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**DYNAMICS OF INFLATION AND ITS EFFECTS ON
THE KENYAN ECONOMY**

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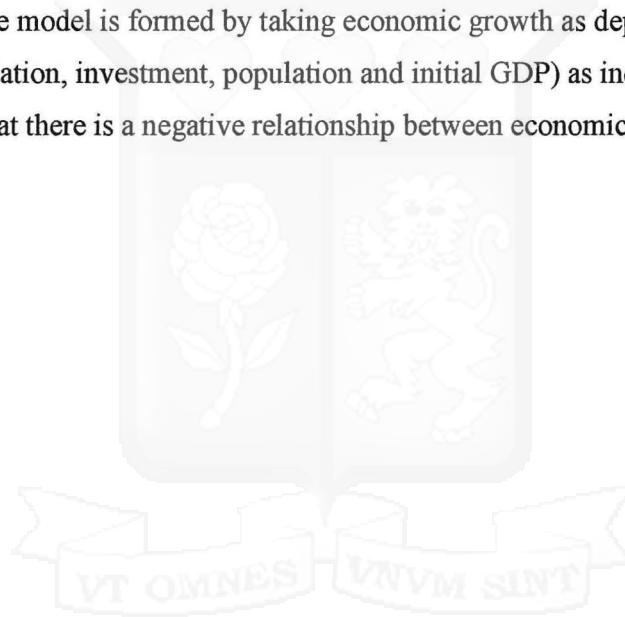
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ABSTRACT

The study on the relationship between economic growth and inflation has attracted attention from both researchers and policy makers. A high and sustained economic growth with low and stable inflation is the central objective of most policy makers. The main purpose of this study is to ascertain the nature of the relationship between inflation and economic growth in Kenya. One of the most important objectives for any countries is to sustain high economic growth. Even though there are main factors that affect economic growth, the concern of this paper is only about inflation. The relationship between economic growth and inflation is debatable. The first objective of this study is to investigate the relationship between inflation and economic growth. To analyze the data the model is formed by taking economic growth as dependent variable and four variables (i.e. inflation, investment, population and initial GDP) as independent variables. The result indicates that there is a negative relationship between economic growth and inflation.



1. INTRODUCTION

1.1 BACKGROUND

Achieving sustainable rapid economic growth is the objective of most countries. It has been a problem to achieve such objective due to many factors that affect economic growth. Among many variables that can be stated as the determinant of economic growth is inflation (Barro, 1995). London economic dictionary (2009) defines inflation as “the consistent tendency for nominal prices to increase which leads to a decline in the purchasing power of a country’s currency while World Bank (2007) defines inflation rate as “an annual increase in the price of goods and services that are purchased by consumers in an economy. High and volatile information can be damaging to both individual businesses and consumers and the economy as a whole.

To attain sustainable economic growth coupled with price stability continues to be the central objective of macroeconomic policies for most countries in the world today. Among others the emphasis given to price stability in conduct of monetary policy is with a view to promoting sustainable economic growth as well as strengthening the purchasing power of the domestic currency (Umaru and Zubairu, 2012).

The question on whether or not inflation is harmful to economic growth has recently been a subject of intense debate to policy makers and macro economists. Several studies have established a negative relationship between inflation and economic growth. Barro (1995) examines the issue and finds a negative relationship between inflation and economic growth, considering variables like fertility rate, education, etc constant. Gultekin (1983) also explained why inflation and economic growth have a negative relationship as growth rate is depended on rate of return but rate of return is decreased by inflation and hence economic growth is negatively related to inflation.

Evidence showing relationship between inflation and economic growth from some of the Asian countries such as India showed that the growth rate of Gross Domestic Product (GDP) in India increased from 3.5% in the 1970s to 5.5% in the 1980s while the inflation rate accelerated steadily from an annual average of 1.7% during the 1950s to 6.4% in the 1960s and further to

9.0% in the 1970s before easing marginally to 8.0% in the 1980s (Prasanna and Gopakumar, 2010).

Kenya has experienced strong economic growth for over nearly a decade, however inflation which was thought to be under control has become a major challenge. The highest inflation rate ever recorded in Kenya was in 1993 at 46% and this was attributed to an excessive money supply, low aggregate demand, depreciation of the Kenyan shilling with a low investor confidence due to tumult surrounding transition to plural politics (Economic Survey, 1994). A few studies in the context of Tanzania for example have already investigated the existence of a relationship between inflation and economic growth (Shitundu and Luvanda, 2000; Kasidi and Mwakanemela, 2013). However, these studies focused only on the existence of relationship and threshold effect between these two variables and ignored the channel through which inflation could relate to economic growth. As the literature stresses that capital accumulation is the important channel through which inflation affects economic growth, therefore, this study is going to fill that gap by exploring the nature of the relationship among inflation, capital accumulation, and economic growth. The data are annual time series from the World Bank Development Indicators Database.

1.2 INFLATION DYNAMICS IN KENYA

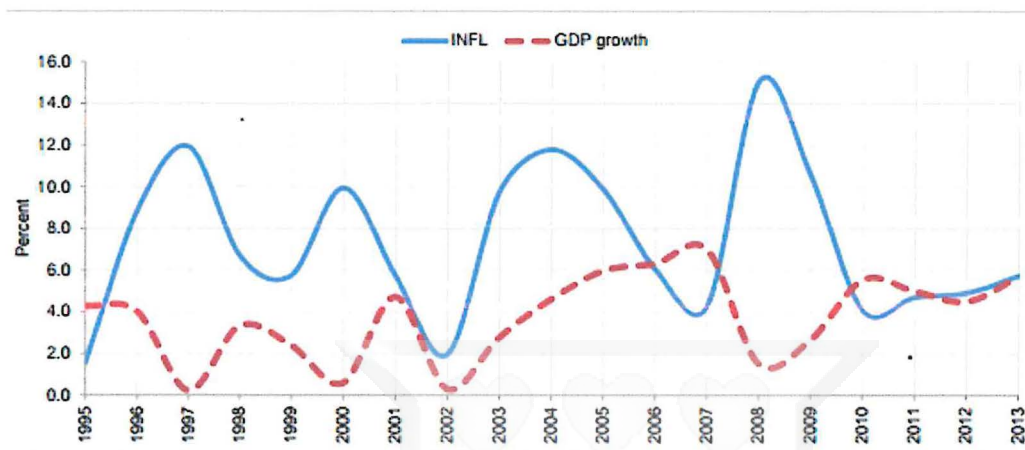
After Kenya's independence, the following first decade was marked by macroeconomic stability when exchange rate was fixed and inflation averaged 3 percent. In the 1970's, with the first oil price shocks and balance of payments problems, the rate of inflation began to increase. This increase was accompanied by devaluations and changes in the exchange rate peg.

