THRESHOLD EFFECTS IN THE RELATIONSHIP BETWEEN INFLATION AND ECONOMIC GROWTH IN KENYA: 1970-2014

BY

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DECLARATION

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

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DEDICATION

This research project is dedicated to my loving parents who by their tireless efforts have helped me come this far, may God bless them mightily and give them long life to see me achieve what I surely desire

ACKNOWLEDGEMENTS

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

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ABBREVIATIONS AND ACRONYMS

AD- Aggregate Demand

AS- Aggregate Supply.

CBK- Central Bank of Kenya

IV– Instrumental Variable

NAIRU- Non-Accelerating Inflation Rate of Unemployment

NLLS- Non Linear Least Square

OECD- Organization for Economic Co-operation and Development

SADC- South African Development Community

TAR- Threshold Autoregressive

OPERATIONAL DEFINITION OF TERMS

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

Threshold Level of Inflation: The level of inflation beyond which the effect of inflation on economic growth turns from positive to negative or from negative to positive.

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

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

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ABSTRACT

It is widely agreed among economists, policy makers and central bankers that all macroeconomic policies seek to attain high levels of economic growth coupled with very low rates of inflation. High inflation rates have resulted to a number of adverse effects on the economic growth of many countries over time. But how low should the inflation rate be so as not to affect economic growth negatively? Economic policymakers in Kenya have been working towards the attainment of a 5 percent rate of inflation as the most ideal rate for economic policy purposes. Is this rate of inflation the most appropriate for economic growth? Recent studies have demonstrated that, inflation only causes detrimental effects in an economy in the event it rises beyond a specific threshold depending on the level of economic development of an economy and the existing economic structure. If the level of inflation is below the identified threshold, then the effect of inflation on economic growth is insignificant or even positive. In an attempt to determine whether or not there existed threshold effects between these two variables of interest in Kenya, this study assumed that economic growth and inflation had a non-linear relationship and used quarterly data spanning the sample period 1970-2014. This study sought;to determine if a first threshold inflation level exists in the relationship between inflation and economic growth in Kenya; to determine if a second threshold inflation level exists in the relationship between economic growth and inflation rate in Kenya; to establish the effect of inflation on the level of economic growth at the estimated lower and upper threshold levels of inflation in Kenya; and to analyze the impact of a structural break on the threshold regression model for the Kenyan economy. A suitable regression model for the threshold was used in this study. The results revealed the existence of two significant threshold levels at 6.1318% and 9.6274%. Inflation causedpositive and significant effects on economic growth at inflation rates below the first threshold level. The effect of inflation on economic growth was also positive and significant at all inflation rates between the two threshold levels. However, at inflation rates above the second threshold level, inflation had a negative effect on the level of economic growth. This study also showed that failure to account for structural breaks in the relationship between economic growth and inflation largely influenced the estimated effects of inflation on growth at the identified threshold levels. The findings of this study provide an important basis for the formulation of monetary policy in Kenya given that they act as a guide in the setting of inflation targets. The findings further provide economic policymakers in Kenya with consistent guidance on matters of inflation in the actualization of long-term economic growth targets.

CHAPTER ONE

INTRODUCTION

1.1 Background

Macroeconomic policy aims at achieving a stable growth of output in an economy coupled with low levels of inflation among other goals (Sergii, 2009). Many economists have supported this policy goal given its advantages are not hard to find. According to Omollo (2012) economies should strive for high and stable output growth as it stimulates demand for labor which in turn provides many employment opportunities for people. High economic growth is also associated with high tax revenue to the public sector which enables the governments allocate more resources to key projects in the economy such as infrastructural development. The development of the public and merit goods means improved welfare for all people and translates to high efficiency of the labor force during production. This then causes the aggregate supply to rise in the long term (Amanja and Morrissey, 2013). Amanja and Morrissey (2013) further adds that increased productivity in the economy improves the standard of living among consumers as they have a wider range of goods and services available to them.

On the other hand, economic policymakers have often stressed the consequences of high and unstable rates of inflation in an economy. According to Gokal and Hanif (2004), inflation causes the returns to investment of various projects to be unpredictable thereby prompting the adoption of extremely conservative strategies of investment that discourage investment growth. Economic growth therefore decreases in such scenarios. Moreover, the borrowing and lending decisions are distorted by high and unstable inflation (Chiu and Meh, 2007). Firms will also incur extra expense as they would have to devote more resources in measures aimed at mitigating the negative effects of inflation. For example, monitoring the prices of rival firms in an attempt to

differentiate price increases due to inflationary pressures or industry specific causes (Gokal and Hanif, 2004).

In Kenya, the government aims at sustaining an output growth rate of 10% for 25 years as envisioned in its economic pillar of Kenya's Vision 2030 (Ndungu, Thugge and Otieno, 2009). This target has however has not been achieved since it's commissioning in 2008 averaging 5.6 percent between 2009 and 2014. In an attempt to achieve this economic pillar, Kenyan policy makers have put in place policy goals to unlocking the bottlenecks to growth (Ndunguet.al., 2009). One of the goals is the increasing of saving and investments to more than 30 percent of GDP. In an effort to achieve this policy goal the Central Bank of Kenya (CBK), whose main aim is maintaining stable prices, has been focusing on maintaining stable prices in order to encourage savings and investment by reducing uncertainty (CBK, 2014). The Central Bank of Kenya formulates the monetary policy with a view of pegging inflation around the 5% target with 2.5 percent band as this low inflation target is expected to cause economic growth through encouraging savings and investments (CBK, 2014).

Given the inflation target policy adopted by the CBK its therefore important to know empirically if this target would help achieve the Vision 2030 economic growth target of 10 percent. This research sought to find the precise inflation thresholds above which the inflation effects become detrimental to the economic growth of Kenya.

1.2 Economic growth and inflation trends in Kenya

In Kenya, low economic growth and fluctuating inflation rates have been experienced over the years as shown in figure 1.1.

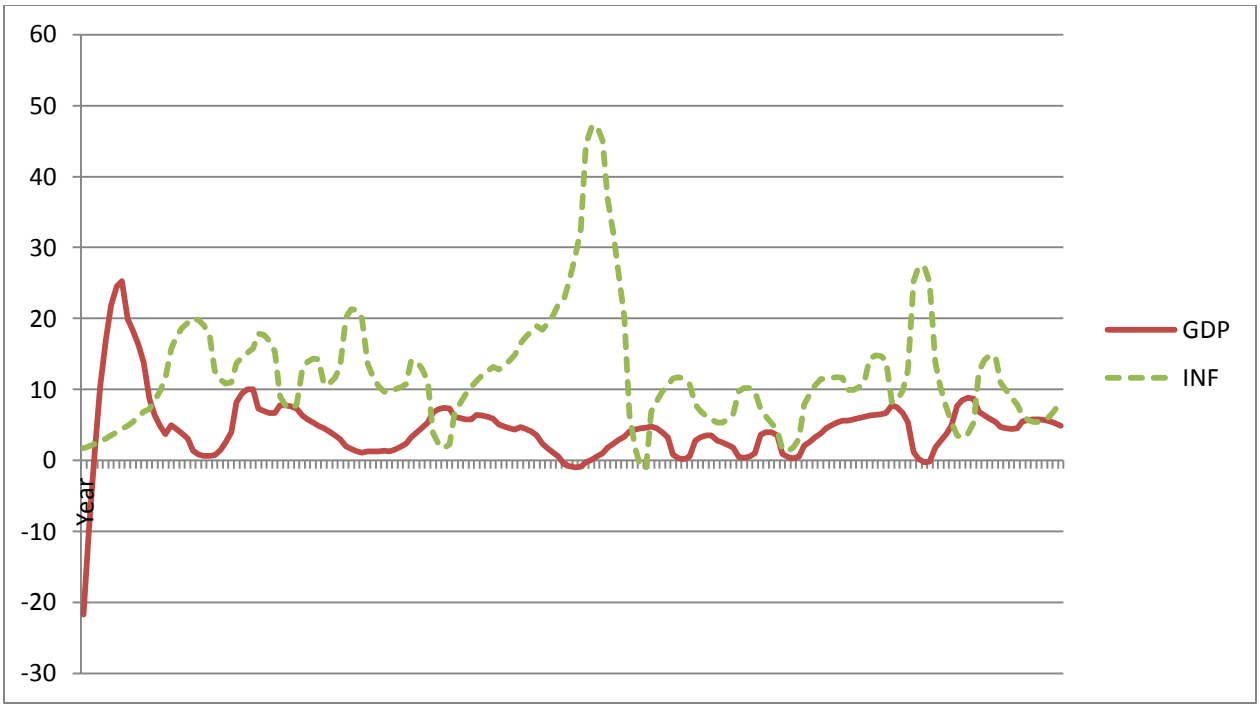

Figure1.1Economic growth and inflation trend in Kenya

Source: World Bank Development Indicators (2015) online data.

In the early 1970s the country experienced high degrees of growth that were as a result of a combined improvement in both the agricultural sector and the industry sector. During this period, the government implemented the land distribution policy that resulted in improved agricultural output. Further, Investment and capital imports grew due to the improved foreign exchange earnings from sustained commodity exports (World Bank, 1984). In the mid-1970s the country was destabilized by the first oil price shock in the 1973/1974. This led to a fall in the growth of GDP to a low of 0.89 percent and inflation rose to 19.12 percent in 1975 (figure 1.1).

The economic growth rate recovered slightly in 1976-1978 due to the coffee booms, however, there was also a rise in inflation rates due to the increased revenue to farmers that led to increased demand for domestic products and thus also an increase in prices (Kigume, 2005). The economy was hitwith a second oil price shock and a decline in the coffee prices in 1979. There

was also a world recession in the 1982 and an attempted coup in 1982 whichfurther worsened the situation. This resulted in average growth rates of 2.2 percent and average inflation rates of 13.8 percent for the period 1982-1985. The economy recovered in the period 1986 to 1990 as the country attained a GDP growth rate of 5.64 percent. This was due to the implementation of policies by the government to improve savings (Republic of Kenya, 1986). This improved growth was also brought about by improved terms of trade from higher coffee and lower oil prices (World Bank, 1990). During this period, inflation rates continued to rise as the economy averaged a rate of 11.33 percent. This was due to increased prices of certain basic consumer products, growth in domestic credit as well as increased costs from the appreciation of the Kenyan shilling during the period (Republic of Kenya, 1989).

The period 1991 to 1994 experienced very low growth rates averaging 0.89 percent. This low economic growth rate during the period was accompanied by high inflation rates which averaged 30.55 percent. This was due to the rising economic debts settled through currency printing and increased expenditure as a result of the elections held in 1992 (Kigume, 2005). There was also a withholding of foreign aid, imposition of import limitations, increased inflation and a depreciation of the Kenyan currency (Republic of Kenya, 1992). By 1995 and 1996 the growth rate in GDP increased to an average of 4.2 percent and inflation decreased an average of 5.2 percent. This was due to the continued pursuit of strict macroeconomic policies and the easing of inflationary pressure by the lowering of VAT rates.

The period 1997 to 2002 averaged economic growth rates of 1.89 percent. This slowdown in growth was due to adverse weather conditions, poor infrastructure, and pre-election violence in 1997 and depressed investments. The period was also characterized by uncertainty in the economy due to the failure to renew funding by the IMF and also the El-Niño rains in 1998

(Republic of Kenya, 2000). The period was also affected by prolonged drought from 1999 to 2000 and low infrastructure development (Republic of Kenya, 2001). This low growth rate was however accompanied by an inflation rate of 7%. This was due to slower growth in money supply, stable shilling, tight monetary policies by the government, stable world petroleum prices and low food prices (Omollo, 2012).

