THE RELATIONSHIP BETWEEN INTEREST RATE AND INFLATION RATE IN KENYA

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THIS RESEARCH PROPOSAL IS SUBMITTED TO THE SCHOOL OF ECONOMICS IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTERS OF ARTS (ECONOMIC POLICY AND MANAGEMENT).

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DECLARATION

This research proposal is my original work and has not been submitted for award of degree or diploma in any other University.

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This research proposal has been submitted for examination with my approval as University supervisor.

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LIST OF ABBREVIATIONS

Δ	First Difference or Change
$I(0)$	A stationary time series
$I(1)$	Integrated time series of order 1
ADF	Augmented Dickeyï Fuller Test
ADF	Augmented Dickeyï Fuller Test
AD-GLS	Dickey-Fuller Generalized Least Squares
AIC	Akaike Information Criterion
ARDL	Autoregressive Distributed Lag Model
CBK	Central Bank of Kenya
CBR	Central Bank Rate
CUSUM	Recursive Cumulative Sum
CUSUMSQ	CUSUM Squared
ECM	Error-correction Mechanism
FPE	Final Prediction Error
GDP	Gross Domestic Product
HQC	Hannanï Quinn Criterion
i.i.d.	Independently and Identically Distributed
IBR	The Kenya Interbank Interest Rate
INF	The Observed Inflation Rate
KES	Kenya shilling
KNBS	Kenya National Bureau of Statistics

MPC	Monetary Policy Committee
OLS	Ordinary Least Squares
SBC	Schwarz Bayesian Criteria
VAR	Vector AutoRegressive

ABSTRACT

In this study the relationship between nominal interest and expected inflation in Kenya is investigated. Monthly data for the interbank rate (IBR) and the inflation rate (INF) calculated from CPI for the period between 2003 and 2016 is used. The regression model, Granger causality and ARDL model are the empirical tasks conducted to investigate the relationship. Regression model and Granger causality test show supporting evidence of relationship between the variables. Granger causality Wald test and the ARDL model show that there is causality from INF to IBR and not vice versa. The ARDL(1,0) model fitted show evidence of partial adjustment of IBR for changes in the INF. Hence monetary authorities may, with precaution, use marginal changes in nominal interest to combat inflationary pressure. Nominal Interest rate may not respond fully to inflation expectation.

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CHAPTER ONE: INTRODUCTION

1.1 Background

Inflation rate and interest rate are important variable in the economic, social, political and financial sectors in Kenya. Actual inflation rate or expected inflation has serious implications in the political and economic well being of a nation. High inflation may cause social and political instability in a nation. Governments and financial authorities thus seek to maintain low and stable inflation.

The CBK works its monetary policy with an aim of maintain overall inflation within the range of between 2.5 and 7.5 percent of the government target. The CBR is used as monetary policy tools in Kenya. The general goals of monetary policy include attaining output stability, price stability, exchange rate stability and developing stable financial markets (Misati *et. al.* 2010). The CBR is also used to anchor inflation expectations. With such close linkage between interest rates and expected inflation, it is important to investigate if there is any empirical evidence of such a relationship.

The relationship between nominal interest rate and inflation expectation is captured by the Fisher effect. A rich bank of empirical studies on the Fisher Effect for various regions and nations exists. These studies have been conducted over a long period of time and using different analytical methods and data sets. Irving Fisher [1867-1947], a neoclassical economist, statistician and social campaigner, gave and investigated the relationship now referred to as Fisher Hypothesis. According to Lee (2009);

> ñThe Fisher effect postulated that real interest rate is constant and that nominal interest rate and expected inflation move one-for-one togetherò.

When expected inflation raises or declines by a given proportion, nominal interest rate raises or declines by an equivalent proportion. These changes do not alter the real rate of interest in the long-run (Fisher, 1930).

Lowering interest rates has an effect of increasing aggregate demand and raising price level. This is because lower interest rates, reduces the incentive to save, reduces borrowing costs, lowers mortgage interest payments**,** causes depreciation in the exchange rate and increases asset prices. All these effect have the result of increasing aggregate demand and raising price levels. Raising interest rate, on the other hand, lowers aggregate demand and cools the economy.

High inflation is harmful since it leads to reduction in the purchasing power, high production cost, uncertainty, high interest burden via the Fisher effect and a wage spiral. In a wage spiral wages and prices push each other up and up. It also increases uncertainty and reduces individuals and firms ability to make sound economic decisions.

The quantity theory of money (QTM) spells out that slower money growth leads to lower prices and higher interest rates. But according to the Gibsonôs paradox, lower (higher) price are accompanied by reduction (rise) in interest rate and not a rise (reduction). This positive correlation, as described by the Gibsonøs paradox, between price levels and interest rate is contrary to the general expectation that correlation would be negative (Keynes, 1930).

Although the Fisher hypothesis has been validated in many empirical studies it does not universally hold in all nations and at all time epochs. The few empirical studies conducted for the Kenyan economy to establish the validity of the Fisher hypothesis offer contradicting results, although most lean towards its validity (Berument *et. al.*, 2007; Laiboni and Jagongo, 2015).

The Central Bank of Kenya uses Repurchase (Repo) rate, reverse repo rate, Vertical Repo and Central Bank Rate (CBR), in their effort stabilize the financial market and control inflation. There are multiple transmission channels that central banks seek to influence when there is a change in the policy rate. These channels include the credit market rates, the asset prices, the confidence channel or expectation and the exchange rate. Adjustment of the policy rate is expected to cause a change in aggregate demand, resulting in changes in price level. How much a policy rate change influences inflation rate and other market rates will depend on whether the policy change was anticipated and how this policy change affects future inflation expectation. It is not easy to predict the impact of a policy rate change on individualøs or firmøs expectation and confidence, but the impact has important implications in their economic activities and price levels (International Monetary Fund, 2010; Mishkin, 2001, 1996; Taylor, 1993; Misati *et. al.* 2010; and Misati *et. al*. 2011).

If real interest rate remains steady in the long-run then economic agents can invest with confidence leading to increased economic activities. Although it is assume that real interest rate remains stable in the long-run, there are fundamental changes that may make this assumption to be untenable. Such fundamental changes include changes in the demography, technology and preference, fiscal policies, regulations, financial depth, monetary policies and debt policy. Such policy changes and shocks may cause shifts in macroeconomic relationships between variables.

1.2 Problem Statement

This research study seeks to test the existence of a long-run Fisher hypothesis in Kenya. This study seeks to investigate whether interest rate change by one-for-one in reaction to change in expected inflation or they only change partially. In investigating the relationship between nominal interest rate and expected inflation it is assumed that real interest rate remains constant. Further this study will evaluate whether there is causality between the selected proxy variables. Is the causality from expected inflation rate to short-term nominal interest rate as per the Fisher hypothesis or vice versa?

The few empirical studies seeking to establish whether the Fisher hypothesis holds in Kenya show conflicting results (Berument *et. al.*, 2007; Laiboni and Jagongo, 2015). These contradictory results may be as a result of the type of data selected or methods of analysis used. Apart from using more up-to-date data, this research study will also use different proxy variables in testing for Fisher hypothesis.

1.3 Research Objectives

The main goal of this study is to examine whether there is a significant relationship between nominal interest and expected inflation rates in Kenya.

The specific objectives are;

i. To investigate whether there is correlation and causal relationship between inflation rate to nominal interest rates, and

ii. To investigate presence and strength of the Fisher relationship in Kenya.

