various issues)

c) Phase three: 1985 - 1990

In this phase, the government adopted the Economic Structural Adjustment Programme (ESAP) after receiving advice from the World Bank and International Monetary Fund (IMF) in 1985. The effects of ESAP were however not pronounced until 1990, when these institutions suspended foreign aid to Kenya until economic and political changes were implemented. In 1986, the Kenyan government published a sessional paper on economic management for renewed growth (Republic of Kenya, 1986). This paper argued that if Kenyans were to enjoy improved standards of living, it was imperative that economic growth becomes a primary concern of economic policy. It also advocated for restoration and sustainment of economic growth rates experienced in

the 1960s (Republic of Kenya, 1986). This was to be brought about by the implementation of appropriate policies, particularly those that alleviate saving constraints, fiscal and foreign exchange constraints. During this year (1986), Kenya's GDP growth of 7.1 percent was the highest rate achieved in the 1980s (World Bank, 1990). The balance of payment position strengthened as a result of higher export volumes and improvements in the terms of trade from higher coffee and lower oil prices (World Bank, 1990).

Real GDP growth increased by 5.8 percent in 1987 but Kenya's external position weakened as a result of a marked fall in its terms of trade, a small reduction in export volumes and large non-recurrent imports. The economic recovery was sustained in 1988 with real GDP growth of 6.2 percent (World Bank, 1990). Inflation continued to rise, reaching 11.2 percent in 1988. This was due to an increase in prices of certain basic consumer products, a faster growth of domestic credit as well as cost escalation arising from further appreciation of the Kenya shilling during the year (Republic of Kenya, 1989). Improved weather conditions, moderately high world coffee and tea prices, increased domestic and international demand, and trade liberalization were the major factors, which provided a boost to the country's economic activities in 1988. In 1989, the real GDP growth decreased slightly to 4.7 percent while the inflation rate continued to rise and reached a level of 12.9 percent (Republic of Kenya, 1990).

In 1990, Kenya's economic growth declined moderately against an international background of sluggish economic growth marked by high oil and machinery import prices and low coffee export prices. The country's real GDP growth rate slowed down slightly from 4.7 percent in 1989 to 4.2 percent in 1990 (Republic of Kenya, 1991). The

inflation rate rose from 12.9 percent in 1989 to 15.2 percent in 1990 (Republic of Kenya, 1991). On the overall, export and private consumption rose appreciably, the latter being a consequence of higher inflation, which led to a lower level of domestic savings. Terms of trade worsened due to the fall in world coffee prices (Republic of Kenya, 1991).

d) Phase four: 1991 - 2003

The real GDP growth rate in this phase continued to decline for the third consecutive year in 1991. The real GDP growth rate fell from 4.2 percent in 1990 to a dismal 1.4 percent in 1991. Inflation continued to rise and was at 19.8 percent (Republic of Kenya, 1992). By 1992, the economy registered a real GDP growth rate of -0.8 percent, the lowest growth rate that had ever been recorded since independence in 1963 (Republic of Kenya, 1993). Dramatic political reforms of 1991/92 resulted in re-introduction of multi-party political system, which were accompanied by economic uncertainty especially towards the general elections of 1992 (Republic of Kenya, 1993). On the other hand, inflation rose to an all time high level of 29.5 percent. This was due to the withholding of donor aid to Kenya, the use of forex certificates in importing goods and services, increases in administered prices, devaluation of the shilling and high monetary expansion (Republic of Kenya, 1993).

In 1993, the economy was beset by severe problems of drought and excessive money supply, which led to high inflation. The combined impact severely affected the living standards of ordinary Kenyans. The real GDP growth rate recorded was 0.4 percent. This scenario was the result of a prolonged drought since 1991, low effective demand, and foreign exchange shortage during the first half of the year and high inflation rate of 45.8 percent (Republic of Kenya, 1994).

In this year (1993), the government introduced significant economic reforms to be able to boost economic activities. These reforms included the liberalization of exchange control regimes, abolition of import licensing, introduction of export retention schemes and the removal of price controls. (Republic of Kenya, 1994). Consequently, the performance of Kenya's economy in 1994 was significantly better than the previous four years. The implementation of appropriate macroeconomic reforms augmented by favourable weather was the major factor that boosted economic activities. Real GDP growth expanded by 2.6 percent compared to a meager revised GDP growth of 0.4 percent in 1993. Inflation rate dropped to 29 percent after rising rapidly to 45.8 percent in 1993. This was mainly attributed to the depreciation of the shilling against major currencies, favourable weather conditions that prevailed in the year and the measures pursued by the monetary authorities to contain expansion in domestic money supply and the budget deficits (Republic of Kenya, 1995).

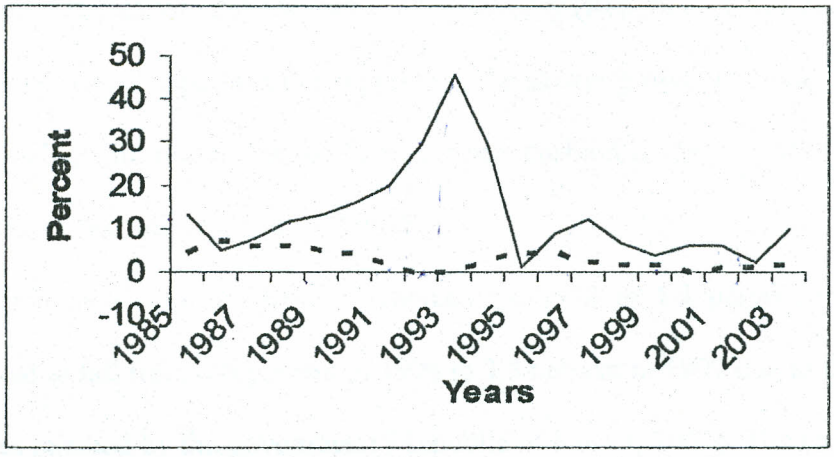
In 1995, there was significant performance in all key sectors of the economy. The GDP grew at an annual rate of 4.4 percent as compared to a growth of 2.6 percent in 1994 (Republic of Kenya, 1996). The continued pursuit of tight monetary policy measures by the central monetary authorities and the lowering of VAT from a rate of 18 percent to 15 percent in the 1995/96 budget resulted in continued decline in inflationary pressures. The inflation rate fell to a single digit level of 0.8 percent (Republic of Kenya, 1996).

The real GDP growth in 1996 declined slightly to an annual rate of 4.1 percent. Inadequate rainfall leading to power rationing, high cost of domestic credit and a more competitive trading environment were the main causes of the slow down in growth of the economy. Inflation was still contained at a single digit level during the year but rose from

0.8 percent to 8.8 percent due to an upward price adjustment of petroleum products, rapid money supply and price increases of some staple food items like maize due to drought (Republic of Kenya, 1997).

The figure that follows plots average annual inflation and real GDP growth rates, 1985 – 2003.

Figure 1.3 Average annual inflation and real GDP growth rates, 1985 – 2003



where - - - - - - - is real GDP growth rate

_____ is inflation rate

Source of basic data: *Economic Surveys* (various issues), *International Financial Statistics* (various issues)

There was a further slowdown in GDP in 1997, which recorded an annual rate of 2.1 percent. This was due to adverse weather conditions, poor infrastructure, pre-election violence and depressed investments due to lack of investor confidence. The average inflation rate rose moderately in this year from 8.8 percent to 12 percent. This is explained by the reduced agricultural output leading to rising prices of basic foodstuffs

and the shilling experienced appreciation against the major currencies following the withholding of donor aid (Republic of Kenya, 1998).

The growth of the economy continued to decline in 1998, reaching an annual rate of only 1.6 percent. There were high inflation rates for most part of the year and the fall in world prices of coffee and horticulture. Additionally, the *El-nino* rains during the first half of the year and the failure to secure renewed funding facilities from the donors, particularly the IMF, increased uncertainties in the economy (Republic of Kenya, 1999). The inflation rate fell from 12 percent to 6.6 percent. The slower growth in money supply and the fairly stable shilling exchange rate further cushioned the economy from inflationary pressures (Republic of Kenya, 1999).

Real GDP growth rate fell from 1.6 percent in 1998 to 1.3 percent in 1999. Inflation continued to fall from 6.6 percent in 1998 to 3.5 percent in 1999 due to the tight monetary policies pursued by the government (Republic of Kenya, 2000). The year 2000 was the most difficult year for the economy with a negative growth rate of -0.2 percent (Republic of Kenya, 2001). This was attributed to the prolonged drought from 1999 to 2000, deterioration of infrastructure and low aggregate demand (Republic of Kenya, 2001). Inflation increased from 3.5 percent in 1999 to 6.2 percent in 2000. This was due to increases in food and fuel prices, increased VAT and upward power adjustments (Republic of Kenya, 2001).

There was a recovery in the economic growth rate from -0.2 percent in 2000 to 1.2 percent in 2001. This was attributed to favourable weather, which had a positive impact on agriculture and power generation, favourable tax reforms and expanded market outlets through the AGOA, COMESA, the EU and the EAC (Republic of Kenya, 2002).

The inflation rate declined from 6.2 percent in 2000 to 5.8 percent due to tight fiscal and monetary policies, stable world petroleum prices and exchange rates and low food prices in the year (Republic of Kenya, 2002).

There was a slight growth of 1.1 percent recorded in 2002 (Republic of Kenya, 2003). This was attributed to poor infrastructure, low output, low prices of major agricultural exports and the uncertainty regarding the general elections. The inflation rate declined down to 2 percent in 2002 from 5.8 percent in 2001. The prudent fiscal and monetary policies and the low demand for imports were the main factors that contributed to the low inflation rate in 2002 (Republic of Kenya, 2003).