The period 2003 to 2007 marked a turnaround in Kenya's economy averaging 5.07 percent in GDP growth rate over that period. This was due to economic growth strategies adopted by the government aimed at poverty reduction. There was also an improvement in the infrastructure development as well as increased expenditure directed towards the agricultural sector (Republic of Kenya, 2005; Republic of Kenya, 2008). However, the period 2003 to 2007 was also accompanied by high inflation rates that averaged 11.19 percent. This occurred as a result of depreciating currency and high inflation rates (Republic of Kenya, 2008). The economy experienced a slump in growth accompanied by high inflation rates in 2008 due to the Post-election violence in 2007/2008. However, the Kenyan economy showed resilience to recover and average an economic growth rate of 5.56 percent between 2009 and 2014. This recovery has been attributed to infrastructure development, favourable tax reforms and expanded market outlets (Republic of Kenya, 2014).

1.3 Problem Statement

The precise relationship between economic growth and inflation has been a subject of debate for many years. Researchers in the previous past have established varying conclusions about these two variables. A misunderstanding has therefore existed both in theoretical and empirical points of view. Theories and previous studies about these two variables suggest non-existence of any effects, presence of positive effects and even existence of negative effects of inflation on

economic growth. However, studies seem to have reached a consensus suggesting that low rates of inflation improve aggregate long-run economic performance (Gokal and Hanif, 2004; Iqbal and Nawaz, 2009; Ayyoub, Chaudhry and Farooq, 2011). The studies suggest that there is need to keep inflation at very low levels but are non-committal as to whether the negative impacts of inflation on output growth renders inflation necessary or as an unwanted evil with regards to economic growth (Datta and Mukhopadhyay 2011; Kasidi and Mwakanemela, 2013).

In an attempt to answer and settle the argument regarding the overall effect of inflation on economic growth, researchers have shifted their focus to the non-linear relationship between the two variables (Li, 2006; Kremer, Bick and Nautz, 2009). In particular, researchers have been looking at the possibility of a non-linear relationship where inflation has apositive effect on economic growth at low levels while posing negative effects on economic growth when at high rates. Bruno and Easterly (1996) demonstrated how some countries recorded very high inflation rates in the region of 20% to 30% over long periods of time and did not witness negative impacts of inflation on their economic growth. The study however noted that in the event the level of inflation exceeded a specific value (40 percent according to Bruno and Easterly's estimation), there occurred significant decline in the level of real economic performance. Khan and Senhadji (2001) in an attempt to precisely examine the kind of relationship existing between the two variables of interest analysed a pool of 140 nations in a period spanning 40 years. They found out that developing nations had a threshold level of inflation between 11 and 12 percent while their counterparts who were already developed had a threshold level between 1 and 3 percent. Further, Li (2006) showed that the nature of the threshold effects differed depending on the level of economic development among countries. The research found that developing countries have two

threshold levels estimated at 14 percent and 38 percent while developed countries only have one threshold level estimated at 24 percent.

Most of the studies that investigated the Growth-Inflation nexus employed cross-sectional and panel data covering large sample of countries. This approach was justified by their policy implication appeal and their ability to generalize empirical findings. However, Lin and Ye (2009) and Espinosa, Leon and Prasad (2010) suggested that there was need to undertake country specific studies as policy designs among other causes were responsible for the differences in study findings; each country's inflation threshold effects should then be estimated separately to allow the incorporation of country specific characteristics.

In regard to the above, this research contributes further to the literature on the existence of some specific threshold level governing the relationship of economic growth and inflation in developing nations.

1.4 Research Questions

This research sought to address the following questions:

i. What is the first threshold level of inflation in the relationship between inflation and economic growth?
ii. What is the second threshold level of inflation in the relationship between inflation and economic growth, above which the marginal effect of inflation on economic growth diminishes?
iii. What is the effect of the inflation on economic growth at the estimated lower and upper threshold levels of inflation in Kenya?

iv. What is the impact of a structural break on the inflation threshold regression model for the case of Kenya?

1.5 Research Objectives

1.5.1 General Objective

This research sought to determine the existence or not of threshold effects in the relationship between economic growth and inflation in Kenya.

1.5.2 Specific Objective

a) To determine the first threshold level of inflation in the relationship between inflation and economic growth.
b) To determine a second threshold level of inflation in the relationship between inflation and economic growth, above which the marginal effect of inflation on economic growth diminishes.
c) To determine the effect of the inflation on economic growth at the estimated lower and upper threshold levels of inflation in Kenya.
d) To determine the impact of a structural break on inflation threshold regression model in Kenya.

1.6 Significance of the Study

This research provides empirical evidence with regards to the inflation threshold level in Kenya. The study provides more information on the kind of relationship existing between economic growth and inflation in Kenya. This study would be of help in the following ways:

I. It would enable Central Bank of Kenya policy makers target the right level of inflation that will encourage growth.

II. It would contribute to the existing literature on matters pertaining inflation threshold levels in the relationship between economic growth and inflation

III. It would stimulate further research the most suitable threshold level for economic growth in Kenya.

1.7 Scope of the Study

This research uses data recorded between the years 1970 and 2014 in Kenya. The data used for this period was quarterly data. This period incorporated all the policy means that have been put in place during the period, to capture the effect that may have on the inflation and economic growth rates.

1.8 Study Organization

This research is composed of five chapters. The first chapter provides an overview section describing the research background, statement of the problem, study objectives and significance of the study. The second chapter gives a thorough literature review in both empirical and theoretical nature and which is related to the topic of study. Chapter three describes the methodology required to satisfy the study objectives. The fourth chapter details the data analysis findings and their interpretations while the last chapter details a comprehensive summary, conclusion and recommendations arising from this study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter looks at both the theoretical and empirical literature on the effect of inflation on economic growth. Section 2.2 analyzes the theoretical literature while Section 2.3 discusses the various empirical studies done and their results and 2.4 give an overview of the literature.

2.2 Theoretical literature

Models of Economic Growth are the main theoretical foundations of inflation-growth dynamics. The Keynesian theorists developed the aggregate demand aggregate supply framework linking inflation and growth. The monetarists on their part emphasized on the key role played bymonetary growth in determining the rate of inflation while the neo-classicals emphasized that inflation affects growth through capital accumulation and investments (Brian and Howard, 2005). The following sub-sections provide a discussion on each of the growth models stated above.

2.2.1 Classical Growth Theory

The classical growth theory is an important theory as it formed a foundation upon which several other growth theories were formulated. The classical growth theory posited a supply driven growth model that linked labor, land and capital, the three main factors in a production function. Equation 2.1 represents its functional form:

$$Y = f(L, K, T) \quad \text{.....(2.1)}$$

Where;

Y represents output

K represents capital

T represents land

L represents Labor

This therefore means that output is a function of labor, land and capital. The classicals further emphasized that since growth exhibits increasing returns to scale then it should be considered self-reinforcing. The classical also viewed savings as a creator of investment which would by extension lead to increased growth. They therefore emphasized that income distribution should be considered important in determining the rate of growth of an economy.

Classical growth theories were however not able to specifically articulate the link between inflation and economic growth but they implicitly suggested that a negative relationship existed between these two variables since higher wage costs results in a reduction in the firm's profit levels.

2.2.2 Keynesian Theory

The Keynesian's explained the inflation growth relationship through the aggregate demand (AD) and aggregate supply (AS) curves. A critical feature of this model is the upward sloping AS curve in the short-run. A change on the demand side of the economy affected prices onlywhen the aggregate supply (AS) curve was vertical. However, a change in the demand affected both the prices and output when the AS curve was upward sloping (Dornbusch, Fischer and Kearney, 1996).

The underline assumption of the Keynesian theory is that the steady state of the economy balances out while transitioning from the short-run to the long-run. The adjustment pathinitially

shows a positive relationship between inflation and economic growth but later turns to negative as it approaches the latter parts of the adjustment path.

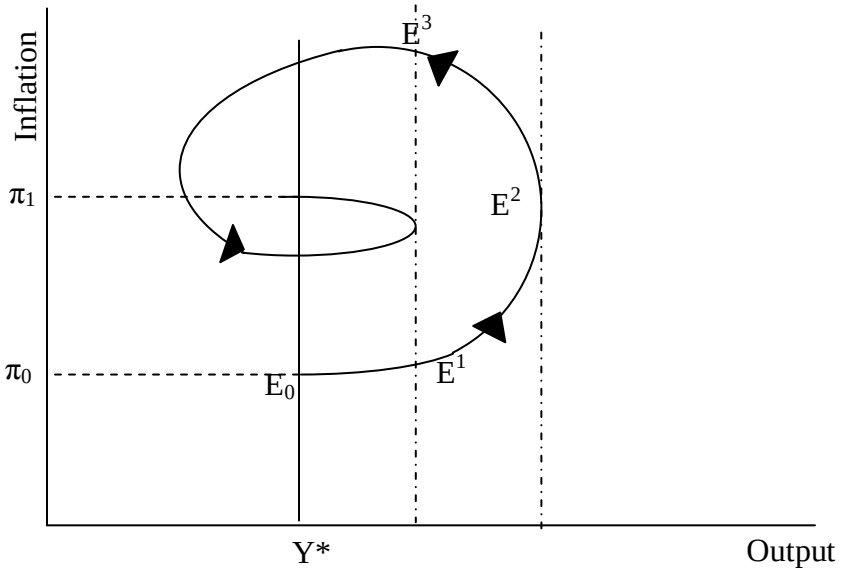

Figure2.1 The Dynamic adjustment of the Short-run AD and AS curve

Figure 2.1 shows the dynamic adjustment of the short-run AD and AS curves. The movement from point $E_0$to E_1 shows the initial positive relationship between inflation and economic growth. This positive relationship is mostly associated with the time inconsistency problem where producers speculate that only their prices have increased while their competitors are still operating at the initial prices. However, this assertion is wrong since in reality the prices have increased for all participants in the market. Due to this wrong assertion, producers end up producing more and this leads to very high output. Another explanation that tries to explain this positive relationship is that some firms already have a predetermined agreement to supply goods at a certain price therefore even in the situation where the prices increase the output remains unchanged as the suppliers are obligated by the agreement to supply the goods at the agreed price (Blanchard and Kiyotaki, 1987).

It's also important to note that the movement from E_2 to E_3represents times when the inflation-growth nexus is negative. At this point output is decreasing as inflation increases this phenomenon is common in empirical literature and is referred to as stagflation. Further, it's important to note that that the movement to a higher inflation rate (movement from$\pi_0 \; to \; \pi_1$)does not occur directly but as seen in figure 2,inflation initially rises and then falls along the adjustment

path.

The Keynesian model suggested that in the short-run a trade-off between change in inflation and output occurs but in the long-run no trade-off exists. The Keynesians recommended that for a steady inflation level output must be held at the natural rate (Y*) and that when output is below the natural rate then inflation will fall.

2.2.3 Monetarist Theory of inflation

The monetarists focus was more on the long-run as opposed to the short-run. Monetarists adopted and improved the quantity theory of money and by this they emphasized how critical monetary growth is in the determination of inflation (Gokal and Hanif, 2004). The basic principal of the quantity theory of money is that the total amount of money in existence is equal to the total amount of spending in the economy.According to the monetarist, inflation occurred when the rate of growth in the economy was lower than the velocity of money in circulation.