1.4 Significance of the Study

The Fisher effect is important due to its role in financial markets, exchange rate, and macroeconomics theory of monetary neutrality. To develop an effective monetary policy and the use of appropriate tools, the monetary authority would benefit from the knowledge on validity of Fisher effect. Inflation rate must respond to the policy rate changes for a central bank to maintain low and stable inflation targets. The study helps us delve into whether it is appropriate to use of nominal interest rate as a policy rate and whether nominal changes influence real changes in the economy.

Interest rates have an effect on price levels through their effect on aggregate demand. Expectations on inflation and economic activities, coupled with the other channels of monetary transmission have an effect on the overall demand of goods and services. The strength of Fisher effect is useful in policy formulation targeted towards economic stability, output stability and exchange rate stability.

According to Fisher effect, real interest rate remains constant and is unaffected by variations in nominal variables. Interest rates determine demand and supply of credit, and hence the efficiency of the banking sector. Real interest rate is a determinant of the stability of credit and financial markets.

1.5 Limitations of the Study

The first limitation of this study is that inflation expectation is not directly observable. Any measure used as measure inflation or any proxy for expected inflation ought to be accurate and reliable. This study utilized inflation calculated from Consumer Price Index (CPI) without evaluating whether this measure is affected by biases associated with CPI as a measure of inflation. An efficient measure of underlying inflation should predict overall inflation and be well linked to monetary policy.

The KNBS reviews the method of calculating the CPI, by including new goods and services, changing the corresponding weights to capture changing consumption behavior. Such reviews are meant to make the CPI more relevant and a better measure of inflation rates (KNBS, 2010).

1.6 Overview

Chapter two comprises of theoretical literature as well as review of econometric methods and applied empirical studies related to this research study. Chapter three is on research methods and data collection. It discusses the theoretical framework, data collection, the empirical model and its validation. Chapter four provides the results from descriptive analysis and empirical model and model diagnosis. Chapter five offers the concluding remarks and policy implications of the results.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter comprises of the following general sections: a review of theoretical literature and a review of empirical investigation on inflation and interest rates with emphasis on Fisher Hypothesis.

2.2 Review of Theoretical Literature

2.2.1 Interest Rates Theories

Mishkin (2001) explains that ñ*the best measure of interest rate is the yield to maturity. It is the interest rate that equates the present value of payments received from a debt instrument with its value today*ò. The different views of interest rate can be classified as real theories or monetary theories. Real theories are long run theories that consider money as a tool for enabling transaction. With real theories economic activities can be explained using goods, services and decisions made about them (Schumpeter, 1956).

Interest rate is determined by market forces according to monetary approach. According to classical economists money is a nominal variable and does not affect the long-run equilibrium values of real variables. Movement in the price levels is as result increase or decrease of quantity of money.

The loanable funds theory is a long-run interest theory that seeks to explain how long-term interest rates are determined. According to this theory, interest rates are determined by real investment demand and real savings supply. Loanable funds demanded by economic agents for purpose of investments, increases as real interest rate, the opportunity cost, decrease. The supply for loanable funds will increase as real interest rate increase since economic agents will be willing to postpone current consumption for future higher returns. The market for loanable funds will depend on, among others, the economic agentsô expectations, income levels, monetary expansion, government plans and other economic conditions (Saunders, 2010; Handa, 2000).

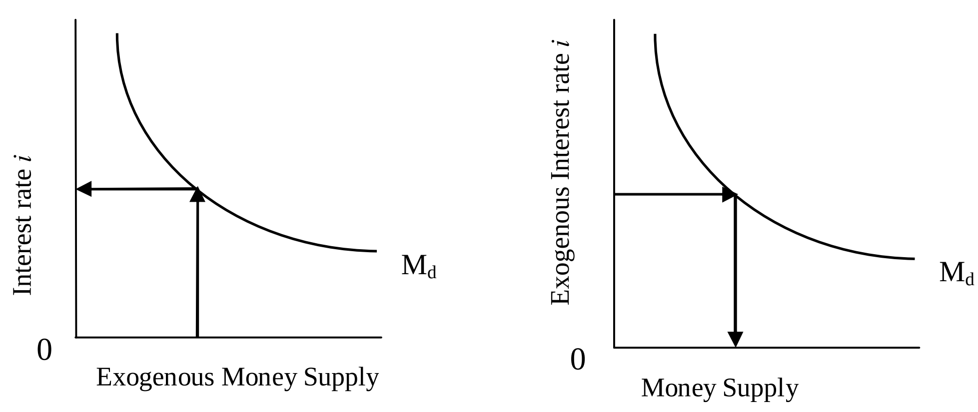
Another approach to interest determination is the Keynes liquidity preference model. It classifies the demand for money into three purposes; transaction purposes, precautionary purposes and speculative purposes. The money held for transacting and for precaution are both increasing functions of income. The amount of money held for speculative reasons reduces as interest rate rises. Interest rate being the opportunity cost of parting with liquidity in order to hold an instrument that is less liquid than money. (Keynes, 1936, 1937; Koutsobinas, 2011). Baumol (1952) and Tobin (1956) explained that money balances held for transaction purposes reduces as the interest rate increases. Money demanded for transacting is thus negatively related to interest rate. Keynesian liquidity preference approach therefore emphasizes the importance of interest rate in the demand for money theory.

The Post-Keynesian approach to interest rate differs from the Keynesian and neo-classical synthesis where interest rate are market determined. Post-Keynesians view interest rate as exogenously determined by authorities and not as adjusting in order to clear demand for real capital with supply for financial capital. Interest rate will then determine the level of investment and in turn economic activity through the effective demand. Since money is not a commodity the Post Keynesians do not consider interest rates as market clearing (Rogers 1986; Kaldor, 1982; Moore, 1988).

Contrary to quality theory of money, post Keynesian view considers monetary aggregates as endogenously determined and not controlled by monetary authorities. Monetary aggregates adjust to demand for money and credit depending on exogenous interest rate, investment activities and income. Interest rates are preset by the monetary authority and are key determinants of investment demand. Interest rates can thus be used to bring economy close to full employment (Rogers 1986; Kaldor, 1982).

We end this subsection by a representation of the different view of interest rates in the figures below. According to Figure (2.1, a) interest rate will adjusts appropriately to ensure equilibrium in the money market. In the post Keynesian view (Figure 2.1, b) the interest rates are exogenous and money supply is endogenous (Moore, 1988; Mitchell-Innes, 2007).

Figure 2.1 Exogenous Money Supply and Exogenous Interest Rate



(a)The Monetarist view (b) Post Keynesian view (Rogers, 1986)

In the Fisher hypothesis real interest is assumed to be constant over time. However real interest rate may vary over time due to among other reasons; i) Change in investment behavior as a result of technological growth, fiscal incentives and taxation policy. ii) Nominal interest rate failing to adjust fully to inflation change. iii) Increasing public debt that forces government to raise real yield on government bonds. iv) Investors perception of risk on particular securities and, v) regulation and deregulation of capital markets (Blanchard and Summers, 1984; Chadha and Dimasdale, 1999).

2.2.2 Sources of Inflation

There are multiple sources of inflation: according to monetarism, monetary policy is more effective than fiscal policy in economic stabilization. Money supply can be used to influence a countries output and price level in the short-run but has no influence on the output in the long-run (Friedman and Schwartz, 1963). Monetarism agrees with the classical QTM that inflation is as a result expanding total money supplied at a rate greater than that of the expansion of output.

