Strathmore UNIVERSITY

# THE RELATIONSHIP BETWEEN STOCK RETURNS AND THE RATE OF INFLATION


**Mwashashu Charles Oloolumbwa, 081386**


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## Declaration

I declare that this work has not been previously submitted and approved for the award of a degree by this or any other University. To the best of my knowledge and belief, the Research Project contains no material previously published or written by another person except where due reference is made in the Research Project itself.



**Mwashashu Charles Oloolumbwa**

**Monday, November 27, 2017**

This Research Project has been submitted for examination with my approval as the Supervisor.

**Meleah Oleche**

**Monday, November 27, 2017**

Strathmore Institute of Mathematical Sciences

Strathmore University

## Abstract

The purpose of the study is to investigate the relationship between stock returns and the rate of inflation in the Kenyan market using monthly time series data between January 2010 and October 2017. The study uses the Unit Root test, Granger Causality test, Johansen's co-integrated test and the Vector Error Correction Model (VECM). The Granger Causality test reveal that returns Granger Cause inflation although the result is inconsistent with the economic theory. However, the Johansen's test of cointegration show that there exists at most one cointegrating and the cointegration estimate reveals that returns have a significant relationship with inflation in the long-run in Kenya. The VECM model reveals that in the short-run, inflation and returns have a significant positive relationship. Similarly, in the long-run, the study finds that returns and inflation have positive relationship. The study gives insights to investors that they can use stocks to hedge against inflation since inflation and returns are cointegrated in the long-run with a positive relationship.

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## List of abbreviations

AIC- Akaike Information Criterion

ARIMA- Autoregressive Integrated Moving Average

BVAR- Bivariate Vector Autoregressive

CBK- Central Bank of Kenya

CMA- Capital Market Authority

CPI- Consumer Price Index

GARCH- Generalized Autoregressive Conditional Heteroskedasticity

GDP- Gross Domestic Product

IVA- Instrumental Variables Approach

KNBS- Kenya National Bureau of Statistics

MIMS- Main Investment Market Segment

NASI- Nairobi All Share Index

NSE- Nairobi Securities Exchange

OLS- Ordinary Least Squares

PPI- Producer Price Index

SBIC- Schwarz's Bayesian Information Criterion

SIC- Schwarz's Information Criterion

VAR- Vector Autoregressive

VECM- Vector Error Correction Model

WPI- Whole Price Index

# 1 INTRODUCTION

## 1.1 Background to the study

### 1.1.1 The stock markets

The securities market deals with the buying and selling of shares of publicly listed companies, government and corporate bonds among other financial instruments such as derivatives. The NSE was formed in 1954 dealing in shares commencing with trading taking place on a gentleman's agreement with no physical trading floor. Over the years, the NSE has undergone various reforms and is now the leading capital market in East Africa and one of the most active in Africa. Capital markets play a vital role in an economy in the sense that borrowers can easily get money from lenders thereby promoting development, foreign currency can also flow into the economy through foreign investments among other benefits. Most public listed companies in Kenya have a large percentage of their capital in equity. Investors prefer equity to other financial instruments due to their high liquidity, ability to provide a hedge against macroeconomic shocks such as inflation, high returns due to the high risks involved among other reasons.

One of the major reform that the NSE has witnessed is the introduction of NASI as an alternative index. NASI incorporates all the traded shares of the day focusing on the overall market capitalization as opposed to the NSE that tracks price movements of individual firms. In 2014, the Nairobi Securities Exchange (NSE) received formal approval from the CMA to offer its shares to the public through an IPO and subsequently self-list its shares on the Main Investment Market Segment (MIMS) of the NSE.

The NSE is divided into two; the bond market and the equity market. The NSE has 68 listed companies. The NSE also has the NSE 20 share index that is a price weight index calculated as a mean of the shares of 20 public listed companies. These companies are selected based on a weighted market performance during the period under review based on the following criteria; a company must have a free float of at least 20%, a minimum market capitalization of KES 20 million, should be profitable and have a trading activity measures weighted in the ratio 4:3:2:1. i. e Market Capitalization 40%, Shares traded 30%, Deals/liquidity 20%, and turnover 10%. The other indices on the NSE are; FTSE NSE Kenya 15, FTSE NSE Kenya 25 and the FTSE NSE Kenya government bond index. Investors still expect more from the NSE.

### 1.1.2 Inflation

Inflation is the general increase in prices in the economy and is commonly measured by the CPI. The CPI is based on a representative basket of goods and services purchased by consumers and is reviewed periodically to get the percentage change in price used to purchase the same goods. Inflation affects all sectors of the economy and an abnormal increase in inflation calls for monetary policies to be put in place. Inflation is also measured by the WPI, PPI and GDP deflector that is used to measure the rate of inflation based on the GDP.

Inflation gradually reduces the purchasing power of money hence the real value of an asset goes down. An increase in inflation will lead increase of the required risk premium and thus a higher discount rate is used leading to low present values, a decline in stock prices. However, it's perceived that increases in inflation will lead to increase in stock prices hence counter the effect of a high discount rate and thus stocks can act as a good hedge against inflation. Both developing and developed countries pay close attention to inflation because hyperinflation curtails growth in the sense that majority of the population will minimize their holdings of local money leading to loss of value of the local currency.

In Kenya, the rate of inflation is controlled by the CBK. The current CBK inflation rate target is 5.00% +/-2.50%. Whenever inflation goes way beyond or above the CBK target, the MPC comes up with stringent monetary and fiscal policies to curb inflation with the CBK target.

### 1.1.3 Stock market returns and inflation

Stock market returns are computed as;

$$\frac{P_t - P_{t-1}}{P_t}$$

whereby;

$P_t$ is the price at time t

$P_{t-1}$ is the price at time t-1.

This therefore implies that for investors to generate positive returns, $P_t > P_{t-1}$. Stock prices are highly volatile due to the exposures of risks inherent in them. One of the most common macroeconomic variable that tends to drive stock prices is inflation. Some literature is of the view that inflation curtails growth since it makes factors of production relatively expensive and thus low production. Low production implies low revenues, reduced margins and finally in most cases, little dividend and a decrease in stock prices. Other literature is of the view that, as inflation increases, the stock prices increase and thus high stock returns.

Several studies have been conducted to examine the effect of inflation on stock returns. Most have concluded that inflation really does affect stock market volatility and therefore stock prices. An increase in inflation curtails growth in the sense that borrowing rates increase thereby a decrease in investments and thus a decrease in stock returns. This is the proxy effect hypothesis as brought forward by Fama (1981).

## 1.2 Problem statement

Most of the empirical studies have been done on the U.S data and other developed economies such as the U.K and other European markets. Although few studies have been done on developing and emerging economies such as the African markets, the empirical results drawn from previous studies are mixed. Some researchers are of the view that stock returns and inflation have a positive relationship and Fisher (1930), whose study on the U.S and U.K data showed a strong positive relationship between stock returns and inflation, pioneered this. He therefore formulated the Fisher hypothesis and concluded that common stock can act as a good hedge against inflation. Solnik and Solnik (1997), who examined the relationship for the US, Germany, France, the Netherlands, the UK, Switzerland, Japan and Canada and found out that all slope coefficients are positive and the Fisher model is not rejected at any horizon, further cementing Fisher's findings. In fact, the magnitude of the slope coefficient gives a stronger support at longer horizons. Moreover, Rapach (2002), examined the relationship between real stock prices and inflation and his result showed that inflation does not corrode the long run real value of stocks means stocks are hedged against inflation. His results were consistent with Schotman and Mark (2000), who concluded that common stocks can be a hedge against inflation and they even perform well when the inflation is persistent in long time horizon. In contrast to the Fisherian hypothesis, Fama (1981) came up with the proxy effect hypothesis that has also received tremendous support from previous researchers. For instance, Gallagher and Taylor (2002), found a strong confirmation of the theory in US data over a 40-year period. Zhao (1999) reports similar findings concerning Fama's hypothesis for China while Chatrath et al. (1997) find only partial support for Fama's hypothesis in India. The relationship between stock returns and inflation has been previously studied in Kenya although inadequately. Mutuku and Kimani (2013) concluded that an increase in inflation negatively affects the performance of the Nairobi Security Exchange. This negative relationship has also been found in other countries in the previous studies such as Pakistan, India and Bangladesh as studied by (Shah, Nasir, & Naeem, 2012). This research investigates the relationship between common stocks and inflation and the effects of inflation on stock returns at different time horizons. The results can also be used to formulate hypothesis regarding hedging against inflation by using common stocks.