In the 1990's one particular turn of events was the slowdown in economic growth, the rapid rise in inflation, money growth and interest rates, and a rapid depreciation of the shilling. The factors behind rapid increase in money supply included the foreign aid embargo at the time, escalating fiscal deficits that were financed through money printing and the exchange rate regime had changed to a dual system in which there was a parallel market.

Over the 15-year period from 1995 to 2010, the growth rate of the economy did not show a steady or regular pattern. In the year 1995 and 1996, the real GDP growth rate was 4.3 percent and 4.0 percent, respectively. However, in the year 1997, the growth rate decreased substantially

to a dismal level of 0.2 percent. The growth rate rose to 4.6 percent and 7.0 percent in 2004 and 2007, respectively

(World Bank)



Graph 1.

The government managed to control headline inflation within the single digit range between 1995 and 1996 mainly due to tight monetary policy. In 1997, inflation however increased to 11.9 percent, associated with general election expenditures. Higher inflation was also witnessed in 2000, 2004, 2009 and 2010, mainly resulting from increased commodity prices.

Growth of real GDP from 1995 to 2001 does not seem to correspond to inflation deceleration. Between 2002 and 2004 however an increase in real GDP growth rate was associated with an increase in inflation. At the same time from 2008 to 2010, the relationship between inflation and economic growth seems to be negative, where a decrease in inflation from 15.1 percent in 2008 to 11.6 percent in 2009 and further to 4.1 percent was associated with a rise in economic growth from 1.5 percent to 2.6 percent and further to 5.6 percent in the same period. Inflation decreased further from 10.6 percent in 2009 to 5.7 percent in 2013, while growth increased from 2.6 percent to 4.5 percent in the same period. The analysis suggests mixed trends between inflation and economic growth in Kenya.

The historical inflation-growth relationship for Kenya is summarized in the table below in which average GDP growth is high when inflation rate is low and high inflation rates are detrimental to growth. There exists an inverse relationship between inflation and growth in Kenya with a negative 0.5 correlation coefficient

Inflation-growth relationship

(World Bank)

Inflation Range / Band	Frequency	Mean	Mean GDP Growth
$2 \leq \text{INFL} < 5$	4	3.4	4.7
$5 \leq \text{INFL} < 10$	11	7.9	4.0
$10 \leq \text{INFL} < 20$	15	12.8	3.6
$20 \leq \text{INFL} < 30$	3	25.6	1.0
$\text{INFL} \geq 30$	1	46.0	-0.1

Table A

1.3 MEASURING INFLATION IN KENYA

There are mainly three methods of measuring inflation; the GDP deflator, the Consumer Price Index (CPI) and the Wholesale price index (WPI). According to (Mburu, 2002) inflation is easy to spot but difficult to measure and the choice of the method of measurement is influenced by information available. Use of CPI was adopted by Kenya in 1961 and has continued to be accepted as the most practical measure. In particular, it is used by the Industrial Court in determining maximum wage increases as per the Government Wage Guidelines which contain predetermined escalators (for unionized employees) defined by the cost of living. The CPI, as a measure of inflation, is used in the design of macroeconomic policies. The expected correlation between the CPI and the GDP deflator is such that an underestimate of inflation as measured by the CPI means that inflation as measured by GDP deflator is also underestimated and, in consequence, the real rate of growth and per capita growth are overstated.

1.4 STATEMENT OF THE PROBLEM

Although the central objective of Kenya's macroeconomic policies is to promote economic growth and to keep inflation on a low level, in recent years there has been substantial debate on the relationship between inflation and economic growth. Previous studies on inflation - economic growth relationship have revealed the complexity of the issue. They show that there might be no-relationship, negative relationship and positive relationship between inflation and economic growth according to different conditions. Most empirical studies support negative inflation - economic growth relationship especially when inflation is above the threshold level. But for the low or moderate inflation, there is distinctive disagreement. Some studies show zero-relationship, while others shows a statistically positive inflation – economic growth relationship. From the aspect of causal direction, two opposite points of view exist. One believes inflation could be conducive to growth. Fischer (1993). Other argues that growth could cause inflation Gokal and Hanif (2004); Wang Zhiyong (2008). Furthermore, Faria and Carneiro (2001) believe in that inflation - economic growth is just a short-run phenomenon. However, Mallik and Chowdhury (2001) evidence that inflation positively relates to growth in the long run. Some scholars, mainly those in favour of the Structural and Keynesian perspectives tend to believe that inflation is not harmful to economic growth whereas other scholars particularly those in favour of monetarist views, argue that inflation is harmful to economic growth. Some findings say that there is significant short-run relationship but not in the long-run. (Datta and Kumar, 2011). Motivated by this economic controversial, this study investigated the impact of inflation on economic growth in Kenya.

1.5 RESEARCH OBJECTIVES

The study is aimed at achieving the following objectives:

- 1) To examine the relationship between inflation and economic growth.
- 2) To measure the degree of responsiveness of Kenya economic growth to changes in the general price levels.

1.6 RESEARCH QUESTIONS

This research paper seeks to answer the following questions:

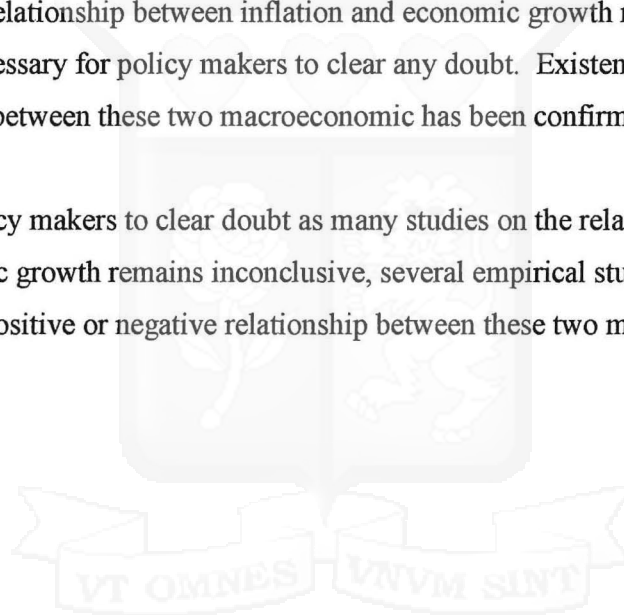
- 1) Is there a significant relationship between inflation and economic growth?
- 2) How does economic growth respond to variations in inflation?

1.7 JUSTIFICATION OF THE STUDY

This study is of great importance to policy makers, macroeconomists, and financial analysts in understanding the responsiveness of GDP to the change in general price level. With so doing they are able to formulate relevant policies so as to keep prices at the reasonable rate that supports and promotes production.

