EFFECTS OF INTEREST RATE ON HOUSING PRICES IN KENYA

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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](image)

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.
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 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:

\[ HP = f(PT, IR, UP, GDPPC, CC, SDF, LDR, HST, DR, EMPr) \]  

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:

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

(2.2)

Where the \( \alpha_i \)'s represent long run parameters for estimation and \( e_t \) is the error term. The variables are as earlier defined. \( \alpha_4 \) and \( \alpha_3 \) represent the partial sums of negative and positive changes in \( IR_t \) which were derived as:

\[ IR_t^\pm = \sum_{i=1}^{t} \Delta IR_t^\pm = \sum_{i=1}^{t} \max(\Delta IR_t, 0) \]  

(2.3)
The interest rate impact on housing prices could have been asymmetric. This is hypothesized by testing $\alpha_4$ and $\alpha_3$ 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:

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

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

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

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

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

$$+ \mu_t$$

The long run effect of increase in interest rate and decrease in interest rate on the prices of housing was represented by $\beta_3$ and $\beta_4$ respectively. $\sum_{i=0}^{q} \theta_i^+$ 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:
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 | Critical Value Bounds |
|-------------------|-------------------|--------------------------|-------------------------------------------------|----------------|-------|---|----------------------|
|                    |                   |                          |                                                 | F-statistic    | 22.17348 | 8 | I0 Bound            |
|                    |                   |                          |                                                 |                |         |   | 1.95                 |
|                    |                   |                          |                                                 |                |         |   | 3.06                 |
|                    |                   |                          |                                                 |                |         |   | I1 Bound            |
|                    |                   |                          |                                                 |                |         |   | 2.22                 |
|                    |                   |                          |                                                 |                |         |   | 3.39                 |
|                    |                   |                          |                                                 |                |         |   | 2.48                 |
|                    |                   |                          |                                                 |                |         |   | 3.7                  |
|                    |                   |                          |                                                 |                |         |   | 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:
Table 3: Short-run effects of Interest rate on housing prices in Kenya

| Variable | Coefficient | Std. Error | t-Statistic | Prob.* |
|----------|-------------|------------|-------------|--------|
| \( \Delta \) Housing prices (lagged once) | -0.107969 | 0.107522 | -1.004157 | 0.3294 |
| \( \Delta \) Housing prices (lagged twice) | -1.184751 | 0.138742 | -8.539210 | 0.0000 |
| \( \Delta \) Housing prices (lagged thrice) | -2.009593 | 0.203270 | -9.886306 | 0.0000 |
| \( \Delta \) Property Taxes | 2.251666 | 0.643427 | 3.499490 | 0.0007 |
| \( \Delta \) Property Taxes (lagged once) | 0.962457 | 0.716255 | 1.343735 | 0.1967 |
| \( \Delta \) Property Taxes (lagged twice) | -2.213459 | 0.799978 | -2.766901 | 0.0132 |
| \( \Delta \) Interest Rate_ Positive | 0.028637 | 0.033545 | 0.853688 | 0.4051 |
| \( \Delta \) Interest Rate Positive series (lagged once) | -0.117002 | 0.042352 | -2.762574 | 0.0133 |
| \( \Delta \) Interest Rate Positive series (lagged twice) | 0.227719 | 0.049776 | 4.574854 | 0.0003 |
| \( \Delta \) Interest Rate Positive series (lagged thrice) | -0.083437 | 0.025092 | -3.325220 | 0.0040 |
| \( \Delta \) Interest Rate Positive series (lagged four times) | 0.038846 | 0.028312 | 1.372068 | 0.1879 |
| \( \Delta \) Interest Rate_negative series | 0.015431 | 0.032034 | 0.481718 | 0.6361 |
| \( \Delta \) Interest Rate negative series (lagged once) | 0.038753 | 0.033432 | 1.108308 | 0.2832 |
| \( \Delta \) Interest Rate negative series (lagged twice) | -0.117614 | 0.045349 | -2.588359 | 0.0191 |
| \( \Delta \) Interest Rate negative series (lagged thrice) | -0.083437 | 0.025092 | -3.325220 | 0.0040 |
| 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 |
| \( \Delta \) Per Capita GDP | 2.663290 | 1.077299 | 2.472191 | 0.0243 |
| \( \Delta \) Per Capita GDP (lagged once) | 58.29126 | 23.97092 | 2.431749 | 0.0264 |
| Employment rate | 58.36000 | 19.93684 | 2.927244 | 0.0094 |
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

|                                                                 | Coefficient | Std. Error | t-Statistic | Prob.  |
|-----------------------------------------------------------------|-------------|------------|-------------|--------|
| 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   | -3.454349   | 0.025  |
| 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   | 0.024  |
| 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 |

| 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.
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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|      |       | 0.39 | 0.24 | 0.01 | 0.23| 0.04  |
| Gdppc| 0.71| 0.39 | 1     | 0.90 | 0.46 | 0.72 | 0.33| 0.09  |
| Hs  | 0.54| 0.24 | 0.90  |      | 0.63 | 0.56 | 0.45| 0.25  |
| Ir  | 0.14| 0.01 | 0.46  | 0.63 | 1    |      | 0.16| 0.11  |
| Cc  | 0.99| 0.23 | 0.72  | 0.56 | 0.16 | 1    |      | 0.23  |
| 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:

|                  | Value 1      | Prob. | Value 2       |
|------------------|--------------|-------|---------------|
| F-statistic      | 2.446293     | 0.0981|               |
| Obs*R-squared    | 5.491493     | 0.0642|               |

Table A2.4 Heteroskedasticity test

Heteroskedasticity Test: Breusch-Pagan-Godfrey

|                  | Value 1      | Prob. | Value 2       |
|------------------|--------------|-------|---------------|
| F-statistic      | 0.811755     | 0.7067|               |
| Obs*R-squared    | 32.17923     | 0.5571|               |
| Scaled explained SS | 5.717625     | 1.0000|               |