The demand-pull inflation result from aggregate demand exceeding aggregate supply at the full employment level. The inflationary gap created by increasing aggregate demand over aggregate supply, at full employment, causes inflation to rise. According to the Keynesian approach increases in money supply will read to lower interest rate. Then lower interest rate leads to increase investment spending. This in turn leads to increased aggregate demand. Thus national output and prices rises since aggregate supply is inelastic.

In the Keynesian framework the goal of increasing money supply is in order to reduce interest rate which enhances investment spending and increases aggregate demand. The resulting increase in aggregate demand increases inflationary pressure.

The cost-push inflation is as a result of fall in aggregate supply. It may be as result of wages increasing more than the productivity of labor, increasing cost of law material, and profit-push by oligopolistic and monopolist firms. In a market imperfections oligopolistic and monopolist firms are able to set prices higher than the equilibrium price in order to keep high profit margin, causing prices to rise.

Worker by adaptive expectations try to keep their wages higher and higher in order to cope with rising prices. When labor unions advocate for higher wages they create a wage-cost spiral, forcing employers to raise the prices of their goods to compensate for increased cost. Such wage spiral will lead to higher and higher inflation as worker try to maintain their standards of living. This form of wage spiral inflation is also referred to as build-in-inflation (Gordon, 1988).

Other than the macroeconomic factors discussed above there are institutional, political and inflation expectations factors that determine inflation. Credibility of the political regime, independence of the central bank and other instructions can be a source of structural inflation. Long run inflationary trend in developing countries could be as result of structural rigidities, market inefficiencies, social and political instabilities, exchange rate fluctuations, food supply and climatic conditions among others. Inflation is thus a combination of the different shocks and we cannot be easily decomposed into the different shocks.

2.2.3 Expectation Formation

Based on adaptive expectation an economic agent forms expectation on inflation based on the average of past values. Fisher in his study used a backward looking distributed lag structure (Fisher 1930). This is an adaptive expectation model for inflation expectation.

The other major approach in expectation formation is the rational expectation approach. Under rational expectation the economic agent make the best future inflation prediction based on all the currently available information (Lucas, 1972; Engsted, 2002). When rational expectation is applied in financial markets it is referred to as efficient markets hypothesis (Fama, 1970). By the efficient market hypothesis the price of a security will reflect all the available information. Fama (1975) assumes that a rational agent will utilize all the information available in the market when forming expectations. He argued that current interest incorporates expected future price changes.

2.2.4 The Fisher Effect

As expressed in to the Fisher (1930) identity ñ*nominal interest rate is the sum of real interest rate and expected inflation*ò (Handa, 2008). According to the identity, Nominal interest rate (i_t) changeôs with an equal percentage, to change in inflation expectation (π_t^e)**.** Real rate of interest (r) remains unaffected by such nominal changes (Mankiw, 2010; Yixiao *et. al.,* 2004). The Fisher effect can be represented using the equation,

Norminal interest rate	=	Real interest rate	+	Inflation expectation

$$i_t = r + \pi_t^e, \qquad (2.1)$$

2.2.5 Departure from Fisher Effect

There may be departure from the Fisher hypothesis due to among others taxes and the effect of inflation on wealth (Darby, 1975; Arusha, 2003; Mitchell-Innes, 2007, Engsted, 1996). Tobin (1965) observes that interest rate and the closely related capital intensity are determined by monetary supply, portfolio choice between money asset and real capital, technology and investor preference. Tobin (1965) argues that inflation may reduce money balances demanded. Economic agent thus increases their capital saving leading to increased capital intensity, and lower real rate of capital returns. According to Mundell (1963) increasing inflation leads to a fall in wealth by its effect on real money balances. It causes increase in rate of savings causing real rate of interest to decrease. Studies by Darby (1975), Feldstein (1976) and Crowder and Hoffman (1996) have found evidence of effects of taxes on the Fisher effect.

2.3 Review of Empirical Literature

The section on the review of empirical studies is structured into studies conducted in developed nations, developing nations, African nations and Kenya.

2.3.1 Developed Nations

Studies conducted in multiple developed nations have found the existence of the full Fisher identity. Some of these studies include, Fatima and Shamim (2012), Atkins and Coe (2002), Malliaropulos (2000) Atkins, F.J. (1989), Fama and Gibbons (1982), Mishkin (1981); Burak *et. al.*, 2015; Tsong and Lee, 2013 and Takayasu Ito, 2009). Studies that have found partial evidence of the Fisher effect are Clemente *et. al.* (2017), Yaya and Keho (2015). Other studies found no evidence of the Fisher identity or that the identity does not universally hold for all time epochs include Mishkin (1984), Summers (1983), and Huizinga and Mishkin (1986).

Ozcan and Ari (2015) investigated the Fisher hypothesis in the G7 countries. In the study they used monthly T-bill rates and CPI data between the period 2000/01 to 2012/11. They found the presence of the partial Fisher hypothesis in the data using panel ARDL cointegration analysis. Clemente *et. al.* (2017) while studying the same countries using data for 1970:Q1ï 2015:Q4 incorporating structural breaks, found evidence of partial form of Fisher effect.

Malliaropulos D. (2000) applied a stationary framework to assess the Fisher Hypothesis in the US. The study utilized quarterly data for the period from1960:Q1 to 1995:Q3 of 91-days T-bill and CPI data. Using a vector autoregressive (VAR) representation of the detrended data he found strong evidence of the presence fisher effect in medium-term and the long-term. Atkins and Coe (2002) applied the ARDL model to study the hypothesis in US and Canada. The application of ARDL has gained popularity due to the fact that it can be applied to short time series while maintaining desirable estimates consistency.

2.3.2 Developing Nations

Investigations of the Fisher hypothesis in the Asian economies include Lee (2009), Zainal (2014) and Tai-Hu (2010), Salah Nusair (2008, 2009), Edirisinghe, *et. al.* (2015), Lee (2009) and Edirisinghe, *et. al.* (2015) used co-integration and ECM to study the effect in Singapore and Sri-lanka respectively. Both discovered the validity of the hypothesis in each country although in Singapore only a partial form was found. On the other hand Aktham and Al-zoubi (2006), Mahmut (2008) and Ahmad (2010) modeled the Fisher hypothesis using ARDL and applied the bound testing procedure for various countries. Aktham and Al-zoubi (2006) confirmed the legitimacy of Fisher identity in the six developing economies, namely, Turkey, Korea, Brazil, Mexico, Malaysia, and Argentina. Ahmad (2010) found evidence of the Fisher effect in Saudi Arabia, Kuwait, Pakistan and India. Mixed results were attained for Sri Lanka and no evidence of Fisher hypothesis in Bangladesh.

2.3.3 African Nations

In the African continent the Fisher effect has been investigated widely with a handful of conflicting results. Several studies conducted in Nigeria (see Obi B., *et. al.*, 2009; Asemota and Bala, 2011; Asemota *et. al.* 2015; Uyaebo *et. al*. 2016 and Ogbonna, 2013) found indication of partial Fisher identity. Yaya (2015), while recognizing that interest rates may not always have the same order of integration as inflation rate, applied ARDL to study the Fisherøs relationship in ten African nations. In seven out of the ten nations the relationship was found to be invalid (Yaya, 2015).

Asemota *et. al.* (2015) demonstrates that care need to take when classifying time series data. They used the ADF, Phillips-Perron (Perron, 1989) and the KPSS (Kwiatkowski, Phillips, Schmidt and Shin, 1992) methods to analyze for unit root in the data for ECOWAS countries. Using these tests they found some conflicting results for the unit root classification for the ECOWAS data. Using Kalman filter approach they realized that the strength of the hypotheses varies or fails completely in the ECOWAS countries.