Many studies on the relationship between inflation and economic growth remain inconclusive and it is therefore necessary for policy makers to clear any doubt. Existence of either positive or negative relationship between these two macroeconomic has been confirmed by several empirical studies.

It is necessary to policy makers to clear doubt as many studies on the relationship between inflation and economic growth remains inconclusive, several empirical studies confirm the existence of either a positive or negative relationship between these two macroeconomic variables.



2. LITERATURE REVIEW

This section reviewed the theoretical and empirical literatures. The theories on economic growth and inflation such as Classical Growth Theory, Keynesian Theory, Money & Monetarism, Neo-classical Theory and Neo-Keynesian are presented first followed by empirical literature review from different authors before finalizing with the hypothesis of the study.

2.1 THEORETICAL LITERATURE REVIEW

The theoretical underpinnings of inflation-growth dynamics have roots in the models of economic growth in which Classical economics basing on supply-side theories, emphasize the need for incentives to save and invest if the nation's economy is to grow. Keynesian theory provides the ADAS framework, which is a more comprehensive model for linking inflation to growth. Monetarism re-emphasized the critical role of monetary growth in determining inflation, while Neoclassical and Endogenous Growth theories sought to account for the effects of inflation on growth through its impact on investment and capital accumulation (Brian and Howard, 2005). A detailed account of each of the growth models in relation to inflation – growth relationship is provided here under.

2.2 CLASSICAL GROWTH THEORY

Classical theorists laid the foundation for a number of growth theories. The foundation for Classical growth model was laid by Adam Smith who posited a supply side driven model of growth and his production function was as follows:

$$Y = f(L, K, T)$$

Where Y is output, L is labour, K is capital and T is land, so output was related to labour, capital and land inputs. Consequently, output growth (g_y) was driven by population growth (g_L), investment (g_K) and land growth (g_T) and increases in overall productivity (g_f). Therefore: $g_y = (g_f, g_K, g_L, g_T)$.

Smith argued that growth was self-reinforcing as it exhibited increasing returns to scale. He also viewed savings as a creator of investment and hence growth. Therefore, he saw income distribution as being one of the most important determinants of how fast (or slow) a nation would

grow. He also posited that profits decline – not because of decreasing marginal productivity, but rather because the competition of capitalists for workers will bid wages up.

The link between the change in price levels (inflation), and its “tax” effects on profit levels and output were not specifically articulated in classical growth theories. However, the relationship between the two variables is implicitly suggested to be negative, as indicated by the reduction in firms’ profit levels through higher wage costs.

2.3 KEYNESIAN THEORY

Traditional Keynesian model comprises of the Aggregate Demand (AD) and Aggregate Supply (AS) curves, which aptly illustrates the inflation – growth relationship. According to this model, in the short-run, the (AS) curve is upward sloping rather than vertical, which is its critical feature.

When the AS curve is vertical, changes on the demand side of the economy affect only prices. However, if it is upward sloping, changes in AD affect prices and output, (Dornbuschet *al.*, 1996). This holds with the fact that many factors drive the inflation rate and the level of output in the short-run. These include changes in: expectations; labour force; prices of other factors of production, fiscal and/or monetary policy.

The above-mentioned factors, and its ‘shock’ on the ‘steady state’ of the economy are assumed to balance out in moving from the short run to the hypothetical long run. ‘Nothing is happening’ in this steady state situation. The ‘dynamic adjustment’ of the short-run AD and AS curves yields an ‘adjustment path which exhibits an initial positive relationship between inflation and growth, however, turns negative towards the latter part of the adjustment path. Initial positive relationship between inflation and economic growth is due to the time inconsistency problem. Negative relationship between inflation and growth is important, as it quite often occurs in practice, as ascertained by empirical literature. This phenomenon is stagflation, when inflation rises as output falls or remains stable. Secondly, the economy does not move directly to a higher inflation rate, but follows a transitional path where inflation rises then falls. Under this model, there is a short-run 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 (Y^*). Any level of inflation is sustainable; however, for inflation to fall there must be a period when output is below the natural rate.

2.4 MONETARISM

Monetarism has several essential features, with its focus on the long-run supply-side properties of the economy as opposed to short-run dynamics. Milton Friedman, who coined the term “Monetarism”, emphasized several key long-run properties of the economy, including the Quantity Theory of Money and the Neutrality of Money. The Quantity Theory of Money linked inflation and economic growth by simply equating the total amount of spending in the economy to the total amount of money in existence. Friedman proposed that inflation was the product of an increase in the supply or velocity of money at a rate greater than the rate of growth in the economy. Friedman also challenged the concept of the Phillips Curve. His argument was based on the premise of an economy where the cost of everything doubles. Individuals have to pay twice as much for goods and services, but they don't mind, because their wages are also twice as large. Individuals anticipate the rate of future inflation and incorporate its effects into their behaviour. As such, employment and output is not affected. Economists call this concept the neutrality of money. Neutrality holds if the equilibrium values of real variables -including the level of GDP - are independent of the level of the money supply in the long-run. Super neutrality holds when real variables - including the rate of growth of GDP - are independent of the rate of growth in the money supply in the long-run. If inflation worked this way, then it would be harmless. In reality however, inflation does have real consequences for other macroeconomic variables. Through its impact on capital accumulation, investment and exports, inflation can adversely impact a country's growth rate.

In summary, Monetarism suggests that in the long-run, prices are mainly affected by the growth rate in money, while having no real effect on growth. If the growth in the money supply is higher than the economic growth rate, inflation will result.

2.5 NEO-CLASSICAL THEORY

Among the earliest neo-classical models was one postulated by Solow (1956) and Swan (1956)? This model showed diminishing returns to capital and labour separately and constant returns to both factors jointly. Investment (growth of K) was replaced by technological change as the primary factor explaining long term growth. Its level was assumed by Solow and other growth theorists to be determined exogenously, meaning independently of all other factors including inflation (Todaro, 2000).

Mundell (1963) was one of the first to articulate a mechanism relating inflation and output growth separate from the excess demand for commodities. His model stated that, an increase in inflation or inflation expectations immediately reduces people's wealth. This works on the premise that the rate of return on individual's real money balances falls. To accumulate the desired wealth, people save more by switching to assets, increasing their price, thus driving down the real interest rate. Greater savings means greater capital accumulation and thus faster output growth.

In this theory there are supporters of no relationship between inflation and economic growth. Sidrauskin (1967) said that an increase in the inflation rate does not change the steady capital stock and economic growth.

Generally, theoretical review in neo classical growth theory demonstrates mixed results regarding relationship of inflation and economic growth.

2.6 NEO-KEYNESIAN

Ideas of the Keynesians lead to the emergence of the Neo-Keynesians. Under Neo-Keynesian one of the major developments was the concept of 'potential output', which is also referred to as natural output.

