EFFECTS OF INTEREST RATE ON HOUSING PRICES IN KENYA

Rodrick Koome and Dr. Stephen Githae Njaramba
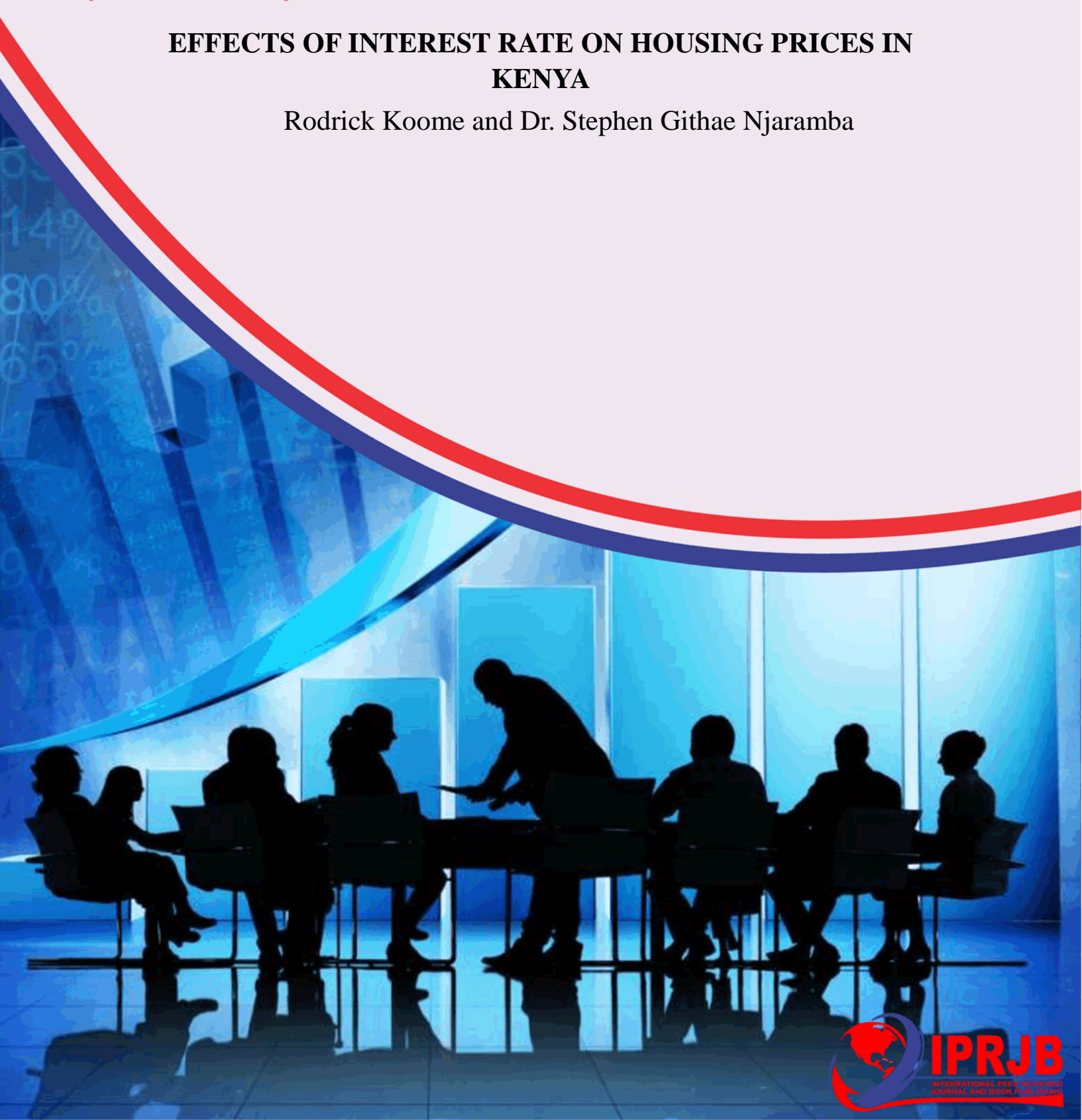
EFFECTS OF INTEREST RATE ON HOUSING PRICES IN KENYA

[1*]Rodrick Koome

Post Graduate Student: School of Economics, Kenyatta University

*Corresponding Author's E-mail: rodrickkoome@gmail.com

[2]Dr. Stephen Githae Njaramba

Lecturer, School of Economics, Kenyatta University

Abstract

Purpose: The objective of the study was to examine the effect of interest rate on housing prices in Kenya.

Methodology: The study used annual quantitative data for period 1960 to 2017. It employed Nonlinear Autoregressive Distributed Lag (NARDL) in determining the effects of negative and positive series of interest rates on housing prices.

Findings: A non-linear relationship between interest rates and housing prices was confirmed. Both the negative series and positive series of interest rate portrayed a negative effect on housing prices in short run. For long run, positive series have positive effect on housing prices while the negative series have negative effect.

Unique Contribution to Theory, Practice and Policy: A completely developed theoretical model putting together all meaningful inter-linkages between macroeconomic variable and price of housing is absent. The only ultimate way to address the issue is through empirical means. The findings indicate the presence of a non-linear relationship between interest rate and housing prices. The Central Bank of Kenya can change the Central Bank Reference rate (CBR rate) to alter the cost of money and consequently housing prices. In formulating a policy change, the Central Bank of Kenya should be cognizant of both the non-linear relationship existing between interest rates and prices of housing and the different magnitudes of effect of the positive and negative series on housing prices. When housing prices increase, either an increase or decrease the interest rate by the CBK will result to a downward movement in prices of housing in the short run, but at higher magnitude from the interest rate decrease. For the long-run, a decrease in interest rate will decrease housing prices, making housing affordable and improving the standards of living for citizens. Any upward movement in interest rate will result to a long-run increase in housing prices making housing more expensive and consequently out of reach of most citizens.

Keywords: *Housing, NARDL, Bubble, Interest Rate*

INTRODUCTION

The housing market has important implications for macroeconomic stability in any economy as exhibited by its impact on aggregate demand and supply (Organization for Economic Cooperation Development, 2011). On the demand side, wealth from housing is a vital component of the value of the private sector and expenses related to housing, such as payments for mortgage and rents, representing a big part of expenditure of the household. As such, changing housing prices affect aggregate demand via the spending on construction of residential housing and non-residential consumption (i.e wealth effect). For the supply side, housing prices pose implications to labor mobility and property assets owned by businesses which account in the production process. Interactions between the demand and supply sides result to prevailing housing prices that represent the housing market (Poghosyan, 2016).

Almost all citizens in an economy are involved in the housing market and disturbances in it can lead to dire consequences for the whole economy. Even though housing was partly present in macroeconomic literature prior to the global crisis in the finance sector, it was viewed as a small component of the vast economy that required less attention (Calza, Monacelli, & Stracca, 2013). However, from the great financial crisis of 2008 to date, much more attention has been paid to housing regarding macroeconomic literature. One of the distinctive characteristics of housing is that of being an asset (both land and associated dwelling) and also a good for consumption (associated housing services). On being a good for consumption, housing services exert the most weight in the scale of measuring the bundle of consumption of a household and for majority of them it is the major important asset. Such, any shock that affects the housing consumption cost or the prices of housing, most likely have effects of first order on most households' welfare (Piazzesi & Schneider, 2016).

Governments intervene in housing markets to enhance their citizens' accessibility to housing and also equitable access to housing and monitor the risk possibly emanating from the housing market. The governments as well collect revenue generated from housing (Green, Malpezzi & Mayo, 2005). The housing market development, with lack of proper government oversight, largely contributed to the global crisis in 2008 with the excessive growth in housing prices being one of the major determinants in the United States of America (USA) and Euro area (Nicole, Brown, & Rossi, 2013). The increase in housing prices was followed by high credit growth and steep rise in leverage. During housing boom in the USA, lending standards eased and the ability of a borrower to repay their loans was

based on continuous growth in the housing prices. As prices commenced to decline, speculative buyers cum home owners who either unwilling or not able to pay for their mortgages could not sell their properties or roll them over and started to default. This eventually led to the crisis which included collapse of insurance companies, investment banks, and construction companies. The collapse also led to loss of wealth for households, drop in wage incomes and unemployment (Mayer, 2008).