The economy in 2003 showed signs of recovery after a subdued growth in the last five years. A real growth rate of 1.8 percent was realized in 2003 compared to a growth of 1.1 percent in 2002. Full economic recovery was however not achieved due to poor inflation, low foreign direct investments and the spillover effects of the previous year's economic downturn. The inflation rate rose significantly from 2 percent in 2002 to 9.8 percent in 2003 and this was occasioned by shortage of food commodities and increase in oil prices.

The observed trend between these two variables may lead to the conclusion that there seems to exist some relationship. This study considers the issue hence raises the question about the nature and the direction of causality of this relationship in the Kenyan case.

1.2 Statement of the Problem

The relationship between inflation and economic growth remains a controversial one in both theory and empirical literature. For example, Yatrakis (1998) and Mallik and Chowdhury (2001), found that there was a direct relationship between inflation rate and economic growth rate, while Bruno and Easterly (1996), found an inverse relationship between the two rates. During the 1950s to 1970s, the issue generated an enduring debate between structuralists and monetarists. The structuralists believed that inflation is essential for growth, whereas the monetarists saw inflation as detrimental to economic progress of a country.

In Kenya, low economic growth and fluctuating inflation rates have been experienced over the years. The growth rate has been falling from an average 6 percent per annum in the 1960s to a low average rate of about 2 percent in the 1990s. On the other hand, the inflation rate has risen from an average 3 percent per annum in the 1960s to an average rate of 14 percent in the 1990s. The inflation and real GDP growth rates seem to have an observed relationship. From the different graphs presented in section 1.1.2, in some years, the two variables seemed to be moving directly together but in other years, they seemed to be moving inversely together.

In order to establish the relationship between inflation and economic growth rate in Kenya, a detailed analysis was needed with attention paid to the direction of causality between these two variables.

The following research questions were addressed by this study:

i. What is the direction of causality between inflation and economic growth?

ii. What is the nature of the relationship between these two variables, and is it static or a lagged relationship?

iii. Is the relationship between these two variables sustained in the short run or in the long run?

iv. What are the appropriate policy implications?

1.3 Objectives of the study

In general, this study investigated the relationship between inflation and economic growth in Kenya. The specific objectives of the study were:

i. To test the inflation-growth relationship for causality.

ii. To model the relationship in order to show its specific nature.

iii. To establish whether there is a short run or long run relationship between inflation and economic growth.

iv. To recommend appropriate policy implications.

1.4 Rationale and Justification of the study

The study was motivated by the fact that there seems to be a relationship between inflation and economic growth in Kenya. The relationship is however not clear hence the need for a detailed empirical analysis. This study is important because it has not been done in Kenya before. It adds evidence regarding the controversy of the nature of the relationship between inflation and economic growth. Investigation on this issue is essential since these two variables are some of the most common macroeconomic variables and can be used as a measure of the economic progress of a country. The results

in this study would benefit the policymakers and academic researchers in designing policies, which aim at encouraging economic growth and having a stable macroeconomic environment.

1.5 Scope and organization of the study

The study focused on the relationship between inflation and economic growth in Kenya for the period extending from 1963 to 2003. This period incorporated all the policy measures that have been put in place since independence, to capture the effect that they may have on the inflation and economic growth rates.

This study is composed of five chapters. Chapter one provides an introductory section, which describes the research background, problem, objectives and rationale of the study. Chapter two reviews the theoretical and empirical literature concerned with the topic. Chapter three describes the methodology required to satisfy the objectives of the study. Chapter four gives the data analysis and interpretation of the results and finally chapter five concludes with the highlights of the study, its limitations and direction for further research.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This section looks at both the theoretical and empirical literature on the relationship between inflation and economic growth. Section 2.2 analyses the theoretical literature while section 2.3 discusses the various empirical studies done and their results.

2.2 Theoretical Literature

After the Second World War, in both developed and developing countries, Keynesian policies were on the agenda, and as a result of these policies, the increase in aggregate demand has caused both the inflation and output to rise. During this period, the majority of economists did not consider inflation to be a problem; besides, the thesis about inflation's positive effect on growth was widely accepted. During 1970s, while inflation rates were prevalent in most countries, the high inflation-high growth thesis was disputed with the falling growth rates (Ercel, 1999). In 1980s, hyperinflation episodes, especially in Latin American countries increased the instability in those economies and affected the development process of those economies adversely (Ercel, 1999). Those developments strengthened the thesis about the negative effects of inflation on growth.

According to Meier (1995), no clear relationship appeared to exist between the rate of inflation and the rate of growth. This was because highly inflated countries tended to stagnate while some of the low inflated countries seemed to grow fast.

Agénor and Montiel (1996) claimed that there was an inverse relationship between output growth and the rate of inflation. This relationship is due to the negative effect of inflation on the profitability of investment. A higher rate of inflation raises the

effective price of capital goods, which, in addition to its market price, incorporates the opportunity cost of holding money to facilitate capital goods. The increase in transactions costs raises the shadow value of installed capital, dampens investment and reduces the growth rate.

Bruno and Easterly (1998) note that the direction of causality between inflation and growth normally considered is that running from distortive effects of high inflation and resulting high variability in relative prices to lower growth. Lower growth could occur either via a lowering of total productivity, through the depressing effect of uncertainty on investment or through the adverse effect on efficiency of credit allocation. At lower inflation levels however, the causality of the inflation-growth relationship is not so obvious. Supply shocks, positive or negative, could simultaneously move growth and inflation in opposite directions.

2.2.1 Theoretical basis of the Phillips curve

According to Branson (1979), from the labour market, an increase in the labour demand brings an increase in the money wage rate due to the excess demand in the market. The assumption is that the percentage increase in the wage rate, $\dot{W}$, depends on the magnitude of the excess demand for labour, $N^d - N^s$, i.e.

$$\dot{W} = f(N^d - N^s) \; ; f' > 0 \quad \ldots\ldots 2.1$$

The demand and supply of labour depend in turn on the level of wage rate. Obtaining the estimate of the labour demand and supply functions involves transforming the excess demand expression in (2.1) into the unemployment rate. A.W. Phillips introduced the inverse relationship between the wage rate and unemployment. Therefore the excess supply on the labour market, $N^s - N^d$, is the negative of the excess demand, i.e.

Excess supply $= N^s - N^d = -(N^d - N^s)$.....2.2

Using this relationship, equation 2.1 is re-written as;

$\dot{W} = -f(N^s - N^d);\ f' > 0$.....2.3

Introduce the unemployment rate, $u = U/L$ as a proxy for excess supply. As excess supply increases, unemployment rises. Substituting the unemployment rate for excess supply in equation 2.2 gives us the wage adjustment equation;

$\dot{W} = g(u);\ g' < 0$.....2.4

Since $\dot{W}$ falls with an increase in excess supply, it also falls with an increase in u. Thus as unemployment rises, the rate of increase of wages falls and vice versa. Equation 2.4 is the basic short run Phillips curve equation relating $\dot{W}$ to u. The g (u) should have a convex shape because as unemployment is reduced by constant amounts, the wage rate will rise at an increasing rate, with $\dot{W}$ approaching infinity as u approaches 0.

The convex shape of the Phillips curve suggests that on average, the economy will have less inflation if the level of unemployment has narrow fluctuations about some average unemployment than if the fluctuations are wider with the same mean of unemployment. If unemployment is fluctuating symmetrically about 5 percent level, for example, the average pressure on prices goes up more below the 5 percent level than it goes down above 5 percent because of the convex nature of the curve. Thus the broader the fluctuation in unemployment level at any given average unemployment rate, the greater will be the cost-push inflationary pressure on the economy.

2.2.2 Theories of inflation

There are some theories that try to link the relationship between inflation and economic growth and these are discussed below.

a) Monetarist theory of inflation

Friedman (1973) developed the monetarist theory arguing that inflation was a monetary phenomenon and was produced by rapid increase in the quantity of money. The monetarists assert that changes in the money supply are more closely related to the changes in output and employment than to the changes in investment and government expenditure, which in the Keynesian approach are the main factors behind the fluctuations or changes in both output and employment. They state that as long as the demand for money is stable, the supply of money is considered as the main determinant of the price level or the key policy tool for controlling the income level. If money supply per unit of output increases with prices remaining stable, people will feel that their cash balances are larger than required, thus raising the public's demand for goods and services and therefore price will increase. Friedman (1973) summarized the inconclusive nature of the relationship between inflation and growth by saying that all possible combinations have occurred that is, inflation with and without growth, no inflation with and without growth.

b) Keynesian theory of inflation

The Keynesian analysis of inflation is based on the fluctuations in aggregate supply and effective demand. If investment increases, it results in an increase in effective demand and not an increase in prices. However, there will be an increase in production until full employment is reached. Beyond this level of full employment, any increase in

aggregate demand in terms of money will cause prices to rise and hence inflation will occur.

According to the Keynesian theory, there being underemployment in the economy, an increase in the money supply leads to an increase in aggregate demand, output and employment. Starting from a depression, as money supply increases, output at first rises proportionately. But as aggregate demand, output and employment rise further, diminishing returns start and a certain bottleneck (semi-inflation) appears and prices start rising. This process continues until full employment level is reached.

In 1958, Keynes studied the statistical relationship between unemployment and the rate of change of money wage rate. Phillips (1958) also analyzed this relationship and found that high inflation causes low rates of unemployment, therefore affects growth positively. The study found out that wage inflation and unemployment in the United Kingdom were inversely related over a hundred-year period. This relationship was strong and relatively stable.