This is a level of output where the economy is at its optimal level of production, given the institutional and natural constraints. This level of output also corresponds to the natural rate of unemployment, or what is also referred to as the non-accelerating inflation rate of unemployment (NAIRU). NAIRU is the unemployment rate at which the inflation rate is neither rising nor falling. With this framework, the 'built-in inflation rate' is determined endogenously, that is by the normal workings of the economy.

According to this theory, inflation depends on the level of actual output (GDP) and the natural rate of employment.

With unemployment being below the natural rate of unemployment and GDP exceeds its potential, all else equal, inflation will accelerate as suppliers increase their prices and built-in inflation worsens. This causes the Philips curve to shift in the stagflationary direction: towards greater unemployment and greater inflation.

If the GDP falls below its potential level and unemployment is above the natural rate of unemployment, holding other factors constant, inflation will decelerate as suppliers attempt to

fill excess capacity, reducing prices and undermining built-in inflation, leading to disinflation. This causes the Phillips curve to shift in the desired direction, towards less inflation and less unemployment.

If GDP is equal to its potential and the unemployment rate is equal to NAIRU, then the inflation rate will not change, as long as there are no supply shocks. In the long-run, the Neo Keynesians believe that the Phillips curve is vertical. That is, the unemployment rate is given and equal to the natural rate of unemployment, while there are a large number of possible inflation rates that can prevail at that unemployment rate.

One problem with this theory however is that the exact level of potential output and natural rate of unemployment is generally unknown and tends to change over time. Inflation also tends to act in an asymmetric way rising more quickly than it falls, mainly due to the downward rigidity in prices.

2.7 ENDOGENOUS GROWTH THEORY

In this theory, economic growth is generated by factors within production process. The model assumes that technological progress is endogenous with this assumption being contrary to neo classical growth theory.

Another difference between the endogenous growth models and neo classical economies is that in the neo classical growth theory capital is assumed to be diminishing on return while endogenous growth theory assumes that marginal product of capital is constant. The rate of return on capital i.e. human capital and physical capital determine the growth rate in the endogenous growth theory.

2.1.1 EMPIRICAL LITERATURE REVIEW

Section above has shown different arguments about inflation and its effects on economic growth. The relationship between inflation and economic growth is more complicated in the context of the real world without the restrictions and assumptions of theories. Previous studies not only try to test the existence of the relationship, but also try to dig this question deeper. The involved studying content includes: what is the causal direction of the relationship; is it a one-way or two-way direction; whether the relationship holds in the long-run or just a short-run phenomenon; is the relationship linear or non-linear; if there are non-linear effects, what is the structural break

point of inflation and etc. Different studies have different focus in researching. It is important to understand through which channels these two variables relate to each other when determining their relationship.

Abramovitz and Solow have adopted growth accounting to formulate the determinants of economic growth. Fischer (1993) furthers the study by relying on the growth accounting method with empirical data. He calculates Solow residuals and makes regression of economic growth and other 15 elements of economic growth (e.g. growth of capital accumulation, productivity residual and so on) based on inflation respectively. His studying results show that inflation can influence economic growth not only through total factor productivity but also through capital accumulation. Fischer (1993) concludes his paper that the negative relationship exists between inflation and economic growth, he still points with much caution that there is no direct evidence to support low inflation-high economic growth pattern, i.e. low inflation is not sufficient condition for economic growth. Many empirical studies support this opinion, though that high inflation is bad for growth is not doubtful, few results show a causal phenomenon that lower inflation will lead to higher growth.

Theoretical models have shown that capital accumulation moves the same direction with economic growth. There is however disagreement on the effect of inflation on capital accumulation. If the inflation-investment relationship is studied under the framework of monetary economy, as mentioned in theory section, it will depend on the relationship between real money balances and investment. Fischer (1993) also believes that inflation will be detrimental to investment. He argues that inflation distorts price mechanism, and then distorted price level will affect the efficiency of resources' allocation. This influence will finally negatively relate to economic growth. Gregorio (1992) also support the view that inflation will affect growth through reducing the efficiency of resources' allocation. He develops a model to elaborate that inflation will change return on money and capital and then alter the choice by firms and consumers. These changes have affected the power of price mechanism and distort the originally effective resources' allocation.

There have been studies pointing out the complexity of the relationship may involve in the non-linear effect. Non-linearity has been the hotspot in the studies of the relationship between inflation and economic growth ever since 1990's. Fischer (1993) is the first that evidences the

non-linearity by adopting spline functions. The spline functions estimates the results by assembling the data of inflation into three ranges according to the level of 16 inflation. His study also shows that there are more than one break points between inflation and economic growth and the negative coefficients of inflation – economic growth relationship is decreasing quicker when inflation is higher. Buerdekin et al. (2000) further the study of non-linearity in inflation – economic growth relationship and argue that levels of break points should be different and distinguished in estimation between developed and developing countries. They find a higher threshold with 8% for developed countries and a lower one with 3% for developing countries.

Khan and Senhadji (2000) adopt economic estimation tool to detect the threshold of inflation instead of fixing them by assumption like Fischer (1993) and Burdekin et al. (2000). They detect the break points of 1-3% for developed countries; 7-11% for developing countries; and evidence again that above the break points, inflation negatively relates with economic growth. Mubarik (2005) follows the study of Khan and Senhadji (2000) and detects a structural break point of inflation of 9% for Pakistan, above the break point there is a negative inflation - economic growth relationship, but no significant relationship below the break point. He also evidences a one-way direction relationship from inflation to growth by Granger Causality method.

Recent studies begin to adopt new econometric techniques such as, the co-integration and error correction models for dealing with time series data to examine the relationship of the model of bivariate variables. Mallik and Chowdhury (2001) first adopt the two above-mentioned models to exploit the inflation - economic growth relationship. They conclude a long-run positive relationship between inflation and economic growth. Ahmed and Mortaza (2005) further employ the above mentioned estimation models to find both long-run and short-run relationship between inflation and economic growth in Bangladesh and then followed by OLS (Ordinary Least Squares) model to evidence the structural break point of inflation for Bangladesh is 6%. Same with most of the other studies for detecting the threshold level of inflation, Ahmed and Mortaza (2005) show that the inflation - economic growth in Bangladesh is negative when inflation exceeds structural break point, but there is no statistically significant relationship below the break point.

2.1.2 HYPOTHESIS OF THE STUDY

From both theoretical and empirical literature reviews analyzed above, this study was governed by the following hypotheses: First, “There is no positive relationship between inflation and economic growth in Kenya.” This hypothesis aims to assess the relationship between inflation and economic growth of Kenya as per the requirement of the study objectives. However due to different studies inflation can also be related to capital accumulation in the country. Therefore the study investigated the truth of these findings for the case of Kenya and was governed by the Hypothesis that “There is no positive relationship between inflation and capital accumulation of Kenya.”