Housing market boom occurs when housing prices increase based on economic fundamentals, that is, when there is a period of economic success in a country. This is a period when a rapid increase in prices occurs that cannot be explained from a rational economic fundamentals or theoretical values and the increase is described as a bubble. If a sharp decline after a surge in the prices occurs, it becomes a burst of the bubble (Smith & Smith, 2016).

In Kenya, there is no consensus whether the housing market is experiencing a boom or a bubble (Kibunyi, 2015). The quest on whether the upward price trend is fundamentally supported or not, seems to have no unanimous agreement. The only clear thing is that the housing and construction sectors as share of Gross Domestic Product in Kenya, continued to rise from 12.66 percent in 2010 to 13.6 percent in 2016 (Gatakaa & Njoroge, 2011; Miregi & Obere, 2014; Njaramba, Gachanja & Mugendi 2018). Figure 1 below gives the trend of housing in Kenya from the year 1960 to 2015.
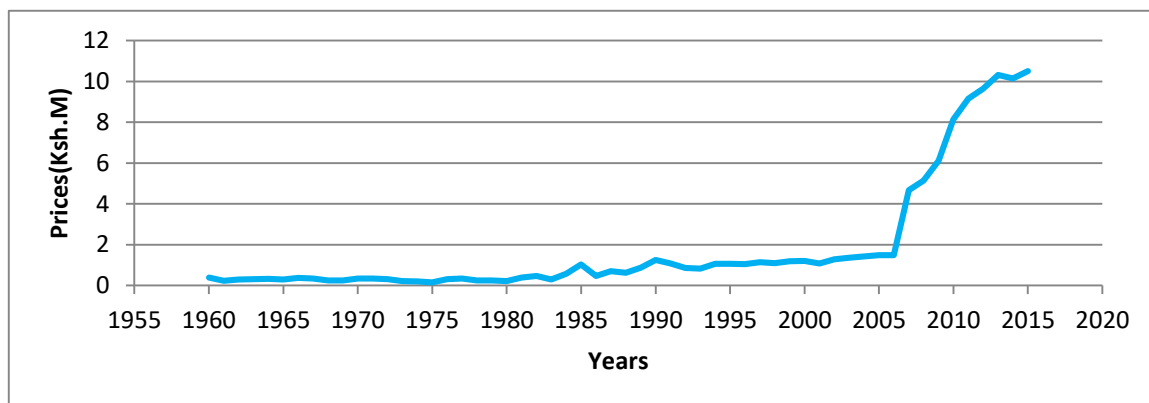
Figure 1: Housing Price Movements
Source: Author's own computation using data from KNBS

As portrayed in the above figure, growth in housing prices was steady up to early 1980s and then started to rise up to around 2007 where it overshot up to date. On average, estates in urban areas such as Nairobi, Mombasa, Kisumu and Nakuru, the rent for single rooms

and one bedroom unit increased by 200 percent from 2010 to 2015 with home loans, mortgage facilities and housing schemes becoming relatively inaccessible to many low-income earners. Majority of people depend on rented accommodation while many others are pushed to informal settlements associated with inadequate services. As a result, Kenyans are experiencing a rise in the cost of living which affects the overall quality of life. This has raised the cost of domestic production and prices of essential goods and services beyond the reach of many citizens and creates a non-conducive environment to support macroeconomic stability for growth, welfare and overall competitiveness (Omiti & Nyalienga, 2015).

Government interventions such as regulations such as the influencing of the number, quality and prices of housing are required. Housing-targeting policies have an effect on performance in the economy and on living standards, as they course how households utilize their savings and also residence and labor mobility (Crow, Dell, Igan, & Rabanal, 2013). An Organization for Economic Cooperation and Development (OECD) analysis showed that developments in the past in residential construction and housing prices were affected by features of the structures and policies made in the markets for housing finance on top of factors in macroeconomy like income and interest rates (OECD, 2010).

For the above reasons, the Kenyan government has made provision of affordable housing one of its main agendas as embedded in the Kenya vision 2030 and has planned to provide 500,000 homes between 2018 and 2022 under the 'Big Four Agenda'. However, more than 200,000 homes need to be built by the government each year to fill the gap in housing provision left by the private sector, but only 50,000 new units are built, leaving about 150,000 Kenyans unhoused every year with middle income earners in urban areas the most affected. More than 67 percent of all residents in Nairobi live in informal settlements. In addition, the portion of owner-occupied households in the urban areas stands at 18 percent compared to 82 percent in rural areas (Republic of Kenya, 2018).

Interest Rate and Housing Prices

One of the objectives of the Central Bank of Kenya (CBK) is to formulate and implement monetary policies to reach and uphold stability in prices. It consists of decisions and actions to ensure supply of money is in tandem with growth and objectives of price. It seeks to achieve inflation that is moderate and sustainability of the value of Kenya Shillings. A stable and low inflation rate in addition to adequate liquidity presence in the entire market aids top levels of private investments and domestic savings. This leads to improvement in economic growth, increased employment opportunities and higher real incomes (Gichuki,

Oduor, & Kosimbei, 2012). The monetary policy is hence designed to back government-desired activities in the economy and target growth (Central Bank of Kenya, 2018)

The main target variable of monetary policy is inflation and also the output. The CBK exerts influence on them in an indirect manner using two main monetary tools namely; interest rate, that represents liquidity price and reserve money that represents amount of liquidity. Other monetary policy tools are; the open market operations, foreign market operations, and the licensing, supervision of commercial banks including how bank decisions are communicated. CBK supervises all the commercial banks and fixes the base lending rate and changes in this Central Bank Rate geared to alter cost of money. These change commercial banks' rates of interest without changing liquidity amount with the commercial banks. Participation in the foreign exchange market and changes in reserve requirements are geared to change money stock and amount of money available. Consequently, commercial bank rates of interest, such as lending rates, change. Therefore, the CBK has to decide whether to engage rates of interest or money stock as the tool to hit the target of low and stable inflation (Central Bank of Kenya, 2018; Republic of Kenya, 2018).

Interest rates are adjustable to respond to output and inflation. A lowering of the official rate encourages the commercial banks to borrow more money from the Central Bank leading to an increase in the economy's money supply. This increases consumption and output towards desired output level. However, this may increase inflation rates and may result to housing price instability if the loans are put into the housing market. On the other part, an upward movement in interest rates renders borrowing to be more expensive, and consequently lowers demand of loans. Moreover, greater interest payments result to lowering of the affordability index, increase capitalization rates and decrease the borrowers that are able to qualify for a loan of a certain size. In addition to tightening of the monetary space reducing leverage in finance market, it may decrease finance consequences of a burst, even though it may not stop a boom in housing prices (Nicolo, Ariccia, Laeven, & Valencia, 2010; Adrian & Shin, 2009).

Interest related factors influencing housing prices include; mortgage rate, interbank exchange rate, discount rates and capitalization rates. An increase in the CBR affects all these interest rates and consequently the housing prices. A change in CBR changes the mortgage rate which in turn changes the mortgage capital cost thereby affecting the supply, demand and prices of the various types of housing. The CBR change can also cause a change in interbank exchange rate leading to a change in the cost of funds which reduce or

add to the capital available for investment. The change can increase or decrease the discount and capitalization rates and this brings changes in returns of competing or substitute investment leading to a decline or incline in housing prices. Moreover, high interest rates in a country attract capital inflows and this may alter supply and the demand for properties and then affect housing prices. However, in Kenya, the relationship is not this clear as demonstrated by Miregi and Obere (2014) and Njaramba, et al. (2018).