## 1.3 Research objectives

This study investigates the relationship between stock returns and the rate of inflation in the Kenyan market. The Fisher Effect will be tested in the Kenyan market to find out whether common stocks can be used to hedge against inflation.

## 1.4 Research questions

i.) What is the nature of the relationship between stock returns and the rate of inflation in the Kenyan market both in the short and long-run?
ii.) Can common stocks be used to hedge against inflation in the Kenyan market?

## 1.5 Significance of the study

This study seeks to provide information on the nature of the relation between stock returns and inflation at different time horizons and whether common stocks can be used to hedge against inflation.

This study will be useful to investors and more especially active portfolio managers as they are involved in rebalancing of the portfolio based on assets performance that is affected by macroeconomic variables such as inflation.

This study will be beneficial to future researchers who will be interested in examining the nature of the relationship between stock returns and the rate of inflation in developing countries in Africa and whether common stocks can act as a hedge against inflation.

This study will also be useful to any interested party that intends to broaden its knowledge on the nature of the relationship between stock returns and the rate of inflation.

This study will be useful to economic planners and regulators such as the CBK, NSE and CMA because whenever there is abnormal increase in inflation, they are able to know the devastating effect of inflation on the stock market and therefore act promptly to curb inflation because it curtails growth.

# 2 LITERATURE REVIEW

## 2.1 Introduction

This chapter presents the literature review. It discusses the main theories: The Fisher Hypothesis and the Proxy Effect Hypothesis. The research works of other authors are also discussed i.e. those that support or contradict the main theories of study.

## 2.2 Theoretical framework

This section documents the various theories formulated by various scholars in their attempt to determine and explain the relationship between stock returns and inflation.

### 2.2.1 The Fisher Hypothesis

The relationship between interest rates and inflation as brought forward by Fisher (1930), postulates that the nominal interest rate in any period can be expressed as the sum the real interest rate and the expected rate of inflation. This is termed the *Fisher Effect* or the *Fisher Hypothesis*. Fisher (1930) hypothesized that the nominal interest rate could be decomposed into two components, a real interest rate plus an expected inflation rate. He claimed that the relationship that exists between inflation and interest rates is that, real interest rates are unrelated to the expected rate of inflation and determined entirely by the real factors in an economy, such as the productivity of capital and investor time preference, i.e. real interest rate is independent of the rate of inflation. This argument was supported by (Hondroviannis and Papapetrou, 2006). Moreover, Fisher (1930) argued that in the long-run when expected inflation increases then expected nominal interest rate also increases, leaving real interest rate unaffected. When we transpose this hypothesis into stock markets, it means stock return should reflect relationship between stock returns and inflation; increase in inflation should lead to an increase in stock returns (Shah et al., 2012). This hypothesis is also supported by the Bodie (1976), who said security returns depend on expected nominal return and also unexpected nominal return, and also on expected and unexpected inflation rate. This is an important hypothesis of the *Fisher Effect* for, if real interest rates are related to the expected rate of inflation, changes in the real rate will not lead to full adjustment in nominal rates in response to expected inflation.

### 2.2.2 The Proxy Effect Hypothesis

Fama (1981) argued that the inverse relationship is the result of a negative relationship between inflation and economic activity and a positive relationship between economic activity and stock prices. This is known as the *Proxy Effect.* Fama (1981) went on to explain that the negative relationship between stock returns and inflation has its basis in the money demand theory and the quantity theory. Fama's hypothesis states that rising inflation rates reduce real economic activity and demand for money hence a negative relationship. When economic activity dips, it negatively affects the future corporate profits, stock prices and returns, hence a positive relationship. The negative relationship between inflation and the stock returns is because of the 'proxy effect' in the sense that it reflects the detrimental consequence of inflation on real economic activity. According to Fama, the statistical relationship between inflation and stock returns should disappear once the effect of real output growth is controlled for. Sharpe (2002) adds that the negative relation between equity valuations and expected inflation occurs because rising inflationary expectations coincide with both lower expected real earnings growth and higher required real returns. Fama's argument has drawn the greatest amount of recent support. Gallagher and Taylor (2002) found a strong confirmation of the theory in US data over a 40-year period. Moreover, they showed that stock prices were negatively correlated with cost-push inflation, but did not find any evidence of relationship between stocks prices and purely demand-pull inflation. Zhao (1999) reports similar findings about Fama's hypothesis for China. However, Chatrath et al. (1997) find only partial support for Fama's hypothesis in India.

### 2.2.3 Tax hypothesis

The *tax hypothesis* posits that when we deduct tax from the stock returns, their relationship with inflation tends to get negative as the quantum and rate of taxes also rise along with inflation as brought forward by (Feldstein, 1980).

### 2.2.4 Inflation Illusion hypothesis

According to Modigliani and Cohn (1979), *Inflation Illusion hypothesis* postulates that when inflation increases, bond yields rise and therefore investors discount expected real earnings and dividends by using a current higher nominal rate this is because most market participants forecast future stock returns based on historical nominal rates ignoring the effect of changing inflation.

This leads to overvaluation of equities during periods of deflation and undervaluation of equities during periods of inflation implying a negative relationship between stock returns and the rate of inflation. Similar to the *tax hypothesis, the inflation illusion hypothesis* posits an inverse relationship between stock returns and the rate of inflation. This theory was further advanced by Brandt & Wang (2003), that risk aversion is time-varying. They implied that due to the volatility of inflation (inflationary risk), investor's risk aversion coefficient increases and thus the equity risk premiums.

Ritter and Warr (2002) find support for the *inflation illusion hypothesis,* documenting that the bull market starting in 1982 was due in part to undervaluation of levered equities caused by mistakes in the use of nominal and real capitalization rates. Campbell and Vuolteenaho (2004) transformed the classic Gordon growth model into a dynamic valuation model to extend the *inflation illusion hypothesis* and used the model to identify the mispricing component of the log dividend yield. They used data from the period 1927 – 2002 and found evidence of inflation-induced mispricing. Cohen et al. (2005) find similar support in a simultaneous analysis of Treasury bills, safe stocks, and risky stocks. Furthermore, Lee (2010) found that the *inflation illusion hypothesis* explained post-war data very well, but not pre-war data. This is consistent across all industrialized countries reviewed.

## 2.3 Empirical Framework

Several studies have been done to find out the nature of the relationship between stock returns and inflation and to investigate the Fisher hypothesis with the emphasis being put on developing countries partly due to rapid growth and increasing liberalization in these countries (Kumari, 2011).

### 2.3.1 The relationship between stock returns and the rate of inflation.

A number of authors has also embraced the idea that stock returns have a positive relationship with inflation. (Fisher, 1930) pioneered the positive relationship between stock returns and the rate of inflation. Fisher (1930) examined the relationship between nominal interest rates and the rate of inflation for the U.S and the U.K using the assumption that expected inflation could be formed on a basis of a distributed time lag structure are distributed over several years and found remarkably high coefficients of correlation, thus indicating that interest rates follow price changes closely in degree, though rather distantly in time.