However, there have been arguments that the Phillips curve only relates to the short run and it does not remain stable. It shifts with changes in expectation of inflation in the long run hence there is no tradeoff between inflation and unemployment. This stable tradeoff between inflation and unemployment was shattered in the late 1960s and early 1970s whereby the attack took the form of the natural rate hypothesis of Friedman and Phelps. Friedman and Phelps argued that the idea that nominal variables, for example money supply or inflation, could permanently affect real variables, such as, output or unemployment, was unreasonable. In the long run, real forces determine the behaviour of real variables.

c) The Structuralists View

The structuralists view was developed in the 1950s. According to the structuralists like Campos (1964), the starting point for the process of inflation started with internal changes in the structure of demand. If the demand for the output of particular sectors was increased, due to changes in the consumer tastes, the prices of goods produced in this sector will rise as a result of the increase in the demand for intermediate goods and raw materials, which enter in the production process of these industries. Thus, in the end, the average level of price and wages will necessarily rise.

d) The Cost-Push theory of inflation

The basic cause of cost-push inflation is the rise in money wages more rapidly than the productivity of labour. In advanced countries, trade unions press employers to grant wage increase considerably in excess of increase in productivity of labour, thereby raising the cost of production of commodities. Producers in turn raise prices of their products. Other sectors in the economy may be affected by money wage increases and their product prices may be rising. In most cases, their products are used as inputs for the production of commodities in other sectors. As a result, production costs of other sectors will rise and thereby push up the prices of their products. Further, an increase in the prices of domestically produced or imported raw materials may lead to cost push inflation since raw materials are used as inputs by the manufacturers of finished goods.

2.3 Empirical Literature

The observed theoretical controversy on the relationship between inflation and growth is backed by mixed empirical evidence. Several empirical studies have been carried out to investigate the relationship between inflation and economic growth rates.

Bruno and Easterly (1996) carried out a study to find out if inflation and growth are inversely associated, directly associated or not associated at all. The study sought to find out if the empirical inflation-growth relationship was primarily a long run relationship across countries, a short run relationship across time or both. The main focus was the behaviour of growth before, during and after discrete high inflation crises. The study used annual data in 26 countries. There was no evidence of any relationship between inflation and growth at annual inflation rates less than 40 percent. They found a short to medium run negative relationship between inflation and growth. However, there was no lasting damage to growth from discrete high inflation crises as countries tended to recover back towards their precrisis growth rate (the growth rate before an inflation crisis).

Romer (1996) analysed the source of the relationship between inflation and output growth. The explanation presented was that the aggregate relationship is due primarily to the behaviour of raw material prices. The model estimated was the Phillips curve specification of price-output relationship given as:

$$\pi_t = \beta_0 + \beta_1 (y_t - \bar{y}_t) + \beta_2 \pi_{t-1} + e_t \quad \ldots\ldots 2.5$$

where π_t - rate of inflation

y_t - logarithm of real output

$\bar{y}_t$ - some measure of trend output

π_{t-1}- inflation inertia

e_t - supply shocks

To test whether the growth rate of output affects inflation, the percentage change in real output (Δy) was added to the regression specification.

Hence the estimated equation was:

$$\pi_t = \beta_0 + \beta_1 (y_t - \bar{y}_t) + \beta_2 \Delta y_t + \beta_3 \pi_{t-1} + e_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2.6$$

Since prices and real output are determined simultaneously, instrumental variables were used. Hence an instrument for the contemporaneous deviation of output from trend was the lagged deviation from trend and an instrument for the percentage change in real GDP was some weighted sum of inflation and the growth rate of real output. The study showed that the effect of the rate of inflation was not just on the deviation of output from trend but also more strongly on the growth rate of output.

Furthermore, the strength of the growth rate effect appeared to vary with the importance of materials in the economy. The study recommended that since the growth rate of output is an important determinant of inflation, policy should attempt to keep output growth steady. Also, a better understanding of the price-output relationship could lead to important changes in how countries manage aggregate demand.

Sarel (1996) examined the possibility of non-linear effects of inflation on economic growth. The study found that the function that relates growth rates to inflation contains a structural break. When inflation is low, it has no significant negative effect on growth and the effect maybe slightly positive. But when inflation is high, it has a

negative effect on growth. This effect was robust, statistically significant and very powerful. The point of the structural break was estimated to occur when the average annual inflation rate is 8 percent.

Loungani and Sheets (1997) examined the relationship between inflation and growth using data from 25 European countries for the years 1991-94. They ran regressions of real GDP growth on lags of itself, inflation, the fiscal balance and a dummy variable for countries at war. The findings were that all these variables were statistically significant and suggested that all European economies were affected by some common adverse shocks. There was a strong evidence of a negative correlation between inflation and subsequent GDP growth. This correlation was robust to the inclusion of the fiscal balance and an index of economic reform. The results indicate that high inflation adversely affects economic growth. To test whether high inflation discourages domestic investment, real investment growth was regressed on lagged investment growth, lagged inflation, lagged GDP growth, lagged fiscal balance and a dummy for countries at war. The results showed a negative and significant coefficient on lagged inflation, suggesting that changes in inflation tend to reduce future investment. Since this coefficient is larger in magnitude than in the growth regressions, they suggested that investment is more sensitive to inflation than was the overall activity. They concluded that the negative relationship between inflation and growth arises due to inflation's adverse impact on investment.

Ghosh and Phillip (1998) examined the relationship between inflation, disinflation and output growth. They used panel data covering IMF member countries over the period 1960-1996. Their primary analytical tool was panel regression and they combined a non-

linear treatment of the inflation-growth relationship with extensive examination of robustness. They found a negative relationship that was statistically and economically significant which holds robustly at all but the lowest inflation rates. However, even if low inflation is associated with more rapid output growth, it was possible that disinflation may, at least in the short run, depress GDP growth. The inflation-growth relationship was non-linear in two senses. First, at very low inflation rates, the relationship was positive and second, at all other inflation rates, the apparent marginal effect of inflation on growth becomes less important as higher inflation rates are considered. They claimed that it was difficult to conceive of any methodology that would decisively prove causality from inflation to growth. They found no sign that the inflation-growth association found in annual panel data was spurious, arising only from short run correlations induced by shocks. They concluded that even though high inflation was bad for growth, disinflation was not good either.

In the later study, Bruno and Easterly (1998) addressed the problem of the growth effects of high inflation crises using the same threshold of 40 percent. The findings were similar to those of 1996 in that there was a negative association of inflation and growth in cases of high inflation crises and extreme inflation observations. There was no cross-sectional correlation between long run averages of growth and inflation. They established a robust finding that growth falls sharply during discrete high inflation crises, and then recovers after inflation falls.

Yatrakis (1998) tested the applicability of conflicting hypotheses on the relationship between inflation and growth using data from African economies. The purpose of the research was to test empirically whether the efficient firm theory holds

true in the case of African economies, as is the case in diverse geographic areas as the Organization for Economic Cooperation and Development (OECD), the G7 countries and the countries of the Caribbean basin. The efficient firm hypothesis states that an environment of low inflation generates conditions that lead to more rapid economic growth in the long run. The study examined growth and inflation data from 32 African economies during the period 1986-1996. The results of this analysis demonstrated a weak direct correlation between inflation and growth. This was attributed to external shocks, such as wars and revolutions, which result in negative economic growth and inflation rates. The study noted that much of this effect should have been removed from the sample by the deletion of outlying observations, that is, countries with inflation rates of over 25 percent. There was a positive but weak coefficient between the two variables, which suggested a direct relationship between the two variables pointing to a Phillips curve effect. The results supported the Neo-Keynesian view that economic policies directed at reducing inflation can also reduce growth in the African countries.

Andersen and Gruen (1999) examined the relationship between inflation and growth for countries with advanced industrial structures with comparable rates of inflation. They applied contributions from Levine and Renalt (1992) and Levine and Zervos (1993) to examine the empirical link between inflation and growth for OECD economies with comparable inflation rates (LR – LZ) approach.

This approach takes a regression analysis of the form:

$$\Delta q = \beta_i I + \beta_m M + \beta_z Z + \mu \quad \text{.....2.7}$$

where Δq - per capita GDP growth

I - set of variables always included in the regression, which are all important variables for growth

M - variable of interest, in this case it is average inflation (measured using the GDP deflator)

Z - a subset from a pool of variables

The approach was applied to 22 low inflation OECD countries. The dependent variable was the average annual per capita GDP growth. The estimated co-efficient on inflation was negative, that is higher inflation was associated with lower growth. They concluded that average inflation is a fragile explanatory variable of economic growth. In addition, cross-country studies of the relationship between inflation and growth found a negative correlation between inflation and growth, which was interpreted as a causal relationship.

Ercel (1999) emphasized the negative effects of uncertainty that is caused by high chronic inflation on Turkey's growth potential. The study indicated that the common view of the relationship between inflation and growth did not emerge either in the empirical nor theoretical studies in the economic literature. Using annual data for the period 1950-1999, the results showed a negative correlation between inflation and economic growth. Further, investment, which is the main determinant of growth in Turkey, was sensitive to inflation rates. The high inflation rate affected growth rate negatively during the last decades in Turkey. A high inflation rate that is persistent since the 1970s has played an important role in the emergence of social and economic problems, which led to lower growth.