2.3.4 Fisher Effect in Kenya

Yaya (2015) tested for the long-run Fisher relationship for ten African nations. Among the ten nations, Fisher identity was supported only in Gabon, Cote dÏvoire and Kenya. There was no relationship found in other nations including, Nigeria, Cameroon, Senegal Benin, Gambia, South Africa and Ghana. The ARDL method used is appropriate for data with small sample sizes.

Bosupeng (2015) investigates the Fisher effect for 20 countries worldwide, including Kenya. Using Saikkonen and Lutkepohl cointegration test, interest rates and inflation data for the sample period starting from 1982 to 2013, the study validates the Fisher effect in many of the countries studied including Kenya.

Laiboni G. M. and Jagongo A. (2015) using monthly inflation rates and T-Bills rate data for January 2009 to August 2015 failed to find a cointegating relationship. Their findings contradict Yaya (2015) and Bosupeng (2015) who found the Fisher relationship to be valid in the Kenyan case. These contradicting results call for further research analysis using different approach establish any possible source of variance in findings.

2.4 Overview

The Fisher identity has been studied using multiple methods. These include descriptive analysis, causality and regression analysis for stationary variables and cointegration if variables are integrated I(1) variables. Most empirical studies have commenced the study of the Fisher relationship with an evaluation of characteristics of the data using the ADF and other unit root tests.

Cointegration analysis has been used to examine for the Fisher relationship where the series are integrated $I(1)$ (Mishkin, 1992; Masih, 2008; Ozcan and Ari, 2015). However Malliaropoulos (2000) and Clemente *et. al.* (2017) conducted their evaluation with nominal interest and inflation rates as stationary series. Other studies modeled the series using long memory processes such as autoregressive heteroskedastic (ARCH) and generalized autoregressive heteroskedastic (GARCH) processes (Berument *et. al.*, 2007).

Descriptive analysis, Grange causality, regression and ARDL bound testing procedure was applied in this study to evaluate the Fisher relationship. ARDL is appropriate if variables are I(0) or I(1). The series must however not be integrated with order higher than one or have more than a single cointegrating relationship. ARDL bound testing is appropriate when dealing with small sample sizes and there is no precondition that the regressors must have equal order of integration (Pesaran *et. al*., 2001). Causality between the selected proxy variables will be studied using Granger-causality (Granger, 1969).

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CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

The chapter contains the following sections; the theoretical framework, the empirical model, data collection methodology and analysis of data.

3.2 The Theoretical Framework

The studyôs theoretical framework is based on the Fisher equation below:

$$i_t = r_t + \pi_t^e , \tag{3.1}$$

Where π_t^e is expected inflation, r_t is real rate and i_t nominal interest rates. The series are assumed to adjust towards a steady state in the long-run.

The relation is derived from the present real value of one shilling invested at the beginning of a period,

$$1 + r_t = \frac{1 + i_t}{1 + \pi_t} .$$

Rearranging and considering that the product of $r_t \pi_t$ is close to zero, $i_t = r_t + \pi_t + r_t \pi_t \cong r_t + \pi_t$. Since decisions are made at the beginning of the period we replace the rate of inflation with expected inflation. This gives the Fisher effect as, $i_t = r_t + \pi_t^e$. Incorporating rational expectation in estimating inflation implies that $\pi_t - \pi_t^e = \varepsilon_t$. Hence

$$i_t = r_t + \pi_t + \varepsilon_t \tag{3.2}$$

Implications of the relation include: if $\pi^e = 0$ then $i_t = r_t$, if $\pi_t^e > 0$ then $i_t > r_t$, if $\pi_t^e < 0$ then $i_t < r_t$ (Manuel, 2013; Owen, 1993).

3.3 The Empirical Model

Assuming perfect rational expectation the regression model used to test the Fisher effect is

$$i_t = \alpha + \beta\pi_t + e_t \tag{3.3}$$

The Fisher identity is true if the inflation coefficient β is not statistically different from one. If β is statistically different from zero but less than one then a weak form of Fisher identity holds. Otherwise if β is zero then there is not Fisher relationship.

Three empirical estimates were done based on three models: the preliminary being regression analysis using OLS, the second being Granger causality test, and finally an ARDL model was estimated to determine the long run relationship between the variables

3.3 Data Collection

Secondary data sourced from both the CBK and the KNBS databases is used. Monthly data from January 2003 to December 2016 was used. It is assumed that during this period the CBK was independent of political interference and conducted credible economic policies. The Kenyan interbank rate (IBR) and observed inflation rate (INF) were used as a proxy for interest rate and expected inflation respectively. The monthly data is used to avoid the bias caused by aggregation as is the case with annual data. The IBR is expected to be receptive to fluctuations in the financial market and banking sector. The Stata® data analysis software is used for econometric analysis.

3.4 Analysis of Data

3.4.1 Univariate Analyses: Properties of the Variables

Finding out the properties of a time series is important in macroeconomic studies since the series may be stationary or non-stationary (Dickey and Fuller, 1981; Nelson and Plosser, 1982; and Stock, 1987, Jamaladeen and Sivagnanam, 2016). Before conducting the three types of empirical estimates, the time series were subjected to unit root tests. The ADF and the DF-GLS (Elliot, Rothenberg and Stock, 1996) test are used to assess the properties of the proxy variables. The ADF is the commonly used approach but the DF-GLS is more powerful than most unit root test. Variables used in ARDL and bound testing ought not to be $I(2)$ or higher.

For instance, the characteristics of interbank rate series can be investigated by testing the unit root null hypothesis $H_0 : \alpha = 0$, against $H_1 : \alpha \neq 0$ on stationarity, in the equation,

$$\Delta IBR_t = \beta_1 + \beta_2 t + \alpha IBR_{t-1} + \sum_{i=1}^{k} c_i \Delta IBR_{t-i} + \varepsilon_t \qquad (3.4)$$

The optimal lag k is determined using either the AIC or SBC. After determining k empirically, it is then possible to determine the type of trend variables or whether the series contain unit root with zero or non-zero drift. A data series has unit root if the level variables have a unit root but the differenced data series is stationary.

3.4.2 Bivariate Analyses

3.4.2.1 Ordinary Least Square (OLS)

The ordinary least square estimates assume that both variables are stationary. In this case the equation is

$$\mathrm{IBR}_t = \alpha + \beta \mathrm{INF}_t + \varepsilon_t \tag{3.5}$$

Spurious regression would result if IBR_t and INF_t have unit root. If the variables have a long run relationship then the OLS model for (3.5) would be the long run equation. The ARDL model fitted after the preliminary OLS model is a remedy to spurious regression due to missing variables (Ghulam *et. al.,* 2018; Granger and Newbold, 1974)

3.4.2.2 Testing for Granger Causality

Using Granger (1969) approach the proxy variables for nominal interest rate are tested to establish whether they are Granger caused by inflation rate or vise versa (Granger, 1969; Nezhad *et. al.* 2007). To test whether the inflation rate (INF) Granger-causes Interbanks Rate (IBR) or vice versa, the following two equations are specified;

$$\mathrm{IBR}_t = a_0 + \sum_{i=1}^{p} b_i \mathrm{IBR}_{t-i} + \sum_{j=0}^{q} c_j INF_{t-j} + v_t \ . \tag{3.6}$$

After performing regression analysis different scenarios may arise;

i. There is Granger-causality from Treasury bill rate to inter-bank rate if $\sum_{j=1}^{q} c_j \neq 0$. Hence inflation rate is useful in predicting inter-bank rate.

ii. If Inflation rate and inter-bank rates are independent and inflation rate not useful in predicting IBR, then $\sum_{j=1}^{q} c_j = 0$ and $\sum_{j=1}^{n} d = 0$.