Firth (1979) conducted a study on UK data and found that there is positive relationship between common stock returns and the rate of inflation. His findings were supported Lee, et al. (2000), who examined the German hyperinflation during the early 1920s employing unit root test, co-integration test, OLS regression analysis and ARIMA model. Results demonstrated that the stock returns, realized inflation, expected inflation and unexpected inflation were co-integrated during the German hyperinflation period hence a positive relationship. Geske & Roll (1983) found that a positive relationship exists between stock returns and inflation, based on the assumption that securities represent claims on real assets. When there is an increase in the rate of inflation, it is expected that prices of real assets will also rise, thereby improving the value of securities representing a claim on such real assets. Spyrou (2004) examined the Fisher hypothesis for 10 emerging countries, namely, Chile, Mexico, Brazil, Argentina, Thailand, South Korea, Malaysia, Hong Kong, the Philippines, and Turkey, and found little evidence to support Fisher hypothesis in these countries

Rapach (2002) studied 16 individual industrialized countries, but did not find any evidence that inflation erodes the long-run real value of stocks. Spyrou (2001) and Floros (2004) examined stock returns-inflation relation in Greece, using the Johansen co-integration test. They found that there is no significant long-run relationship between inflation and stock returns in Greece

The inverse relationship between stock returns and inflation has received tremendous support from various authors. Shiller and Beltratti (1992) found little evidence of a long-run inverse relationship. Ahmad and Mustafa (2005) studied the relationship for Pakistan, for the period from 1972-2002 using monthly and annual data. The Full Information Maximum Likelihood (FIML) method was employed. Results revealed that relationship between real returns and unexpected growth and unexpected inflation are negative and significant.

The negative relationship between stock returns and inflation was further supported by Khil and Lee (2000), examined the relationship between stock prices and inflation on ten pacific-rim countries and on USA employing the BMAR and BVAR model. The findings of the study summarized that among 11 countries, 10 exhibit a negative relation between real stock returns and inflation. Among the US and European countries, Malaysia is a country that exhibits positive relations between stock returns and inflation.

Sari and Soytas (2005) conducted a study on inflation, stock returns and real activity in Turkey, using data for the period 1986-2002 employing HPE, unit root test, and Granger causality test. In all estimations, results demonstrated that, expected inflation and real returns are not correlated. Hassan (2008) further supported their results. He studied the relationship in the context of UK employing alternative techniques of linear regression, VECM and VAR model. The findings suggested negative relationship between stock returns and inflation.

Lee (2008) analyzed the causal relationship in the UK. The sample period ranged from 1830 to 2000. The sample period was further divided into two sub periods, 1830-1969 and 1970-2000. Unit root test, co-integration test, BVAR and GARCH models were employed. The empirical findings of the study reported that there is a significant negative correlation between unpredictable stock returns and inflation for the sub-period 1970- 2000. Nevertheless, unpredictable stock returns were hardly correlated to unpredictable inflation during the same sub-period.

However, there have also been researchers who found mixed results on the relationship between inflation and stock returns. Barnes and Boyd (1999) in low to moderate inflation economies, there is no relationship between inflation and stock returns but there is a positive relationship between stock returns and the rate of inflation in high inflation economies. Their results were consistent with Kolluri and Wahab (2008) who found an inverse relationship between stock returns and inflation during the low inflation periods and a positive relationship between stock returns and inflation during the high inflation periods.

Other authors who also found mixed results are (Lee, 2010) and (Kim and Francis, 2005). Lee (2010) found that there was a negative relationship between stock returns and inflation in the post war period but after war results supported that a positive relationship between stock returns and inflation in all developed economies. Kim and Francis (2005) studied the Fisher hypothesis based on a wavelet multi-scaling method for the US, for the period 1926-2000. Findings revealed that there is a positive relationship between stock returns and inflation in the shortest period, while a negative relationship is found in long period contradicting the *Fisher Effect.*

Jung et al. (2007) conducted a research on four European markets that is France, Italy, Germany and the UK examining the effects on expected and unexpected inflation and other macroeconomic variables such as interest rates on stock returns. They used quarterly data from the first quarter of 1975 through the first quarter of 2001 to avoid the potential effect of the 9 November 2001 incident and the 2001 recession. They found out that unexpected inflation and unexpected interest rates have a statistically significant effect on the real stock returns in France, Italy and the UK. Their findings showed that unexpected inflation does appear to influence real stock returns in three of the four countries, France, Italy and the UK. It is puzzling that in France unexpected inflation exhibits a positive influence on stock returns while in Italy and the UK unexpected inflation has a negative impact although Spyrou (2004), found similar inconsistencies.

(Shah et al., 2012) found mixed results on the relationship between stock returns and inflation. They arrived at this by conducting a research on whether common stocks can be used to hedge against inflation basing his study on SAARC countries. He found a negative relationship in Pakistan, India and Bangladesh but a positive relationship in Sri Lanka. However, he used the Wald test and found out that relationship does exist between inflation and stock returns in all countries.

### 2.3.2 Using common stocks to hedge against inflation

Fisher (1930) examined the relationship between nominal interest rates and the rate of inflation for the U.S and the U.K using the assumption that expected inflation could be formed on a basis of a distributed time lag structure i.e. long-term and short-term. Fisher's findings were that, there was a high correlation of 0.86 on the US annual data (1890-1927) when the lag was over 20 years while the UK had a correlation of 0.98 on its annual data (1820-1924) when the lag was 28 years. A study of short-term commercial paper rates in relation to quarterly price movements for the US further corroborated the evidence from correlating long-term interest rates and price changes. Fisher therefore concluded that when the effects of price changes upon interest rates are distributed over several years, we have found remarkably high coefficients of correlation, thus indicating that interest rates follow price changes closely in degree, though rather distantly in time. Fisher hypothesis, therefore, infers a positive homogenous relationship of degree one between stock returns and inflation. In other words, Fisher hypothesis implies that stocks offer a hedge against inflation. Stocks provide a hedge against inflation when investors are totally compensated for increase in the price level through increase in nominal stock returns thereby leaving the real returns unaffected.

Solnik and Solnik (1997) examined the relationship for the US, Germany, France, the Netherlands, the UK, Switzerland, Japan and Canada using the monthly stock indexes from 1958 to 1996 employing the Instrumental Variables Approach (IVA). Results revealed that all slope coefficients are positive and the Fisher model is not rejected at any horizon. However, the magnitude of the slope coefficient lends stronger support at longer horizons implying that common stocks provide a good hedge against inflation at longer time horizons.

Crosby and Otto (2000) found empirical results that support the view that the long-run level of the capital stock is invariant to permanent changes in the inflation rate. This postulation was further supported by Rapach (2002), who examined the relationship between real stock prices and inflation and his result show that inflation does not corrode the long run real value of stocks means stocks are hedged against inflation. Schotman and Mark (2000) concluded that common stocks can be a hedge against inflation and they even perform well when the inflation is persistent in long time horizon. Their argument was further supported by (Choudhry, 2001).

Al-Khazali & Pyun (2004) investigated the statistical relationship between stock prices and inflation in nine countries in the Pacific Basin using the Johansen co-integration test. They concluded that stock prices in Asia reflect a time-varying memory associated with inflation shocks, that make stock portfolios a reasonably good hedge against inflation in the long run i.e. they found a negative relationship in the short-run, but positive relationship in a co-integration analysis for the long-run.