After both the empirical and theoretical literature analyzed above, the study was governed by the following hypotheses:

1. “There is no positive relationship between inflation and economic growth in Kenya.”
This hypothesis aims to assess the relationship between inflation and economic growth of Kenya as per objectives of the study.
2. Due to different studies however, inflation can also be related to capital accumulation in the country. The study therefore investigated the truth of these findings for the case of Kenya and was governed by the hypothesis that “There is no positive relationship between inflation and capital accumulation of Kenya.”

3. METHODOLOGY

3.0 INTRODUCTION

This part introduces the methodology and the model specifications of this study. Also the chapter indicates the type of the study, the area of the study as well as the source and types of data.

The section explains how to examine the relationship between inflation and economic growth. Five variables such as real GDP per capita, inflation, population, initial per capita GDP, and investment rate are included in the model. Population, initial per capital GDP and investment are used as control variables. Each variable and the way to measure each variable are explained as follows:

Economic growth- the dependent variable of the study and it is measured by the growth rate of real GDP per capita. The data is taken from World Bank's database. This variable is denoted by GGDP.

Inflation- this variable which is also the main concern of this paper is the first explanatory variable. There is no a clear cut decision about relationship between inflation and economic growth. This variable is denoted by INF with Inflation data been taken from World Bank's database.

Population growth- this is another explanatory variable which is the exponential rate of growth of midyear population. There is no any uniform conclusion on relationship between population and economic growth. Some argued to positive effects of population on economic growth while others said high population growth creates pressure on limited natural resources, and reduces private and public capital formation and economic growth. It is denoted by GPOP.

Investment rate- In this paper investment rate is denoted by INVT. It is another explanatory variable with most studies indicating a positive impact of investment on economic growth.

Initial per capita GDP- Researches show different result for the effect of initial per capita GDP on economic growth. Blomstrom (1996) has found a positive relationship between initial GDP and economic growth but Barro (1997) has shown a negative relationship between the two. The variable is denoted by GDP0.

3.1 TYPE OF THE STUDY

This study is a typical empirical study that used econometric techniques to assess the relationship between inflation and Economic growth of Kenya from 1992 to 2012 using secondary data from World Development Indicators of the World Bank.

3.2 TYPES AND SOURCE OF DATA

This study used secondary annual time series data for the period of 1990 to 2013 from World Development Indicators of the World Bank. The data are real GDP per capita (constant 2005 U.S. Dollars), Consumer Price Index (Annual Average, year 2010=100) as a proxy for Inflation and last is gross fixed capital formation (constant 2005 U.S. Dollars) as a proxy for Capital accumulation.

3.3 DATA ANALYSIS METHOD

The data analysis based on the objectives of this study. For the first objective descriptive statistics shows the trend of inflation and GDP growth for the period of 1990 to 2013. Also the same approach was used to show the trend of inflation and Capital accumulation for the same period of time. For the second objective, three economic variables were adopted to detect inflation - economic growth relationship which was obtained from World Development Indicators of the World Bank. One is real GDP per capita (constant 2005 U.S. Dollars) of Kenya from 1990 to 2015 and the other one is Consumer Price Index (Annual Average, year 2010=100) of Kenya from 1990 to 2015 as a proxy for Inflation and last is gross fixed capital formation (constant 2005 U.S. Dollars) of Kenya from 1990 to 2015 as a proxy for Capital accumulation.

This study uses the following the model to meet its objectives.

$$GGDP_t = \beta_0 + \beta_1 INVT_t + \beta_2 GPOP_{it} + \beta_3 INF_{it} + \beta_4 INVT * Inf_t + \varepsilon_t$$

INF- Inflation is measured as annual percent change of average consumer price index

GPOP- population growth rate is measured as annual population growth rate.

INVT- investment is measured as gross fixe capital formation as percent of GDP and openness is measured as share of export plus import in GDP.

Stata software has been used to analyze the data with estimation been done by fixed effect. The equation above can be modified in to different ways: with model (1) formed without considering time and country effect.

3.4 REDUCED FORM REGRESSION EQUATION

To investigate the impact of inflation on economic growth in Kenya, the study used a modified model of the following model adopted from Khan and Senhadji, (2001) for the analysis of threshold level of inflation for Bangladesh.

$$GDP_t = \beta_0 + \beta_1 INFL_t + \beta_2 D(INFL_t - K) + U_t \quad (1)$$

Where GDP stands for Gross domestic product, INFL= Inflation,

U_t = error term, D= Dummy variable, and K is the threshold level of inflation (the rate of inflation at which structural break occurs).

We then go ahead to examine the impact of inflation on economic growth in Kenya as follows:

$$GDP_t = \beta_0 + \beta_1 INFL_t + U_t \quad (2)$$

After getting reduced form regression equation, the study established coefficient of elasticity by differentiating the equations with respect to Inflation (INFL).

3.5 COEFFICIENT OF ELASTICITY AS THE MEASURE OF DEGREE OF RESPONSIVENESS

To measure the degree of responsiveness of GDP to changes in general price levels, this study employed the logarithmic techniques. Moreover, Ramanathan (2002) underlined elasticity with non-linear regression equation by using $\ln(Y) = \alpha + \beta \ln(X) + \varepsilon$ as an example. He interpreted β as elasticity. Kasidi, (2010) added that in the basic regression without logs, Y tends to change by β units for a one unit change in X. However, in the regression containing both logged dependent and explanatory variables Y tends to change by β percent for one percent change in X. That is, instead of having to worry about units of measurements, regression results using logged variables are always interpreted as elasticity. Therefore, for the purpose of getting elasticity in the linear reduced form regression equation, the formula adopted a model in Ramanathan, (2002)

$$Y = \beta_0 + \beta_1 X \quad \text{where its elasticity becomes } \beta_1 (X/Y) \quad (3)$$

Where Y= GDP Growth rate and X=Inflation rate (INFL). When equation (2) is transformed into logarithm it becomes as

$$\text{LogGDP}_t = \beta_0 + \beta_1 \text{LogINFL}_t \quad \text{where its elasticity becomes } \beta_1 \quad (4)$$

3.6 UNIT ROOT TEST FOR STATIONARY OF DATA

Main importance of conducting unit root test is that if we use the data without checking their stationary properties, results derived from the regression models would produce the so called spurious results (Datta and Kumar, 2011). Before estimating our modified model in the equation (2) it was very important to test out stochastic properties of the variables to be estimated.