The monetarist went further to challenge the Phillips curve concept. Friedman (1973) argued that in the scenario where prices of goods and services double in the economy people will have to pay double for the goods and services, however, they won't mind doing so since their wages will have doubled also. Friedman (1973) argued that individuals will always predict the future rates

of inflation and therefore adjust their behaviours in the present to incorporate any future inflation effects and as a resultemployment and output remains unaffected. This concept is what Lucas (1973) referred to as the neutrality of money. Lucas (1973) argued that in the long-run for Neutrality to hold, real variables such as the level of GDP should not depend on money supply level. Monetarists therefore argued that inflation is harmless in affecting output in the long-run. However, in reality, inflation affects factors such as exports, capital accumulation and investment and as a result affects growth in the end.

Monetarists therefore focusing on the long-run, argue that growth in money supply affects prices and prices themselves have no effect on growth. They also conclude that when the growth in output is lower than growth in money supply then inflation will occur.

2.2.4 Neo-classical Theory

Solow and Swan (1956) were among the earliest neo-classical economists. Solow and Swan's (1956) model showed that when used jointly, labour and capital exhibit constant returns to scale but had diminishing returns to scale when the factors were used separately. In this model investment was replaced by technological change and Solow and Swan (1956) assumed that it was determined exogenously.

Mundell (1963) developed one of the first inflation-growth models among the neo-classist.According to the model wealth decreases with an increase in inflation. This wealth decrease makes people save more in order to increase their wealth and which results in an interest rate decrease. This in the end leads to a growth in output since the increased savings mean more capital accumulation.

Tobin (1965) while borrowing from Solow and Swan (1956), further improved Mundell's model while treating money as a store of value. According to Tobin (1965),holding money, maintaining precautionary balances in spite of the higher returns offered either by capital or by acquiring capital, substitutes current consumption of an individual or household.

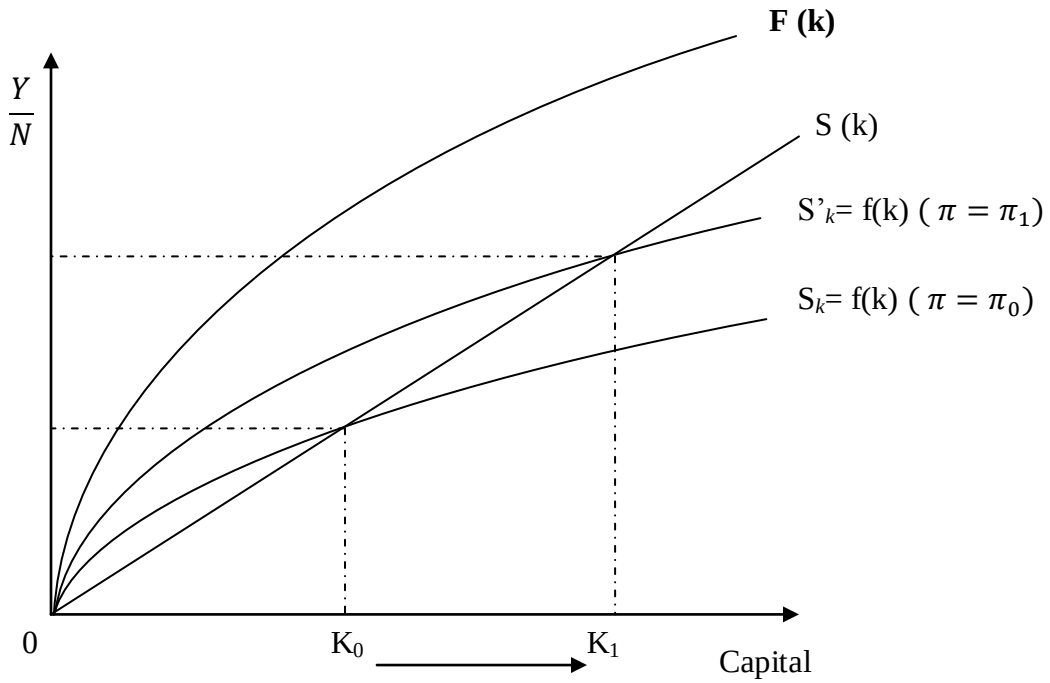

Figure2.3Tobin Effect

If inflation rate increases from$\pi_0 to\ \pi_1$ ($\pi_1 > \pi_0$), the return to money falls and people opt for capital instead of holding money. This results in the shift from $S_k$to S_k' and thus the steady state capital also increases from K_0 to K_1. From this it can be noted that when inflation increases the level of output increases also but growth in output is temporary as it only occurs as the steady state capital transitions from K_0 to K_1. In simple terms, the Tobin's effect implies that as inflation increases individuals prefer holding assets that can earn interest overtime instead of money

andtherefore there shall be more capital accumulated in the economyand this will lead to output growth. Therefore, Tobin (1965) implies that inflation affects economic growth positively.

Sidrauki (1967), another neo-classist, developed a model where money was considered super-neutral and the individuals were assumed to have infinite lives. Super neutrality occurs in the long-run where real variables, including economic growth rate, are not dependenton the growth in money supply (Friedman, 1973). According to Sidrauki's (1967) economy, inflation rate changes have no effect on the steady state capital stock. This therefore implies that economic growth also remains unaffected.

Stockman (1981) developed a model that showed that the steady-state output level would decrease with an increase in inflation rate. One of the reasons that could explain why the relationship between inflation and the steady state level of output was negative is because Stockman (1981) used money as a form of capital in his model. Stockman (1981) argued that firms also finance projects using some of their cash and that at times banks do not offer help to firms if firms don't show that they have some initial capital as cash in their accounts. Therefore, if inflation increases then the purchasing power of money will reduce which will in the end result in low purchases of cash goods and capital goods as well. In effect, Stockman's (1981) model suggeststhat inflation and the level of output have a negative relationship.

In Summary, the neo classical disagree when it comes to the inflation-growth relationship. For some the two variables have a positive relationship (Tobin Effect) while others its negative (Stockman Effect) while others argue there is no effect at all (Sidrauki).

2.2.5 Neo-Keynesian

The major development of the Neo-Keynesians was the concept of potential output which is associated with the optimal level of production and corresponds to the natural rate of unemployment (Sergii, 2009). The natural rate of unemployment is also known as the non-accelerating inflation rate of unemployment (NAIRU) where inflation rate neither rises nor falls. The neo-Keynesians used the built-in inflation rate which is determinedendogenously by the normal working of the economy.

Firstly, inflation accelerates only when GDP and unemployment exceed their potential output and natural rate respectively. This is because the high GDP will cause suppliers to increase their prices and thus the inflation rises. The Phillips curve will therefore shift towards the stagflationside which is associated with high inflation and high unemployment.

Secondly, Inflation will decelerate only when GDP and unemployment are below the potential level and the natural rate respectively. At this point the suppliers will lower their prices leading to lower rates of inflation and thus resulting in disinflation. The Phillips curve will shift to the disinflation side associated with low levels of inflation and less unemployment.

Lastly, in the case where GDP and unemployment are equal to the potential level of output and the NAIRU, respectively, the rate of inflation will not change. The neo-Keynesians believe that in the long-run, where the rate of unemployment is equal to the NAIRU, different inflation rates can prevail.

2.3 Empirical Literature Review

Empirically the relationship between inflation and growth has yielded different results depending on factors such as the period of time, methodology and the country where the study was performed. Bhatia (1960) was one of the earliest researchers to investigate the inflation-growth

relationship with a linear model using data from the United Kingdom, Germany, Sweden, Canada and Japan from 1812 to 1912. The study found that high the growth ratesmeant highinflation rates for the case of the United Kingdom, Sweden and Canada. In Germany and Japan the relationship between these two variables was negative. Conducting their research in developed and developing countries,Dorrance (1963) and Johanson (1967) found out that the relationship between inflation and growth was not significant. These findings were in line with the popular view at that time (1950s and 1960s),for both developed and developing countries,that inflation and economic growth had no significant relationship.

However, after the two oil price shocks in 1973 and 1979 accompanied very high rates of inflation and declined economic growth in many countries the view changed. As a resultthe relationship between inflation and economic growth was given more attention in the subsequent studies.

Using a sample of 47 countries Kormendi and Meguire (1985), performed a cross-country study for the period 1950 to 1977 with an aim of establishing the effect of inflation on GDP growth. The findings revealed that there existed a negative relationship between inflation and economic growth where an increase in inflation by1 percent results in a decrease in GDP growth by 0.57 percent. Fisher (1993) also found that inflation and economic growth displayed a negative relationship for a large set of country. Fisher (1993) also showed that inflation causes economic growth but economic growth does not cause inflation.

In another study, Barro (1995) using data spanning over the period 1960 to 1990 examined the inflation growth nexus for 100 countries. The Instrumental Variable (IV) estimation method was applied and the study found out that the two variables exhibit a negative relationship where if

inflation increased by 1 percent then economic growth decreased by 0.02 percent per year. Motley (1998) using data forthe same period, 1960-1990, performed a cross-country study and similar results and the findingsrevealed that if inflation increased by 5 percent then economic growth would have decreased by 0.1 to 0.5 percent.

In the 1990s many authors including Sarel (1996)and Bruno and Easterly (1996) conducted researches that showed that a threshold level exists in the relationship between inflation and economic growth where the negative relationship only occurs past the threshold level. There was therefore pressure on the policy makers to maintain inflation at low levels.But the many policy makers did not know how low they should maintain inflation. Therefore, different researchers in the 1990s went a step further by testing the inflation threshold estimate in the relationship between inflation and economic growth. In an attempt to determine this threshold level many studies developed new inflation-economic growth models that proved non-linearity in the relationship. Below is a summary of some empirical evidence from different studies.

Sarel (1996) in testing for a threshold effect in the relationship between inflation and economic growth adopted a non-linear model. The study used data for the period 1970 to 1990 for 87 countries to test for the threshold level. The control variables used in the study were real exchange rate, population growth rate, terms of trade, government expenditure, and investment rates. The findings revealed an inflation threshold level of 8 percent below which the effect of inflation on growth was insignificant.Sarel (1996) however, further modelled the growth-inflation nexus in the presence of a structural break. Afterincluding the structural break point,the study concluded that failure to determine and account for the structural breaking point biases the effect of inflation on growth by a factor of three.

Bruno and Easterly (1996) using cross-sectional data for 26 countries sought to find out the determinants of economic growth for the period 1960-1992. The findings revealed that inflation only affected economic growth negatively when one uses high frequency data or when there exists extreme inflation observations. The findings showed that there existed a threshold level of 40 percent above which the inflation-growth relationship was negative; and below which the inflation growth relationship was inconclusive.

Hansen (2000) developed asymptotic distribution theory for threshold estimation in a paper titled 'sample splitting and threshold estimation'. The study also developed a method for the construction of asymptotic confidence intervals by inverting the likelihood ratio statistic. Using the Monte Carlo simulations, Hansen (2000) showed that the generated confidence intervals were accurate. Hansen (2000) went ahead to illustrate the relevance of this theory empirically using the multiple equilibrium growth model of Durlauf and Johnson (1995). Durlauf and Johnson (1995) had used the Summer-Hetson data set which contained the variables population growth rate, GDP growth, investmentand literacy level. The study aimed at determining two possible threshold estimates from two threshold variables that measure initial endowment, that is, capital output and adult literacy rate, both measured in 1960. Hansen (2000) using the same data tries to find the threshold estimates using the asymptotic distribution theory. The findings showed the presence of two statistically significant threshold points, the first being a GDP threshold point at $863 and a second threshold point of the literacy rate variable at 45%. This study in testing and estimating inflation threshold levels will follow the same procedures developed by Hansen (2000).