In their study, Ricardo and Francisco (2001) investigated the relationship between inflation and output in the context of an economy facing persistent inflation. They considered Brazil, since it was a country, which had faced a long period of high inflation rates. Data was collected for the period 1980-95 and the series was the monthly indices of real output and consumer prices. They imposed minimal structure and made use of the idea that inflation shocks can be decomposed into permanent and temporary components. They used a bivariate vector auto regression (VAR) composed of output growth and the change in inflation in order to test the hypothesis that inflation has long run effects on output. They estimated a dynamic model to assess the short run relationship between the two variables. The growth rate of the economy was considered as the dependent variable and the inflation rate as the explanatory variable.

For VAR to be applicable, the time series had to be characterized by permanent shocks to the inflation rate and to the level of output, that is the series must be integrated of order one, that is, I (1). The unit root tests failed to reject the hypothesis of a unit root for both variables hence suggested that permanent inflation shocks did not have significant permanent effects on output growth rates. Therefore, inflation had no real impact in the long run. They concluded that there was a zero long run response of output to a permanent inflation shock in the context of a high inflation economy. They also found that there was a negative impact of inflation on output in the short run.

Harris (2001) presented a monetary model of endogenous growth and specified an econometric model consistent with it. The model was to find out if there was a negative inflation-growth effect. Empirical evaluation of the model was based on a large panel of OECD member countries over the years 1961-1997. Time effects and country effects

were treated as random variables leading to a random effects approach or as fixed parameters, a fixed effect approach. The economic model utilized, predicted a negative inflation-growth relationship, but more importantly a non-linear one, whereby the marginal effect was stronger at lower inflation rates than at higher ones. The estimation results showed that the reduction of high and medium inflation to moderate single digit figures had a significant positive effect on growth for the OECD countries. It was also clear that the marginal benefit of the deceleration process increased as the inflation rate was lowered. Both unobserved time and country effects proved to be important in the sense that country effects could, in part, capture differences in tax regimes and time effects represented unexpected inflation.

Mallik and Chowdhury (2001) found a positive relationship between inflation and growth for four South Asian countries (Bangladesh, India, Pakistan and Sri Lanka). The four were chosen on the basis that they were under pressure from the international lending agencies (the IMF and the World Bank) to reduce their inflation rates in order to boost their economic growth. They had moderate inflation rates of between 7-10 percent. Based on annual data, cointegration and error correction models were used to empirically examine the short run and long run dynamics of the inflation-growth relationship for the four countries. The data collected was from different years depending on the data availability of each country. The Engle-Granger two-step cointegration procedure was used to test the presence of cointegration between the two variables. The study found a long run positive relationship between GDP growth rate and inflation for all the four countries. There were also significant feedbacks between them. The results were that the sensitivity of inflation to changes in growth rates was larger than that of growth to

changes in inflation rates. They concluded that moderate inflation is helpful to growth, but faster growth feeds back into inflation.

Stilianos (2002) used univariate GARCH models of inflation and output growth and monthly data on inflation and output growth in the G7 countries for the 1960-2000 period to examine all possible causal relationships between inflation, output growth, real and nominal uncertainty and hence tested for a number of economic theories. They found that there was strong evidence that inflation is negatively associated with output growth. The effect worked both directly and indirectly via the inflation uncertainty channel. They also found that in most countries, output growth uncertainty was a positive determinant of the growth rate.

Singh and Kalirajan (2003) sought to know the inflation - growth nexus in developing countries with a special interest in India. They used annual data for the period 1971 – 1992. They sought to address the question whether there is any threshold level of inflation for India. They found that any increases in inflation from the previous period negatively affected growth. Hence the most desired policy for India was the one in which there is always a downward pressure on inflation, without having to worry about what the threshold level was. The results indicated that bringing down inflation in India to the then current level of inflation in the major trading partners like the USA, Germany, Japan, United Kingdom and France, would increase the perception growth by about 2 percentage points. Hence advocated that the policymakers should note that any increase in inflation from the previous period at any level had negative effect on economic growth.

2.4 Overview of Literature

From the theoretical literature, the relationship between inflation and economic growth is not clear. The structuralists see inflation as good for economic growth while the monetarists view it as bad for growth. The empirical literature also brings out this controversy. The studies done show that no clear relationship between inflation and growth has been consistently confirmed.

In general, most of these studies concluded that there was a significant negative relationship between inflation and GDP growth. Some studies however like Yatrakis (1998) and Mallik and Chowdhury (2001) found a positive relationship between these two variables. This shows that there is no conclusive evidence on the relationship between inflation and economic growth.

Most of the studies in the literature measured the inflation rate using the consumer price index (CPI) except Andersen and Gruen (1999) that used the GDP deflator as a measure of inflation. The real GDP growth rate was used to measure economic growth except Andersen and Gruen (1999) that used per capita GDP growth. Majority of the data applied was annual data. However, Stilianos (2002) and Ricardo and Francisco (2001) used monthly data on inflation and output growth.

Different studies use different rates of inflation thus the cause of the differences in conclusions. For example, Bruno and Easterly (1996) used a threshold of inflation rates of 40 per cent and found a negative relationship between inflation and economic growth. On the other hand, Mallik and Chowdhury (2001) used a moderate inflation rate of between 7 – 10 per cent and found a positive relationship. Therefore, the direction of the effect of the rate of inflation as a determinant of economic growth is not conclusive.

None of the studies used tests such as Granger causality to determine if there is causality between inflation and economic growth.

In Kenya, evidence is lacking as regards the relationship between inflation and economic growth. Therefore, this study added evidence to the literature about the nature of this relationship in Kenya.

CHAPTER THREE

THEORETICAL FRAMEWORK AND METHODOLOGY

3.1 Introduction

This section presents the theoretical framework of the relationship between inflation and economic growth. It shows how the stationarity and causality tests would be conducted and the models that were estimated.

3.2 Theoretical framework

As stated earlier, the approach that claims the existence of a relationship between inflation and economic growth is the Phillips curve approach. Phillips (1958) showed that there was a strong and relatively stable negative relationship between unemployment and wage inflation in the United Kingdom.

In the expectations – augmented Phillips curve, prices and wages are fully flexible, so that changes in aggregate demand have no real effects in the long run. Thus the long run aggregate supply curve is vertical and disturbances on the demand side of the economy do not affect output. The level of output at which the long run supply curve is vertical is known as the natural rate of output ($\bar{Y}$). A typical modern Keynesian formulation of aggregate supply is;

$$\text{In } P_t = \text{In}P_{t-1} + \pi^*_t + \lambda(\text{In}Y_t - \text{In}\bar{Y}_t) + e_t^s,\ \lambda > 0 \quad \ldots\ldots 3.1$$

Or $$\pi_t = \pi^*_t + \lambda(\text{In}Y_t - \text{In}\bar{Y}_t) + e_t^s \quad \ldots\ldots 3.2$$

Where $\pi_t \equiv \text{In } P_t - \text{In}P_{t-1}$ is inflation

$\lambda(\text{In}Y - \text{In}\bar{Y})$ - implies that at any time, there is an upward sloping

relationship between inflation and output; the relationship is log-linear for simplicity ($\lambda>0$)

e^s - captures supply shocks

π^* - is what inflation would be if output is equal to its natural rate and there are no supply shocks. It is known as the core or underlying inflation.

π^* equals the previous period's actual inflation, that is $\pi^*_t = \pi_{t-1}$

Hence there is a trade off between output and the change in inflation, but no permanent trade off between output and inflation. For inflation to be held steady at any level, output must equal the natural rate. But for inflation to fall, there must be a period when output is below the natural rate. The aggregate supply curve shown by equation 3.2 implies an upward sloping relationship between output and inflation and the aggregate demand side of the model implies a downward sloping relationship between the two variables.

To explore causality between inflation and economic growth, the concept of causality due to Granger was used to test for the prediction between these two variables. According to Granger causality approach, Y is said to be Granger caused by X if X helps to explain Y or if X helps in the prediction of Y or if the coefficients of the lagged X's are statistically significant (Engle and Granger, 1987). Therefore, if P_t is inflation and Y_t is economic growth, then P_t is caused by Y_t if the first variable is better predicted from past values of the first and second variables together rather than from the past values of the first variable alone. Three patterns of causality can be expected between variables, i.e. (i) unidirectional, a causality from the second to the first variable, (ii) bi-directional

causality, a causality from the second to the first variable and vice versa and (iii) no causality.

3.3 Empirical Model

To explore causality between inflation and economic growth, the concept of causality due to Granger was used to test the prediction between the two variables.

To test for causality between inflation and economic growth, the following models were used:

$$Y_t = \beta_0 + \beta_1 P_t + u_t \quad \ldots\ldots 3.3$$

$$P_t = \alpha_0 + \alpha_1 Y_t + v_t \quad \ldots\ldots 3.4$$

Where Y_t - is the rate of economic growth at time t

P_t - inflation rate at time t

u_t, v_t - random error terms.

Hence to test for Granger-causality, extensions of equations 3.3 and 3.4 were written including the lags of both the left hand side and right hand side variables as follows:

$$Y_t = \beta_0 + \sum_{i=1}^{p} \beta_{1i} P_{t-i} + \sum_{j=1}^{p} \beta_{1j} Y_{t-j} + u_t \quad \ldots\ldots 3.5$$

$$P_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} P_{t-i} + \sum_{j=1}^{p} \alpha_{1j} Y_{t-j} + v_t \quad \ldots\ldots 3.6$$

By estimating the above models, causality between the two variables was tested.

To be able to know how well the model fits the data, it was important to determine the lag length. Adding lags was beneficial because it reduced the sum of squares of the estimated residuals. The Akaike Information Criterion (AIC) and the Schwarz Bayesian Criterion (SBC) were used to determine the lag length.