In 2006 the CBK increased its Central Bank Rate (CBR) from 8 percent to 10 percent. Many banks had fixed mortgage lending rates between the period 2007 and 2010 as a result of stable interest rate. Housing prices were also stable at this period. However, most banks had to hedge risks by adopting floating rates as interest rates spiked in 2011 to 2012. CBK increased its base lending rate to 18 percent due to rising exchange rate and inflation. Despite the CBK's increase in interest rates, housing prices and rental rate continued to grow. Mortgage lending rates rose to an all-time high of 30 percent and annuity payments increased to 60 percent. The annuity increases consequently led to this increase in housing prices and rental rate (Muthaura, 2012). Figure 1.2 shows the trend of interest rates and housing in Kenya from 1991 to 2015.
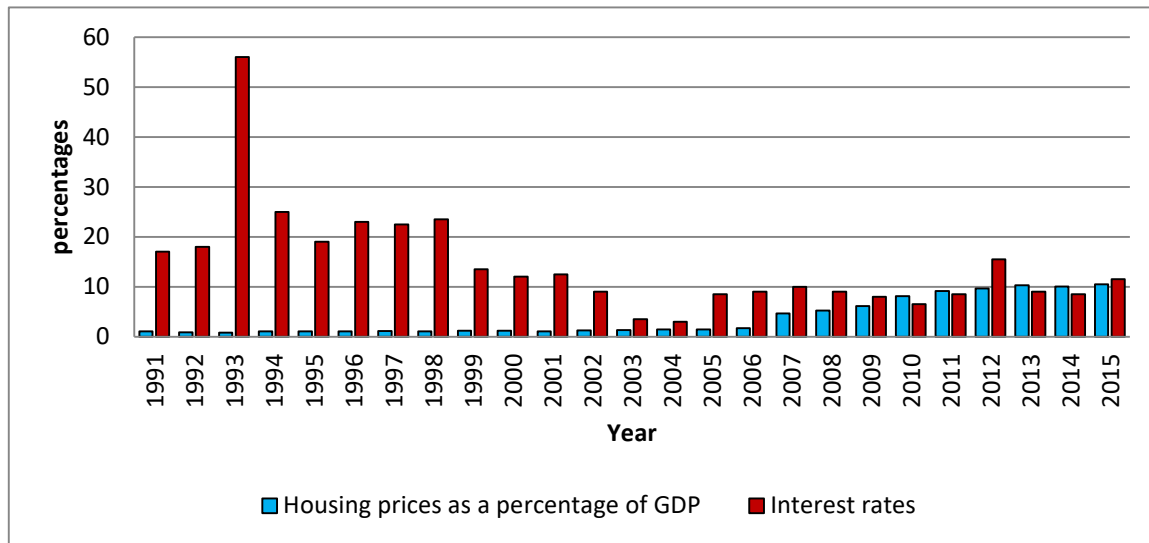
Figure 2: Interest rates and Housing price movements

Sources: Author's own computation using data from The Central Bank of Kenya and Economic surveys (various issues)

It is inferenced from figure 2 that when interest rates were declining between the years 2007 to 2010, the housing prices were depicting a rising trend, and when interest rates were raised between the years 2010 to 2015, the housing prices continued increasing. The following figure shows the changes in housing prices and that of the changes in interest rate from 2000 to 2015.
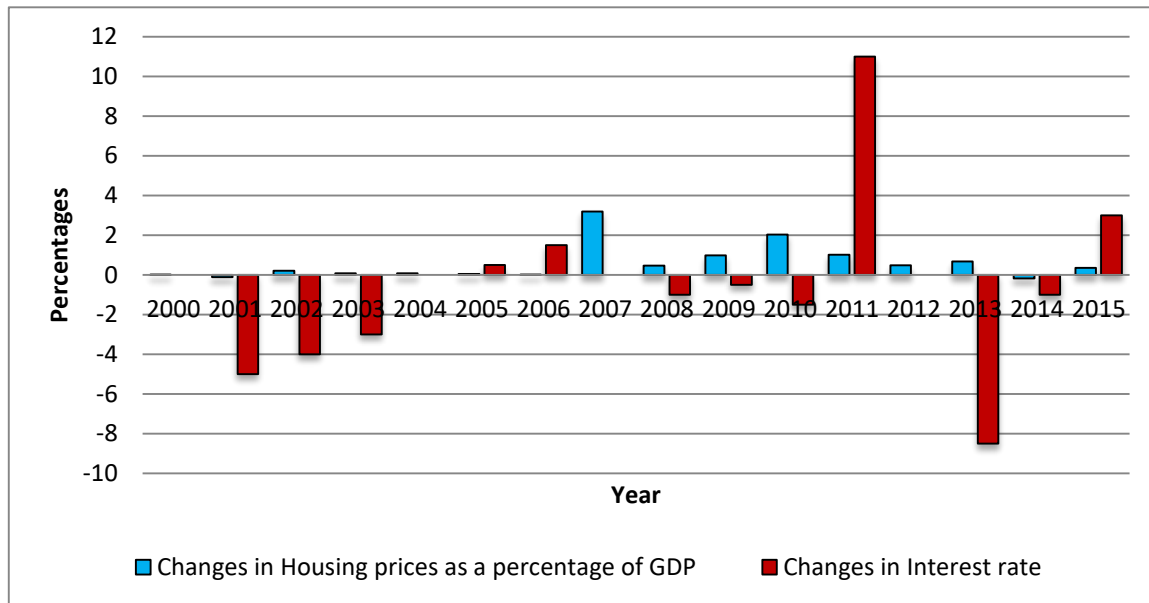
Figure 3: Interest rate changes and Housing price changes movement in Kenya

Source: Author's own computation using data from Central Bank of Kenya and Kenya Bureau of Statistics.

In figure 3, the positive and negative changes in interest rate suggest an unproportioned movement with housing prices as that of a non-linear relationship. Since 2016, the CBK has been lowering its base lending rate and it currently stands at 9 percent. In addition, it has previously explored the option of capping the rate to a maximum of 4 percent of any loans advanced. This intention of increasing the uptake of mortgages and in turn stirring access to housing, is signaling a systemic risk whereby non-performing loans are increasing. Commercial banks in Kenya recorded 63 billion shillings in non-performing loans in 2017. The value of bad loans was larger than 80 percent of the profit before tax made by all commercial banks, with this ratio of non-performing loans doubling from 6 percent in 2014 to 12 percent in 2018. Home ownership in urban areas remains low at 18 percent despite the trigger to increase the uptake on mortgages as the prices maintain the upward trend (Central Bank of Kenya, 2018). As an economic fundamental, interest rates are depicted to pose significant long-run effect on housing prices. Low interest rates cause cheap money in the economy. The cheap money causes rise in housing demand thereby causing a rise in housing prices. On the other side, an upward movement in interest rate leads to a decline in the price of houses (Makena, 2012; Wachera, 2013). However, there is a contrast which

could indicate a positive effect of interest rates on housing prices that may lead to the conclusion that the increase in prices is not based on the economic fundamental (Miregi & Obere, 2014). Moreover, if interest rates are found to be positively related to housing prices this would mean a contradiction to the existing literature (Gatakaa & Njoroge, 2011; Kibunyi, 2015).

Statement of the Problem

The housing and construction sectors' contribution to the Gross Domestic Product continued its rise from 12.66 percent in 2010 to 13.6 percent in 2016 increasing the sectors' relevance to the attainment of Kenya vision 2030. However, there has been a constant debate concerning the Kenyan housing market. The main concerns are the questions whether the Kenyan housing market is in a bubble and how it can be regulated using policies. This is to reduce uncertainty in the financial sector and the management in the ability to provide commercially viable homes at affordable prices as these two repercussions are already observable in the Kenyan housing market. The housing prices have continued to portray a rapid growth leading to owner-occupied houses in urban areas standing at 18 percent.   The rents for single rooms and one bed room units increased by 40 percent in the period 2010 to 2015. Loans for homes, mortgage facilities and housing schemes are increasingly inaccessible to low-income earners. Most people depend on rented accommodation whereas many others are segregated to informal settlements with inadequate services. Consequently, there is a rise in the cost of living for Kenyan citizens which affects the overall quality of life.   This has raised domestic production costs and the prices of essential services and goods beyond the reach of many Kenyans. As a result, it has created a non-conducive environment to anchor macroeconomic stability for growth, welfare and overall competitiveness (Omtiti & Nyalenga, 2015; Njaramba et al., 2018; Republic of Kenya, 2018).

An investigation on policies useful in the management of the housing market to avoid negative effects that usually emanate from the market and also to manage affordability is prompted. Studies have been undertaken in Kenya to investigate the effect of policies like interest rates on housing prices (Gatakaa & Njoroge, 2011; Kibunyi, 2015; Wachera, 2013; Miregi & Obere, 2014). However, the review of these studies yielded inconclusive results with some studies showing that interest rate is a significant variable in affecting the housing prices and that it has a negative relationship with the housing prices, whereas others show a positive effect of interest rate on housing prices. This could be as a result of studies using small period data in their analysis and only concentrating in Nairobi which is a small area

in representing the housing analysis of the vast country. Moreover, the studies used inadequate econometric tools, such as ANOVA based tests, to detail the relationship between the macroeconomic variables.