This task is realised by conducting unit root test. However, one of the weaknesses of unit root test is related to small number of observations and that a minimum number of 20 observations are required so as to get reliable results which can be made inference (Gujarati and Porter, 2009; Gujarati, 2004). The analysis was done using the Dickey-Fuller (DF) or more convenient ADF that is Augmented Dickey-Fuller and Phillips-Perron unit root test. The study proceeded with the estimation of the model in equation (2). The null hypothesis for the two tests was unit root or the time series was non-stationary (i.e. $\delta = 0$) while the alternative hypothesis states that there is no unit root or the time series was stationary (i.e. $\delta \neq 0$). The general form of DF and ADF is estimated by using the following models:

$$Y_t = \gamma Y_{t-1} + \varepsilon_t \quad (5a)$$

If $\gamma = 1$, equation above becomes a random walk, that is, a non-stationary process. As a result of this there tends to be the so called unit root problem which means there is a situation of non-stationarity in the series. However, if $\gamma < 1$, this means that the series $t Y$ is stationary.

However, the unit root problem can be eliminated or stationarity can be achieved by differencing the data set (Wei 2006). The basic idea behind the ADF unit root test for non-stationarity is to simply regress Y_t on its (one period) lagged value Y_{t-1} and find out if the estimated γ is statistically equal to one or not. In this case, this equation can be further manipulated by subtracting Y_{t-1} from both sides and obtain:

$$Y_t - Y_{t-1} = (\gamma - 1)Y_{t-1} + \varepsilon_t \quad (5b)$$

The equation above can be re-written as follows:

$$\Delta Y_t = \delta Y_{t-1} + \varepsilon_t \quad (5c)$$

Where $\delta = (\gamma - 1)$, and Δ is the difference operator. Instead of estimating equation (5a), the study estimated equation (5c) and tested for the null hypothesis of $\delta = 0$ against the alternative hypothesis of $\delta \neq 0$. If $\delta = 0$, then $\gamma = 1$ which means that there is a unit root problem and the series

under consideration is non-stationary. The decision to accept or not to accept the null hypothesis of $\delta=0$ was based on the Dickey-Fuller critical values of the τ statistic. The ADF test tends to include the lags of the first difference in the regression equation so as to make the error term ε_t white noise and thus, the testing procedure for the ADF unit root test is applied to the following model:

$$\Delta y_t = \alpha_0 + \alpha_1 t + \gamma y_{t-1} + \sum_{j=1}^p \delta_j \Delta y_{t-j} + \varepsilon_t \quad (5d)$$

From equation (5d), α_0 is a constant, α_1 the coefficient on a time trend series, γ the coefficient of y_{t-1} which measures the unit root, ρ is the lag order of the autoregressive process, δ_j is a measure of lag length, $\Delta y_t = y_t - y_{t-1}$ are first differences of y_t , y_{t-1} are lagged values of order one of y_t , Δy_{t-j} are changes in lagged values, and ε_{it} is the white noise (Ssekuma, 2011).

In testing the unit root, the study employed ADF instead of DF test because the ADF took care of possible serial correlation in the error terms by including the lagged difference of the dependent variable. Moreover, Phillips-Perron was used to test for the presence of unit root because it also take care of serial correlation in the error terms by using the non-parametric statistical method without addition of lagged difference terms (Hussain 2011). The Phillip-Perron test is based on the following model:

$$\Delta y_t = \phi + \beta (t- T/2) + (\rho-1) y_{t-1} + x\Delta Y_{t-1} + \varepsilon_t \quad (6)$$

3.7 CO-INTEGRATION TEST

Two variables are said to be co-integrated if they have a long-term, or long run equilibrium, relationship between them. If two variables, dependent and an independent, are individually nonstationary but their residual (combination) is stationary, those variables are co-integrated on the long run (Gujarati, 2004; Yang, 2000).

In this case, the study used the Johansen co-integration test to test co-integration since it is the only test which can estimate more than one co-integration relationship if the data set contains two or more time series as well as gives the maximum rank of co-integration (Ssekuma, 2011). According to Hjalmarrsson and Osterholm, (2007), the Johansen's methodology takes its starting point in the vector auto regression (VAR) of order ρ given by:

$$Y_t = \mu + A_1 Y_{t-1} + \dots + A_\rho Y_{t-\rho} + \varepsilon_t \quad (7a)$$

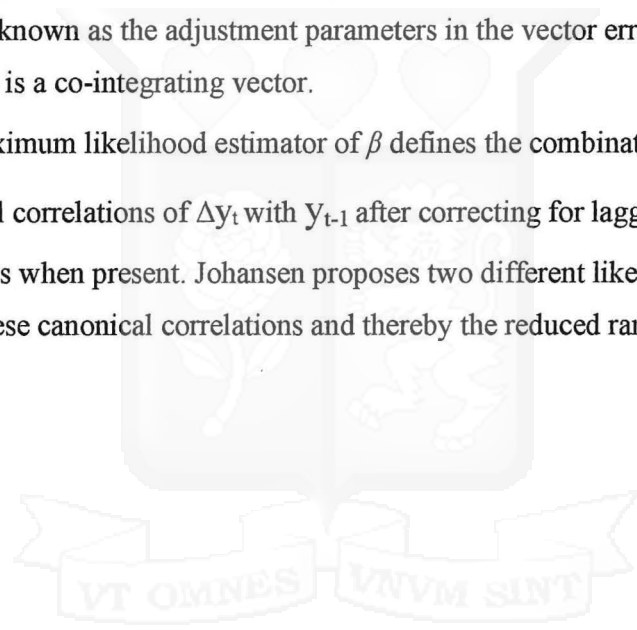
Where y_t is an $n \times 1$ vector of variables that are integrated of order one, commonly denoted by $I(1)$, and ε_t an $n \times 1$ vector of innovations. This VAR can be re-written as:

$$\Delta y_t = \mu + \Pi y_{t-1} + \sum_{i=1}^{\rho-1} \Gamma_i \Delta y_{t-1} + \varepsilon_t \quad (7b)$$

$$\Pi = \sum_{i=1}^{\rho} A_i - I \quad \text{and} \quad \Gamma_i = -\sum_{j=i+1}^{\rho} A_j \quad (7c)$$

If the coefficient matrix Π has reduced rank, $r < n$ then there exists $n \times r$ matrices α and β each with rank r such that $\Pi = \alpha\beta'$ and $\beta' y_t$ is stationary. r is a number of co-integrating relationships, the elements of α are known as the adjustment parameters in the vector error correction model and each column of β is a co-integrating vector.

For a given r , the maximum likelihood estimator of β defines the combination of y_{t-1} that yields the r largest canonical correlations of Δy_t with y_{t-1} after correcting for lagged differences and deterministic variables when present. Johansen proposes two different likelihood ratio tests of the significance of these canonical correlations and thereby the reduced rank of Π matrix:



4. DATA ANALYSIS, INTERPRETATION AND RESULTS

The study analyzed Unit root tests, co-integration test, and empirical impact of inflation on economic growth by using reduced form regression equation. Analysis of sensitivity of economic growth (GDP) on inflation as well as relationship between inflation and economic growth were put forward quantitatively. Data analysis followed chronological order of the objectives stated above starting stationarity test by applying Unit root test results.