3.4 Stationarity of data

Before conducting causality tests, the two variables were to be individually stationary. To test for stationarity, the Augmented Dickey Fuller (ADF) and the Phillips Perron tests were proposed. The ADF test had an advantage over the Dickey Fuller (DF) test since the ADF test accounts for higher auto correlations in the residuals.

The ADF equations used were as follows:

$$\Delta y_t = \alpha_0 (\alpha_1 - 1) y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + u_t \quad \text{.....3.7 (random walk with drift)}$$

$$\Delta y_t = \alpha_0 (\alpha_1 - 1) y_{t-1} + \alpha_2 t + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + u_t \quad \text{.....3.8 (random walk with drift and trend)}$$

The simple Dickey Fuller tests assumed that the errors were independent and had a constant variance. With the Augmented Dickey-Fuller tests, the unit root tests were valid even with the presence of serial correlation of unknown form, for example say AR (p) process (Gujarati, 1995). If the null hypothesis of a unit root (non-stationary) was rejected, a time series was considered as integrated of order zero, i.e. I (0), in levels. If not, the time series was not stationary in levels but was stationary at first difference.

3.5 Data Type and Sources

To achieve the objectives of the study, annual time series data for the period 1963 to 2003 were obtained from the International Financial Statistics and the Kenya's Economic Surveys. The data collected included the inflation rate and the real Gross Domestic Product (GDP) growth rate.

3.6 Measurement of variables

Inflation (P) – measured by the CPI, which represents a form of weighted average of prices of consumer items, taken periodically at various locations within a given economy.

Economic growth (Y) – expressed as the increase in total employment real GDP over time and is given as a percentage.

CHAPTER FOUR

MODEL ESTIMATION AND ANALYSIS OF RESULTS

4.1 Introduction

This chapter presents the model estimation based on the empirical model outlined in chapter three. Prior to the estimation, data were tested for stationarity and causality. The Augmented Dickey Fuller (ADF) and the Phillips Perron (PP) tests were used to test for stationarity of inflation and economic growth rates while Granger causality tests were used to test for causality, taking in mind the existence of the three cases i.e. unidirectional, bilateral or independence. Other diagnostic tests, like stability and residual tests, were also carried out to test for the statistical soundness of the models.

4.2 Stationarity tests

a) Graphical inspection method

The graph in figure A.1 in appendix II suggests that the time series of the real GDP growth rate exhibits relative fluctuations over the years. This shows that the series could be stationary. The graph in figure A.2 in appendix II suggests that the time series of the inflation rate exhibit relative tranquility except periods of high volatility such as the year 1993 (The causes of this behaviour are already discussed in the background of this study). This shows that the series could be non-stationary. However, basing a decision on casual or an eyeball inspection may be misleading therefore another appropriate method for testing for stationarity was used.

b) Unit root tests

The inflation and real GDP growth rates were tested for stationarity using the ADF and the PP tests. The first step was to obtain an appropriate lag length by choosing the lag length with a corresponding probability of not more that 0.05. Then each variable was tested for unit root at the optimal lag length. The stationarity test results are presented in table A.2 in appendix II. The real GDP growth rate was found to be an I (0), hence it was stationary at levels since the null hypothesis of a unit root was rejected. Inflation on the other hand was an I (1), meaning that this variable was stationary at first difference.

4.3 Granger Causality Tests

The Granger causality test was used to determine the direction of causality between inflation rate and economic growth rate. It was assumed that the information relevant to the prediction of the respective variables was solely contained in the time series data on each variable. The table that follows shows the Granger causality test results.

Table 4.1 Granger Causality Test Results

Null hypothesis	Number of lags	F-statistics
GDP does not Granger cause inflation	2	1.08
GDP does not Granger cause inflation	3	0.94
GDP does not Granger cause inflation	4	1.19
Inflation does not Granger cause GDP	2	0.10
Inflation does not Granger cause GDP	3	0.04
Inflation does not Granger cause GDP	4	0.49

$F_{0.01}= 7.29$, $F_{0.05}= 4.04$, $F_{0.10}= 2.79$

The Granger causality tests for the second, third and fourth lag lengths are presented in table 4.1 above. All the results are not statistically significant therefore, the causality tests reveal that there is no causality between inflation rate and economic growth rate in Kenya. This led to the conclusion that there was independence between the two variables. It is however noted that lack of a Granger-causal relationship from one group of variables to the remaining variables cannot necessarily be interpreted as lack of a cause and effect relationship (Lutkepohl, 1993). Further, since the real GDP is net of inflation, i.e. real GDP = nominal GDP – inflation, then it was not expected that GDP could cause inflation and vice versa, hence the insignificance of the causality of the variables.

4.4 Model Selection Criteria

Before estimating the model, a decision was to be made regarding the number of lags to be included in estimating the inflation and growth rate models. The Akaike Information Criterion (AIC) and the Schwarz Bayesian Criterion (SBC) were used to determine the appropriate lag length of the models. A *priori* notion that three years was sufficiently long enough to cover the dynamics, was used as a guidepost. The following table gives the results of the selection criteria for the economic growth model.

Table 4.2 Results of the Lag Length Selection for the economic growth model

Lag Length	AIC	SBC
4	4.8035	5.2479
3	4.7680*	5.1199*
2	4.9410	5.2022
1	4.9586	5.1309

The decision rule was to choose a model with the lowest value of the information criteria. From the results above, AIC and SBC point to three (3) as the appropriate lag

length for the economic growth model. Hence this model was estimated using three lags. The following table shows the results of the inflation model selection criteria.

Table 4.3 Results of the Lag Length Selection for the inflation model

Lag Length	AIC	SBC
4	7.0406	7.4850
3	6.9887	7.3046
2	6.8737*	7.1349*
1	7.0624	7.2348

In this case, the two criteria point to two (2) as the appropriate lag length for the inflation model. Hence this model was estimated using a lag length of two.

The economic growth and inflation rate models were initially estimated at levels. The regression results are presented in table A.8 and table A.9 in appendix III respectively. However, after testing for the various diagnostic tests, most of the tests failed for both models as shown in table A.3 for the economic growth rate model and table A.4 for the inflation rate model, both of which are presented in appendix II. After a rigorous process, the diagnostic tests that the estimated models passed are presented in section 4.5 that follows.

4.5 Diagnostic tests for regression residuals

4.5.1 Residual tests

The diagnostic test results for the economic growth and inflation models are presented in table A.5 and table A.7 respectively, both of which are in appendix II.

a) Histogram – Normality test

It tests whether the series is normally distributed. The null hypothesis is normal distribution in the residuals. The economic growth and inflation models pass the normality tests with a probability of 0.77 and 0.49 respectively, hence the null hypothesis

is accepted at 5 percent significance level. Therefore, the errors for both models are normally distributed with a mean of zero and a constant variance.

b) Serial Correlation LM test

This test may be used to test for higher order ARMA errors where the null hypothesis is no serial correlation in the errors. The probabilities of GDP and inflation are 0.12 and 0.44 respectively, hence accepting the null hypothesis at 5 percent significance level. Therefore, the disturbances for both models are also normally distributed with a mean of zero and a constant variance.

c) ARCH LM test

This is a test for autoregressive conditional Heteroskedasticity (ARCH) in the residuals. Ignoring ARCH effects may result in loss of efficiency. GDP and inflation have probabilities of 0.98 and 0.76 respectively hence concluding that there is no ARCH present in the residuals. The null hypothesis of no ARCH in the residuals is accepted at 5 percent significance level.

d) White Heteroskedasticity test

This is a test of the null hypothesis of no Heteroskedasticity of some unknown form in the residuals. Heteroskedasticity of the error term violates the assumption that the disturbances are normally distributed with a mean of zero and a constant variance. The economic growth and inflation model show that there is no Heteroskedasticity present in the residuals since their probabilities are 0.59 and 0.57 respectively, therefore the null hypothesis is accepted at 5 percent significance level.

4.5.2 Stability tests

a) Chow break point test

The test fits an equation separately for each sub-sample and tries to see whether there are significant differences in the estimated equations. A significant difference indicates a structural change in the relationship. The growth model fails this test since its probability is 0.03 therefore the null hypothesis of no structural change is rejected at 5 percent. This shows that there was a structural change in the relationship.

b) Chow forecast test

It estimates the model for a sub-sample, which is then used to predict the values of the dependent variable in the remaining sub-sample. The null hypothesis is that there is no structural change. The growth model accepts the null hypothesis at 5 percent since its probability is 0.64 concluding that there was no structural change in the series.

c) Ramsey RESET test

It is a general test that tests for omitted variables, incorrect functional form of a model and correlation between the independent variables and the error term. Under such specification errors, the Least Square estimates are biased and inconsistent. The null hypothesis is that there is no misspecification in the model. The results of the growth and inflation models show that both models are well specified with a probability of 0.69 and 0.29 respectively. Hence concluding that these two models accept the null hypothesis of no misspecification at 5 percent significance level.

d) CUSUM test

This test is based on the cumulative sum of the recursive residuals. It plots the cumulative sum together with the 5 percent critical lines. The test finds parameter

instability if the cumulative sum goes outside the area between the two critical lines. The CUSUM tests for the economic growth and inflation models, as shown in figure A.3 and figure A.4 respectively in appendix II, proved that the models were stable since the respective cumulative sums do not go outside the area between the two critical lines.

After establishing that all the diagnostic tests were significant at 5 percent level, the economic growth and inflation estimating models were adopted for interpretation and forecasting.