Despite the CBK use of monetary policy by changing the base lending rates and influencing the overall interest rates with an attempt to stabilize prices, the housing prices have continued to grow. The relationship and effect of interest rates on housing prices remains inconclusive and the uncertainty of the effectiveness of the monetary policy arises indicating a need to investigate this relationship. This study investigated possibility of a nonlinear relationship between interest rates and housing prices and used Nonlinear Autoregressive Distribution Lag (NARDL) for analysis.

Overview of the Literature Review

A completely developed theoretical model putting together all meaningful inter-linkages between macroeconomic variable and price of housing is absent. The only ultimate way to address the issue is through empirical means. However, some conclusions made in the existing reviewed literature require further examination. In other economies where the housing market has experienced substantial instability, the empirical literature reveals some contrasts in the relationship between interest rates and prices of housing whereby the conclusion that interest rates pose a significant negative effect on housing prices dominates. Other reviews contest this by suggesting that interest rates are insignificant in relation to housing prices hence making monetary policy ineffective. Moreover, an additional study suggested an asymmetric relationship between interest rate and housing prices.

In the Kenyan context, studies conducted to investigate the effect of policies such as interest rates on housing prices produced mixed results. Gatakaa and Njoroge (2011) rejected the presence of a bubble sighting that interest rates are insignificant because they had a positive relation with house prices contrary to existing literature. Kibunyi (2015) also concluded that there was no bubble in the Kenya housing market by stating that the interest rates were insignificant since they turned out to be positively related to housing prices. According to Wachera (2013), interest rates were the most significant of the economic fundamentals and had a negative relationship with housing prices. Miregi & Obere (2014) also investigated the effects of interest rates on prices of housing in Kenya and did not find significant relationship between the variable and housing prices and concluded that the prices were not supported fundamentally by any variable investigated.

It is evident that the econometric methodologies used by most of these studies are

inadequate in producing definite conclusions. The methods overlook interactions between prices of housing and the macroeconomic variables in a dynamic way hence no clear suggestion on the monetary and fiscal policies necessary in the Kenyan housing market.

This study sought to take care of non-linearity consequences by use of dynamic modelling aimed at examining non-linear responses to establish the empirical effects of interest rates on housing price movements in Kenya.

METHODS

Factors linked with housing prices have been identified from the Tobin's q theoretical framework and from empirical literature. They include property taxes (PT), Interest Rate (IR), urban population (UP), GDP per capita (GDPPC), cost of construction (CC), stamp duty fees (SDF), loans to deposit ratio (LDR), Housing stock (HST), diaspora remittances (DR) and employment growth rate (EMPr). The general empirical model for this study was expressed as:

$$HP = f(PT, IR, UP, GDPPC, CC, SDF, LDR, HST, DR, EMPr) \quad (2.1)$$

The first objective was to investigate effect of interest rate on the prices of housing in Kenya. This paper examined the asymmetric relationship between interest rate and housing prices using the nonlinear ARDL approach. NARDL is an asymmetric extension to ARDL and captures both the short run and long run asymmetries in variable of interest. Notably, there is possibility of employing optimal number of lags that differ among variables. Following Shin et.al (2011), the following asymmetric long run equation of prices of housing was specified:

$$HP_t = \alpha_0 + \alpha_1 GDPPC_t + \alpha_2 PT_t + \alpha_3 IR_t^+ + \alpha_4 IR_t^- + \alpha_5 HST_t + \alpha_6 UP_t + \alpha_7 CC_t + \alpha_8 SDF_t + \alpha_9 LDR_t + \alpha_{10} DR_t + \alpha_{11} EMPr_t + e_t \quad (2.2)$$

Where the α_i's represent long run parameters for estimation and et is the error term. The variables are as earlier defined. α_4 and α_3 represent the partial sums of negative and positive changes in IRt which were derived as:

$$IR_t^+ = \sum_{i=1}^{t} \Delta IR_t^+ = \sum_{i=1}^{t} \max(\Delta IR_t, 0) \quad (2.3)$$

$$IR_t^- = \sum_{i=1}^{t} \Delta IR_t^- = \sum_{i=1}^{t} \min(\Delta IR_t, 0) \qquad (2.4)$$

The interest rate impact on housing prices could have been asymmetric. This is hypothesized by testing α_4 and α_3 in equation (3.10) as it captured the effect of negative and positive changes in interest rate on prices of housing respectively. If $\alpha_3 = \alpha_4$, there was no asymmetry existing, and if $\alpha_3 \neq \alpha_4$ then there existed a nonlinear relationship. Rewriting equation 3.10 to an ARDL form based on Peseran, Shin, & Smith (2001), it became:

$$\Delta HP_t = \alpha + \beta_0 HP_{t-1} + \beta_1 GDPPC_{t-1} + \beta_2 PT_{t-1} + \beta_3 IR_t^+ + \beta_4 IR_t^- + \beta_5 HST_t + \beta_6 UP_t$$

$$+ \beta_7 CC_t + \beta_8 SDF_t + \beta_9 LDR_t + \beta_{10} DR_t + \beta_{11} EMPr_t + \sum_{i=1}^{p} \emptyset_i \Delta HP_{t-i}$$

$$+ \sum_{i=0}^{q} \gamma_i \Delta GDPPC_{t-i} + \sum_{i=0}^{q} \gamma_i \Delta PT_{t-i} + \sum_{i=0}^{q} \gamma_i \Delta HST_{t-i} + \sum_{i=0}^{q} \gamma_i \Delta UP_{t-i}$$

$$+ \sum_{i=0}^{q} \gamma_i \Delta CC_{t-i} + \sum_{i=0}^{q} \gamma_i \Delta SDF_{t-i} + \sum_{i=0}^{q} \gamma_i \Delta LDR_{t-i} + \sum_{i=0}^{q} \gamma_i \Delta DR_{t-i}$$

$$+ \sum_{i=0}^{q} \gamma_i \Delta EMPr_{t-i} + \sum_{i=0}^{s} (\theta_i^+ \Delta IR_{t-i}^+ + \theta_i^- \Delta IR_{t-i}^-)$$

$$+ \mu_t \qquad (2.5)$$

The long run effect of increase in interest rate and decrease in interest rate on the prices of housing was represented by β_3 and β_4 respectively. $\sum_{i=0}^{s} \theta_i^+$ measured the short run effects of interest rate increases on prices of housing while $\sum_{i=0}^{s} \theta_i^-$ measured the short run effects exerted by interest rate decreases on price of housing. Apart from the asymmetric long run relation, some asymmetric short run effects of rates of interest changes on housing prices were also incorporated.

Analysis of Time Series Data

The study examined the interest rate and property taxes policies on the housing market in Kenya and employed time series data for the period 1960 through 2017. It utilized a non-experimental research design since the research does not involve the control of the

variables. To avoid the problem of spurious regression, time series properties had to be tested. They included unit root and cointegration tests.

Unit Root Test

The study adopted the Phillips-Perron (PP) test to test for stationarity of data and determine order of integration of each of chosen variables since it sorts out the issues of serial correlation and structural breaks. Only employment growth rate (EMPr) and loan to deposit ratio (LDR) were stationary at level hence integrated of order zero [I (0)]. All the other variables had unit root at levels. However, at first difference, housing prices (HP), property taxes (PT), interest rate (IR), construction cost (CC), GDP per capita (GDPPC) and housing stock (HS) became stationary resulting to integrated of order one [I (1)]. Urban population (UP) was neither stationary at level nor at first difference hence it could not be included in the NARDL model since only a variable integrated of order zero and order one is eligible. The rest of the series were tested for cointegration.

Cointegration Test

If a series is cointegrated, the estimated relationship between variables is valid and not spurious in that a policy targeting one of the variables will have an impact on the other hence transmitting the intended effect to the economy. If there is no cointegration between variables, in that they are spuriously related, fundamentally, their movements have little to do with each other hence a policy targeting one variable will be severely hampered in its effectiveness.