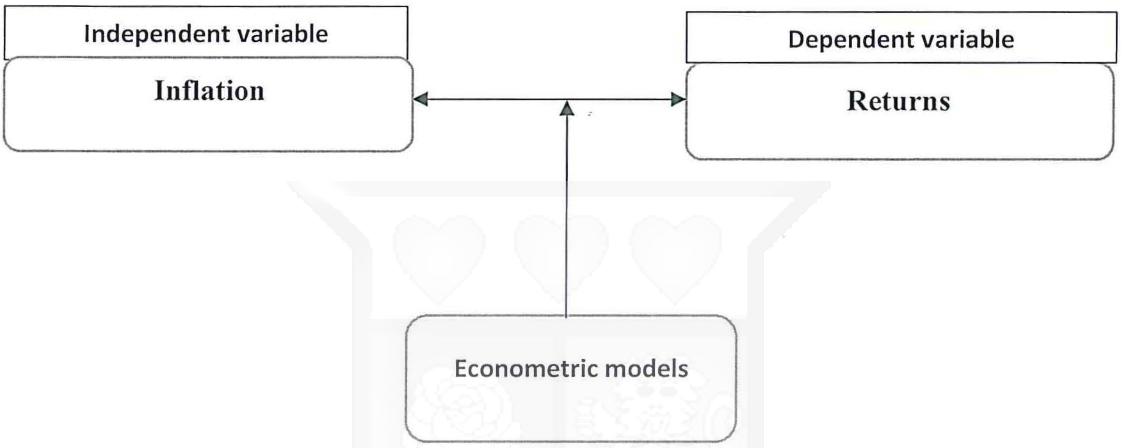
In addition, the evidences from Irish economy supporting the generalized Fisher hypothesis examined by Ryan (2006) for Irish stock returns, short-term and long-term bonds, and inflation was used to investigate long span perspective of the Irish stock returns and inflation relations. OLS and IVA were employed to estimate the co-movements between stock returns and inflation. Ryan concluded that real stock returns are independent of expected inflation over the long run, while a positive relationship between *ex post* long horizon nominal stock returns and inflation exists in Ireland. This hypothesis also found support from Alagidede and Panagiotidis (2010), who studied six African countries employing unit root test, co-integration test, DW test, and VECM. The results demonstrated no evidence of long-run relationship between stock prices and goods prices in Morocco. Except Morocco, the other five countries showed evidence of co-integration and they concluded that common stocks could be used to hedge against inflation. Akash, et al. (2011) found a positive and important relationship between stock market index and inflation. They also found that there exists a short and long relationship between stock return and inflation.

Inversely, Reilly, et al, (1970) made a portfolio of common stock and found that common stocks are not hedged against inflation. Prabhakaran (1989) further supported this hypothesis. Nelson (1976) using the monthly data, studied the relationship for the US for the postwar period, 1953-1972. Box and Jenkins' ARIMA method was used. The study demonstrated a negative relationship between stock returns and both expected and unexpected inflation implying that stocks are not hedged against inflation. Nelson's findings were further supported by Samarokoon (1996), who studied the relationship between stock returns and inflation for Sri Lanka, using the monthly and quarterly data for the period 1985-1996. The Box and Jenkins' ARIMA model was used. Empirical findings showed stock returns do not provide hedge to Sri Lankan inflation.

Bodie (1976), Fama and Schwert (1977) and Adams, et al. (2004) analyzed the hedging properties of shares and found that there is a poor hedging of common stock against inflation, not only unexpected inflation but also expected inflation, thereby indicating a negative relationship equity returns and inflation. Liflong, et al. (2010) examined the statistical relationship of stock return and inflation and showed that in the short-run, UK stock market fails to hedge against inflation but in the medium term there is mixed results.

Kumari (2011) conducted a research on the Indian market to examine the relationship between stock returns and inflation. He carried out his study during the period 1991 to 2009 using weekly, monthly and quarterly indexes of BSE Sensex and NSE Nifty with both Whole Price Index and Consumer Price Index. He considered this period because it is characterized by different reforms in the Indian economy and the global meltdown thereby capturing both the boom and recessionary phases. The results obtained through all standard econometric tests showed that there is no relation between stock returns and inflation during the studied period. The stock returns-inflation relation in India was also examined during the sub period 2002-2009 using unit root tests, Granger causality test and regressions. The Granger causality tests results suggested no significant relation between stock returns and the rate of inflation. This also held for the sub period 2005-2009, the period of financial crises. The results suggest that there exists no significant relation between inflation and stock returns implying that stock returns do not provide a hedge against inflation.

## 2.4 Conceptual framework




## 2.5 Summary of the literature review

Most of the empirical studies have been done on the U.S data and other developed economies such as the U.K and other European markets. Although few studies have been done on developing and emerging economies such as the African markets, the empirical results drawn from previous studies are mixed. Some researchers are of the view that stock returns and inflation have a positive relationship and Fisher (1930), whose study on the U.S and U.K data showed a strong positive relationship between stock returns and inflation, pioneered this. He therefore formulated the Fisher hypothesis and concluded that common stock can act as a good hedge against inflation. Solnik and Solnik (1997), who examined the relationship for the US, Germany, France, the Netherlands, the UK, Switzerland, Japan and Canada and found out that all slope coefficients are positive and the Fisher model is not rejected at any horizon, further cemented Fisher's findings. In fact, the magnitude of the slope coefficient lends stronger support at longer horizons. In contrast to the Fisherian hypothesis, Fama (1981) came up with the proxy effect hypothesis that has also received tremendous support from previous researchers. For instance, Gallagher and Taylor (2002), found a strong confirmation of the theory in US data over a 40-year period. Zhao (1999) reports similar findings concerning Fama's hypothesis for China while Chatrath et al. (1997) find only partial support for Fama's hypothesis in India. The relationship between stock returns and inflation has been previously studied in Kenya although inadequately. Mutuku and Kimani (2013) concluded that an increase in inflation negatively affects the performance of the Nairobi Security Exchange. This negative relationship has also been found in other countries in the previous studies such as Pakistan, India and Bangladesh as studied by ((Shah et al., 2012). I have decided to investigate this relationship in deeper details to test the Fama's proxy hypothesis, examine the relationship between common stocks and inflation, and whether common stocks can be used to hedge against inflation in Kenya.

# 3 RESEARCH METHODOLOGY

## 3.1 Introduction

This chapter details how the proposed study will be carried out. It outlines the research design, the population of the data, sampling i.e. sample size and the sampling technique, sources of data eventually analysis of the data in order to generate research findings.

## 3.2 Research design

The study adopted a descriptive and cross-sectional survey research design. Mark Saunders (2009) defined a descriptive survey as being concerned with finding out who, what, where, when and the how of the variables. Cross-sectional studies form a class of research methods that involve observation of all of a population, or a representative subset, at a specific point in time whereby data is collected once. The data studied is quantitative in nature and thus a quantitative type of study. The independent variable in this study is the rate of inflation while the dependent variable is the stock return. The unit of analysis are a sample of companies listed in the Nairobi Securities Exchange.

## 3.3 Population of the study

The research intends to use inflation data obtained from the KNBS. The inflation rate is estimated from the CPI. For the stock returns, the population under consideration is from the NSE particularly the monthly values of the NASI.

## 3.4 Sampling

The study intends to use the NASI because the study seeks to cover the average effect of inflation on stock returns regardless the industry a company operates. The sample data used in this study consists of monthly time series data from January 2010 to October 2017. The data will be collected from the NSE. This is because inflation has varied magnitude on stock returns based on the sector that the company operates in i.e. stocks returns in the oil and gas and information technology sector tend to be more sensitive compared to the other sectors and thus NASI is used for standardization.

## 3.5 Data collection

The study seeks to use secondary data. Stock returns are computed based on stock prices as listed by the NSE. The inflation data will be collected from the KNBS. The data collected is quantitative in nature. The data collected is valid and reliable because of the credibility of its sources i.e. the NSE and the KNBS.