4.6 Model estimation and results

The first difference of inflation was used in estimation since inflation is an I(1), failure to which the results would be misleading. GDP was estimated at levels since it is an I (0).

Table 4.4 Regression results of the economic growth model

Independent variables	coefficients	t-ratio
Constant	1.58	1.78*
First differenced inflation, 0 lags	-0.07	-1.21
First differenced inflation, 1 lag	0.02	0.43
First differenced inflation, 2 lags	-0.02	-0.28
First differenced inflation, 3 lags	0.09	1.57
Economic growth rate, 1 lag	0.54	3.30*
Economic growth rate, 2 lags	0.29	1.75*
Economic growth rate, 3 lags	-0.25	-1.15

Note: *Significant at 5 % level

Adjusted $R^2 = 0.35$ DW=1.65 F-statistic=3.72 Prob=0.0057

The coefficient of the inflation rate is negative at levels, showing that there is a negative relationship between inflation and economic growth rate in the short run though the inflation rate is statistically insignificant. Further, the inflation rate of the previous year has a positive impact on growth. However, the impact of inflation on growth goes on

decreasing with past periods as is shown by the reducing values of the t-ratios. The growth model shows that economic growth is significantly affected by its first and second lags as indicated in the table above. This means that economic growth in the present year can be used to predict the growth rate of the next two years. However, this impact will be felt only in the medium run, after which no further predictions can be made. The impact of inflation on growth, though insignificant, shows that a change in inflation in the present year would affect growth negatively since a rise in the prices would lead to a reduction in the purchasing power of consumers hence leading to a reduction in consumption and this has a negative impact on growth. For the following year, inflation impacts growth positively since producers would have increased their output as a result of the increased prices so that they could maximize their profits.

The adjusted R-squared is 0.35 implying that only 35 percent of the variations in the economic growth rate are significantly caused by its past values. The coefficients of the lags of the inflation rate have different signs, indicating that there is a cyclical relationship between these two variables, although this relationship is not statistically significant.

The residual graph for the initial inflation model (table A.10 in appendix III) is presented in figure A.5 in appendix III. It shows that there is an extreme shock in the year 1993, 1995 and 1979. To capture the extreme values operating in these three periods of high volatility, three dummy variables were introduced. The equation was then re-estimated and its residual graph presented in figure A.6 in appendix III.

The following are the regression results for the re-estimated inflation model.

Table 4.5 Regression results of the inflation model

Independent variable	coefficients	t-ratio
Constant	-3.21	-2.42*
Economic growth rate, 0 lags	-0.88	-3.69*
Economic growth rate, 1 lag	0.56	2.12*
Economic growth rate, 2 lags	1.14	4.78*
First differenced inflation, 1 lag	-0.33	-3.92*
First differenced inflation, 2 lags	-0.15	-1.83*
Drought, 1993	22.58	5.59*
Tight monetary policy, 1995	-26.14	-6.15*
Second oil price shocks, 1979	-17.91	-4.38*

Note: *Significant at 5 % level

Adjusted $R^2 = 0.79$ F-statistic=11.28 Prob=0.000 DW=1.92

The inflation model, whose results are presented above, shows that all the variables are statistically significant. The effect of the shocks caused by drought in 1993, the tight monetary policy measures in 1995 and the second oil price shock in 1979, are very significant. This means that policy interventions, like tight monetary measures, have the greatest impact on inflation as shown by the biggest t-ratio. This impact is negative showing that when monetary policy measures are implemented, this will lead to a decrease in inflation instantaneously. The climatic shocks are also very significant with a positive effect on inflation. This implies that when such a shock occurs, for example drought, this will lead to food shortages instantaneously and therefore this leads to an increase in prices.

The inflation rate is negatively affected by its own lags meaning that an increase in inflation this year would lead to a decrease in inflation in the next two years and vice versa. This would probably be as a result of government intervention and the impact would be felt for atleast two years. The inflation rate is negatively affected by economic growth rate in the short run, implying that high prices lead to the reduction in productivity in the short run and vice versa. Inflation is also positively affected by two lags of economic growth rate. This implies that inflation impacts growth positively since producers will have increased their output as a result of the increased prices to be able to maximize their profits. This impact will be felt atleast in the medium run.

The adjusted R-squared improved significantly from 0.19 to 0.79 after the inclusion of the dummy variables showing that they are very significant in this model. The adjusted R-squared of 0.79 implies that 79 percent of the variations in inflation are caused by changes in economic growth rate together with its past values, the past values of the changes in the inflation rate and shocks.

The coefficient of economic growth is negative showing that there is an inverse relationship between inflation and economic growth rate in the short run. However, in the long run, this relationship is positive. The long run relationship is obtained by setting all the first differences to zero and then adding the coefficients of the other variables (Johnston and Dinardo, 1997). If the resultant sum of the coefficients is positive, then this represents a long run relationship between the dependent and independent variables. In this case, the sum of the coefficients is 0.82 hence there is a positive long run relationship between inflation and economic growth. The probability of the F-statistic is 0.00 hence

the null hypothesis that the coefficients are equal to zero, is rejected. This implies that there exists a meaningful relationship between inflation and the explanatory variables.

These results reveal that there is a short run negative relationship between inflation and economic growth. However in the long run, there is a positive relationship between inflation and economic growth. Theoretically, there is a debate between the monetarists and the structuralists. In the debate, the monetarists view inflation as bad for economic growth while the structuralists view inflation as an accompaniment for growth. This study therefore agrees with the monetarists that high inflation rate is detrimental to economic growth rate. However, this is only applicable in the short run. In the long run, inflation is good for growth as is viewed by the structuralists.

Empirically, these results are similar to Ricardo and Francisco (2001) who established that there was a negative short run relationship between inflation and economic growth. Mallik and Chowdhury (2001) further found a positive long run relationship between inflation rate and economic growth rate as is the case with the results of the long run relationship in this study. The empirical results presented above show the short run negative relationship and the long run positive relationship between inflation and economic growth. Bruno and Easterly (1996) also found a short to medium run negative relationship between these two variables. Other studies that also established a negative relationship between inflation and economic growth in the short run are Loungani and Sheets (1997), Ercel (1999), Harris (2001) and Singh and Kalirajan (2003). The results of this study however differ from those of other studies like Yatrakis (1998) who found a positive but weak short run relationship between inflation and growth.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND POLICY RECOMMENDATIONS

5.1 Summary and Conclusions

This study examined the relationship between inflation rate and economic growth rate in Kenya using annual published data covering the period 1963 to 2003. Specifically, this study was interested in determining the nature of this relationship and the direction of causality between inflation and economic growth. This study also sought to establish whether this relationship is a short run or a long run one. The Phillips curve approach was used in this study. This approach tried to present a positive relationship between inflation and economic growth, which is sustainable in the short run. Granger causality tests were used to test for causality between the variables.

The unit root tests indicated that the economic growth rate was stationary at levels and the inflation rate was stationary at first difference. The Granger causality tests revealed that there was no causality between inflation and economic growth. The estimated results indicated that there was a negative relationship between inflation and economic growth in the short run. However, the relationship is positive in the long run. Further, the results showed that economic growth is statistically affected by its first and second lags. On the other hand, inflation was statistically affected by economic growth, the first and second lags of inflation and the shocks caused by the oil price, drought and tight monetary policy measures.

Empirical results show that the Phillips curve is not applicable to Kenya. This is because, there is a negative short run relationship and a positive long run relationship between inflation and economic growth in Kenya. The results however contradict the

Phillips curve approach since this approach presents a short run positive relationship between inflation and economic growth.

5.2 Policy Recommendations

The government should develop policies that focus on how to keep the inflation rate at a specified low target and at the same time improve on the productive capacity of this country in the short and medium term. Monetary policy interventions should be implemented since these help to keep the inflation rate low in the short run, thereby boosting economic growth. The government should also put measures that will reduce the impact of climatic shocks like drought on the inflation rate and put into place disaster preparedness plans to be ready in case of disaster. Since in the long run the impact of inflation on economic growth is positive, the government should provide incentives to farmers and producers so that they can be able to increase their production and be able to increase their exports in the long run.

5.3 Limitations of the Study and suggestions for further research.

In the course of undertaking this research, the major limitation was the unavailability of research material on this topic that is relevant to Kenya. Another limitation was that this study assumed that inflation was only affected by growth and vice versa. It did not take into consideration other variables that affect inflation and economic growth. Therefore, further research could be done on the relationship between inflation and economic growth taking into consideration the significant variables that affect the two variables respectively. Since this study focused on time series data, studies can also be done using panel or cross-sectional data and compare the empirical results with those of this study.

BIBLIOGRAPHY

Agénor, P. and Montiel, P.J., (1996), *Development Macroeconomics*, New Jersey: Princeton University Press.

Andersen, P. and Gruen, D., (1999), *Macroeconomic Policies and Growth*, New York: Oxford University Press.

Branson, W.H., (1979), *Macroeconomic Theory and Policy*, 2nd Edition, New York: Harper and Row Publishers.

Bruno, M. and Easterly, W., (1996), "Inflation and Growth: In Search of a Stable Relationship", *Federal Reserve Bank of St. Louis*, Vol.39 No. 4 Pp 134-157.

Bruno, M and Easterly W, (1998), "Inflation Crises and Long-Run Growth", *NBER Working Paper* No. 5209.

Campos, R., (1964), "Two views of inflation in Latin America", *Leading Issues In Development Economics*, New York: Oxford University Press.