Granger-causality test are useful in the specification of the autoregressive distributed lag model.

3.4.2.3 Autoregressive Distributed Lag (ARDL)

The ARDL bound testing procedure is used in testing for relationship between level time series observations. ARDL bound testing approach is selected since it is possible to test for level relationship. The test can be performed without prior classification of data to either $I(0)$ or $I(1)$. However the test cannot be applied to $I(2)$ variables and higher orders of integration (Pesaran *et. al.*, 2001; Zainal *et. al.*, 2014). The ARDL equation for the interbank rate (IBR_t) and the inflation rate (INF_t) is of the form,

$$\mathrm{IBR}_t = \alpha_0 + \sum_{i=1}^{p} \varphi_i \mathrm{IBR}_{t-i} + \sum_{j=0}^{q} \gamma_j INF_{t-j} + \varepsilon_t \ . \tag{3.7}$$

The Fisher long run coefficient β can be computed from the coefficients φ_j and γ_j using

$$\beta = \sum_{j=0}^{q} \gamma_j \Big/ \left(1 - \sum_{j=1}^{p} \varphi_j\right) \tag{3.8}$$

The ARDL model in (3.7) can be specified as the ECM,

$$\Delta\mathrm{IBR}_t = \alpha + \gamma \mathrm{IBR}_{t-1} + \theta INF_{t-1} + \sum_{j=1}^{p-1} \varphi_j \Delta\mathrm{IBR}_{t-1} + \sum_{i=0}^{q-1} \phi_i \Delta INF_{t-i} + \varepsilon_t \ . \tag{3.9}$$

The optimal lags p and q are selected using the AIC, SIC or HIC criteria. The lags are so that the errors, ε_t, are serially uncorrelated according to the ARDL model assumption.

An F-test of no long-run equilibrium relationship, $H_0^F : \gamma = 0$ and $\theta = 0$, against $H_0^F : \gamma \neq 0$ and $\theta \neq 0$ will be performed using an F. A t-test is also performed for the hypothesis $H_0^t : \gamma = 0$, against $H_0^t : \gamma \neq 0$ if the $H_0^F : \gamma = 0$ and $\theta = 0$ is rejected. The critical values for ARDL bound testing procedure are specified in Pesaran *et. al.* (2001) and Narayan (2003). The upper bound and lower bound are based on the deduction that the regressors are either purely I(1) or I(0) respectively. A relationship exists if the F value estimated is larger than the upper bound and vise versa. If F value calculated falls between the limits then the test is inconclusive. In this case an evaluation of order of integration is necessary (Pesaran and Shin, 1998; Pesaran, 2001; Narayan, 2003; Pesaran *et. al.*, 2001; Hassler, 2006).

3.4.4 Model Validation

Both the diagnostic test and stability test were conducted in order to validate the ARDL model fitted. First, to ensure that the residual of the ARDL model are independent and are not serially correlated two tests are conducted. The Durbin-Watson d-statistic should be equal to two if the residuals are not serially. Another test used is the Breusch-Godfrey serial correlation test (Godfrey, 1988). The Lagrangian Multiplier (LM) test, null hypothesis corresponds to the conjecture that the model errors are serially uncorrelated up to a specified lag order.

Also the graphical representation of the CUSUM and CUSUMSQ was used to verify the stability of the model parameters. The plot of the CUSUM should be within the 5 % significant level for the parameters to be stable (Gujarati, 2007; Turner, 2010).

CHAPTER FOUR: EMPIRICAL RESULTS

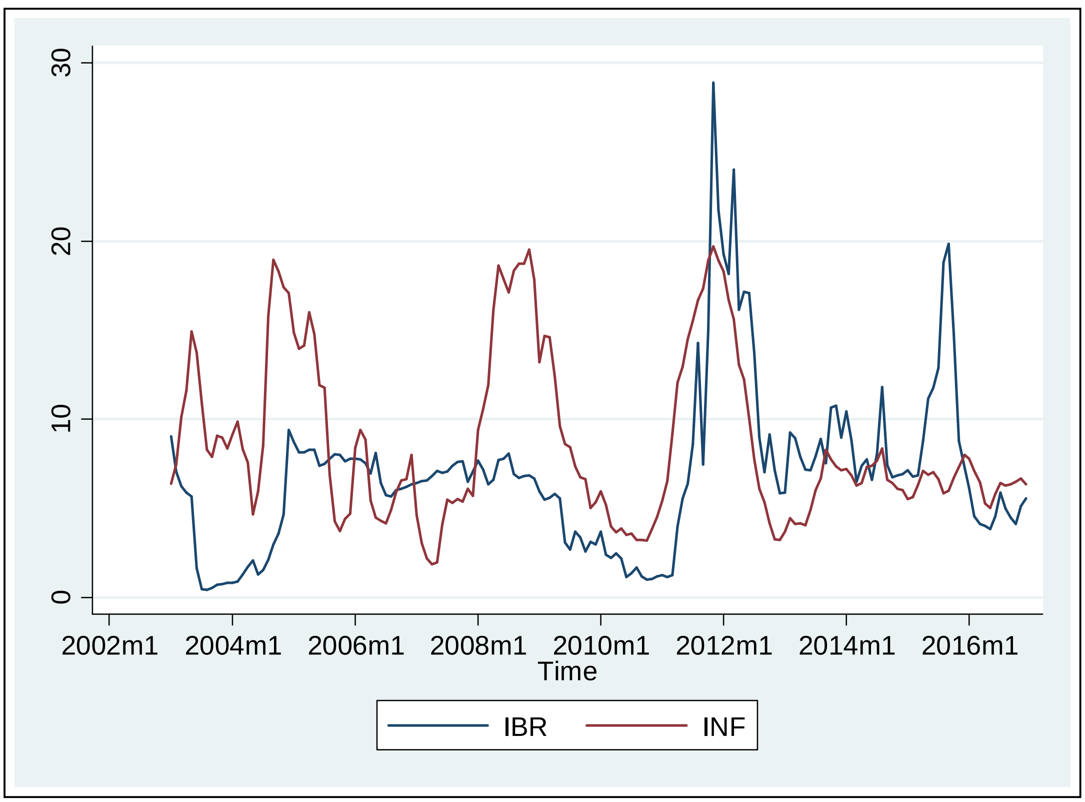
4.1 Introduction

The chapter contains the following sections: descriptive statistics, exploring properties of the time series, Granger causality and results from regression and the ARDL empirical models.

4.2 Descriptive Statistics

4.2.1 The Time Series Plots

Figure 4.1Time Series Plot for the Interbank Rate and the Inflation Rate.



The plot shows that IBR (interbank offer rate) and INF (inflation rate) series tend to increase or decrease together. There is a general co-movement of the two series although INF shows more fluctuations than the IBR. A major fluctuation in the rates is experienced around January to March 2012. The INF showed other fluctuations around April to December 2008 and around September to December 2004. The IBR rate saw increased variations around August to October 2015 although inflation remained relatively low. The inflation rate remained relatively stable after the fluctuations of early 2012. Table 4.1 shows summary statistics of the two data series.