## 3.6 Data analysis

### 3.6.1 Model specification

The study will start by first specifying a model for estimation. The input variables in the estimation model will be inflation rate and stock returns. Inflation will be represented by the CPI and will be the independent variable whereas stock returns will be represented by the NASI and will be the dependent variable. The model is summarized as follows;

$$NASI_t = f(CPI_t)$$

### 3.6.2 Unit root tests and lag length criteria

Several parametric and non-parametric tests have been developed for examining whether a time series data is stationary or has a unit root i.e. non-stationary. The order of integration is ascertained using the ADF test. The null hypothesis of the ADF test is that a unit roots exists in the autoregressive representation of the data whereas the alternative hypothesis is that the series is stationary. The decision criteria are to reject the null hypothesis if the absolute t-value of the ADF test is greater than the MacKinnon critical value and accept the alternative hypothesis.

Lag lengths are selected optimally using the SIC because when fitting models, it is possible to increase the likelihood by adding parameters, but doing so may result in overfitting. Both SIC and AIC attempt to resolve this problem by introducing a penalty term for the number of parameters in the model; the penalty term is larger in SIC than in AIC hence the former is preferred over the latter.

### 3.6.3 Granger Causality test

Granger proposed the idea of Granger-Causality in his 1969 paper to describe the 'causal relationships' between variables in econometric models. Clave Granger argued that causality in econometrics could be tested for by measuring the ability to predict future values of a time series using prior values of another time series. The idea of Granger-Causality is that a time series X is said to Granger-Cause Y if it can be shown that variable Y can be better predicted using the historic values of both X and Y than it can be predicted using the filtration of Y alone.

Granger Causality test is done on two variables to find out which one Granger causes the other. The null hypothesis is that returns does not Granger Cause inflation and vice versa. The decision criteria are to accept the null hypothesis if the p-value calculated is greater than 5% otherwise accept the alternative hypothesis. Similarly, optimal lag lengths are chosen based on the SIC. Causal studies are important because policy makers are able to forecast the consequences of the various policies they formulate or modify.

### 3.6.4 Johansen Cointegration test

Cointegration is an important technique to examine whether financial time series variables are cointegrated i.e. have a long-run relationship. It is based on the statistical properties of the residual from the regression analysis when the respective time series data are non-stationary but integrated of the same order (Engle & Granger,1987). The Johansen-Cointegration is employed to test whether a cointegrating relationship exists. Johansen (1988) suggest two tests; the trace and maximum eigen-value test statistic. Optimal lag lengths are chosen based on the SBIC.

The trace test's null hypotheses are; there's no cointegrating equation between the variables or there's at most one cointegrating equation between the variables or there are at most two cointegrating equations between the variables and so on. The null hypothesis is accepted if the p-value is greater than 5% or the t-statistic is less than the critical value.

The maximum eigen-value test's null hypotheses are; there's no cointegrating equation between the variables or there's at most one cointegrating equation between the variables or there are at most two cointegrating equations between the variables and so on. The null hypothesis is accepted if the p-value is greater than 5% or the max-eigen statistic is less than the critical value.

### 3.6.5 Vector Error Correction Model

If the variables are integrated of the same order and are cointegrated, then the VAR model should have an error correction term. The VAR model incorporating the ECM is specified in a VECM as;

$$\Delta X_t = \sum_{i=1}^{p-1} \beta_i \, \Delta X_{t-j} + \sum_{i=1}^{p-1} \alpha_i \, \Delta Y_{t-j} + z_i ECT_{t-1} + e_t$$

Where Δ is the differenced operator, $z_i$ is the long-run coefficient, $\beta_i$ and $\alpha_i$ are short run coefficients, $ECT_{t-1}$ is the error correction term, and $e_t$ is the residuals. The residuals are assumed to be normally distributed. $z_i$ determines the number of co-integrating vectors that consists of μ and Ω representing speed of adjustment towards long-run equilibrium and long-run parameter. $ECT_{t-1}$ is lagged value of residuals derived from the cointegrating regression of X on Y. The error correction term has long-run relationship information as it is derived from the long-run cointegrating relationship.

The VECM differentiates between the short and long-run dynamic relationships and tests for the hypothesis that the coefficients of lagged variables and the error correction terms calculated from the cointegrating regression are zero. If the coefficients in the system are jointly significant, then the lagged variables in the system are important in predicting current movements of the dependent variables.

# 4 FINDINGS

## 4.1 Introduction

This chapter documents the data analysis and interpretations. The analysis includes descriptive statistics and test for normality of the data used, unit root tests i.e. to test whether the time series data is stationary or has a unit root, Granger Causality test to find out which variable causes the other, Cointegration test,

## 4.2 Descriptive statistics and test for normality of variables

### 4.2.1 Descriptive statistics.

***Table 1: Summary statistics: 2010 M02 to 2017 M10***

| | RETURNS | INFLATION |
|---|---|---|
| Mean | 0.007838 | 0.005955 |
| Median | 0.016675 | 0.005168 |
| Maximum | 0.107459 | 0.098782 |
| Minimum | -0.102519 | -0.062808 |
| Std. Dev. | 0.045476 | 0.017002 |
| Skewness | -0.631720 | 1.100986 |
| Kurtosis | 3.082269 | 18.37621 |
| | | |
| Jarque-Bera | 6.211805 | 934.9461 |
| Probability | 0.044784 | 0.000000 |
| | | |

Table 1 displays the descriptive statistics for the model's variables: monthly stock returns and monthly inflation rate considered in the scope of the study. The means for both variables are positive and their maximum values almost equal in magnitude.

### 4.2.2 Test for normality of variables.

The market indicates the presence of heavy tails. This is shown by the kurtosis that are in excess of three, the expected value of a normal distribution, indicating a leptokurtic distribution. However, the kurtosis of returns is slightly more than three, expected value of a normal distribution, relatively to that of inflation which is way above 3. This means that inflation has relatively heavy tails compared to returns. Returns were negatively skewed at -0.63 while inflation was positively skewed. A skewness value other than 0, expected value of a normal distribution, is an indication of asymmetric distribution. Therefore, both returns and inflation are asymmetrically distributed but returns are less asymmetric distributed evidenced by its skewness and kurtosis which are almost as those of the normal distribution.

The test for normal distribution was further conducted by the Jarque-Bera test. The null hypothesis of the Jarque-Bera test is that data is normally distributed ($H_0$ = Normally distributed) while the alternative hypothesis is that data is not normally distributed ($H_1$ = Not normally distributed). The decision criteria are to accept the null hypothesis whenever the p-value calculated is more than 5%. Table 1 shows that both inflation and returns are not normally distributed because their p-values of the Jarque-Bera test are less than 5%.

## 4.3 Regression model

The regression model of returns and inflation is estimated using the OLS and the results displayed in table below.

*Table 2: Regression model*

Dependent Variable: RETURNS
Method: Least Squares
Date: 11/15/17 Time: 19:29
Sample (adjusted): 2010M03 2017M10
Included observations: 92 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| INFLATION | 0.248303 | 0.267823 | 0.927118 | 0.3563 |
| LAGRETURNS | 0.136849 | 0.104588 | 1.308462 | 0.1940 |

Table 2 above shows that returns and inflation are positively correlated as shown by the coefficient of inflation (0.248303). This means when inflation goes up by one unit, on average returns goes up by 0.24 units and vice versa.

The lag of the returns is included in the regression equation to remove serial correlation of the residuals. Serial correlation test is conducted on the model. The null hypothesis is that the residuals don't have serial correlation whereas the alternative hypothesis is that the residuals have serial correlation. The null hypothesis is accepted whenever the p-value is greater than 5%. The results of the autocorrelation test are displayed in the table below.

*Table 3: Serial correlation test results*

Breusch-Godfrey Serial Correlation LM Test:

| | | | |
|---|---|---|---|
| F-statistic | 2.129689 | Prob. F(4,86) | 0.0840 |
| Obs*R-squared | 8.291745 | Prob. Chi-Square(4) | 0.0815 |

Table 3 shows that the regression model is desirable since its residuals don't have serial correlation i.e. the p-value (8.15%) is greater than 5%.

