European Journal of Business and Management
ISSN 2222-1905 (Paper) ISSN 2222-2839 (Online)
Vol.10, No.24, 2018

Effect of GDP, Population and Interest Rate on Residential House Prices in Nairobi County, Kenya

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Abstract
Previous studies have shown an increasing trend in house prices over the past ten years and it is anticipated that the trend is likely to continue into the foreseeable future. This trend has been attributed to various factors, both microeconomic and macroeconomic. However, there is scant information on the effect of various macroeconomic factors such as GDP, population and interest rate on house prices in Kenya. Consequently, there is need for more research to be undertaken in order to determine the effect of such factors on house prices over time using the latest data. This study therefore sought to address the current literature gap by determining the effect of various macroeconomic factors on house prices in Kenya. In particular, the study sought to examine the effect of; GDP, population and interest rate on residential house prices in Nairobi count. To achieve this, the study adopted an explanatory research design as it attempted to explain the effect of GDP, population and interest rate on residential house prices for the period 2004-2016. The target population comprised of quarterly (2004Q1-2016Q4) observations of the House Price Index (HPI) and the quarterly observations of the variables. Data on quarterly observations of the House Price Index was obtained from Hass Property Consult Ltd while that on quarterly observations of the variables was obtained from Kenya National Bureau of Statistics and Central Bank of Kenya. Vector Error Correction Model (VECM) estimates were used to establish the long-run relationship between the determinants and residential house prices. Results confirm the existence of a long-run equilibrium relationship among variables in the model. The size of the coefficient of the error correction term ($\beta = -0.0004$, $p = 0.0383$) suggests a relatively lower speed of adjustment from the short-run deviation to the long-run equilibrium. VECM coefficients specifically revealed that in the long-run GDP ($\beta = -0.6067$, $p = 0.0071$) and interest rate ($\beta = -17.99$, $p = 0.0009$) have a negative significant effect on house prices. Though having a negative relationship with house prices, the study failed to identify any long-run relationship between population and house prices ($\beta = -0.5340$, $p = 0.4562$). The study recommends that the government of Kenya should create an enabling environment for availability of credit to spur economic growth and hence check the house prices. Further, there is need to check on urban population growth so as to match the number of houses available with the increase in population.
Keywords: House price Index, Gross Domestic Product, Interest Rate, Population.

1. Introduction
House prices are pivotal in generation of business cycles and financial dynamics, a fact that has been acknowledged by both practioners and empiricists since the 2007/2008 global financial crisis (Valadez, 2012; Shi & Jou, 2013). Volatility in house prices can greatly influence economic activities of a country since housing is considered a fundamental aspect of household wealth (Beltratti & Morana, 2009). Extant literature has shown that fluctuations in house prices can result to significant changes in the real side of the economy by affecting the financial system which in return affects the real economy. This phenomenon has been witnessed before like it happened in the case of the US financial crisis of 2007-2008 (Kozicki, 2012). Other studies such as that by Tsatsaronis and Zhu (2004) have also established that house prices significantly impact the business cycle by first affecting aggregate expenditure and the prevailing financial system. The volatility of house prices has similarly been documented in Africa. South Africa for instance, has witnessed a rapid appreciation in home values (Das et al., 2011). Kenya in particular has registered significant house price changes within a short time. A study by Hass consult (2015) that sought to determine house prices in Kenya for example estimated the average price for apartments in Nairobi to be KSH 11.58M, which was a significant increase when compared to the year 2000 whereby the apartments were estimated at KSH 5.2M. In this report, the author had also established that within the formal market, homes were retailing for at least KSH 2M over the same period of the study. However, exact statistics show that these houses trade at about KHS 14M by the first quarter of 2016.

According to Hass Consult (2011), the Kenyan housing market has attracted many investors, both individual and institutional, among them private developers who are seeking to diversify their portfolios. Through its revised National Housing Policy of 2004, Kenyan authorities have majorly focused on resolving the housing crisis within the country's capital city through initiatives such as the government's slum-upgrading programs. Affordable housing is also one of the four major economic development pillars that the government seeks to implement in bolstering the country's growth and development. Previous studies like that by Knight (2014) had also established that over the past ten years, the Kenyan real estate market had experienced boom and that the trend was expected to remain unchanged in the foreseeable future. Despite the country's ambitious program through its economic development blue print to make Kenya a middle-income economy, much needs to be done in order to address the current house shortage though affordable housing. Other studies like that by CAHF (2016) have projected that 50,000 housing units are required per annum in order to meet the prevailing demand for affordable housing in Kenya against the current 35,000 that are being constructed as at the moment.