Khan and Senhadji (2001) also sought to find out the threshold effects of inflation on growth for developing and industrial countries separately. Khan and Senhadji (2001) developed a new

econometric method that facilitated the estimation of threshold estimates and their asymptotic p-values. The study used panel data set covering 140 countries for both the developing and industrial countries. Since the inflation threshold was considered non-linear and non-differentiable the study used conditional least squares methods. The empirical results showed that there exists a threshold point beyond which inflation has a negative effect on output growth. For the industrial countries the threshold level was 1-3 percent while the threshold level was 11-12 percent for the developing countries. The study therefore concluded that the threshold estimate for developing countries was higher than that of the industrial countries. The study also recommended that economies should strive for low and stable inflation as this would lead to more growth in the economy. This study borrows from the model developed by Khan and Senhadji (2001) as it allows for the estimation of the threshold effects on economic growth and can alsobe modified to determine different threshold levels as was proven by Li (2006).

Sepehri and Moshiri (2004) also tested for the threshold level in the relationship between inflation and economic growth.The study divided the countries into four groups as according to their stages of development. The study employed the econometric technique developed by Khan and Senhadji (2001). The findings showed that 15 percent was the threshold level for the low-middle-income countries, 11 percent for thelow income countries and 5 percent for the upper-middle income countries.However, the results showed that inflation and economic growth had no significant relationship for the OECD countries.The research also found that there would be a potential bias if you decide to estimate the inflation growth relationship by combining all the countries at the different levels of development.

Mubarik (2005) carried out a study to determine the threshold level of inflation in Pakistan. Mubarik (2005) appliedthe new threshold technique developed by Khan and Senhadji (2001) on

a time series data for the year 1973 to 2000. The study used the following variables in the growth regression model: Inflation, GDP growth rate, population growth and total investment. Mubarik (2005) found out that Pakistan had a 9 percent inflation threshold level and that causation runs from inflation to GDP growth. Mubarik (2005) therefore advised the Pakistan policy makers to always maintain inflation levels below 9 percent.

Hussain (2005) also carried out a study on the inflation threshold level for Pakistan, reviewing the work of Mubarik (2005). Hussain (2005) argued that Mubarik's (2005) could not be relied upon since the study employed the Hodrick-prescot (HP) filter whichlacks economic content. Hussain (2005) argued that Mubarik's (2005) results were highly doubtful also because of the high R^2 and the low DW statistic in the study. Hussain (2005) also highlighted that it was important for a study to first test for the existence of a threshold before testing for an inflation threshold estimate, something Mubarik (2005) did not do. Hussain (2005) therefore revisited the research also borrowing the methodology applied by Khan and Senhadji (2001) while using data that ranging from 1973 to 2005. The findings of the study indicated that Pakistan had a threshold inflation level of 5 percent, below which the relationship between inflation and economic growth is positive and above which the relationship is negative.

Li (2006) estimates a non-linear relationship between inflation and economic growth and thetransmission mechanism through which inflation affects economic growth non-linearly. Li (2006) conducted the study for 27 developing and 90 developed countries for the years 1961 to 2004. Applying the technique applied by Khan and Senhadji (2001), Li (2006) extended the model to be able to accommodate two inflation threshold levels.The findings showed that developing countries had two threshold points at 14 percent and 38 percent. The findings showed that the inflation growth relationship was insignificant and positive below the 14 percent

threshold.The effect was statistically significant and negative at inflation levels between 14 percent and 38 percent and above 38 percent the effect remained negative. Li (2006) however did find only one statistically significant threshold for the developed countries at 24 percent, below which the relationship is positive and above which the relationship is negative. The study suggested that further work needs to be done taking a country by country approach so as to clearly elucidate the channels through which inflation affects growth. This study will besimilar to Li's (2006) work as it seeks to find out if there exists two threshold levels of inflation for the case of Kenya.

Sergii (2009) carried out a study using data from some CIS countries in order to determine the presence of a threshold level in the relationship between inflation and output growth.Sergii (2009) used data for the period 2001 to 2008 and adopted the Khan and Senhadji (2001) methodology. The inflation threshold point was estimated at 8 percent. Sergii (2009) therefore recommended that the CIS countries should therefore maintain inflation rates below the 8 percent threshold.

Kremer, Nautz and Bick (2009) also did a panel data study in estimating threshold level of inflation. The study employed a dynamic panel threshold model for the period 1950-2004. The study aimed at determining the threshold levels for 76 developing and 48 developed countries. The findings showed that there existed aninflation threshold point at 17.2 percent for developing countries and 2.5 percent for the developed countries. However, the study recommended that researchers in the future should focus more on finding the threshold levels for individual countriesas this would give guidance that is more accurate to policy makers while setting inflation targets. Sergii (2009) explained that the study may have differed from Khan and Senhadji (2001) because of the methodology adopted and also the choice of counties used.

Seleteng, Bittencourt and Van (2011) examined the growth-inflation relationship for SADC countries. The study employed panel data for the years 1980 to 2008. In order to estimate the inflation threshold level the study employed a smooth transition regression model (PSTR).Results showed that the SADC countries had an inflation threshold at 18.9 percent and therefore concluded that the policy measures by the SADC countries of trying to maintain inflation rates at single digit levels was a mistake as this level was way below the estimated threshold level of inflation.

Hasanov (2011) sought to find theinflation threshold point for Azerbaijan. The study covered the period 2001 to 2009 and used the variables inflation, GDP growth and gross fixed capital formation. This study also adopted the technique employedby Khan and Senhadji (2001). Results showed that Azerbaijan had an estimated inflation threshold point of 13 percent. The study concludes by arguing that a positive relationship between inflation and economic growth does exist in Azerbaijan below 13 percent and if inflation exceeds this level then the relationship turns to negative. The study recommends that policy makers maintain inflation rates below the 13 percent threshold point.

Marbuah (2011) also sought to test and estimate the threshold effect of inflation and economic growth for the case of Ghana using data from 1955 to 2009. Applying the technique used by Khan and Senhadji (2001), Marbuah (2011) estimated the threshold effect model at different samples and specifications as a check for robustness. The study also tested and accounted for a possible structural breakpoint in the data using Zivot and Andrews (1992) unit root test. The results revealed the presence of two threshold estimates for the case of Ghana of6 percent and 10 percent which are growth-enhancing.

Marbuah (2011) also confirmed Sarel's (1996) assertion that failure to account for structural breaks significantly bias the estimated effect of inflation on economic growth. Upon incorporating the structural break the study found out that the effect of inflation on growth increased by a factor of 1.8. The findings also showed that a decrease in inflation below 6 percent would decrease growth by 0.119 percent while an increase in inflation beyond 10 percent would decrease growth by 0.09 percent. The study concluded that the government's inflation target of 8.8 percent was within the 6-10 percent threshold band that boosts economic growth. Following Marbuah's (2011), this study will adjust for structural breaks in the inflation threshold model as well as determine the effect of inflation on economic growth at the estimated threshold level(s).

Studies on the non-linearity in the relationship between inflation and economic growth are very scarce on the Kenyan economy. This is very surprising given the interest and importance of inflation and economic growth to policymakers in Kenya. A scan through literature reveals that only one study has been done in an attempt to determine the nonlinearity in the relationship between inflation and economic growth.

Yabuand Kessy(2015) sought to ascertain an appropriate level of inflation for growth from three east African countries (EAC), that is, Uganda, Kenyaand Tanzania. The study used panel data for the three countries and used a linear regression with a squared inflation term to capture the non-linear relationship. The findings suggested that there is a non-linear relationship in the relationship implying that a threshold level of inflation exists. The estimated inflation threshold for the three EAC countries combined was 8.46 percent.

The study further estimated the threshold levels for the individual countries by running a seemingly unbiased regression for panel data. The results estimated a threshold level of 6.77 percent for Kenya, 8.80 percent for Tanzania and 8.40 percent for Uganda. The study concludedthat policy makers need to continue implementing monetary policies aimed at maintaining inflation at single digit values.

2.4 Overview of literature

From theoretical literature there seems to be no clear conclusion as regards the relationship between inflation and economic growth. Classical theorists suggested that inflation affects economic growth negatively since higher wage costs leads to a decrease in firm's profits. The Keynesians on the other hand suggested changes in output in the short-run affects inflation levels but in the long-run the two have no relationship as change in inflation do not affect growth in any way. The monetarists also argued that inflation is affectedby growth in money but that it has no long-run effect on growth.While the neo-classical theorists differed in opinion with some implying that the inflation-growth relationship can either have a positive effect (Tobin, 1965), negative effect (Stockman, 1981) or no effect at all (Sidrauki, 1967).

From empirical literature review, most studies concerning the non-linearity of inflation and growth used panel data covering a large number of countries. However, a few studies on developing countries applying the methodology by Khan and Senhadji (2001) used time series data to estimate the threshold level for individual countries (Hussain, 2005; Mubarik, 2005; Hasanov, 2011). These studies confirmed that even for specific countries there existed a threshold point. This study follows the work of Li (2006) and Hansen (2000) whichused the bootstrapping technique to test for the existence of two threshold levels.

Compared to Yabu and Kessy (2015) on the appropriate threshold level of inflation for three east African countries (EAC), this study differedin several ways. Firstly, this study employed the methodology by Khan and Senhadji (2001) as opposed to a linear regression model with a squared inflation term (π^2) used by Yabu and Kessy (2015). This methodology by Khan and Senhadji (2001) has been widely used by researchers who have investigated the threshold level of inflation and allows for the computation of the effect of inflation on economic growth above and below the estimated threshold level. Secondly, this study went a step further by determining whether a second threshold level of inflation exists for the Kenyan case as proposed by Li (2006). Thirdly, this study used time series data for Kenya in order to capture Kenya's country specific characteristic and this ensured that shocks on the Kenyan economy are considered. Lastly, this study determinedSarel (1996) proposed the impact of a structural break on the effects of inflation economic growth at the estimated threshold levels as.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

In this chapter the methodology used to analyze the data collected is explained in order to establish the threshold effects in the relationship between inflation and economic growth in Kenya. This chapter also includes the research design, the theoretical framework, the model specification, data types and sources and the data analysis.

3.2 Research Design

This is an exploratory study that uses time series secondary data for GDP growth rates and inflation rate for Kenya between the periods 1970 to 2014, a 48-year period. The sampling frame is one of time series quarterly data for both the independent and dependent variables for the period under consideration in this study.

Descriptive and inferential analysis would be used to analyse the data, all in an effort to achieve the objectives of this study. This study employs a threshold regression modelwith two threshold levelsto determine threshold effects of inflation on economic growth and a threshold model with a structural break was be used to find out the effect of the presence of a structural break point on the estimated effects of the threshold levels of inflation.

3.3 Theoretical framework

A neoclassical growth theory proposed by Solow and swan (1956)is adopted for this research. Four variables are the focus of this model: Technology (A), Labor (L), Capital (L) and Output (Y). According to Solow and Swan (1956)production will not occur unless some amount of these four variables are combined. Equation (3.1) shows the functional form of the production finction:

$Y = F(AL, K)$ (3.1)

It should be noted that A and L enter multiplicatively in this production function and the model assumes constant returns to scale. It should be noted that A is exogenously determined and that AL represents effective labor. Given that the Solow and Swan model follows a Cobb-Douglas production function (Dwivedi, 2010),equation (3.1) can further be expressed as:

$Y = K^{\alpha}(AL)^{1-\alpha}$(3.2)

Taking the logarithms of equation (3.2)gives

$\log Y = \alpha\, logK + (1-\alpha)\log A + (1-\alpha)\log L$ (3.3)

In Ghura and Hadjimichael (1996) the growth of knowledge is represented by the function below:

$A = A_0 e^{gt+X\theta}$(3.4)

Where;

g represents the rate of technology progress

X represents a vector of factors and policies that affect technology and efficiency;

θrepresents a vector of coefficients that represent each of these policies and factors;

t represents the time factor.