4.1 UNIT ROOT TEST RESULTS

The study conducted unit root test on the variables under study before testing for cointegration to establish the stationary properties of the data. Augmented Dickey-Fuller tests and Phillips Perron tests were employed on the time series variables. The results for the two tests are presented in Table 1 and 2.

Table 1: Results: unit root test (level variables)

Variable	Augmented Dickey-Fuller		Phillips-Perron	
	Test Statistics	Critical value at 5%	Test Statistics	Critical value at 5%
GDP	-1.572	-3.000	-1.645	-3.000
INFL	-1.607	-3.000	-1.629	-3.000

Table 2: Results: unit root test(First Difference)

Variable	Augmented Dickey-Fuller		Phillips-Perron	
	Test Statistics	Critical value at 5%	Test Statistics	Critical value at 5%
GDP	-4.126	-3.000	-4.130	-3.000
INFL	-4.161	-3.000	-3.912	-3.000

Results of the unit root tests (Table 1, 2) revealed that inflation and GDP were non-stationary without lag. The computed absolute values of the tau statistics ($|\tau|$) do not exceed the ADF (or MacKinnon) critical tau values, implying that we cannot to reject the null hypothesis ($\delta = 0$) that there was unit root or the time series was non-stationary. The same applied to Phillips-Perron test whereby the computed absolute values of the tau statistics ($|\tau|$) do not exceed the ADF (or MacKinnon) critical tau values. On the other hand, Table-2 showed that both variables became stationary after first difference as the computed absolute values of the tau statistics ($|\tau|$) exceeded the ADF (or MacKinnon critical tau values, which led the study to accept the null hypothesis ($\delta = 0$).

The test at first difference however was performed with no constant (no intercept) meaning that the process under null hypothesis is a random walk without drift, meaning that the time series data observed a difference stationary process.

4.2 CO-INTEGRATION TEST

When two variables are said to be co-integrated, it means they have a long-term, or long run equilibrium relationship between them.

If two variables, dependent and an independent, are individually nonstationary but their residual (combination) is stationary, those variables are co-integrated (Gujarati, 2004). When two time series variables are integrated of order one, $I(1)$, there could be a linear combination between them which may be integrated of order zero, $I(0)$ (Green 2002). In order to establish co-integration, the test was conducted by using Johansen co-integration test. Table 4.3 presented the results of the test.

Table 3: Results: Johansen tests for co-integration

Trend : constant		Number of observations = 20			
Sample: 1992-2011		Lags = 2			
Maximum rank	Parms	LL	Eigenvalue	Trace statistic	5% critical value
0	6	-110.81099	-	10.0768*	15.41
1	9	-106.89296	0.32416	2.2408	3.76
2	10	-105.77256	0.10599		

From the above results of table 3, it is revealed that the study cannot reject the null of having no rank (that is, the first significant values where trace statistics is less than critical value at 5 percent was found at maximum rank of zero. No co-integration is detected from the results. This is because the Johansen's test for co-integration is based on maximum likelihood estimation and two statistics: maximum eigenvalues and a trace statistics, and that if the rank is zero means there are no cointegration relationship. The rank is one there is one, if it is two there are two (Parlow, 2010). These results are in line with the results found by Chimobi, (2010) in the study of the relationship between inflation and economic growth in Nigeria. The inclusion of lags is often necessary in order for the regression model to be able to predict the future, that is, to predict what will happen in the period (t) based on knowledge of what happened up to (t-1) (see Ernst et al., 2005). Due to the absence of co-integration, no Error Correction Model was run.

4.3 THE IMPACT OF INFLATION ON ECONOMIC GROWTH

The study applied regression techniques as explained above to estimate the impact of inflation on economic growth. Using the linear regression equation as illustrated below, to quantify the extent of impact, the study measured impact of inflation on economic growth.

Results for regression equation with and without lags are presented in equation 1(a) and 1(b) respectively. In order for the regression model to be able to predict the future, that is, to predict what will happen in the period (t) based on knowledge of what happened up to (t-1), lags were included. (see Ernst, Nau and Bar-Joseph, 2005)

$$GDP_t = 18.24506 - 0.48105141INFL_t \quad (1a)$$

(10.55) (-4.72)

$$R^2 = 0.54$$

$$GDP_t = 18.84073 - 0.5358219INFL_t \quad (1b)$$

(12.26) (-5.95)

$$R^2 = 0.6394$$

The estimated equation (1a) uncovered that the impact of inflation on Kenyan GDP can be interpreted that as the general price level (inflation) goes up by one percent (1%), economic growth (GDP) goes down by 48.105%. The coefficient of determination (R^2) = 0.54 implied that 54% of the variations in economic growth (GDP) have been explained by inflation and about 46% was captured by other factors which have substantial influence on GDP but were excluded from the model.

This is because the economic growth does not only get influenced by inflation but also by other factors such as higher initial schooling and life expectancy, lower fertility, lower government consumption, better maintenance of rule of law, and improvements in the terms of trade (see Barro, 1996). Since the large percentage of variations in GDP was explained by inflation, this means that inflation has strong contribution to economic growth (GDP) of Kenyan economy. Moreover, the summary of the results showed that the impact of inflation on economic growth is statistically significant at 5 percent level for its absolute t-values was greater than two (Gujarati, 2004). The regressor inflation has the sign that accord with prior expectations, that is, inflation has a negative impact on economic growth. The estimated equation (1b), on the other hand, indicated that the impact of inflation on Kenya's GDP can be interpreted that a decrease in GDP by 53.582% was a result of an increase in the general price by 1%. The Coefficient of Determination (R^2) = 0.6394 implied that about 64% of changes in economic growth (GDP) have been explained by inflation and only 36% was captured by other factors which were not included in the model.

The minor difference in results from the estimated equation (1a) and (1b) precipitated the study to make conclusion based on equation (1b) results. The reason for this is that the Coefficient of Determination (R^2) in estimated equation (1b) is relatively higher compared to that of equation (1a). The implication of this is that, the impact to GDP in equation (1b) has been explained by inflation by large percentage than that of equation (1a). Moreover, the absolute values of t statistics are relatively larger in equation (1b) than that of estimated equation (1a) implying that the impact of inflation on economic growth is statistically significant at 5 percent level. These results agreed with various theories of inflation and economic growth (Monetarists) as well as other previous researchers such as (Barro, 1995; Ghosh and Phillips, 1998; Quartey, 2010).

These statistically significant results indicated that persistent increase in the general price has a negative impact on economic growth in Kenya.