Table 4.1: Summary Statistics

Variable	Observations	Mean	Std. Dev.	Minimum	Maximum
INF	168	8.65	4.670007	1.85	19.72
IBR	168	6.88	4.567234	0.43	28.9

There is a moderate pairwise correlations coefficient between the IBR and the INF of 0.31. It was observed from the time series plot that the INF is more correlated the IBR for the period after the fluctuations of 2012 than it was before with values of 0.68 and 0.41 respectively.

4.3 Characterizing the Time Series

The ADF and DF-GLS tests for unit root were used to establish whether the INF and the interbank rate (IBR) series are stationary or are I(1). The optimal lag for the data consisting of 164 observations from January 2003 to December 2016, is selected using the sequential modified likelihood (LR) criteria, p-value, FPE, AIC, HQIC and SBIC. An optimal lag of 3 was selected using the different methods, as in Table 4.2 below.

Table 4.2: Lag Selection

lag	LL	LR	df	p-Val	FPE	AIC	HQIC	SBIC
0	-961.2				432.71	11.74	11.76	11.78
1	-653.4	615.59	4	0.000	10.65	8.04	8.09	8.15
2	-633.07	40.59	4	0.000	8.73	7.84	7.92 *	8.03*
3	-627.84	10.46*	4	0.033	8.60*	7.83*	7.93	8.09
4	-625.28	5.1332	4	0.274	8.84	7.84	7.98	7.80

The lags selected are, lag of two by SBIC and HQIC, lag of three by LR, FPE, AIC and HQIC criteria. The p-value is significant up to the lag of three. The results unit root tests are given in Table 4.3 below.

Table 4.3: Unit Root for Level Values of IBR and INF.

Series	Lags No	Test statistics	0.01 Critical	0.05 Critical	MacKinnon Z(t) P-value
IBR	3	-2.959	-3.489	-2.886	0.0389
INF	1	-3.541	-3.488	-2.886	0.0070

The test implies that the series are stationary at the 0.05 level of significance. For the ADF test statistics although barely significant are very close to the critical values at 5% level of significance. The INF is stationary at the 0.05 level but the test statistics is however not very different from the critical values.

Almost similar results are obtained using the modified but more powerful ADF test by Elliott, Rothenberg and Stock (1992) (ADF-GLS test). The DF-GLS test also gives similar results with critical values of -3.28 and -3.207 for the IBR and INF. The statistics are not significant at 0.05 level of significant. The series are stationary at low level of significant but show presence of unit root at higher level of 1%.

For the differenced series an optimal maximum lag of one is selected by most of the methods including the LR, p-value, AIC, HQIC and SBIC optimal lag selection criteria. The result for the ADF test for the differenced series with zero lag are given in the Table 4.4 below

Table 4.4: Results for Unit Root for 1st Difference of IBR and INF.

Differenced Series	Test statistics	0.01 Critical	0.05 Critical	0.10 Critical	MacKinnon Z(t) P-value
D(IBR)	-13.373	-3.489	-2.886	-2.576	0.000
D(INF)	-7.941	-3.489	-2.886	-2.576	0.000

First differences of the series are distinctly stationary as the results in Table 4.4 above. The test statistics are distinctly large and negative, clear evidence that they are stationary. Similar results are obtained using the modified and more powerful augmented Dickeyï Fuller test by Elliott, Rothenberg and Stock (1992) (ADF-GLS test). Thus the variables may have a single unit root, but are not I(2). An autoregressive distributed model, ARDL can be fitted since the variables are not I(2).

4.4 Granger Causality

To investigate temporal causal dependency between IBR and the INF we conduct Granger causality using the Wald test. Results of testing for causality using ARDL model will be discussed in the next section. A VAR model was fitted followed by a test on Granger causality using the Wald test. There is statistical evidence that INF Granger causes IBR but not vice versa. Table 4.5 below gives the breakdown of the analysis,

Table 4.5 Granger Causality.

Equation	Excluded	chi2	df	Prob > chi2
IBR	INF	6.86	1	0.009
INF	IBR	3.20	1	0.074

Granger causality is statistically significant and running from the INF to the IBR. However causality from IBR to INF is not statistically significant.

4.5 The Empirical Model

The relationship between the variable is investigate using ordinary least square model related to equation (3.3) to be:

$$\begin{array}{lccc} IBR = & 4.25 & + & 0.34\text{INF} \\ \text{t} & (5.99) & & (4.21) \end{array} \qquad (4.1)$$

Where α and β are the estimates of the regression coefficients. This is indicative of significant relationship between the IBR and the INF assuming no spurious regression.

Table 4.6 Fitting Ordinary Least Squares

IBR	Coef	Std. Err.	T value	P-value	95% Conf. Interval
INF	0 .304	0. 072	4.21	0.000	0.161 0 .446
_cons	4.247	0.709	5.99	0.000	2.848 5.647

From Table 4.6 the regression coefficient is significant with since value of F is 17.75 and a probability value of 0.00. The R-squared value of 0.09 is does not show a good fit. The results in this case favor only a partial adjustment of IBR to change in INF. The low value of R-squared may be a pointer to possible missing variables (lagged values).

ARDL(p,q) model was fitted since none of the variables is I(2) or more. The relationship fitted is between IBR and the INF as in the equation below,

$$\mathrm{IBR}_t = a_0 + \sum_{i=1}^{p} a_i \mathrm{IBR}_{t-i} + \sum_{j=0}^{q} b_j INF_{t-j} + \varepsilon_t \tag{4.2}$$

The ARDL model also shows that the relationship runs from inflation rate to IBR and not from IBR to inflation rate. ARDL(1,0) shows that IBR is explained by its own lag and the current value of INF. The short run model which has a significant F-value and an adjusted R-squared value of 0.785, is given in equation (4.3)

$$\underset{}{\mathrm{IBR}_t} = \underset{(0.37)}{0.14} + \underset{(22.86)}{0.86\ \mathrm{IBR}_{t-1}} + \underset{(2.61)}{0.10\ \mathrm{INF}_t} \tag{4.3}$$

The values in brackets are the t-values which are significant for IBR lagged variable and current value of INF. For this fit $R^2 = 0.79$ hence 79 percentage of variation in the data is explained by model. From the relationship in equation (4.3) inflation rate Granger causes the IBR. A model fitted with the INF and the IBR as the dependent and independent variables respectively, showed that the IBR does not Granger cause the INF. Causality runs from the INF to the IBR and not vice versa. The significant lagged term may be an indicator that there is a component of expected inflation contained in short term interest rates (Fama 1975, 1976).

The ARDL model in equation (4.2) can be specified as below for purpose of conducting bounds test for cointegration;

$$\Delta \mathrm{IBR}_t = a_0 + a_1 IBR_{t-1} + b_1 INF_{t-1} + \sum_{i=1}^{p} a_i \Delta \mathrm{IBR}_{t-i} + \sum_{j=0}^{q} b_j \Delta INF_{t-j} + \varepsilon_t \qquad (4.4)$$

The null hypothesis of the bound test is that the coefficients of the long run relationship are equal to zero. That is the null hypothesis is $H_0 : a_1 = b_1 = 0$ verses the alternative $H_1 : a_1 \neq b_1 \neq 0$. The error correction model with unrestricted intercept and no time trend for the fitted ARDL(1,0) results are given in Table 4.7 below,

Table 4.7 ARDL Bound Test

D.IBR	Coefficients	Std. Err.	t- Value	P>|t|	[95% Conf. Interval]	
ADJ						
IBR L1.	-0.143	0.037	-3.84	0.000	-0.216	-0.069
LR						
INF L1.	0.670	0.270	2.48	0.014	0.136	1.204
SR						
INF D1.	0.100	0.036	2.63	0.009	0.024	0.168
_cons	0.133	0.390	0.34	0.733	-0.636	0.903

Testing the null hypothesis that there is no level relationship, an F = 8.863 and t = -3.841 values are acquired. The F-value is more extreme than the I(0) and I(1) critical values which are 4.98 or 5.80 respectively. The t-value is more extreme than the I(0) and I(1) critical values which are -2.87 or -3.24 respectively (Kripfganz and Schneider, 2018; Pesaran et.al., 2001). All the p-values are significant at 0.05 thus the null hypothesis of no level relationship is thus rejected. The long run coefficient $\beta = 0.67$ and the adjustment parameter $\lambda = -0.143$ are significant. The errors of the previous period will therefore be corrected for in the current period.