NARDL bounds test and NARDL cointegration and long run tests were utilized to determine whether explanatory variables influenced dependent variable in long run. Results are in table 1 below:

www.iprjb.org

Table 1: NARDL Bounds Test

NARDL Bounds Test		
Sample: 1966-2017		
Included observations: 52		
Null Hypothesis: No long-run relationships exist		
Test Statistic	Value	K
F-statistic	22.17348	8
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	1.95	3.06
5%	2.22	3.39
2.5%	2.48	3.7
1%	2.79	4.1

Source: Author's Computation

The table shows that F-statistic of the bound tests is larger than upper bound of 3.39 at 5 percent level of significance and also upper bound of 4.1 at 1 percent level of significance. This led to conclusion that there is an existing long run relationship between the independent variables and explanatory variables.

Diagnostic tests

Before adopting estimation results in answering the objectives of research, diagnostic and stability tests were carried out to check the appropriateness of NARDL. Equation (2.5) was estimated so that the appropriate model for diagnostic test, stability test and analysis of NARDL could be selected. By adopting automatic selection of lags using Schwarz Information Criterion (SIC), adopted lags were (3, 2, 4, 3, 2, 1, 4, 4, 3). The R-squared and Adjusted R-squared for model fit were 0.96 and 0.88 indicating that set of data employed was a good fit. Ability of this model was in addition, affirmed by a standard error of 0.195, F-statistic of 12.24 and probability value of 0.000001 for joint significance of all independent variables. Hence, null hypothesis stating that estimated parameters of independent variables were jointly coming to zero had to be rejected at 1 percent significance level. The model qualified for use as optimal hence got subjected to diagnostics tests summarized in table 2 below:

Table 2: Diagnostics Tests

Diagnostics Test	Result	Conclusion
Multicollinearity Test	A correlation coefficient between the variables was less than 0.8	No serious Multicollinearity
Normality Test	The statistics for the Jarque Bera had a probability value of 0.11 which is greater than 0.05 (5 percent).	The regression model had a normality distributed error term
Serial Correlation Test	Breusch-Godfrey Serial Correlation LM Test indicated that probability of observed R-squared was greater than 5 percent	No serial correlation
Heteroskedasticity Test	Breusch-Pagan-Godfrey test indicated that the probability value is greater than 0.05 (5 percent)	No problem of heteroskedasticity in the model
Model Stability	CUSUM test, which is based on the cumulative sum of the recursive residuals, indicated that the estimates fall within acceptable region at 95 percent level of confidence	Coefficients of NARDL model are stable

FINDINGS

The objective was to investigate effect of interest rate on housing prices in Kenya. The nonlinear effect of interest rate on housing prices in Kenya has not been studied. This paper included an examination of the asymmetric relationship between interest rate and housing prices using the nonlinear ARDL approach (NARDL). NARDL is an asymmetric extension to ARDL and captures both the short run and long run asymmetries in variable of interest. Notably, there is a possibility of using optimal number of lags that differ among variables.

Short-Run Effects of Interest Rate on Housing Prices in Kenya

The estimation results are presented in the table 3 below:

www.iprjb.org

Table 3: Short-run effects of Interest rate on housing prices in Kenya

Dependent Variable: HPD1				
Method: NARDL				
Sample (adjusted): 1966 2017				
Included observations: 52 after adjustments				
Maximum dependent lags: 4 (Selected Automatically)				
Method for Model selection: Schwarz criterion (SIC)				
Dynamic regressors (Automatic, 4 lags): PTD1 IRD1_POS IRD1_NEG LDR GDPPCD1 EMPR CCD1 HSD1				
Fixed regressors: C				
Number of models evaluated: 1562500				
Selected Model: NARDL(3, 2, 4, 3, 2, 1, 4, 4, 3)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Δ Housing prices (lagged once)	-0.107969	0.107522	-1.004157	0.3294
Δ Housing prices (lagged twice)	-1.184751	0.138742	-8.539210	0.0000
Δ Housing prices (lagged thrice)	-2.009593	0.203270	-9.886306	0.0000
Δ Property Taxes	2.251666	0.643427	3.499490	0.0027
Δ Property Taxes (lagged once)	0.962457	0.716255	1.343735	0.1967
Δ Property Taxes (lagged twice)	-2.213459	0.799978	-2.766901	0.0132
Δ Interest Rate_Positive	0.028637	0.033545	0.853688	0.4051
Δ Interest Rate Positive series (lagged once)	-0.117002	0.042352	-2.762574	0.0133
Δ Interest Rate Positive series (lagged twice)	0.227719	0.049776	4.574854	0.0003
Δ Interest Rate Positive series (lagged thrice)	-0.083437	0.025092	-3.325220	0.0040
Δ Interest Rate Positive series (lagged four times)	0.038846	0.028312	1.372068	0.1879
Δ Interest Rate_negative series	0.015431	0.032034	0.481718	0.6361
Δ Interest Rate negative series (lagged once)	0.038753	0.034966	1.108308	0.2832
Δ Interest Rate negative series (lagged twice)	-0.117614	0.045439	-2.588359	0.0191
Δ Interest Rate negative series (lagged thrice)				
Loan-Deposit Ratio	0.150449	0.047942	3.138153	0.0060
Loan-Deposit Ratio (lagged once)	-2.744145	0.970400	-2.827848	0.0116
Loan-Deposit Ratio (lagged twice)	1.036553	0.919000	1.127914	0.2750
Δ Per Capita GDP	2.663290	1.077299	2.472191	0.0243
Δ Per Capita GDP (lagged once)	58.29126	23.97092	2.431749	0.0264
Employment rate	58.36000	19.93684	2.927244	0.0094

Table 3: Short-run effects of Interest rate on housing prices in Kenya			
Employment rate (lagged once)	0.024229	0.027932	0.867415	0.3978
Employment rate (lagged twice)	-0.028247	0.021115	-1.337773	0.1986
Employment rate (lagged thrice)	-0.057769	0.018047	-3.200995	0.0052
Employment rate (lagged four times)	0.006895	0.015424	0.447049	0.6605
Δ Construction costs	0.062991	0.017767	3.545349	0.0025
Δ Construction costs (lagged once)	1.986944	0.145724	13.63502	0.0000
Δ Construction costs (lagged twice)	0.404743	0.130704	3.096639	0.0066
Δ Construction costs (lagged thrice)	0.670757	0.141541	4.738961	0.0002
Δ Construction costs (lagged four times)	1.460463	0.186632	7.825375	0.0000
Δ Housing Stock	0.228539	0.092202	2.478683	0.0240
Δ Housing Stock (lagged once)	0.001071	0.385067	0.002783	0.9978
Δ Housing Stock (lagged twice)	-0.411920	0.350165	-1.176359	0.2557
Δ Housing Stock (lagged thrice)	-1.628164	0.345496	-4.712541	0.0002
C	3.082635	0.746276	4.130692	0.0007
R-squared	-0.979083	0.640348	-1.528986	0.1447
Adjusted R-squared	0.960759	Mean dependent var		0.196737
S.E. of regression	0.882278	S.D. dependent var		0.569582
Sum squared residue	0.195427	Akaike info criterion		0.199134
Log likelihood	0.649261	Schwarz criterion		1.114203
F-statistic	40.17748	Hannan-Quinn criteria.		0.304369
Prob(F-statistic)	12.24190	Durbin-Watson stat		2.480446
	0.000001		

Source: Author's Computation

From table 3, variations in explanatory variables jointly explain 96 percent of variations in housing prices, ceteris paribus. The remaining 4 percent of variations in prices of housing were explained by variables not included in the study. When adjusted for degrees of freedom, the explanatory variables account for 88 percent of variations in housing prices as shown by the value of adjusted R-squared. It is confirmed to have a good fit and hence useful in explaining the changes in housing prices since adjusted R-squared is greater than 50 percent.

The P-value of F-statistic is 0.000001 showing that the entire model had significance in

explaining relationship between housing prices and chosen variables. Moreover, Durbin-Watson statistics of 2.48 was above 2 and implied no serious autocorrelation problems.

Short-run results presented coefficients of independent variables that were differenced and this portrayed marginal effects in short-run. These coefficients described explanatory variables' effects on dependent variables in short-run.