Taking the logarithm of equation (3.4):

$\log A = \log A_o + gt + X\theta$(3.5)

Equation (3.5) and equation (3.3)can be merged to form equation (3.6):

$$\log Y = \alpha \ \log K + (1-\alpha)\log A_o + (1-\alpha)gt + (1-\alpha)X\theta + (1-\alpha)\log L \quad (3.6)$$

Or

$$\log Y = \vartheta + \alpha \log K + \sigma t + \gamma X + \beta \log L \quad (3.7)$$

Where;

$\vartheta = (1-\alpha)\log A_o$,

$\sigma = (1-\alpha)g$,

$$\gamma = (1-\alpha)\theta$$

$$\beta = (1-\alpha)$$

Equation (3.7) is the theoretical growth model for this study where X captures all other explanatory variables that affect growth but not mentioned in the model. Capital would be captured by investment following Cass and Coopmans (1965) model while population growth rates would be used as a proxyof labor following the works ofLebovic and Ishaq (1987) DeRouen (2000) and Sergii (2009).

3.4 Model Specification

This study adopts the methodology used by Li (2006) and a threshold regression with a structural break to test for the presence of non-linearity with two threshold points in the relationship between inflation and growth. This study also adopts the bootstrapping method by Hansen (2000) to come up with asymptotic p-values in order to test for the significance of the threshold points.

3.4.1 General growth regression model

So as tochooseexplanatory variables represented by vectorX in equation (3.7), this study follows the works ofSala-i-martin (2004) who recommended the use of a growth regression model to represent the relationship between inflation and economic growth. This function in its general form is represented as:

$Y_t = f(x_t)$(3.8)

Where: $Y_t$and $x_t$are vectors of the dependent and independent variables respectively.

Sala-i-martin (2004) argued thatit'shard to determine the set of explanatory variables to be included in equation (3.8) from growth theory. Investment and population are considered key factors of the growth theory by the Neoclassical's (Cass and Koopmans, 1965), while technology human capital and knowledge are considered the key factors in the endogenous growth theory (Romar, 1996; Grossman and Helpman, 1991). Sala-i-martin (2004) highlighted that there exists a manyvariables that can be used as explanatory variables to explain growth but not all of them are significant and therefore proposed that the robustness of the regressors should be checked econometrically to determine the most important variables.

After testing for robustness of the regressors, Sala-i-martin (2004)in his study to determine the economic growth determinants identified the following explanatory variables as among the most important determinants of growth: population growth, trade openness, inflation rate, investment,government expenditure and Foreign direct investment; a common feature for these variables is that they are systematically correlated with growth. Therefore, this study adopted the growth regression model used by sala-i-martin (2004) that took the following form:

$$Y = f(\pi, GovtExp, INV, POP, OPEN, INC, CONS) \quad (3.9)$$

Where;

Y represents log of real GDP growth

πrepresents log of inflation

POP is the log of annual population growth rate

Govtexp represents the log Government expenditure

INC represents the log of income per capita

INV stands for the log of investment

CONSstands for consumption expenditure

OPEN is the log of trade openness

The linear model is specified as;

$$log\ Y_t = c + a_1 log\ \pi_t + \beta_1 log\ INV_t + \beta_2 log\ POP_t + \beta_3 log\ OPEN_t + \beta_4 log\ CONS_t +$$

$$\beta_4 log\ INC_t + \beta_5 log\ GovtExp + \varepsilon_t \qquad (3.10)$$

The marginal impact of investment in equation (3.10) is expected to be positive, since according to the accelerator principal investment change results in increased growth. Further, the harrod-domer model propagates that growth is dependent onthe share of investment spending in GDP and savings. Population growth rate on the other hand may affect growth in output either positively or negatively. Todaro (1996) argued that population affects growth positively as large populations means enough labor supply for production and also high demand in the market. However, Kelley (1998) pointed out that population growth could impact negatively on

economic growth if the dependency of young people could divert spending from investment to basic spending in order to meet basic needs.

Regarding openness and economic growth the relationship seems ambiguous both in theory and in empirical studies. Some economists have argued that trade is the engine for growth and called for promotion of exports (Sachs and Warner, 1995; Edwards, 1998). In contrast some have emphasized on the monetary and balance of payment consequences of trade (Thirwall, 2000). Therefore, the effect of trade openness to growth is an empirical issue of concern. Consumption, income per capita and government expenditure are expected to positively affect GDP growth rate.The explanatory variables in equation (3.10) are similar to those used by other researchers such as Khan and Senhadji (2001), Hussain (2005), Sergii (2009) and Kremer et al. (2009).

3.4.2 Threshold Regression Model

In order to achieve the main objective of this study which is to investigate the existence of threshold effects in the relationship between inflation and economic growth in Kenya this studyemploys a two threshold model employed by Li (2006) which is an extension of the model developed by Hansen (2000) and was also employed by Mubarik (2005) and Hussain (2005) for Pakistan, and Marbuah (2011) for Ghana. The model is represented as:

$$log\ Y_t = \beta_0 + \beta_1 * log\ \pi_t * D_1(\pi_t < \pi_1^*) + \beta_2 * log\ \pi_t * D_2(\pi_1^* \leq \pi_t \leq \pi_2^*) + \beta_3 * log\ \pi_t * D_3(\pi_t > \pi_2^*) + \theta' X_t + e_i \quad (3.11)$$

Where $Y_t$and the vector of control variables $X_t$are as defined in equation (3.10), and π_1^* and π_2^* are two threshold levels of inflation. $D_1(\pi_t < \pi_1^*)$, $D_2(\pi_1^* \leq \pi_t \leq \pi_2^*)$ and $D_3(\pi_t > \pi_2^*)$ are dummy variables that take the value one when the situation represented in parenthesis is true and takes the value zero if the situation is false.The effects of inflation are represented by three

coefficients:$\beta_1,\ \beta_{2,}\ and\ \beta_3$. Where $\beta_1$represents the effect of inflation below the threshold level π_1^*, $\beta_2$represents the inflation effect between the two threshold points π_1^* and π_2^*, while$\beta_3$represents the effect of inflation beyond the inflation threshold valueπ_2^*.Therefore, the whole inflation data is divided among the low inflation, middle level inflation and high inflation subgroups. The coefficients $\beta_1, \beta_2$and$\beta_3$therefore represent inflation effects on economic growth the low, middle and high inflation levels respectively.

3.4.3 Test for the existence of threshold effects

Before running the threshold model represented by equation (3.11), this study first has to test for the presence of threshold effects. This implies that a null hypothesis of a no inflation threshold in the linear regression model against an alternative of hypothesis of two thresholds needs to be tested. Hansen (2000) stated that conventional methods of hypothesis testing cannot be applied to test for the presence of a threshold in a threshold regression model. Instead, Hansen (2000) proposed the generation an F-test and likelihood ratio statistic through the Langrage multiplier (LM) to perform relevant hypothesis testing as well as generating relevant p-values that are computed by fixed bootstrap method. According to Hansen (2000) the first step involves testing the null hypothesis of no threshold against one threshold. The F-test and likelihood ration statistic is represented as:

$$F_1 = \frac{S_0 - S_1(\hat{\pi})}{\hat{\sigma}} \qquad (3.12)$$

$$LR_1(\pi) = \frac{S_1(\pi) - S_1(\hat{\pi})}{\hat{\sigma}^2} \qquad (3.13)$$

Where $S_0$and S_1 are the residual sum of squares; for the model without a threshold andfor the model with a threshold variable, respectively.$S_1(\pi)$and$S_1(\hat{\pi})$ are the residual sum of squaresgiven the true value and estimated value, respectively. If $F_1$is significant it implies that

the null hypothesis will be rejected and the single threshold model is expected. The given statistic $LR_1(\pi)$ is not normally distributed and therefore Hansen (2000) computed a no rejection region represented as, $c(\alpha)$, where α is a given asymptotic level. Therefore, if $LR_1(\pi) \leq c(\alpha)$, where $c(\alpha) = -2\ln(1-\sqrt{1-\alpha})$, then the null hypothesis is not rejected. Once the threshold effect has been proven to exist, the threshold value is then estimated.

Once the first threshold has been determined, the next step is to determine the presence of a second threshold level. Hansen (2000) proposed the sample splitting method to determine this second threshold level. Assuming that we know the estimated single threshold level $\hat{\pi}_1$ the entire sample is split into two sub-samples. The first sub-sample contains observations of inflation rate below the above estimated threshold value ($q<\hat{\pi}_1$) and the second subsample contains the observations of inflation are above the estimated threshold value ($q>\hat{\pi}_1$).

The second sub sample is then to be testedwith the null hypothesis that there is no threshold against the alternative hypothesis that there exists a threshold. The F-test and the likelihood ratio statistic represented in equation (3.12) and (3.13) are then computed. If the significant tests reject the null hypothesis then a second threshold level exists and needs to be determined, however, failure to reject the null hypothesis means that the model does not have a second threshold point. In the case where the former happens then the second threshold level exists and therefore needs to be estimated.

3.4.4Threshold Model with Structural break

Sarel (1996) cautioned that it is important to account for a structural break while investigating the non-linearity in the relationship between inflation and economic growth otherwise the findings will be biased. This study employs the Zivot and Andrews test to determine the precise

breaking point.In using the ZA test three possible structural breaks can be determined: a structural break in the intercept, a structural break in the slope and a structural break at both the trend and intercept. The null hypothesis of the ZA unit root states that the data is not stationary with no structural breaking point while the alternative hypothesis is that the data is stationary with a structural break.

Once the structural breaking point for the dependent variable, that is GDP growth rate,is obtained from the ZA test, a shift dummy is constructed. Therefore our new threshold inflation model with a structural break to be estimated is defined as follows:

$$log\ Y_t = \beta_0 + \beta_1 * log\ \pi_t * D_1(\pi_t < \pi_1^*) + \beta_2 * log\ \pi_t * D_2(\pi_1^* \leq \pi_t \leq \pi_2^*) + \beta_3 * log\ \pi_t * D_3(\pi_t > \pi_2^*) + \beta_4 StrB + \theta' X_t + e_i \qquad (3.14)$$

WhereY_t, X_t, π_t,π_1^* and π_2^* are as defined in equation (3.11) and *StrB* is a dummy variable that takes the value zero (0) before the structural breaking point and one (1) after the structural breaking point. Estimation is then be done on the model in equation (3.14) and the coefficient β_5 tested for significance. If the coefficient β_5 is significant then the results are compared with the results of equation (3.11) to determine if the effect of the estimated threshold inflation levels in the two equations is significantly different from each other. This threshold inflation model with a structural break is similar to the model adopted byMarbuah (2011).

3.5 Definition and measurement of variables

Inflation – This refers to an annual increase in the price of a basket of goods and services that are purchased by consumers in an economy leading to the decline of the purchasing power of a country's currency.

Economic growth – Refers to the growth rate of real GDP per capita. In this study, this is the dependent variable.

Growth rate of population - is measured as annual population growth rate. Population measure is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship.

Openness of the economy - is measured as the ration of sum of exports to imports to GDP.

Investment - is measured as gross capital formation (formerly gross domestic investment) and consists of outlays on additions to the fixed assets of the economy plus net changes in the level of inventories.