Engle, R. and Granger, C., (1987), "Cointegrating and Error Correction: Representation, Estimation and Testing", *Econometrica*, Vol. 55 No.3, Pp 251-276.

Ercel, G., (1999), "The Relationship between Inflation and Growth", *Journal of Macroeconomics*, Vol. 12 No. 3 Pp56 – 71.

Friedman, M., (1973), *Money and Economic Development*, Toronto: Lexington Books.

Ghosh, A and Phillip, S., (1998), "Warning: Inflation may be harmful to your Growth", *IMF Staff Papers*, Vol.45, No.4, Pp 212-227

Gujarati, D.N., (1995), *Basic Econometrics*, 3rd edition, New York: Macgraw Hill.

Harris, N., (2001), The Negative Inflation - Growth Effect: Theory and Evidence, *Melbourne Institute Working Paper*, No. 12/01

Higgins, B., (1969), *Economic Development: Principles, Problems and Policies*, 2nd

Edition, London: Constable and Company Limited.

International Monetary Fund (2002), *International Financial Statistics*, Washington D.C. Yearbook.

Johnston, J and Dinardo, J. (1997), *Econometric Methods*, 4th Edition, New York: The McGraw-Hill Company Inc.

Levine, R. and Renalt, J., (1992), " Policy and Growth from cross-sectional studies", American Economic Review, Papers and Proceedings, Vol. 79, Pp 212-219

Levine, R. and Zervos, S.J., (1993), "What We Have Learnt About Policy and Growth From Cross-Country Regressions", American Economic Review, Papers and Proceedings, Vol.83, Pp 426-430.

Loungani, P. and Sheets, N., (1997), "Central Bank Independence, Inflation and Growth In Transition Economies", *Journal of Money, Credit and Banking*, Vol.29 No.3, New York: Ohio State University Press.

Lutkepohl, H., (1993), *Introduction to Multiple Time Series Analysis*, 2nd Edition, Ohio: Southwestern Publishing Company.

Mallik, G. and Chowdhury, A., (2001), "Inflation and Economic Growth: Evidence From Four South-Asian Countries", *Asia Pacific Development Journal*, Vol. 8 No.1 Pp 123-132.

Meier, G.M., (1995), *Leading Issues in Development Economics*, 6th Edition, New York: Oxford University Press.

Phillips, A.W., (1958). "The Relationship Between Unemployment and the Rate of Change in Money Wages in the UK, 1861-1957", *Economica*, Vol. 25, Pp 283-299.

Republic of Kenya (1965), *Sessional Paper No.10 of 1965 on African Socialism and its Application to Planning in Kenya*, Nairobi: Government Printer.

Republic of Kenya (1986), *Sessional Paper No.1 of 1986 on Economic Management for Renewed Growth*, Nairobi: Government Printer.

Republic of Kenya, *Economic Surveys*, (Various Issues), Nairobi: Government Printer.

Ricardo, J.F. and Francisco, G., (2001), "Does High Inflation Affect Growth in the Long and Short Run", *Journal of Applied Economics*, Vol.4, No.1, Pp89 – 105.

Romer, D., (1996), Inflation and the Growth Rate of Output, *NBER Working Paper Series*, No.5575.

Sarel, M., (1996), "Non-Linear Effects of Inflation and Economic Growth", *IMF Staff Papers*, Vol.43 No.1, Pp199 – 214.

Singh, K. and Kalirajan, K., (2003), "The Inflation – Growth Nexus in India: An Empirical Analysis", *National Council of Applied Economics Research*, New Delhi: Kings Publishers.

Spencer, M., (1983), *Contemporary Macroeconomics*, 5th Edition, New York: Worth Publishers, Inc.

Stilianos, F., (2002), "Inflation, Output Growth and Nominal Uncertainty: Empirical Evidence for G7 Countries", *Journal of Monetary Economics*, Vol. 6 Pp 166-187.

World Bank, (1984), *Trends in Developing Countries*, Washington D.C.: World Bank.

World Bank, (1985), *Trends in Developing Countries*, Washington D.C.: World Bank.

World Bank, (1990), *Trends in Developing Countries*, Washington D.C.: World Bank.

Yatrakis, P.G, (1998), "Effects of Inflation on Economic Growth in Africa", *Journal of Applied Business and Entrepreneurship*, Vol. 22 No.10 Pp 154-169.

APPENDICES

APPENDIX I: RAW DATA

Table A.1: Raw Data

YEAR	GDP (%)	Inflation (%)		GDP (%)	Inflation (%)
1963	6.5	2.2	1984	1.8	10.3
1964	6.8	1.1	1985	4.3	13
1965	2.4	5.8	1986	7.1	4.8
1966	10.5	1.2	1987	5.9	7.6
1967	3.36	0.25	1988	6.2	11.2
1968	8.6	0.4	1989	4.7	12.9
1969	5.5	-0.2	1990	4.2	15.6
1970	7.4	2.2	1991	1.4	19.8
1971	6.9	3.8	1992	-0.8	29.5
1972	9.5	5.8	1993	0.4	45.8
1973	6.8	9.3	1994	2.6	29
1974	1.5	17.8	1995	4.4	0.8
1975	3.4	19.1	1996	4.1	8.8
1976	7	11.4	1997	2.1	12
1977	9.4	14.8	1998	1.6	6.6
1978	10.8	16.9	1999	1.3	3.5
1979	3.7	8	2000	-0.2	6.2
1980	5.6	13.9	2001	1.2	5.8
1981	4.3	11.6	2002	1.1	2
1982	1.5	20.7	2003	1.8	9.8
1983	1.3	11.4			

Data Source: *International Financial Statistics*, Yearbook, 2002

Economic Surveys, various issues.

Figure A.1 Real GDP growth rate, 1963 - 2003

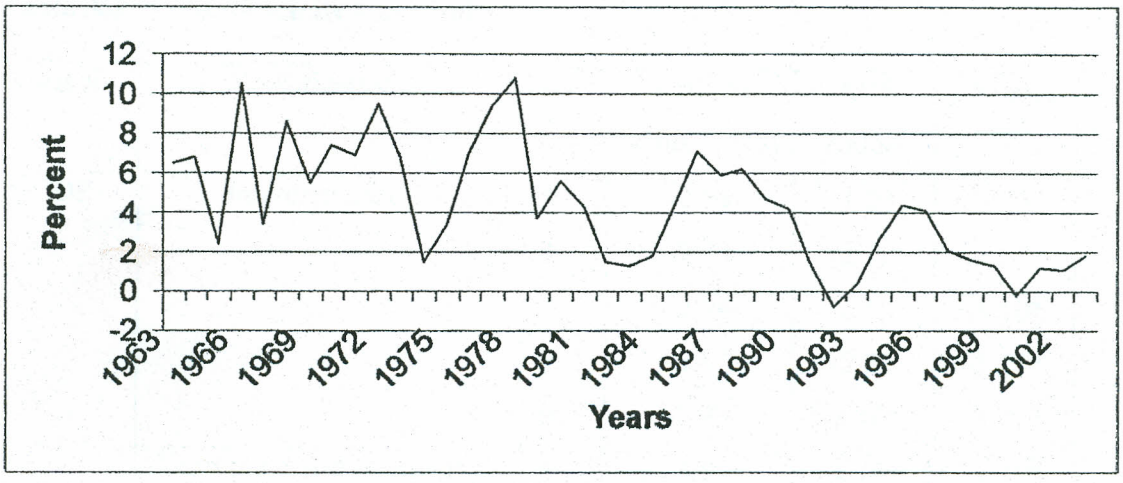
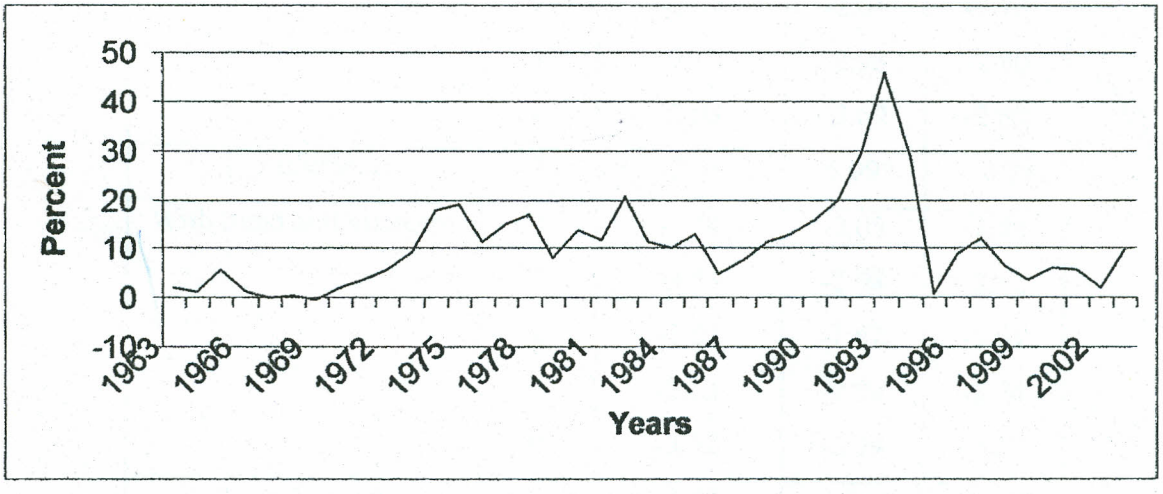