4.4 THE RELATIONSHIP BETWEEN ECONOMIC GROWTH AND INFLATION

In order to quantify the extent to which Inflation is related to GDP, the study estimated variables (GDP and inflation) and correlation coefficient. The results for estimated variables and correlation coefficients are provided in equation (2) and (3) below

$$GDP_t = 18.84073 - 0.535821INFL_t \quad (2)$$

(12.26) (-5.95)

$$R^2=0.6394$$

From the results, we can see that there is a negative relationship between inflation and economic growth in Kenya's economy in the period of study. This results implied that as the general level of prices increases, the GDP decreases. An increase in the general price level (inflation rate) by 1% results in a decrease of GDP by 18.305%. This could imply that an increase in the general price level was harmful to economic growth. In addition, the study decided to regress Inflation against GDP in order to know the nature of relationship when Inflation was dependent variable and GDP was independent variable. The results for the estimation of Inflation are provided in equation (3) below.

$$INFL_t = 27.75812 - 1.193227GDP_t \quad (3)$$

(11.092) (-5.95)

$$R^2=0.6394$$

The results of the estimated equations indicated that there was a negative relationship between GDP and inflation in Kenya. The estimated coefficients are highly statistically significant at 5 percent and negative for both regressions implying that both GDP and Inflation affected each other negatively. Equation (3) implied that an increase in GDP by 1 percent resulted in a decrease of the general price levels by about 1.19. The relationship between the two variables

only existed in the short-run because the Johansen co-integration test revealed that the first significant values where trace statistics is less than critical value at 5 percent was found at maximum rank of zero. This could mean that inflation is harmful to economic growth and economic growth helps to reduce inflation in the country.

4.5 THE DEGREE OF RESPONSIVENESS OF GDP TO INFLATION

The study applied regression equation to determine the degree of responsiveness of GDP to changes in the general level of prices as illustrated below. Results for regression equation is presented in equation (4) below:

$$\ln GDP_t = 1.848391 - 0.80472 \ln INFL_t$$

(18.31) (-8.9)

$$R^2 = 0.7983$$

Prognostication of the log-log results produced very interesting results to the question about responsiveness of GDP to general price changes. The elasticity coefficient of GDP to inflation rate is inelastic due to the fact that inflation rate is a very important macroeconomic variable to the changes of GDP. The result showed that Kenyan GDP is inelastic on inflation because the value of estimated coefficient β_1 (-0.8047261) is less than one. The result was also statistically significant at 5 percent level. This study concluded (from the above results) that the degree of responsiveness of change in GDP due to changes in the general price levels in Kenya is inelastic to the tune of -0.8. Also $R^2 = 0.7983$ is very strong indicating that about 79.83% responsiveness of GDP has been explained by changes in the general price levels.

5. CONCLUSION AND RECCOMENDATIONS

5.1 CONCLUSION OF THE FINDINGS

Examining the impact of inflation on economic growth in Kenya was the main objective of this study. The data used entailed annual time-series data for the period of 1992-2012. For all variables, diagnostic tests were carried out and were all satisfied, that is, no serial correlation and heteroskedasticity were observed, implying that the estimates are reliable and therefore can be relied upon.

The methodology employed in this study included the regression analysis to examine the impact, stationary test was carried out using the Augmented Dickey-Fuller technique and Phillips-Perron (PP) test. The results of unit root suggested that both variables in the model were stationary after first difference. The results from regression analysis revealed that inflation has the negative impact on economic growth of Kenya. This indicated that inflation is harmful to economic growth of Kenya. The same results were found by (Quartey, 2010) in Ghana.

To establish the relationship between inflation and GDP, correlation coefficient and co-integration technique were used. Using the Johansen co-integration test, the results showed that over the period of 1992-2012 there was no co-integrating relationship between inflation and economic growth. That is, no any statistically significant long-run relationship between inflation and economic growth in Kenya. Only a negative and statistically significant short term relationship was found. These results are consistent with other previous studies such as (Ahmed, 2010; Chimobi, 2010; Carneiro and Faria, 2001). Moreover, the study found that the degree of responsiveness of GDP to changes in the general price levels is large.

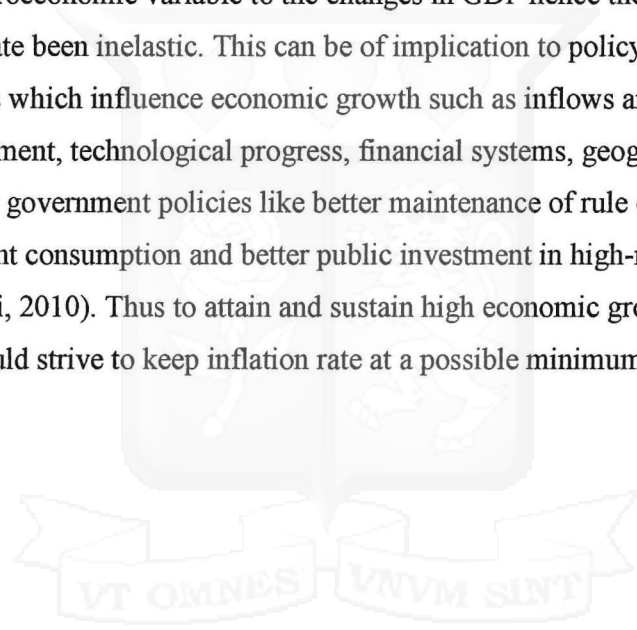
5.2 POLICY IMPLICATIONS AND RECOMMENDATIONS

An increase in the general price level has been detrimental to sustainable economic growth in Kenya as concluded in the study. Controlling inflation is a necessary condition for promoting economic growth and these results therefore have important policy implications for both domestic policy makers and development partners. Maintaining inflation at a low rate should be the main focus of policy makers.

Maintaining the inflation rate stability is an important factor as the results from the findings indicated about 64% of the variations in GDP have been explained by inflation.

This could imply any fluctuation in country's general price level has a significant impact on economic growth. In this regard the study concluded that all factors which cause an increase in the general price levels such as energy crisis, exchange rates volatility, and increase in money supply, poor agricultural production and so forth should be addressed with the appropriate policies so as to foster economic growth.

Agricultural produce may be increased provision of labour force, improving infrastructure, training to farmers as well as strategies like loan provision schemes with affordable interest rates and establishment of permanent markets for their products should be undertaken. Inflation rate is a very important macroeconomic variable to the changes in GDP hence the elasticity coefficient of GDP to inflation rate been inelastic. This can be of implication to policy makers that even if there are other factors which influence economic growth such as inflows and outflow of FDI, human capital, investment, technological progress, financial systems, geographical position of the country as well as government policies like better maintenance of rule of law, less non-productive government consumption and better public investment in high-return avenues (see Hussain, 2011; Kasidi, 2010). Thus to attain and sustain high economic growth (GDP) policy makers in Kenya should strive to keep inflation rate at a possible minimum rate.



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