Government Expenditure – The amount of money that the government spends during a particular year

Income per Capita –the mean income of the people in Kenya.It's calculated by taking the gross national income and dividing it by the total population.

Consumption expenditure –a total of the expenditure incurred by households in Kenya on individual consumption of goods and services.

3.6 Data type and sources

The data used in this study was secondary data only obtained from the Kenyan bureau of statistics, the IMF world development indicators 2015 and the Kenya economic surveys. The studyusedquarterly data from 1970 to 2014.The data to be collected include the inflation rate, investments as a share of GDP, consumption expenditure, initial income per capita, Government Expenditure, population growth rates, openness of the economy and the real GDP growth rate.

3.7 Data Analysis

This study addresses three research objectives. To achieve the first objective which is to determine the existence of a second threshold level of inflation in the relationship between inflation and economic growth this research developed a confidence interval following Hansen (2000)to test the significance of a second inflation threshold point. The second objective of this study is to determine the effects of inflation on economic growth at the estimated threshold levels. This was achieved by interpreting the coefficients in equation (3.11) that relate to the different inflation levels. The third objective of this study is to determine the effect of a structural break on the estimated threshold effect of inflation. This was achieved by estimating equation (3.15) which has a structural break dummy that was determined using the Zivot and Andrew (ZA) test.

The significance of the models was determined by testing for the variation in GDP as explained by openness of the economy, inflation rates, investments as a share of GDP, government expenditure, income per capital,consumption expenditure and population growth rates using the R^2. The significance of the variables will be checked using the student t-test.

The study uses data from 1970 to 2014. All the data on the variables of interest are expressed in quarterly basis from the Kenyan bureau of statistics, Kenya's economic surveys and the IMF world development indicators 2015.

3.8 Time Series Properties

Time series properties was tested for the variables before estimation. This ensures that the results got are meaningful.

3.8.1 Unit Root Test

A unit root test was conducted on the variables in the study using the ADF unit root test whichrevealed their level of integration. Thisis to avoid any meaningless and spurious results that results from presence of trend in the data. (Greene, 2012; Enders, 2009)

CHAPTER FOUR

ANALYSIS AND INTERPRETATION OF THE 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 using the Augmented dickey fuller (ADF) test. Threshold regression models with and without structural beaks were estimated and other diagnostic tests, like stability and residual tests, was also carried out.

4.2 Descriptive Statistics

Table4.1Descriptive statistics for the study variables

	Summary Statistics				
Variable	Observations	Mean	Min	Max	Std. Deviation
GDP per capita growth	180	4.4907	-4.6554	22.173	4.3219
Population growth	180	3.1507	2.4610	3.8227	0.5181
Investment per GDP	180	20.7313	15.000	29.7900	3.4445
Inflation	180	12.2344	1.5543	45.9788	8.2563
FDI as a Percent of GDP	180	0.5980	0.0047	2.5323	1.8637
Gross National Expenditure as a percent of GDP	180	106.3422	95.05122	117.2760	5.0040
Trade Openness	180	0.5810	0.4770	0.7457	0.06742

Source: Authors computations, 2016

The data summary for Kenya presented in table 4.1 shows that GDP per capita averaged 4.4907.The data shows that GDP attained a minimum growth rate of -4.6554and a maximum of 22.173for the period 1970 to 2014 with a standard deviation of 4.3219. Inflation rates averaged a high of 12.2344 percent for the period under study with a minimum of 1.5543 and a maximum of 45.9788 with a high standard deviation of 8.2563 which may imply that Kenya's inflation has been subject of major shock from the world economy. The high inflation rates may possibly explain the low average GDP growth rates experienced in Kenya over the period.

The Data showed that Kenya's population is growing at a high average rate of 3.2 percent, attaining a minimum of 2.5 and a maximum of 3.8 but with little variability since the standard deviation was 0.5. The share of Investment in GDP averaged 20.7 percent with a minimum of 15 and a maximum of 29.8 with a standard deviation of 3.4. FDI as a percent of GDP had a very low mean of 0.6 percent with a minimum of 0.005 and a maximum of 2.53 with a standard deviation of 1.9. This may imply little effort by the government encourage FDI investment in

Kenya over the period under study. The data however showed that the Government of Kenya majorly invested in its economy over the period 1970 to 2014 as the share of government expenditure in GDP averaged 106.3 percent with a minimum of 95.1 and a maximum of 117.3 with a relatively low standard deviation of 5. Kenya's Trade openness had an average of 0.6 with a minimum of 0.5 and a maximum of 0.7 with little variability as the standard deviation stood at 0.07.

4.3 Unit Root Test

A unit root test was carried out on the variables to tests for their stationarity using the ADF unit root test. The ADF unit root test was conducted at level for intercept only and intercept and trend. Since some variables were found to be non-stationary at level, the first difference of those variables was conducted to make them stationary.

Table4.2ADF unit root test

	Level		**First Difference**	
Variables	**Constant without trend**	**Constant with trend**	**Constant without trend**	**Constant with trend**
Log GDP	-2.8824**	-2.9613**	N/a	N/a
Log INF	-3.5094***	-3.6539**	N/a	N/a
Log INV	-1.7456	-1.3559	-4.5444***	-4.6668***
Log GOVTEXP	-0.8504	-2.3863	-3.7915***	-3.9103**
Log Open	-3.0988**	-3.8882**	N/a	N/a
Log Pop	-1.1250	-2.4714	-5.1951***	-5.1841***
Log Cons	-0.8201	-2.5235	-4.3179***	-4.3177***
Log Inc	-0.8588	-2.3216	-3.4350**	-3.4440**

Source: Authors computations, 2016

Note: '***' represents statistical significance at 1 percent, '**' represents statistical significance at 5 percent, '*' represents statistical significant at 10%. The SIC was used to select the lags automatically.

The results in Table 4.2indicated that the logarithm of economic growth (GDP), inflation and openness in the economy were all stationary at level with a 5% significance level which implied that GDP, Inflation andtrade openness were integrated of order zero(I(0)) in this study. As forthe logarithm of government expenditure, investment, consumption, income and population growth the null hypothesis of stationaritythe null hypothesis of a unit root at level is not rejected. This study therefore further went ahead to test for their stationarity at first difference. The findings indicate that these variables (i.e government expenditure, investment, consumption, income and population growth) became stationary at first difference since the null hypothesis of a unit root at first difference was rejected at both 5 percent and 10 percent significance level. This meant that the variables government expenditure, investment, consumption, income and population growth are integrated of order one (I(1)) and therefore the first difference of the logarithms of government expenditure, investment, consumption, income and population growth were used so as to avoid spurious results.

4.4 Determination of the threshold effects

Before applying running the threshold model, we first tested for the presence of threshold effects withinflation rates serving as the threshold variable. The test process followed the sample splitting procedure proposed by Hansen (2000) and explained in section 3.4.3 of this study. The test process was done in the STATA software and the procedure and results are attached in Appendix I. The first step involves the formulation of the F-test and the likelihood ratio statistic in order to testwhether a threshold exists in the whole sample. Usingbootstrap replications (5000 bootstraps was used for this study) as proposed by Hansen (2000), the p-value generated for the threshold model was 0.0002 as shown in table 4.3 and appendix I. This implies that there was a

significant threshold leveland therefore this study rejected the null hypothesis of no threshold. This study therefore goes ahead and estimates the threshold value using the likelihood ration sequence.The Figure 4.1 displays the normalized likelihood ratio sequence $LR_n^*(\pi)$ whichis a function of the threshold in inflation. The minimum values in the graph is the inflation threshold estimate and in this graph it occurs at $\hat{\pi}$=6.1318.

Table4.3Results of inflation threshold effects test for Kenya

Null Hypothesis	Alternative Hypothesis	LM Test	Bootstrap p-value	Estimated threshold
No Threshold	One threshold	38.6103***	0.0002	π_1^*=6.1318 π_2^*=9.6274
One Threshold	Two threshold	23.0897**	0.0064	

Source: Authors Computation, 2016

Note: The thresholds are determined by the minimum sum of squares residual.'***', '**', '*' represent statistical significance at 1 percent, 5 percent and 10 percent, respectively.

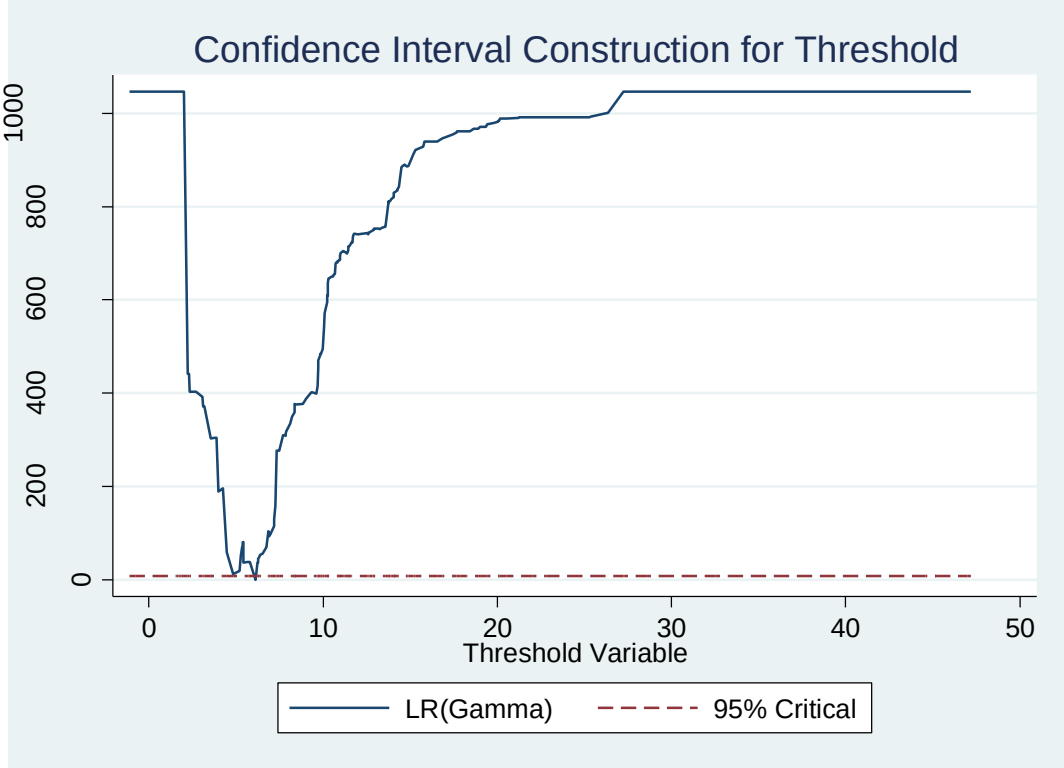

Figure4.4Confidence interval construction for the first threshold level.

Source: Authors Computation, 2016

Following Hansen (2000), the second step involves splitting the sample from the already estimated inflation threshold level of 6.1318. All the observations with an inflation level above the estimated threshold point ($q > \hat{\pi} = 6.1318$) form the sub sample to determine our second inflation threshold level.This sub sample is further tested for the presence of a significant threshold point. The results, after 5000 bootstraps, show that there is presence of a second inflation threshold since the bootstrap p-value is 0.0064. Therefore the null hypothesis of no second threshold is rejectedand this study concludes that a second threshold inflation level exists. This study therefore proceeded to estimate the value of this second threshold. The generated normalized likelihood ratio sequence $LR_n^*(\pi)$which is a function of the threshold in inflationis presented in figure 4.2. The results show that the$LR_n^*(\pi)$is minimized when the value of inflation is $\hat{\pi}$=9.6274 which now becomes our second threshold variable.