4.6 Testing for Goodness of Fit

Performing diagnosis of the fitted model, the Durbin-Watson d-statistic at (4, 167) degrees is 1.97. The value is close to two and thus the residual are not auto-correlated. The Breusch-Godfrey LM test for autocorrelation has a chi-square value of $\chi^2(1) = 0.03$. The null hypothesis cannot be rejected hence the residuals are not serially correlated. However the IM-test gives a chi-square value of $\chi^2(1) = 38.60$, which show the presence of unrestricted heteroskedasticity in the data.

The CUSUM is used to detect systematic movement or structural instability in the coefficients of the model is plotted below.

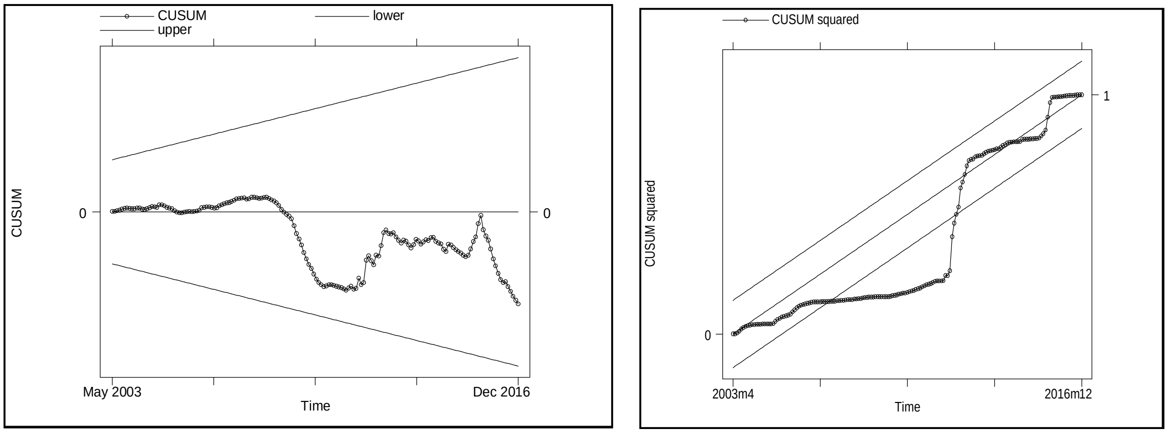


Figure 4.2: CUSUM and CUSUM Squared for Testing Parameter Stability.

The CUSUM are within the 95% bounds. Although there is no breakpoint found, as in Figure 4.2 above, the recursive sums are tending toward the negative latter half of the study period. However random changes not necessarily from coefficient structural changes are detected using the CUSUM squared. There are multiple breakpoints found for the CUSUM squared.

CHAPTER FIVE

CONCLUSIONS, DISCUSSION OF THE RESULTS AND POLICY IMPLICATIONS

5.1 Conclusions and Discussions

This study sought to establish whether there exists any relationship between the nominal interest rate and the expected inflation rate in Kenya. The actual inflation rate was used as proxy of the expected rate of inflation. The dynamics of the real rate of interest were however not explored, empirically. Granger causality test was conducted and then the relationship was investigated further using a regression model and the ARDL models. The ARDL model is used in order to test for short-run and long-run relationship. The results show the existence of a positive and significant relationship between nominal interest rate and expected inflation in Kenya for the period between Jan, 2003 and Dec, 2016.

There is Granger causality from the inflation rate to the interbank offer rate and not vice versa. Both the Wald test and the ARDL model fitted also show that causality is in one direction only. The preliminary regression model found that the inflation rate has a statistically significant relationship with interbank rate. However the regression model had a low measure of goodness of fit. This may explain why an investigation by Laiboni and Jagongo (2015) on the Fisher hypothesis failed to validate long term relationship.

An ARDL(1,0) model, $\text{IBR}_t = 0.14 + 0.86\,\text{IBR}_{t-1} + 0.10\,\text{INF}_t$, was fitted to the data as a deterrent to spurious regression that may influence regression model. Lagged values of short term interest rate and current value of the inflation rate were found to have a statistically significant influence on interbank rate. This model gave a better goodness of fit measure, with an R-square of 0.785. The need for lagged value to explain nominal interest rate may be as a result of the influence of monetary policies of the Central Bank of Kenya and the influence of the policies on expected inflation. The CBK sets the Central Bank Rate (CBR) which directly affects the interbank rate (Misati et. al. 2011). The significant lagged variable may also be as a result of the component of expected inflation in short term interest rate (Fama, 1976).

The results from the regression analysis, Granger causality and ARDL model have strong indication of the presence of the Fisher effect in Kenya for the period 2003 to 2016. The results however showed only partial adjustment of the interbank rate to the rate of inflation. The significant empirical evidence of the partial Fisher effect implies that real interest rate in Kenya may be marginally affected by nominal changes. the Interbank rate may not respond fully to inflation expectation.

Considering the different empirical studies conducted in different regions there is no consensus on the best techniques for testing for Fisher hypothesis in cases of stationary series or non-stationary series. Multiple research studies have questioned the presence of unit root in the inflation rate and the nominal interest rate series for other regions, for example Atkins and Coe (2002) and Malliaropoulos (2000). The ARDL-bound testing approach used in this study can be applied to test for long-run relationship level variable whether they are I(0) or I(1). The ARDL approach is even more appropriate as a deterrent to spurious regression caused by missing varies.

5.2 Limitations and Areas of Future Research

Some of the limitations encountered included the fact that the entire period was considered to be homogeneous in terms of monetary policy, institutional and structural environment and political regime. Also the appropriateness of month on month inflation rate as a proxy for the inflation expectation was assumed. Improving the measurement of inflation expectation may bring better insight in a similar study.

Structural and institutional changes may cause variations on the real rate of interest in the study period. As was indicated earlier the dynamics of the real rate of interest were not explored, empirically. Further research work may be undertaken to investigate the empirical model in the context of the dynamics of the real interest rate and the effect of taxes.

Given that the Kenyan economy is a small economy, investigations of macroeconomic hypotheses and relationships, like the Fisher hypothesis, may benefit from controlling or augmenting for changes that occur within the international market. Changes in the international market may influence changes in the exchange rate and import prices. Changes in the international market were not considered.

5.3 Policy Implications

The result have shown a causality runs from INF to interbank rate which is the proxy used for nominal interest rate. The regression model and the ARDL model show evidence indicative of the Fisher hypothesis. However full one-for-one adjustment of nominal interest rate to changes in expected inflation was not verified.