### 4.4 Unit Root test

The data is quickly examined for stationarity by plotting a time series graph of the variables. Time series data are mostly assumed to be non-stationary i.e. exhibit a trend and thus cannot be used for analysis otherwise an occurrence of spurious regression. Spurious regression exists when two or more variables show a statistical significant relationship between them although none exists. A time series graph of the logarithm of both NASI and CPI exhibit an increasing trend over time hence non-stationary.

Unit root test is executed by the ADF test. The ADF test's null hypothesis is that a unit root exists ($H_0$ = presence of a unit root, non-stationary) while the alternative hypothesis is that data is stationary ($H_1$ = Stationary). The decision criteria are to reject the null hypothesis if the absolute t-value of the ADF test is greater than the MacKinnon critical value.

*Table 4: ADF test results of logarithms NASI*

Null Hypothesis: LNASI has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -1.028384 | 0.7404 |
| Test critical values: | 1% level | -3.502238 | |
| | 5% level | -2.892879 | |
| | 10% level | -2.583553 | |

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

Table 4 shows that that the absolute value of the t-statistic (1.03) is less than the absolute MacKinnon critical value (2.89) hence acceptance of the null hypothesis. The series is then transformed into stationarity by taking its logarithmic difference i.e.

$$R_t = \ln NASI_t - \ln NASI_{t-1}$$

And test for stationary using the ADF test.

***Table 5: ADF test results of returns***

Null Hypothesis: RETURNS has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -4.773067 | 0.0001 |
| Test critical values: | 1% level | -3.503879 | |
| | 5% level | -2.893589 | |
| | 10% level | -2.583931 | |

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

Table 5 shows that the absolute t-statistic (4.77) is greater than the absolute MacKinnon critical value (2.89) thus the null hypothesis is rejected i.e. data is stationary.

The ADF test is carried out on the logarithms of CPI and the results are displayed in the table below;

***Table 6: ADF test results of CPI***

Null Hypothesis: LCPI has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -1.280365 | 0.6360 |
| Test critical values: | 1% level | -3.503049 | |
| | 5% level | -2.893230 | |
| | 10% level | -2.583740 | |

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

Table 6 shows that CPI has a unit root since the absolute t-statistic (1.28) is less than the absolute MacKinnon critical value (2.89) hence acceptance of the null hypothesis. The series is then transformed into stationarity by taking its logarithmic difference i.e.

$$\pi_t = \ln CPI_t - \ln CPI_{t-1}$$

The ADF test is carried out on the inflation rate and the results are displayed in the table below. Since the absolute t-statistic (13.74) is greater than the absolute MacKinnon critical value (2.89), the null hypothesis is rejected i.e. data is stationary.

*Table 7: ADF test results of inflation*

Null Hypothesis: INFLATION has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

| | | t-Statistic | Prob.* |
|---|---|---|---|
| Augmented Dickey-Fuller test statistic | | -13.74501 | 0.0001 |
| Test critical values: | 1% level | -3.503049 | |
| | 5% level | -2.893230 | |
| | 10% level | -2.583740 | |

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

## 4.5 Granger Causality test

Granger Causality test is done on the two variables to find out which one Granger causes the other. The null hypothesis is that returns does not Granger Cause inflation and vice versa. The decision criteria are to accept the null hypothesis if the p-value calculated is greater than 5% otherwise accept the alternative hypothesis.

At 2 lags, null hypotheses could not be rejected as shown in figure below since both p-values calculated were greater than 5%.

*Table 8: Granger Causality test results, lags =2*

Sample: 2010M01 2017M10
Lags: 2

| Null Hypothesis: | Obs | F-Statistic | Prob. |
|---|---|---|---|
| INFLATION does not Granger Cause RETURNS | 91 | 1.91232 | 0.1540 |
| RETURNS does not Granger Cause INFLATION | | 1.81356 | 0.1693 |

However, when the number of lags was increased to four as shown in table 9, the null hypothesis that inflation does not Granger Cause returns is accepted since its p-value (0.37) is greater than 5% while that of returns does not Granger Cause returns is rejected because its p-value (0.02) is less than 5% hence acceptance of the alternative hypothesis that returns Granger Cause inflation. This means that past values of returns can be used for the prediction of future values of inflation i.e. predictions of future values of inflation based on its own past values and on the past values of returns are better than predictions of future values of inflation based only on its own past values.

*Table 9: Granger Causality test results, lags=4*

Sample: 2010M01 2017M10
Lags: 4

| Null Hypothesis: | Obs | F-Statistic | Prob. |
|---|---|---|---|
| INFLATION does not Granger Cause RETURNS | 89 | 1.06860 | 0.3776 |
| RETURNS does not Granger Cause INFLATION | | 3.06766 | 0.0210 |

## 4.6 Cointegration test

The Johansen test of cointegration is conducted on the two variables, that is, NASI and CPI. The requirements to carry out cointegration test is that the variables have to be non-stationary but should be integrated of the same order i.e. when converted to first difference, they become stationary. Tables 4 and 6 shows that both the logarithms of NASI and CPI are non-stationary at level but are integrated of the same order, I (1) i.e. become stationary at the same level. Satisfied that the two variables are non-stationary and are integrated of the same order, the Johansen test of cointegration is applied on returns and inflation. One period lag returns are also included as an exogeneous variable since its inclusion removes serial correlation between returns and inflation. The results of the test are displayed in the table below based on the Johansen Cointegration Trace test.

*Table 10: Johansen Cointegration Trace test results*

Unrestricted Cointegration Rank Test (Trace)

| Hypothesized No. of CE(s) | Eigenvalue | Trace Statistic | 0.05 Critical Value | Prob.** |
|---|---|---|---|---|
| None * | 0.220789 | 21.95510 | 15.49471 | 0.0046 |
| At most 1 | 1.62E-05 | 0.001429 | 3.841466 | 0.9683 |

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

The null hypotheses are; there's no cointegrating equation between the variables or there's at most one cointegrating equation between the variables or there are at most two cointegrating equations between the variables and so on. The null hypothesis is accepted if the p-value is greater than 5% or the t-statistic is less than the critical value. Table 10 exhibits the null hypothesis of zero cointegrating equation between the variables is rejected since the t-statistic (21.95) is greater than the critical value (15.49) as well as the p-value (0.46%) is less than 5%. Consequently, the null hypothesis that there is at most one cointegrating equation is accepted since the t-statistic (0.0014) is less than the critical value (3.84) as well as the p-value (96.83%) is greater than 5%.

Moreover, the Johansen test of cointegration is applied on the time series data based on the maximum eigenvalue test. The results are displayed in the table below.

*Table 11: Johansen Cointegration Maximum Eigenvalue test results*

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

| Hypothesized No. of CE(s) | Eigenvalue | Max-Eigen Statistic | 0.05 Critical Value | Prob.** |
|---|---|---|---|---|
| None * | 0.220789 | 21.95367 | 14.26460 | 0.0025 |
| At most 1 | 1.62E-05 | 0.001429 | 3.841466 | 0.9683 |

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

The Johansen Cointegration Maximum Eigenvalue test further confirms the results obtained in table 10 from the Johansen Cointegration Trace test since the p-value (0.25%) is less than 5% and the Max-Eigen statistic (21.95) is greater than the critical value (14.26) leading to rejection of the first null hypothesis. The second null hypothesis that there's at most one cointegrating equation is accepted because the p-value (96.83%) is greater than 5% and the Max-Eigen statistic (0.0014) is less than the critical values (3.84).

From the Johansen test of cointegration, it's evident that returns and inflation are cointegrated i.e. exhibit a long run relationship.

## 4.7 Vector Error Correction Model

The VECM is fitted on the two variables because they are cointegrated. The VECM model estimates the coefficients of the Causality model so as to find out the long run and short run causality in the model.