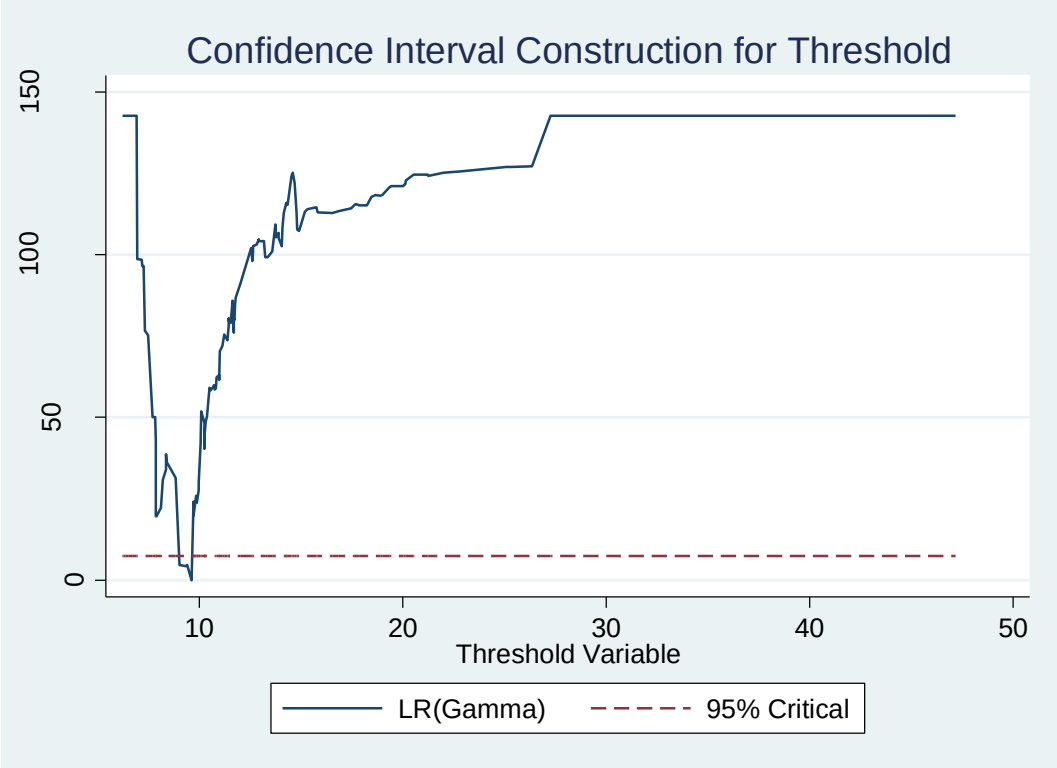

Figure4.5Confidence interval construction for the second threshold level.

Source: Authors Computation, 2016

The resultsshow that there are two significant inflation threshold estimates and therefore this study can further estimate the threshold regression model with two threshold levels (Equation 3.11). These findings collaborate with those of Khan and Shenhadji (2001) whose results showed that developing countries have inflation threshold between 7 percent and 11 percent, Marbuah (2011) who found two threshold points of 6 percent and 10 Percent for Ghana and Mubarik (2005) who found a 9 percent threshold level for Pakistan. However, there is a disparity with Li's (2006) study who found a 14-38 percent range for developing countries and Quartey (2010) who found a 22.2% threshold for Ghana.

4.5 Threshold Regression Model

Since the inflation threshold effects have been determined, this research proceeds to estimate the threshold growth regression model with two inflationthreshold levels.

Table4.4Threshold Regression model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
d Log Investment	4.578663	4.893072	0.935744	0.3261
d log (Government expenditure)	29.45307	61.03225	0.482582	0.6924
dlog_income	10.87477	2.167682	5.016775	0.0000***
d log (population)	-36.99711	13.99356	-2.643867	0.0090***
d Log_Consumption	20.65173	28.79481	0.717203	0.4743
Log Openness	0.365378	0.119717	3.052011	0.0013***
$\pi_t * D_1(\pi_t < 6.1318)$	0.473159	0.240986	1.963433	0.0513*
$\pi_t * D_2(6.1318 \leq \pi_t \leq 9.6274)$	0.216569	0.116835	1.853624	0.0698*
$\pi_t * D_3(\pi_t > 9.6274)$	-0.042634	0.020243	-2.10612	0.0493**
C	1.193029	0.512879	2.326140	0.0213**
R-squared	0.621273	F-statistic		10.10433
Adjusted R-squared	0.539014	Prob (F-statistic)		0.000000
Durbin-Watson stat	2.59344			

Source: Authors Computations, 2016

Note: '***', '**', '*' represent statistical significance at 1 percent, 5 percent and 10 percent, respectively.

The summary estimates for the growth regression model are represented in Table 4.4. The adjusted R-squared for the model was 0.539 which meant that 53 percent of all changes in GDP growth are explained by the explanatory variables (Income, government expenditure, population growth rate, Investment, Inflation and Consumption) and this means that the model is a good fit. The overall probability value for the model is 0.000 and the F-statistic is 10.10. This therefore means that the model as a whole is significant in explaining GDP growth in Kenya. The DWstatistic that indicates the presence of serial correlation had the value of 2.60 which means that there is no serial autocorrelation.

Residual diagnostic testing was also carried out on the model and the findings are presented in appendix I. The residuals were tested for normality and the model passed the normality tests with a probability of 0.53, hence the null hypothesis of residuals being normally distributed is accepted at 5 percent significance level. Therefore, the errors for the threshold model are normally distributed. A serial correlation test was also carried out. With a probability value of 0.42 the null hypothesis of no serial correlation in the residuals was accepted. Finally a stability test was carried out and the findings are represented by figure A.1 in appendix I. The CUSUM test proved that the threshold regression model was stable since the respective cumulative sums do not go outside the area between the two critical lines.

The results show that the coefficient for the inflation levels below 6.13 percent, which is represented by the first dummy variable, hasa positive significant effect on economic growth at 10 percent significance level. The coefficient is given as 0.473, which implies for any increase in inflation in this level by one percent would result in a 0.473 percent increase in economic growth. As for the inflation group with inflation levels between 6.13 percent and 9.63 percent,

the coefficient was positive and significant at 10 percent level of significance taking the value 0.217. This meant that an inflation increase by 10 percent causes an increase in economic growth by 2.17 percent. As for the extremely high inflation group (which contains inflation rates above 9.63 percent), the coefficient of inflation was significantly negative at a 5 percent level of significance and taking the value -0.042. This means that aninflation increase by 10 percent causes a decrease in economic growth by 0.42 percent

From this results then inflation can be divided into three parts. Firstly is when the inflation effect on growth is positive, associated with the rise from zero percent to the first threshold point of 6.13 percent. Secondly is when the inflation rate rises beyond this first threshold point towards the second threshold point of 9.63 where the inflation effect is still positive but the effect is less as compared to the first rise since the effect reduced to 0.22 from 0.47. The smaller positive coefficient implies that the inflation growth relation flattens as the inflation rate rises towards the second threshold point of 9.63. The third part is where inflation rises beyond the second threshold point of 9.63 where the threshold effect changes to negative. This implies that for the Kenyan economy to experience the maximum economic growth inflation needs to be maintainedbelow the first threshold point of 6.13 percent. However, positive growth can still be attained if inflation is maintained between the 6.13 percent and 9.63 percent but this would mean that the economy would be operating at aeconomic growth level that can be improved by maintaining inflation below the first threshold level.

As for the control variables in this study, their effects were as expected though not all were significant. Specifically, the results showed that investment, government expenditure and expenditure on consumption were insignificant in explaining the growth rate in GDP therefore there was no relationship between these variables and growth. The income level was significant

at 1 percent level and positive as according to expectations with a coefficient of 10.87. This implies that an increase in the income level by 1 percent would cause an increase in economic growth by 10.87 percent.Population growth was significant at 1 percent level also but was negative in its effect to GDP growth with a coefficient of -36.997. This implied that a 1 percent increase in population growth rate results in a decrease economic growth by 29.2 percent. Openness in the economy was also significant at 1 percent level and positive with a coefficient 0.365. This implied that an increase in openness in the economy by 1 percent would lead to an increase in growth in GDP by 0.365 percent.

4.6 Threshold Regression Model with a Structural Break

As cautioned by Sarel (1996)its important test for the presence of a structural break and include it in the threshold regression model if it's there otherwise it may significantly bias the estimated inflation effects. This study therefore runs equation (3.15) which includes a structural break point for the economic growth variable in the growth regression model. But before running this equation a ZA unit root test is conducted in order to find out when a structural break occurred. Table 4.5 represents the findings of the ZA unit root test.

Table4.5Results for the ZA unit root test

Sample: 1970-2014	
Number of observations: 180	
Null Hypothesis: LOGGDP has a unit root with a structural break in both the intercept and trend	
lag length: 4	
Chosen break point: 2000Q2	
	T-Statistic
Zivot-Andrews test statistic	-3.195257
1% critical value:	-4.80
5% critical value:	-4.42
10% critical value:	-4.11

Source: Authors computations, 2016

The results showthat the null hypothesis of a unit root process with a structural break ought not be rejected at 5 percent significance level. The ZA unit root test suggests that the structural break occurred in 2000Q2 with both intercept and trend. This study therefore constructs a shift dummy taking the value zero (0) before the breakpoint (i.e. 0 for 1970Q1-2000Q1) and one (1) at the breakpoint and beyond (i.e. 1 for 2000Q2-2014Q4). The 2000 breakpoint corresponds to the year after the prolonged 1999 drought and marked the year when the government adopted the millennium development goals (MDG's). Table 4.6 below depicts the estimated threshold results after accounting for the possible structural break in the threshold regression model with threshold levels 6.13 and 9.63.

Table4.6Threshold Regression Model with a structural Break

Variable	Coefficient	Std. Error	T-Statistic	Prob.
Log Investment	5.983963	10.3960	0.5756	0.5518
d log (Government Expenditure)	31.52233	20.7193	1.5214	0.1528
d log (population)	-27.60512	8.7529	-3.1538	0.0030***
Log Consumption	18.35324	26.0514	0.7045	0.4829
Log Income	8.55775	4.7739	1.7926	0.0671*
Log Openness	0.397242	0.1270	3.1277	0.0030***
StrB	0.410906	0.1549	2.6523	0.0088***
$\pi_t * D_1(\pi_t < 6.1318)$	0.491865	0.2637	1.8653	0.0640*
$\pi_t * D_2(6.1318 \leq \pi_t \leq 9.6274)$	0.242517	0.1150	2.1087	0.043**
$\pi_t * D_3(\pi_t > 9.6274)$	-0.054297	0.0120	-4.5252	0.001***
C	1.035962	0.5069	2.043324	0.0427**
R-squared	0.652500	F-statistic		11.97003
Adjusted R-squared	0.550781	Prob(F-statistic)		0.000000
Durbin-Watson stat	2.998136			

Source: Authors Computations, 2016

Note: '***', '**', '*' represent statistical significance at 1 percent, 5 percent and 10 percent, respectively.

The adjusted R squared of the threshold model with a structural break is 0.55 which means that about 55 percent of the dependent variable (GDP growth rate) is explained by the dependent variables (government expenditure, consumption, openness in the economy, population growth

rate, investment, inflation and income per capita) in the model. The F-statistic is 11.97 with its corresponding probability statistic of 0.00. This means that the entire model is significant.