Coefficient of first lag of housing prices change is -0.10 which is negative and not significant statistically. However, the coefficients of the second and third lags are -1.18 and -2.01 which are also negative but significant statistically at 1 percent level. A change in prices of housing in the current year will have no effect in the first year but will affect the housing prices in the second and third years. An increase in house price this year will not have a significant effect on housing price in the following year. However, it will exert a negative but significant effect in second and third year on increase. An increase in 1 unit of real house price in the current year, decreases the housing price by 1.18 in second year, and 2.01 in third year. A past positive change in housing prices will exert a significant negative effect to prices of housing in short-run. If price for a housing is set at the current market price, the price will decrease significantly in the short run. This can indicate that when housing is purchased for speculative purposes, the selling price can be lower than the buying price in short run. This indicates that short run prices in the Kenyan housing market are in a bubble that deflates after the initial purchase of a housing unit as supported by Miregi & Obere (2014).

The positive series of interest rates was found to exert a positive effect of 0.03 on housing prices in the current year. This effect was not significant. The positive series had a significant negative effect of 0.02 on housing prices in the first year which was contrary to the expectation. When interest rates increase, mortgages or borrowing to invest in housing becomes more expensive leading to less supply of housing in the market. This will in turn cause housing prices to increase due to higher demand and lower supply. This negative effect is corrected in the second year to positive then negative again in third year.

The negative series of interest rates was found to have negative effect of 0.02 and 0.04 on housing prices in the current and first year respectively. These effects were not significant. However, the negative series portrayed significant positive effect of 0.12 on prices of housing in second year which was contrary to expectation. However, this positive effect was corrected into a negative effect of 0.15 in the third lag.

Property taxes portrayed positive effect of 2.25 on prices of housing in current year.

However, this is reversed in the third year to a negative effect of 2.21 on housing prices at 5 percent level of significance.

Loans to deposit ratio (LDR) was confirmed to be significant in explaining the movement in prices of housing in short run. An upward movement in total number of loans advanced will lead to a higher ratio and vice versa. In the current year, an upward movement in the ratio led to a decrease of 2.74 in the prices of housing. This postulates that advancing more loans will ensure channeling of funds into supply of housing which in turn leads to decrease in housing prices when demand is low or constant. A reversal of this effect is encountered in the third year, whereby, an upward movement in the ratio has a positive effect of 2.66 on housing prices at 5 percent significance level. This confirms the presence of a bubble in housing market pushed up by speculators who were attracted by the lower prices in the first and second years and then borrowed funds to purchase housing. This finding is consistent with Igan & Kang (2011).

Per Capita GDP had the most effect on housing prices compared to other explanatory variables. A unit increase in the Per Capita Gross Domestic Product led to a 58 unit increase in housing prices with a 5 percent level of significance. It indicated that the greater disposable income individuals have, the more they engage in the housing market with an aim to maximize their wealth through speculation and this exerts an upward pressure on housing prices.

Employment rate had an insignificant positive effect on housing prices in current and first year but a significant negative effect of 0.06 the second year with a 1 percent level of significance. It indicates that when employment rate increases in first year, the housing market gets more robust due to increased purchases which lead to increase in prices of housing. However, in the second year, the demand for housing decreases leading to decline in housing prices. This insinuates a decrease in speculative demand for housing as a source of income, as stability in employment is experienced. Households move away from the housing bubble to explore other stable investments.

Construction costs had a positive and significant effect of 1.98 on housing prices at 1 percent level of significance. When construction costs increased, the burden was transferred to households as portrayed by the increasing housing prices.

Housing Stock had an insignificant effect on housing prices in the current and first year. A negative effect of -1.628 was exerted on housing prices at 1 percent significance level. It lined with law of demand that increase in housing led to a decrease in housing prices.

However, this law is broken in the third year when an upward movement in housing stock leads to significant positive effect of 3.08 on housing prices at 1 percent significance level, strengthening that a bubble occurs in the Kenyan housing market after every three years.

Short-Run Effects of Interest Rate on Housing Prices in Kenya

The estimation results are presented in the table 4 below:

Table 4: Long-run effects of Interest rate on housing prices in Kenya

NARDL Cointegrating And Long Run Form				
Dependent Variable: HPD1				
Selected Model: NARDL (3, 2, 4, 3, 2, 1, 4, 4, 3)				
Sample: 1960-2017				
Included observations: 52				
Cointegrating Form				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Change in Housing prices (lagged once)	3.194344	0.291594	10.954778	0.0000
Change in Housing prices (lagged twice)	2.009593	0.203270	9.886306	0.0000
Change Property taxes	2.251666	0.643427	3.499490	0.0027
Change in Property taxes (lagged once)	2.213459	0.799978	2.766901	0.0132
Change in Interest Rate Positive series	0.028637	0.033545	0.853688	0.4051
Change in Interest Rate Positive series (lagged once)	-0.227719	0.049776	-4.574854	0.0003
Change in Interest Rate Positive series (lagged twice)	0.083437	0.025092	3.325220	0.0040
Change in Interest Rate Positive series (lagged thrice)	-0.038846	0.028312	-1.372068	0.1879
Change in Interest Rate Negative series	0.015431	0.032034	0.481718	0.6361
Change in Interest Rate Negative series (lagged once)	0.117614	0.045439	2.588359	0.0191
Change in Interest Rate Negative series (lagged twice)	-0.150449	0.047942	-3.138153	0.0060
Change in Loan-Deposit Ratio	-2.744145	0.970400	-2.827848	0.0116
Change in Loan-Deposit Ratio (lagged once)	-2.663290	1.077299	-2.472191	0.0243
Change in Per Capita GDP	58.291263	23.970919	2.431749	0.0264

Table 4: Long-run effects of Interest rate on housing prices in Kenya

Change in Employment rate	0.024229	0.027932	0.867415	0.3978
Change in Employment Rate (lagged once)	0.057769	0.018047	3.200995	0.0052
Change in Employment rate (lagged twice)	-0.006895	0.015424	-0.447049	0.6605
Change in Employment rate (lagged thrice)	-0.062991	0.017767	-3.545349	0.0025
Change in Construction costs	1.986944	0.145724	13.635018	0.0000
Change in Construction costs (lagged once))	-0.670757	0.141541	-4.738961	0.0002
Change in Construction costs (lagged twice))	-1.460463	0.186632	-7.825375	0.0000
Change in Construction costs (lagged thrice))	-0.228539	0.092202	-2.478683	0.0240
Change in Housing Stock	0.001071	0.385067	0.002783	0.9978
Change in Housing Stock (lagged once))	1.628164	0.345496	4.712541	0.0002
Change in Housing Stock (lagged twice))	-3.082635	0.746276	-4.130692	0.0007
Speed of Adjustment	-4.302313	0.327772	-13.125927	0.0000
Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Property taxes	0.232587	0.311723	0.746134	0.4658
Interest Rate Positive series	0.022026	0.011740	1.876134	0.0779
Interest Rate Negative series	0.020226	0.011001	1.838491	0.0835
Loan-Deposit Ratio	0.222136	0.172518	1.287612	0.2151
Per Capita GDP	27.113618	7.437674	3.645443	0.0020
Employment Rate	0.001882	0.011016	0.170879	0.8663
Construction costs	1.104393	0.050760	21.757017	0.0000
Housing Stock	0.242572	0.182360	1.330185	0.2010
C	-0.227571	0.151416	-1.502958	0.1512

Source: Author's Computation

The above table indicates that the positive series of interest rate had a positive effect of 0.02 on prices of housing meaning that increasing positive interest rate by one unit, housing prices will increase by 0.02 units. If the interest rate translates to lending rate, the additional cost of borrowing will be factored into the housing prices leading to a price increase. On the other hand, the negative series of interest rate had a negative effect of 0.022 on prices of housing which means increasing the negative interest rate by one unit will lead to a 0.022 decline in housing prices. If the interest rate translates to lending rate, the reduced cost of borrowing will be factored into the housing prices leading to a price decrease. These long-run effects were significant at 10 percent level significance. Unlike short-run, effects of negative and positive series of interest rate are consistent with existing literature in the long-run.

Per capita GDP and construction cost had significant positive effects of 27 and 1.1 on housing prices respectively. The long run and significant effect of per capita GDP was supported by Gatakaa & Njoroge (2011) and Wachera (2013). On the other hand, NARDL analysis of property taxes, loans to deposit ratio, employment rate and housing stock portrayed no significant effect on housing prices.