*Table 12: VECM estimates*

Vector Error Correction Estimates
Date: 11/16/17 Time: 14:20
Sample (adjusted): 2010M04 2017M10
Included observations: 91 after adjustments
Standard errors in ( ) & t-statistics in [ ]

| Cointegrating Eq: | CointEq1 |
|---|---|
| LNASI(-1) | 1.000000 |
| LCPI(-1) | -1.584400 |
| | (0.62756) |
| | [-2.52469] |
| C | 3.098103 |
| **Error Correction:** | **D(LNASI)** |
| CointEq1 | -0.041612 |
| | (0.02307) |
| | [-1.80358] |
| D(LNASI(-1)) | 0.098583 |
| | (0.10298) |
| | [ 0.95730] |
| D(LNASI(-2)) | 0.262335 |
| | (0.10279) |
| | [ 2.55209] |
| D(LCPI(-1)) | -0.556400 |
| | (0.29074) |
| | [-1.91373] |
| D(LCPI(-2)) | -0.012346 |
| | (0.29566) |
| | [-0.04176] |
| C | 0.007642 |
| | (0.00567) |

The error correction term coefficient indicates whether there's a long-run causality. The error correction term has information about the long-run relationship as it is derived from the long-run cointegrating relationship. The sign of the coefficient tells us the direction of the long-run causality. Since it's a negative as shown in table 13, it means that there exists a long-run causality from returns to inflation. This is consistent with the Granger Causality test results in table 9.

In order to determine whether a coefficient is significant or not, the VECM equation is estimated by the OLS and results displayed in the table below. A coefficient is significant if its p-value is greater than 5%. C (1) is the coefficient of the error correction term i.e. contains information about the long-run relationship between the variables. C (1) is significant at the 5% level since its p-value is greater than 5%. Moreover, the coefficient is negative at (-0.0416) indicating its significance and a moderate speed of convergence to equilibrium. The implication of this is that there also exists a short-run causal relationship between inflation and stock returns.

*Table 13: Coefficient p-values*

Dependent Variable: D(LNASI)
Method: Least Squares (Gauss-Newton / Marquardt steps)
Date: 11/16/17 Time: 14:37
Sample (adjusted): 2010M04 2017M10
Included observations: 91 after adjustments
D(LNASI) = C(1)*( LNASI(-1) - 1.58439958936*LCPI(-1) + 3.09810320021 ) + C(2)*D(LNASI(-1)) + C(3)*D(LNASI(-2)) + C(4)*D(LCPI(-1)) + C(5) *D(LCPI(-2)) + C(6)

| | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C(1) | -0.041612 | 0.023072 | -1.803580 | 0.0748 |
| C(2) | 0.098583 | 0.102980 | 0.957304 | 0.3411 |
| C(3) | 0.262335 | 0.102792 | 2.552094 | 0.0125 |
| C(4) | -0.556400 | 0.290741 | -1.913731 | 0.0590 |
| C(5) | -0.012346 | 0.295658 | -0.041757 | 0.9668 |
| C(6) | 0.007642 | 0.005668 | 1.348330 | 0.1811 |

| | | | |
|---|---|---|---|
| R-squared | 0.156092 | Mean dependent var | 0.007161 |
| Adjusted R-squared | 0.106450 | S.D. dependent var | 0.045584 |
| S.E. of regression | 0.043090 | Akaike info criterion | -3.387405 |
| Sum squared resid | 0.157822 | Schwarz criterion | -3.221854 |
| Log likelihood | 160.1269 | Hannan-Quinn criter. | -3.320615 |
| F-statistic | 3.144375 | Durbin-Watson stat | 2.091623 |
| Prob(F-statistic) | 0.011846 | | |

C (4) and C (5) have information about the short-run causality. The Wald-test coefficient diagnosis is applied on C (4) and C (5). The null hypothesis is that both are zero and therefore no short-run causality. The null hypothesis is rejected whenever the p-value is greater than 5%. The results of the Wald-test coefficient diagnosis are displayed in the table below

*Table 14: Wald test results*

Wald Test:
Equation: Untitled

| Test Statistic | Value | df | Probability |
|---|---|---|---|
| F-statistic | 2.088084 | (2, 85) | 0.1302 |
| Chi-square | 4.176167 | 2 | 0.1239 |

Table 14 shows that both C (4) and C (5) jointly affect returns are significant since the p-value (12.29%) is greater than 5%. Therefore, there exists a short-run causality between returns and inflation.

4.7.1 Test of significance

Based on the R-squared value, a model is significant if its R-squared value is greater than60%. The R-squared value (15.60%) is less than 60% as shown in table 13. However, the p-value (1.18%) in table 13 is less than 5% hence significant i.e. a model is significant if its p-value is less than 5%. This means that data was fitted well in the model.

4.7.1.1 Residual diagnosis

4.7.1.1.1 Serial correlation test

Normally, the residuals of a good model don't have serial correlation. Autocorrelation occurs if the pattern of a time series variable repeats itself over a period of time. The null hypothesis of a serial correlation test is that there's no serial correlation while the alternative hypothesis is that there's serial correlation. The null hypothesis is accepted if the p-value is greater than 5% otherwise the alternative hypothesis is accepted. The results of the serial correlation test are displayed in the table below.

*Table 15: Serial correlation LM test results*

Breusch-Godfrey Serial Correlation LM Test:

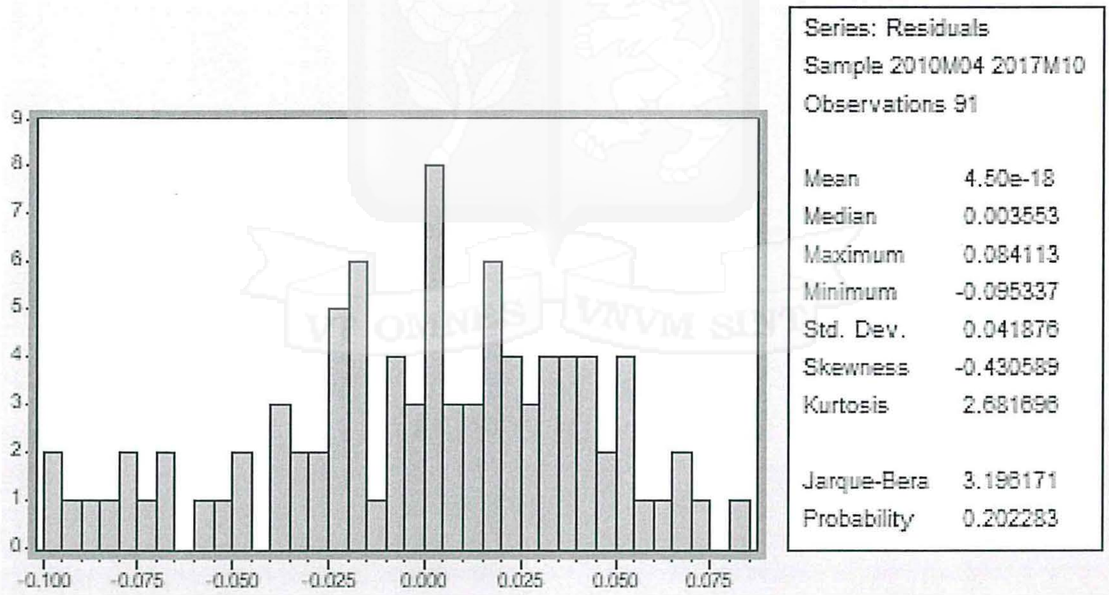
| | | | |
|---|---|---|---|
| F-statistic | 1.590723 | Prob. F(2,83) | 0.2099 |
| Obs*R-squared | 3.359325 | Prob. Chi-Square(2) | 0.1864 |

Table 15 shows that the residuals are not autocorrelated since the p-value (18.64%) is greater than 5%.