Figure A.2 Inflation rate over the years, 1963 - 2003



APPENDIX II: DIAGNOSTIC TEST RESULTS

Table A.2 Stationarity test results

Variable	Specification	Lag	Critical value (5%)	ADF value	PP value
GDP	Intercept only	4	-2.94	-1.23	-3.47*
		3	-2.94	-2.20	-3.47*
		2	-2.94	-2.53	-3.50*
		1	-2.93	-2.23	-3.35*
		0	-2.93	-3.46*	-3.46*
	With trend and intercept	4	-3.54	-4.19*	-4.71*
		3	-3.54	-4.18*	-4.79*
		2	-3.53	-5.22*	-4.88*
		1	-3.53	-3.55*	-4.84*
		0	-3.52	-4.84*	-4.84*
INFLATION	Intercept only	4	-2.94	-2.31	-2.68
		3	-2.94	-2.34	-2.66
		2	-2.94	-2.01	-2.70
		1	-2.93	-2.98	-2.80
		0	-2.93	-2.69	-2.69
	1st difference	0	-2.93	-5.99*	-5.99*
	With trend and intercept	4	-3.54	-2.05	-2.59
		3	-3.53	-2.08	-2.58
		2	-3.53	-1.82	-2.61
		1	-3.53	-2.89	-2.74
		0	-3.52	-2.59	-2.59
	1st difference	0	-3.53	-5.98*	-5.98*

* Significant at 5 percent significance level

Table A.3 Diagnostic test results for the economic growth model at levels

Test type		
Jarque-Bera normality test	Test statistic	1.10
	Probability	0.58
White Heteroskedasticity test	Test statistic	0.36
	Probability	0.69
Serial correlation LM test	Test statistic	5.91
	Probability	0.006
Ramsey RESET test	Test statistic	0.03
	Probability	0.88
ARCH LM test	Test statistic	5.20
	Probability	0.03
Chow break point test	Test statistic	9.13
	Probability	0.003
Chow forecast test	Test statistic	1.85
	Probability	0.44

Table A.4 Diagnostic test results for the inflation model at levels

Test type		
Jarque-Bera normality test	Test statistic	17.67
	Probability	0.00
White Heteroskedasticity test	Test statistic	4.09
	Probability	0.02
Serial correlation LM test	Test statistic	10.43
	Probability	0.00
Ramsey RESET test	Test statistic	3.11
	Probability	0.09
ARCH LM test	Test statistic	4.70
	Probability	0.04
Chow break point test	Test statistic	0.32
	Probability	0.73
Chow forecast test	Test statistic	4.42
	Probability	0.04

Table A.5 Diagnostic test results for the estimated growth model

Test type		
Jarque-Bera normality test	Test statistic	0.53
	Probability	0.77
White Heteroskedasticity test	Test statistic	0.88
	Probability	0.59
Serial correlation LM test	Test statistic	2.33
	Probability	0.12
Ramsey RESET test	Test statistic	0.16
	Probability	0.69
ARCH LM test	Test statistic	0.009
	Probability	0.98
Chow break point test	Test statistic	2.72
	Probability	0.03
Chow forecast test	Test statistic	0.84
	Probability	0.64

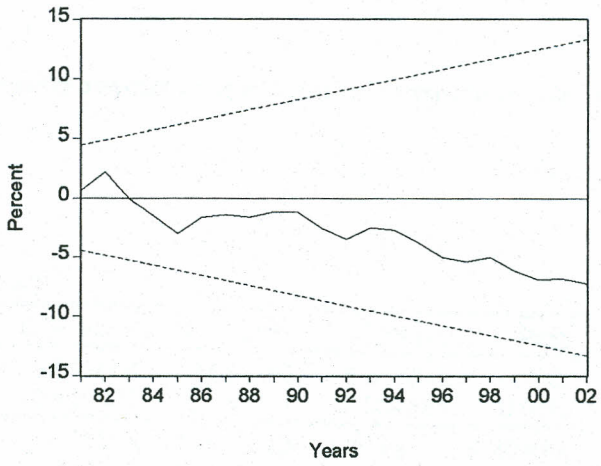
Table A.6 Diagnostic test results for the initial inflation model

Test type		
Jarque-Bera normality test	Test statistic	9.28
	Probability	0.01
White Heteroskedasticity test	Test statistic	1.87
	Probability	0.09
Serial correlation LM test	Test statistic	0.85
	Probability	0.44
Ramsey RESET test	Test statistic	8.45
	Probability	0.01
ARCH LM test	Test statistic	0.09
	Probability	0.76
Chow break point test	Test statistic	0.71
	Probability	0.64
Chow forecast test	Test statistic	2.46
	Probability	0.06

Table A.7 Diagnostic test results for the re-estimated inflation model

Test type		
Jarque-Bera normality test	Test statistic	1.42
	Probability	0.49
White Heteroskedasticity test	Test statistic	0.89
	Probability	0.57
Serial correlation LM test	Test statistic	0.35
	Probability	0.71
Ramsey RESET test	Test statistic	1.31
	Probability	0.29
ARCH LM test	Test statistic	0.10
	Probability	0.75

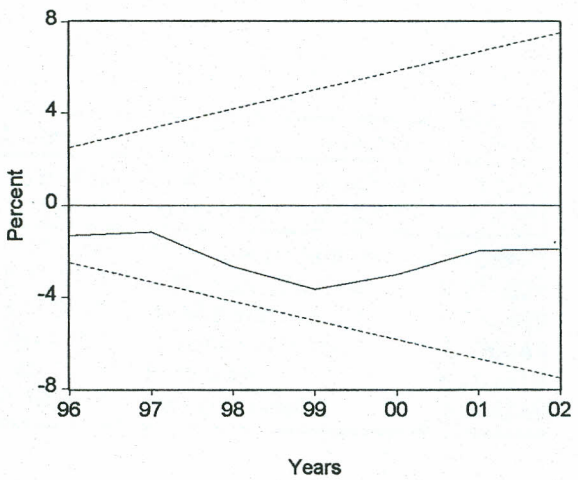
Fig. A.3 CUSUM test of the economic growth model



where..... is cumulative sum

_____is 5% significant level

Fig. A.4 CUSUM test of the inflation model



where..... is cumulative sum

_____is 5% significant level

APPENDIX III: ESTIMATED MODELS AND RESIDUAL GRAPHS

Table A.8 Regression results of the economic growth model at levels

Dependent Variable: GDP

Method: Least Squares

Sample: 1963 2002
Included observations: 40

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.693054	0.684768	8.313842	0.0000
INF	-0.121997	0.048747	-2.502681	0.0167

R-squared	0.141503	Mean dependent var	4.404000
Adjusted R-squared	0.118911	S.D. dependent var	3.040331
S.E. of regression	2.853847	Akaike info criterion	4.983920
Sum squared resid	309.4889	Schwarz criterion	5.068364
Log likelihood	-97.67840	F-statistic	6.263415
Durbin-Watson stat	1.108475	Prob(F-statistic)	0.016745

Table A.9 Regression results of the inflation model at levels

Dependent Variable: INFLATION

Method: Least Squares

Sample: 1963 2002
Included observations: 40

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	15.67440	2.470180	6.345445	0.0000
GDP	-1.159888	0.463458	-2.502681	0.0167

R-squared	0.141503	Mean dependent var	10.56625
Adjusted R-squared	0.118911	S.D. dependent var	9.374621
S.E. of regression	8.799612	Akaike info criterion	7.235999
Sum squared resid	2942.461	Schwarz criterion	7.320443
Log likelihood	-142.7200	F-statistic	6.263415
Durbin-Watson stat	0.763616	Prob(F-statistic)	0.016745

Table A.10 Regression results of the initial inflation model without dummies

Dependent Variable: DINFLATION
Method: Least Squares

Sample(adjusted): 1966 2002
Included observations: 37 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.571671	2.408349	-0.652593	0.5188
DINF1	-0.069160	0.153461	-0.450671	0.6554
DINF2	-0.349063	0.150880	-2.313520	0.0275
GDP	-0.802855	0.449501	-1.786101	0.0839
GDP1	0.032962	0.473211	0.069657	0.9449
GDP2	1.072940	0.454786	2.359220	0.0248

R-squared	0.305900	Mean dependent var	-0.102703
Adjusted R-squared	0.193948	S.D. dependent var	7.783449
S.E. of regression	6.988010	Akaike info criterion	6.873662
Sum squared resid	1513.801	Schwarz criterion	7.134892
Log likelihood	-121.1628	F-statistic	2.732429
Durbin-Watson stat	2.016103	Prob(F-statistic)	0.037039

Fig. A.5 Graph of the initial regression residual inflation model (without dummies)

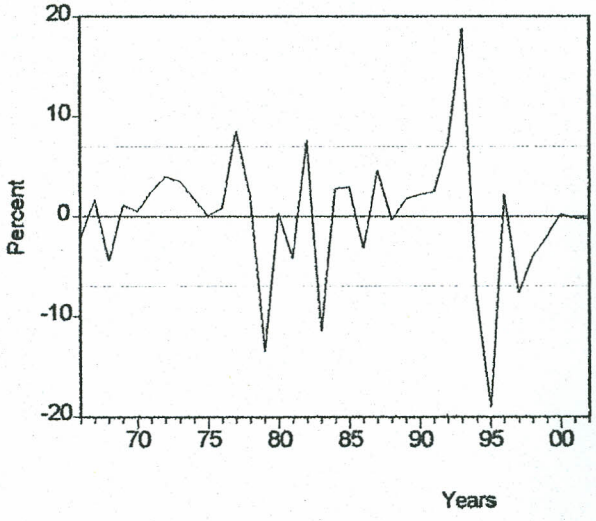


Fig. A.6 Graph of the regression residual inflation model with dummies