The empirical evidence of the presence of the Fisher hypothesis implies nominal interest rate can be used as a predictor of expected inflation. However precaution should be exercised since interest rates do not fully reflect changes in the inflation rate. Monetary authorities can control inflationary pressure in the economy by minor change of short-term interest rates. Economic agents who participate in investments and savings may be marginally affected by nominal inflationary changes. .

APPENDICES

0.1 DATA

YEAR	MONTH	Interbank IBR	Inflation MOM INF	cpi
2003	JAN	9.04	6.37	56.21
	FEB	7.06	7.44	55.91
	MAR	6.22	10.12	57.24
	APR	5.88	11.64	58.21
	MAY	5.67	14.92	61.23
	JUN	1.62	13.74	61.96
	JUL	0.45	10.91	60.46
	AUG	0.43	8.27	59.27
	SEP	0.54	7.89	58.85
	OCT	0.69	9.08	59.44
	NOV	0.73	8.97	59.69
	DEC	0.81	8.35	60.28
2004	JAN	0.82	9.14	61.35
	FEB	0.9	9.85	61.41
	MAR	1.27	8.32	62
	APR	1.72	7.57	62.61
	MAY	2.05	4.65	64.08
	JUN	1.29	5.94	65.64
	JUL	1.52	8.54	65.62
	AUG	2.1	15.8	68.63
	SEP	2.95	18.96	70.02
	OCT	3.56	18.29	70.32
	NOV	4.66	17.4	70.07
	DEC	9.41	17.08	70.57
2005	JAN	8.72	14.87	70.48
	FEB	8.14	13.94	69.97
	MAR	8.13	14.15	70.78
	APR	8.28	16.02	72.64
	MAY	8.3	14.78	73.54
	JUN	7.37	11.92	73.46
	JUL	7.51	11.76	73.34
	AUG	7.77	6.87	73.35

	SEP	8.03	4.27	73
	OCT	7.98	3.72	72.93
	NOV	7.64	4.4	73.33
	DEC	7.79	4.7	74.04
2006	JAN	7.78	8.39	76.22
	FEB	7.73	9.39	76.19
	MAR	7.52	8.85	76.62
	APR	6.97	5.44	76.23
	MAY	8.11	4.47	76.48
	JUN	6.41	4.28	76.44
	JUL	5.74	4.16	76.3
	AUG	5.66	4.92	76.87
	SEP	6.02	5.93	77.23
	OCT	6.08	6.55	77.54
	NOV	6.18	6.64	77.82
	DEC	6.34	7.98	79.46
2007	JAN	6.43	4.63	79.75
	FEB	6.52	3.02	78.57
	MAR	6.55	2.19	78.4
	APR	6.81	1.85	77.76
	MAY	7.11	1.96	78.08
	JUN	6.98	4.07	79.53
	JUL	7.07	5.48	80.41
	AUG	7.38	5.3	80.86
	SEP	7.59	5.53	81.43
	OCT	7.65	5.38	81.66
	NOV	6.5	6.08	82.47
	DEC	7.05	5.7	83.91
2008	JAN	7.66	9.4	86.07
	FEB	7.18	10.58	87.25
	MAR	6.35	11.9	88.22
	APR	6.59	16.12	90.85
	MAY	7.72	18.61	92.68
	JUN	7.79	17.87	92.89
	JUL	8.07	17.12	92.75
	AUG	6.92	18.33	93.79
	SEP	6.7	18.73	94.72
	OCT	6.81	18.74	95.29
	NOV	6.83	19.54	96.95
	DEC	6.67	17.83	96.89

2009	JAN	5.95	13.22	97.55
	FEB	5.49	14.69	100
	MAR	5.57	14.6	100.96
	APR	5.81	12.42	101.84
	MAY	5.55	9.61	101.84
	JUN	3.08	8.6	102.05
	JUL	2.69	8.44	102.33
	AUG	3.68	7.36	102.94
	SEP	3.38	6.74	103.42
	OCT	2.57	6.62	103.68
	NOV	3.11	5	103.87
	DEC	2.95	5.32	104.66
2010	JAN	3.69	5.95	104.89
	FEB	2.39	5.18	105.18
	MAR	2.21	3.97	104.97
	APR	2.46	3.66	105.56
	MAY	2.16	3.88	105.79
	JUN	1.15	3.49	105.61
	JUL	1.35	3.57	105.98
	AUG	1.66	3.22	106.25
	SEP	1.18	3.21	106.74
	OCT	0.98	3.18	106.97
	NOV	1.01	3.84	107.86
	DEC	1.18	4.51	109.38
2011	JAN	1.24	5.42	110.57
	FEB	1.13	6.54	112.05
	MAR	1.24	9.19	114.62
	APR	3.97	12.05	118.29
	MAY	5.54	12.95	119.48
	JUN	6.36	14.48	120.91
	JULY	8.61	15.53	122.44
	AUG	14.29	16.67	123.97
	SEP	7.46	17.32	125.23
	OCT	14.95	18.91	127.2
	NOV	28.9	19.72	129.13
	DEC	21.75	18.93	130.09
2012	JAN	19.27	18.31	130.82
	FEB	18.15	16.69	130.76
	MAR	24.02	15.61	132.51
	APR	16.15	13.06	133.74

	MAY	17.16	12.22	134.09
	JUN	17.09	10.05	133.06
	JULY	13.71	7.74	131.92
	AUG	8.97	6.09	131.51
	SEP	7.02	5.32	131.89
	OCT	9.14	4.14	132.46
	NOV	7.14	3.25	133.33
	DEC	5.84	3.2	134.25
2013	JAN	5.86	3.67	135.62
	FEB	9.25	4.45	136.59
	MAR	8.93	4.11	137.96
	APR	7.9	4.14	139.28
	MAY	7.16	4.05	139.52
	JUNE	7.14	4.91	139.59
	JULY	7.93	6.03	139.87
	AUG	8.88	6.67	140.29
	SEP	7.52	8.29	142.82
	OCT	10.66	7.76	142.75
	NOV	10.77	7.36	143.14
	DEC	8.98	7.15	143.85
2014	JAN	10.43	7.21	145.4
	FEB	8.83	6.86	145.95
	MAR	6.47	6.27	146.61
	APR	7.4	6.41	148.2
	MAY	7.76	7.3	149.7
	JUN	6.6	7.39	149.91
	JUL	8.08	7.67	150.6
	AUG	11.79	8.36	152.02
	SEP	7.43	6.6	152.24
	OCT	6.73	6.43	151.92
	NOV	6.86	6.09	151.85
	DEC	6.91	6.02	152.51
2015	JAN	7.12	5.53	153.43
	FEB	6.77	5.61	154.14
	MAR	6.85	6.31	155.86
	APR	8.77	7.08	158.7
	MAY	11.17	6.87	159.98
	JUN	11.78	7.03	160.46
	JUL	12.89	6.62	160.57
	AUG	18.8	5.84	160.9

	SEP	19.85	5.97	161.33
	OCT	14.82	6.72	162.13
	NOV	8.77	7.32	162.97
	DEC	7.27	8.01	164.72
2016	JAN	6.12	7.78	165.37
	FEB	4.54	7.09	164.67
	MAR	4.1	6.45	165.92
	APR	4.01	5.27	167.07
	MAY	3.82	5	167.99
	JUN	4.56	5.8	169.76
	JUL	5.88	6.4	170.84
	AUG	4.98	6.26	170.97
	SEP	4.47	6.34	171.56
	OCT	4.12	6.47	172.62
	NOV	5.11	6.68	173.85
	DEC	5.55	6.35	175.18

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