4.7.1.1.2 Normality test

Moreover, the residuals are tested for normality since the residuals from a good model should be normally distributed. The Jarque-Bera test is applied and the results are displayed in figure below.

***Figure 1: Normality test results***




The null hypothesis of the Jarque-Bera test is that residuals are normally distributed otherwise the alternative hypothesis. The null hypothesis is accepted whenever the p-value is greater than 5%. Figure 4.1 shows that the residuals are normally distributed because the p-value (20.22%) is greater than 5% hence acceptance of the null hypothesis.

#### 4.7.1.1.3 Heteroskedasticity test

Furthermore, heteroskedasticity test is applied on the model to test its goodness of fit using the Breusch-Pagan-Godfrey heteroskedasticity test. A desirable model should not have heteroskedasticity. The null hypothesis of the Breusch-Pagan-Godfrey heteroskedasticity test is that there's no heteroskedasticity and is accepted if the p-value is greater than 5%. The results of the Breusch-Pagan-Godfrey heteroskedasticity test are displayed in the table below.

***Table 16: Breusch-Pagan-Godfrey heteroskedasticity test results***

Heteroskedasticity Test: Breusch-Pagan-Godfrey

| | | | |
|---|---|---|---|
| F-statistic | 1.514261 | Prob. F(6,84) | 0.1834 |
| Obs*R-squared | 8.882004 | Prob. Chi-Square(6) | 0.1803 |
| Scaled explained SS | 6.516037 | Prob. Chi-Square(6) | 0.3679 |

### 4.7.1.2 CUSUM test and the CUSUM of squares test

Finally, the stability of the model is tested using the CUSUM test and the CUSUM of squares test.

#### 4.7.1.2.1 CUSUM test

The results of the CUSUM test are displayed in the figure below.

**Figure 2: CUSUM test results**

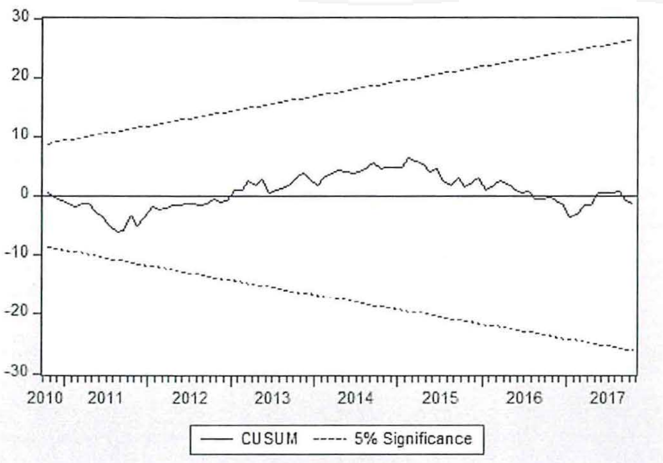
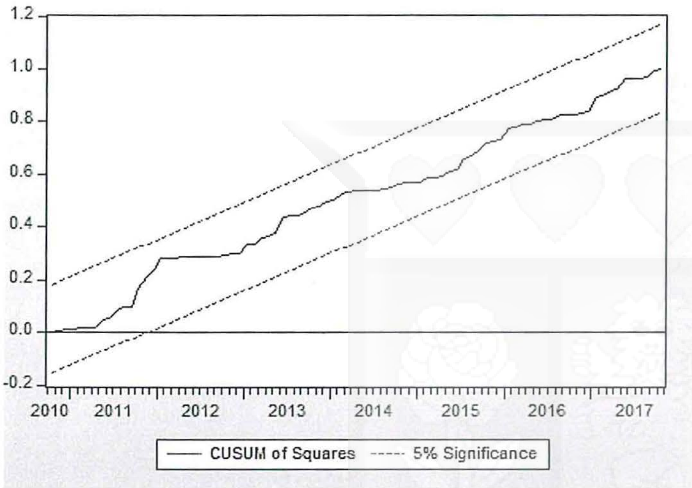



Figure 2 shows that our model is stable since the CUSUM lies within the significance region.

4.7.1.2.2 CUSUM of squares test

The stability of the model is also confirmed by the CUSUM of squares test where it is seen that the CUSUM of squares lies within the 5% significance as shown in the figure below. The model is smooth since the sample period chosen had an economic 'calm'.

*Figure 3: CUSUM of squares test results*



# 5 SUMMARY, CONCLUSION AND RECOMMENDATIONS

## 5.1 Introduction.

This chapter's main focus is on the summary of the research findings, conclusions and recommendations, and limitations of the study.

## 5.2 Summary

The objective of this research was to determine the nature of the relationship between inflation and stock returns both in the short and long-run. Moreover, the study also aimed at determining whether stocks can be used to hedge against inflation in the NSE. The independent variable for this study was inflation measured by the CPI whereas returns was the dependent variable measured by the NASI. In order to investigate the relationship between stock returns and inflation, the study explored various literature and particularly the major hypotheses i.e. Fisher's theory, proxy-effect hypothesis, inflation illusion hypothesis and tax hypothesis.

The data for the study was obtained from KNBS and NSE for inflation and stock returns respectively. The time series data was converted to log normal values and the descriptive statistics obtained. Table 4.1 shows that both returns and inflation have a positive mean value of 0.78% and 0.59% respectively and their maximum values almost equal in magnitude. The Jarque-Bera statistics affirmed that both variables were not normally distributed. The regression model of returns and inflation was estimated using the OLS and it was found out that returns and inflation are positively correlated. The results of the ADF test found that the time series data had a unit root but was stationary once converted to stationarity by taking its first differenced as shown in tables 4, 5, 6 and 7. The Granger Causality test was applied on series to find out if there exist any causal relationships between the variables. The results of the Granger Causality test show that returns Granger Cause inflation. The next task was to examine if there exists a long run relationship between stock returns and inflation. This meant that Cointegration test had to applied. The results of the Cointegration test showed that returns and inflation had a long run relationship with at most one cointegrating equation. In order to determine the nature of the long-run association ship, the VECM was fitted on the variables. The coefficient of the long-run relationship was significant and therefore returns and inflation have a long-run positive relationship. Similarly, the short run coefficients joint was significant exhibiting a short run relationship between stock returns and inflation.

## 5.3 Conclusions

The study examines the short and long-run relationship between stock returns and inflation in Kenya. The study also investigates whether stock returns can be used to hedge against inflation. Empirical evidence reveals conflicting results as some suggest that returns and inflation are positively related others show negative relationship while others both depending on the time frame of the study. Similarly, empirical evidence also reveals conflicting results on whether stock returns can be used to hedge against inflation. As expected, scholars who found a positive relationship between stock returns and inflation were of the view that returns can be used to hedge against inflation and vice versa. The results from the data analysis show that returns and inflation are positively related and are co-integrated i.e. have a long-run relationship. Based on the study, the VECM estimates exhibit a significant long-run positive relationship between returns and inflation and that stock returns can be used to hedge against inflation. This study therefore affirms the proposition of the *Fisher's Effect* that purports a positive relationship between stock returns and inflation.

## 5.4 Recommendations

The study recommends that investors can use stocks to hedge against inflation both in the short and long-run. The study also recommends that the policy makers to stabilize the inflation rate as this will boost investors' confidence and thus development. The study also recommends further research as the relationship between stock returns and inflation is still a debatable topic.

## 5.5 Limitations of the study

The study was based on the NSE and thus the findings are limited in the stock market of Kenya and may or may not apply in other stock market i.e. empirical evidence shows different relationships between inflation and stock returns. The study also used a short time series data i.e. January 2010 to October 2017 translating to roughly 8 years. This data was limited. Large volumes of data would lead to more accurate results. Moreover, the data was historic and thus the current situation i.e. policies formulation regarding inflation and the stock market may not be the same as implemented used initially.

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