Conclusion

The NARDL model confirms that a non-linear relationship between interest rates and prices of housing exists. This is because an upward movement in interest rate affects housing prices with a different magnitude from that exerted by a downward movement in interest rate. A decrease in interest rate poses a greater magnitude of effect on prices of housing than an increase in interest rate. In short-run, an upward movement in interest rate will result to a decrease in prices of housing, contrary to expectation. On the other hand, in short-run, a decrease in interest rate will result to a decrease in prices of housing as expected. In the long-run, an upward movement in interest rate will lead to an increase in housing prices whereas a decrease in interest rate will cause a decline in prices of housing as expected.

NARDL short-run analysis also portrays that an increase in per capita GDP, construction cost, loans to deposit ratio and housing stock will cause an upward movement in prices of housing. On the contrary, an upward movement in employment rate and property taxes will cause a decrease in housing prices. In long-run, only an increase in per capita gross domestic product and construction costs will cause a significant upward movement in housing prices.

Recommendations

The Central Bank of Kenya can change the CBR rate to alter the cost of money and consequently housing prices. CBR affects the mortgage rate which in turn changes the mortgage capital cost thereby affecting the supply, demand and prices of the various types of housing. The CBR rate change can also cause a change in interbank exchange rate leading to a change in the cost of funds which reduce or add to the capital available for investment. The change can increase or decrease the discount and capitalization rates and this brings changes in returns of competing or substitute investment leading to a decrease or increase in housing prices. High interest rates in a country attract capital inflows and this may influence the supply and demand for property and as a result affect housing prices.

In formulating a policy change, the Central Bank of Kenya should be cognizant of both the non-linear relationship existing between interest rates and prices of housing and the different magnitudes of effect of the positive and negative series on housing prices. When housing prices increase, either an increase or decrease the interest rate by the CBK will result to a downward movement in prices of housing in the short run, but at higher magnitude from the interest rate decrease. For the long-run, a decrease in interest rate will decrease housing prices, making housing affordable and improving the standards of living for citizens. Any upward movement in interest rate will result to a long-run increase in housing prices making housing more expensive and consequently out of reach of most citizens.

REFERENCES

Adrian, T., & Shin, S. (2009). *Liquidity and leverage.* New York: Federal reserve bank of New York.

Alonso, W. (1964). *Location and land use.* Cambridge: Harvard University Press.

Arreger, N., Brown, M., & Rossi, E. (2013). Transaction taxes, capital gain taxes and house prices. *Swiss National Bank working papers, 2013-2* .

Bahl, R. (2009). Property tax reform in developing and transition countries, fiscal reform and economic governance project. *United States Agency for international development*.

Barako, J., & Shibia, G. (2015). Fiscal decentralization and determinants of property tax performance in Kenya: Cross-county analysis. *KIPPRA*.

Bellettini, G., & Taddei, F. (2011). Real estate prices and the importance of bequest taxation. *Collegio Carlo Alberto Notebooks*. Retrieved from www.carloalberto.org

Calza, A., Monacelli, T., & Stracca, L. (2013). Housing finance and monetary policy. *Journal of the European Economic Association, II*(51),   pp 101-122.

Capozza, D., & Helsley, W. (1989). The fundamentals of land prices and urban growth. *journal of economic theory, 26*,   pp 295-306.

Central Bank of Kenya. (2018). *Bank supervision annual report.* Nairobi: Central Bank of Kenya.

Central Bank of Kenya. (2018). *Monetary policy statement.* Nairobi: Central Bank of Kenya.

Chow, G. (1960). Test of equality between sets of coefficients in two linear regressions. *Econometrica, 28*(3),   pp 591-605.

Crow, C., Dell, G., Igan, D., & Rabanal, P. (2013). How to deal with real estate booms: Lessons from country experiences. *Journal of financial stability, 9*, pp 300-319.

Dias, D. A., & Joao, B. D. (2019). Monetary policy, housing rent, and inflation dynamics. *International Finance Discussion Papers*(1248). Retrieved from https;/doi.org/10.17016/IFDP.2019.1248

Eickmeir, S., & Hofmann, B. (2010). Monetary policy, housing boom and financial (im)balances. *European Central Bank*(1178).

Engle, R., & Granger, C. (1987). Co-integration and error correction: Representation, estimation, and testing. *Econometrika: journal of econometric society*, pp 251-276.

Fougere, D., Lecat, R., & Ray, S. (2017). Real estate prices and corporate investment: Theory and evidence of heterogenous effects across firms. *Banque de France, 626*.

Gatakaa, M., & Njoroge. (2011). is there a real estate market boom or bubble in urban Kenya? A case study of residential real estate in Nairobi metropolitan region. *Infrastructure and economic services division Kenya Insitute for public policy research and analysis*(126). Retrieved from http://www.kippra.org

Gichuki, J., Oduor, J., & Kosimbei, G. (2012). The choice of optimal monetary policy instrument for Kenya. *International journal of economics and management sciences, 1*(9), pp 1-23.

Hassconsult limited. (2016). *The property market in Kenya.* Nairobi: Hass Property Index, Annual report.

Hefferan, M., & Boyd, T. (2010). Property taxation and mass appraisal valuations in Australia- Adapting to a new environment. *Property Management, 28*(3), 149-162. doi:10.1108/02637471011051291

Igan, D., & Kang, H. (2011). Do loan-to-value and debt-to-income limits work?evidence from Korea. *International Monetary Fund, 11*(297).

IMF. (2001). Real estate and the macroeconomy in Japan. *International Monetary Fund, 01/220*.

Kamau, W. (2017). The effect of property taxation on economic growth in Kenya. *Unpublished Masters research project, school of Busines, Nairobi University*.

Kelly, R. (2000a). Designing a property tax reform strategy for sub-Saharan Africa: An analytical framework applied to Kenya. *Public Budgeting and Finance*.

Keynes, J. (1936). *The general theory of employment, interest and money.* New York: Oxford University Press.

Kibunyi, D. (2015). Real estate prices in Kenya: Is there a bubble? *Unpublished thesis, Strathmore University*. Retrieved from https://su-plus.strathmore.edu/handle/11011/4721

Konyimbi, T. (2000). Land value taxation: Rating principles and guidelines for Kenya. *Cambridge MA*.

Koustas, Z., & Lamrche, J. (2006). Policy-induced mean revision of the real interest rate? *Working Paper 601, Department of Economics, Brock University*.

Makena, S. (2012). Determinants of residential real estate prices in Nairobi. *Unpublished Reserch project, University of Nairobi*.

Miregi, M., & Obere, A. (2014). Effects of market fundamental variables on property prices in Kenya. *Journal of Economics & Finance, 5*(5), pp 101-113. Retrieved from www.iosrjournals.org

Mulinge, J., & Ocharo, N. (2018). External debt servicing and current account balance in Kenya. *International society for development and sustainability*.

Muthaura, A. (2012). The relationship between interest rates and real estate investment in Kenya. *Unpublished Research project, University of Nairobi*.

Nicole, A., Brown, M., & Rossi, E. (2013). Transaction taxes, capital gains taxes and house prices. *Swiss National Bank Working Paper*.

Nicolo, D., Ariccia, D., Laeven, L., & Valencia, F. (2010). Monetary policy and bank risk taking. *International monetary fund*.

Njaramba, S., Gachanja, P., & Mugendi, C. (2018). The sources of housing prices growth in Kenya. *International Journal of Economics, 3*(2), pp 7-30. Retrieved from www.iprjb.org

Noord, P. (2005). Tax incetives and the house price volatility in the Euro area: Theory and evidence. *Economie Internationale CEPII Research Center, 1*(101), pp 29-45.

Odanya, N. (2017). An evaluation of property rates collection and enforcement in devolved systmes of governance: Acase study of Nairobi city county. *Unpublished research project, University of Nairobi*.

OECD. (2010). Housing and the economy: Policies for renovation, economic policy reforms. *OECD Economic outlook, 2010*(2).

Omiti, J., & Nyalienga, G. (2015, January-June). Can we tame the rising cost of living in Kenya? *Policy monitor KIPPRA: improving public policy making for economic growth and poverty reduction, 2*(7).