Residual diagnostic testing was also carried out on the threshold regression model with the structural break and the findings are displayed in Appendix. The residuals were tested for normality, serial correlation and stability and the results showed that the model was stable, with normally distributed residuals and no serial correlation.

The structural break term enters the model significantly at the estimated threshold level points of6.13 percent and 9.63 percent. These findings corroborate to findings by Sarel (1996) who found a significant structural break point at 8 percent. Comparing table 4.6 and table 4.4 shows that the structural breaking point should not be ignored since the inflation effects have significantly changed. Failure to account for this structural break reduces the impact of the estimated lower threshold level (i.e 6.13 percent) by as much as 3.95 percent or a bias factor of 1.04 (i.e 0.491865/0.473159). The impact on the middle level inflation threshold range due to the omission of the structural break reduces by 11.98 percent or a bias factor of 1.1198 (0.242517/0.216569) while the upper threshold level impact is reduced by 27.35 percent or a bias factor of 1.27 (-0.05429/-0.04263). These results are similar to Sarel (1996) who found a bias factor of 3 for his sample and Marbuah (2011) who found a bias factor of 1.8.

These results demonstrate the importance of accounting for a structural break in any non-linear model involving inflation and economic growth and the consequences of ignoring it. The monetary policy implication of the same cannot be over emphasized as it underestimates the true effect that inflation exerts on economic growth. The results in table 4.6 imply that an increase in inflation by1 in the lower inflation group (below 6.13 percent) leads to an increase in economic

growth by 0.49 percent. As for the middle level inflation groupan increase in inflation by 1 percent would result in economic growth decreasing by 0.24 percent. As for the upper threshold group (above 9.63 percent), an increase in inflation by 1 percent leads to 0.05 decrease in economic growth.

As was with the threshold model with no structural break (Table 4.4), investment, government expenditure and consumption are insignificant though they have the expected signs. Openness in the economy, incomeper capita and population growth on the other hand have their theoreticalexpected signs and significant. Specifically, an increase in openness in the economy by10 percent results in an increase of 0.39 percent in economic growth rate, as for income per capita an increase by 1 percent results in a 8.55 percent increase in economic growth and as forpopulation growth rate, an increase of 1 percent results in a decrease in economic growth rate by 27.60 percent.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, POLICY IMPLICATIONS AND RECOMMENDATIONS

5.1 Introduction

This section provides comprehensive summary and factual conclusions as derived by the findings of this study. The policy implications and other concerns not addressed in this research but which require further research have been suggested.

5.2 Summary and conclusion

This study sought to determine threshold effects existing between economic growth and inflation in Kenya for the period between 1970 and 2004. Specifically, this study was interested in determining the following objectives: establish whether or not an upper threshold level of inflation with significant effects on economic growth really exists in Kenya, identify the impacts of inflation on the growth of Kenyan economy at the estimated lower and upper inflation threshold levels and to examine the effects of a break in structure on the estimated threshold impact of inflation on the Kenyan economic growth.

An ADF unit root test was carried out and showed that the variables inflation, economic growth and market liberalization were all constant at level. Other variables such as investment, income per capita, consumption, government expenditure and population growth were initially constant at the first difference. Therefore, the first difference of government expenditure and population growth was used. Using the sample splitting method proposed by Hansen (2000) this study found evidence of significant minimum and a maximum threshold levels at 6.13 percent and 9.63 percent where RSS is minimized.

The threshold regression model showed that at levels lower that 6.13% inflation yields significant and positive impacts on economic growth at 5 percent significance level; at inflation rates between the two threshold levels, inflation still yields some positive and significant impact on the level of economic growth while at very high inflation rates i.e. those above the upper threshold, inflation yields significant impacts on economic growth though negative. All the coefficients of all the variables in the study met prior expectation but investment, government expenditure and consumption were insignificant at 10 percent significance level.

The study also showed that ignoring the presence of structural breaks significantly alters the identified inflation effects on growth at the threshold levels. The research established that making adjustments for breaks in structure within economic models only serves to increase the overall impact of inflation on the rate of economic growth by 1.04, 1198 and 1.27 for the lower, middle and upper inflation groups.

This study therefore answers the question of which level of inflation below or beyond which growth is either constrained or enhanced in Kenya. Considering that most studies have focused on one threshold level (below which inflation affects inflation positively and beyond which inflation inhibits growth), this study goes further to show the presence of an upper level threshold (beyond it, a drop in any additional impact of inflation on economic growth drops). This study goes further to also show the importance of including breaks in structure during analysis of a threshold effect between inflation and economic growth.

5.3 Policy Implications

This study recommends all economic policies to seek maintenance of the rates of inflation at a region between 6.13 percent and 9.63 percent as this would bolster growth over the medium term. However, this study recommends that the central bank should aim at maintaining inflation

rates below 6.13 percent as this would ensure efficient performance in the economy. This therefore shows that the aim by central bank to maintain inflation rates below 5 percent are justified and will yield economic growth for Kenya. Inflation rates higher than 9.63 percent will have substantial negative effects on the economy since a 1 percent increase in inflation in this range reduces the level of economic growth by 0.05 percent. Therefore policy makers should be cautious when dealing with inflation rates beyond this level.

The Central bank of Kenya should also further commit itself to greater transparency by improving its communications strategy and accountability to give the current monetary policy framework more credibility. It should tame inflation within growth-enhancing ranges, policy tightening through complementary mix of monetary and fiscal policies is recommended. In particular, prudent fiscal management through controlled public expenditure beyond a certain optimal threshold must be vigorously pursued while paying attention to the quality of public investments to minimize waste of financial resources in the economy. Favourable inflation rates that boost economic growth can also be achieved through macroeconomic policies that seek to avoid any form of depreciation in the exchange rate of an economy.

5.4 Suggestions for further research

All the threshold impacts of inflation on the economic growth of Kenya have been revealed in this study. However, no transmission mechanism has been established. Therefore, this is an area that needs more exploration. This study remains non-committal with regards to the perception that high inflation rates cause high levels of inflation uncertainty within an economy. Further, it does not specify the kind of relationship existing between inflation uncertainty and normal inflation. Therefore, this would be an area where further research can be carried out.

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APPENDICES

APPENDIX I

Figure A.1: Stata output for the first threshold estimate

```
. thresholdtest gdp inv cons govt inc inf pop openess , q( inf ) trim_per (0.15) rep(5000)


Test of Null of No Threshold Against Alternative of Threshold
Allowing Heteroskedastic Errors (White Corrected)

_____________________________________________________________________
Number of Bootstrap Replications:  5000
Trimming Percentage:                .15


LM-test for no threshold:          38.610318
Bootstrap P-Value:                 .0002
_____________________________________________________________________


. thresholdreg gdp inv cons govt inc inf pop openess , q( inf ) h(1)
Global OLS Estimation, Without Threshold


Threshold Estimation
_____________________________________________________________________

Threshold Estimate:                6.13176537
.95 Confidence Iterval:            [6.13176537,6.13176537]
Sum of Squared Errors              856.643218
Residual Variance:                 5.22343425
Joint R-Squared:                   .784751709
```

Figure A.2: Stata output for the second threshold estimate

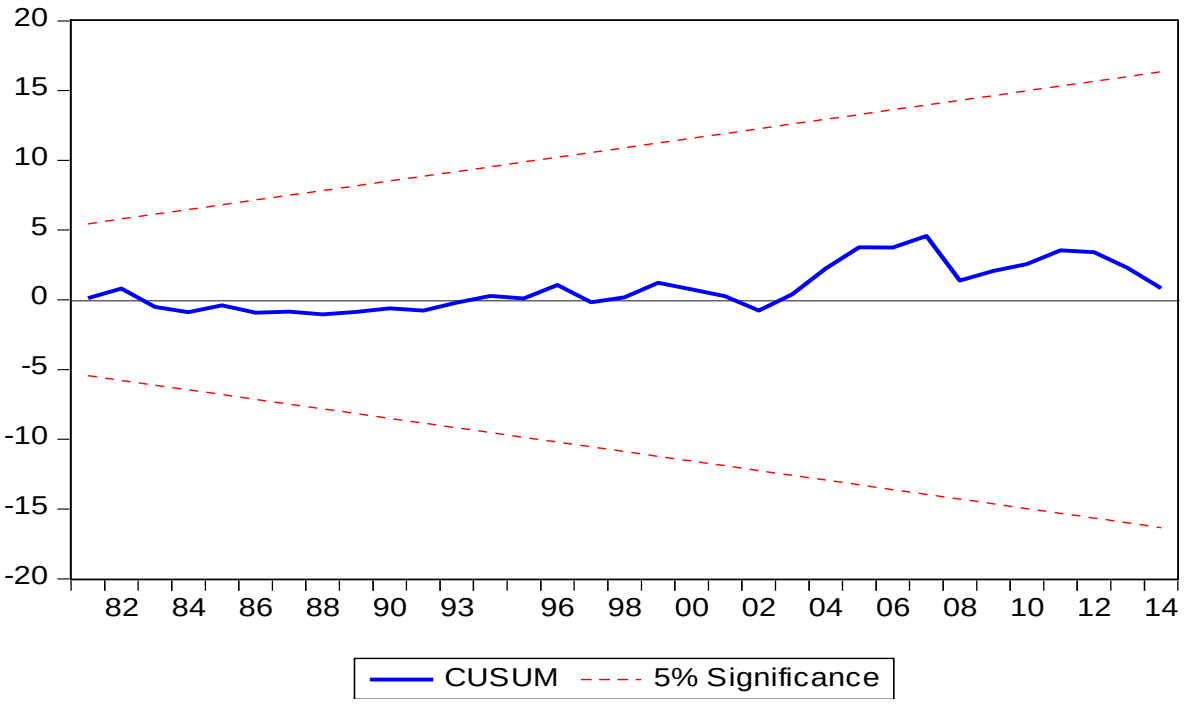
```
. drop if inf<=6.13176537
(37 observations deleted)

. thresholdtest gdp inv cons govt inc inf pop openess , q( inf ) trim_per (0.15) rep(5000)


Test of Null of No Threshold Against Alternative of Threshold
Allowing Heteroskedastic Errors (White Corrected)

_____________________________________________________________________________
Number of Bootstrap Replications:  5000
Trimming Percentage:                .15

LM-test for no threshold:         23.0896807
Bootstrap P-Value:                .0064
_____________________________________________________________________________


. thresholdreg gdp inv cons govt inc inf pop openess , q( inf ) h(1)

Threshold Estimation
_____________________________________________________________________________

Threshold Estimate:               9.62743187
.95 Confidence Iterval:           [9.01912975,9.62743187]
Sum of Squared Errors             288.619674
Residual Variance:                2.27259586
Joint R-Squared:                  .707680304
```

APPENDIX II

Table A.1: Residual Diagonistic Test results for the Threshold Regression Model without a structural Break

Test Type		
Breusch-Godfrey Serial Correlation LM Test:	Test Statistic	1.4939
	Probability Value	0.4233
Jarque-Bera Normality Test	Test Statistic	0.6021
	Probability Value	0.5321

Figure A.3: CUSUM test for the threshold regression model without a structural break



APPENDIX III

Table A.2: Residual Diagonistic Test results for the Threshold Regression Model with a structural Break

Test Type		
Breusch-Godfrey Serial Correlation LM Test:	Test Statistic	0.4504
	Probability Value	0.5422
Jarque-Bera Normality Test	Test Statistic	1.4822
	Probability Value	0.4493

Figure A.4: CUSUM test for the threshold regression model with a structural break