Omondi, V., Wawire, N., Manyasa, E., & Thuku, G. (2014). Effects of tax reforms on bouyancy and elasticity of the tax system in Kenya: 1963-2010. *International Jouranl of Economics and Finance, 6*(10).

Omtatah, A. (2014). Determinants of housing demand in Nairobi. *Unpublished research project, University of Nairobi.*

Ouma, O. (2015). Effects of macroeconomic variables on real estate prices in Kenya. *Unpublished research project, University of Nairobi.*

Peseran, M., Shin, Y., & Smith, R. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of applied econometrics, 16*(3), pp 289-326.

Phillips, P., & Perron, P. (1988). Testing for a unit root in a time series regression. *Biometrika, 75*(2), pp 335-346.

Piazzesi, M., & Schneider, M. (2016). Housing and macroeconomics. *National Bureau of Economic Research*(22354).

Poghosyan. (2016). Can property taxes reduce house price volatility? Evidence from U.S. regions. *International Monetary Fund, 16*(216).

Republic of Kenya. (2013). *Economic surveys.* Nairobi: Government Printer.

Republic of Kenya. (2018). *Economic surveys.* Nairobi: Government Printer.

Smith, M., & Smith, G. (2016, March). Bubble, bubble, where's the housing bubble? *Brookings Panel of Economic Activity*.

Song, Y., & Zenou, Y. (2006). Property tax and urban sprawl: Theory and implications for US cities. *Journal of Urban Economics, 60*(3), pp 519-534.

Syagga, P. (2015). Porperty taxation in Kenya. *National conference on county own source revenue enhancement.* Department of real estate and construction management, University of Nairobi.

Tajani, F., Morano, P., Torre, M., & Liddo, F. (2017). An annalysis of the influence of property tax on housing prices in the Apulia region Italy. *MDPI*, 67. doi:10.3390/buildings7030067

Tan, C., Lee, C., Tan, Y., & Keh, C. (2018). A nonlinear ARDL analysis on the relation between housing price and interest rate: The case of Malaysia. *Journal of Islamic, social, economic and development, 3*(14), 109-121. Retrieved from www.jised.com

Tobin, J. (1972). Inflation and unemployment. *American economic review, 1*(4), pp 1-18.

www.iprjb.org

Wachera, K. (2013). Determinants of residential real estate prices in Kenya. *Unpublished research project, University of Nairobi*.

Wheaton, W. (1974). A comparative static analysis of urban spatial structure. *Journal of economic theory, 9*,   pp 223-237.

APPENDIX I: FIGURES

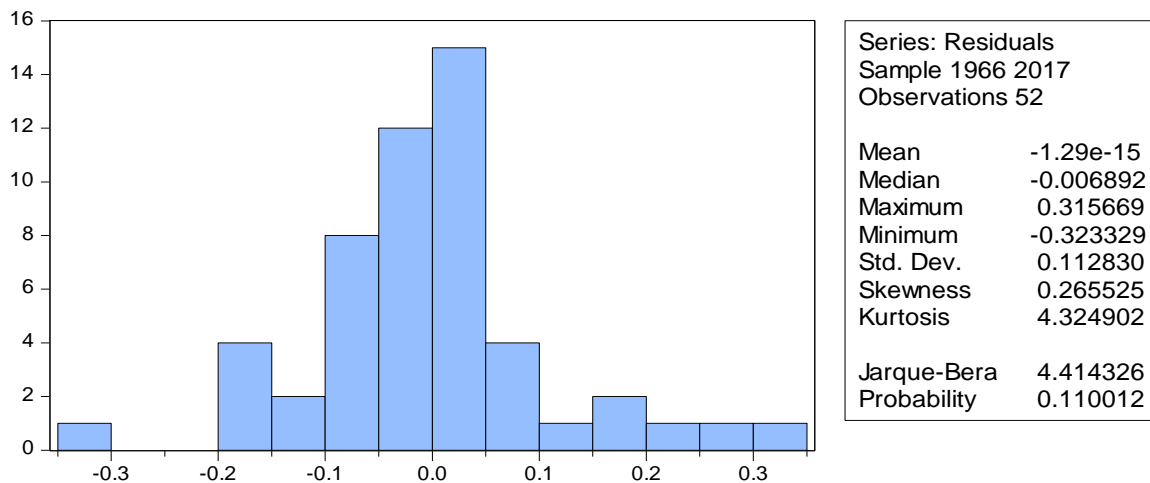**Figure A1.1: CUSUM stability test**
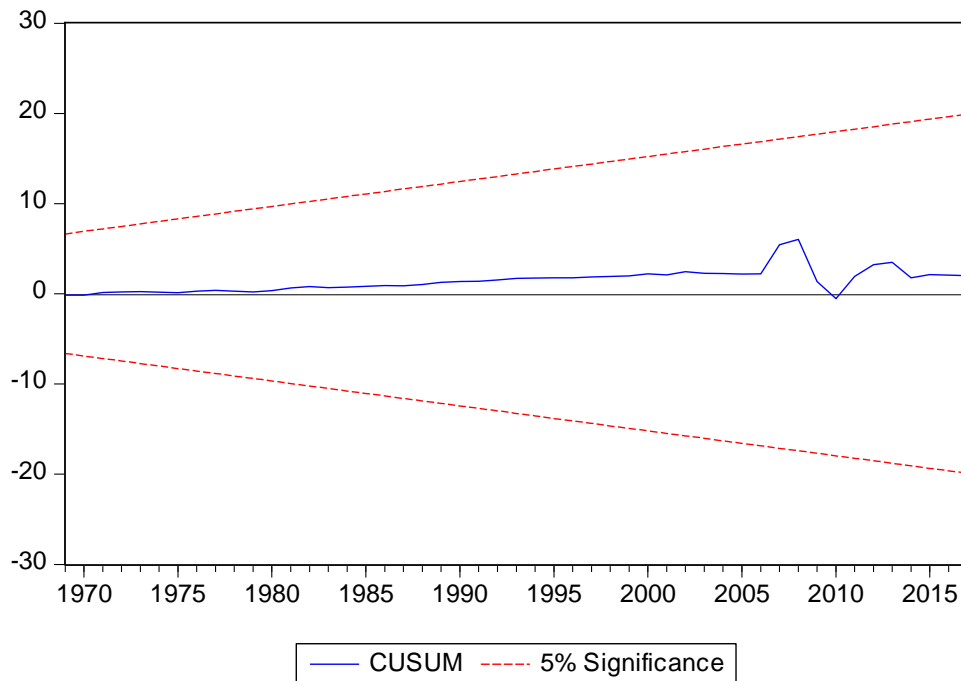
APPENDIX II: TABLES

Table A2.1: Multicollinearity results

	Hp	Empr	Gdppc	Hs	Ir	Cc	Ldr	Pt
Hp	1.00	0.22	0.71	0.54	0.14	0.99	0.20	-0.32
Empr	0.22	1	0.39	0.24	0.01	0.23	0.04	0.13
Gdppc	0.71	0.39	1	0.90	0.46	0.72	0.33	0.09
Hs	0.54	0.24	0.90	1	0.63	0.56	0.45	0.25
Ir	0.14	0.01	0.46	0.63	1	0.16	0.11	0.09
Cc	0.99	0.23	0.72	0.56	0.16	1	0.23	-0.29
Ldr	0.20	0.04	0.33	0.45	0.11	0.23	1	0.17
Pt	-0.32	0.13	0.09	0.25	0.09	-0.29	0.17	1

Table A2.2: Normality test

Series: Residuals
Sample 1966 2017
Observations 52

Mean	-1.29e-15
Median	-0.006892
Maximum	0.315669
Minimum	-0.323329
Std. Dev.	0.112830
Skewness	0.265525
Kurtosis	4.324902
Jarque-Bera	4.414326
Probability	0.110012

Table A2.3: Serial Correlation test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	2.446293	Prob. F (2,45)	0.0981
Obs*R-squared	5.491493	Prob. Chi-Square (2)	0.0642

Table A2.4 Heteroskedasticity test

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.811755	Prob. F(34,17)	0.7067
Obs*R-squared	32.17923	Prob. Chi-Square(34)	0.5571
Scaled explained SS	5.717625	Prob. Chi-Square(34)	1.0000