Several demographic factors have been documented among them housing permits, number of households and total population being significant in Cyprus (Sivitanides, 2014). The long-run demographic change in developed countries has been known to affect house price developments. Population in particular, shapes the growth rate of prevailing market price of houses in various markets (Hiller & Lerbs, 2015). The relationship between population and housing is two sided; population change leads to change in housing demand and supply of housing influences the opportunities for population increase through migration (Mulder, 2006).

Available statistics show that Kenya has thirty per cent of its population living in urban areas. As at 2016, Kenya's urban population was projected to rise at a rate of 4.2 percent per annum by the Centre for Affordable Housing Finance in Africa (CAHF). This increased population in the country's capital city has over time led to increased pressure on the few available houses and hence the high demand for house as currently is the case in Nairobi. Shortage of affordable housing has been mainly brought about by rapid rural-urban migration, especially among the youthful [population who are relocating to the capital city in search of greener pastures. Failure to secure the anticipated job opportunities has however rendered the available houses unaffordable and hence the surge in informal settlements which are considered within the reach of low-income earners. Kagochi and Kiambigi (2012) had earlier established that informal settlements house close to sixty percent of Kenya's urban dwellers. In their study, the authors also reported that majority of the informal settlers (73 per cent) live below the poverty line of 1US$ a day. Similar findings had been reported by NACHU (2004).

Despite many studies having shown that many urban dwellers live below the poverty line that is catapulted by high prevalence of poverty and unemployment, it is still not clear as to what really drives house prices significantly. However, related studies that have been undertaken before seem to suggest that low supply of houses can be attributed to various factors such as high construction costs, rural-urban migration, population growth, lack of resources and borrowing constraints (Tipple, 1994; Matteo, 2005). Statistics show that 22 per cent of Kenya's population are urban dwellers and that the urban population is growing at an annual rate of 4.2 per cent. With this level of growth, 150,000 new houses are required every year to meet the demand (KNBS, 2016; National Housing Survey, 2013).

1.2. Research problem

One of the features of a liberalized economy is that both buyers and sellers have perfect information about the market. In such a scenario, market prices of commodities is detrm0ined through the forces of demand and supply. This may however not be the case for house prices given that the demand for houses is price inelastic. It therefore follows that when it comes to housing, an increase in house prices may not necessarily be the force behind an increase in the demand for houses. Instead, such an increase is attributed to future expectation of further increases in prices of houses (Mckenzie & Betts, 2006). This is true especially for the Kenyan case which is characterized with excess demand and a chronic under-supply of formal housing, a situation which fundamentally impact on house prices (AFDB, 2013).

Existing research has shown that excess demand for housing has continued to increase at a faster rate over time than the supply of houses (National Housing Corporation, 2009). Further findings by this research indicate that while the projected number of houses constructed annually is nearly 30,000 units, demand for houses stood at 150,000 units per annum in the same period (National Housing Survey, 2013). Low supply of houses can be attributed to high construction costs, rural-urban migration, population growth, lack of resources and borrowing constraints (Tipple, 1994 & Matteo, 2005). Statistics show that 22 percent of Kenyans live in cities and that the urban population is growing at an annual rate of 4.2 percent. With this level of growth, 150,000 new houses are required every year to meet the demand (National Housing Survey, 2013; KNBS, 2016; CAHF, 2016).

2. Empirical literature review

2.1 Gross Domestic Product and House Prices

Gross Domestic Product (GDP) is one of the macroeconomic factors that play a key role in determining the prevailing house prices in many liberalized economies such as Kenya. Previous researchers (Maclennan and Pryce, 1996) used GDP to represent the economic conditions of countries. Other studies (Valadez, 2012) have established that determinants of the relationship between HPI and GDP can either be indirect or overlapping. According to these studies, possible correlation between variables where the data is normally distributed can increase the confidence level of measuring any linear relationship between those variables.

In a similar study that sought to determine the relationship between GDP and house prices, Zhang et al., (2012) used the NARMAX Model where they established that GDP had a significant nonlinear effect on house price dynamics. In their study, the authors also reported that personal disposable income in particular had no explanatory power on Chinese house prices, findings which were attributed to the country's financial repression policies. Further research has also shown that an individual's disposable income can be constrained by various competing needs subject to the portfolio selection criteria of such an individual.

2.2 Interest Rate and House Prices

The link between interest rates and house prices has for a long time drawn interest from researchers and economists. Interest rates have a significant effect on the cost of financing and mortgage rates both of which are key determinants of property prices. Fluctuation in property prices are expected in an ideal economy and as a result, buyers will always be speculating on future price movements of property based on the prevailing rates of interest. Trends in interest rates affect the demand for housing given the inverse relationship between interest rates and demand for houses. An increase in interest rates will result to an increase in the cost of borrowing and which in return will reduce the demand for houses since potential buyers may be discouraged by the increased property costs (Otwoma, 2013). High cost of property may also be as a result of high mortgage repayments which makes house prices rise beyond the reach of many potential buyers.

When interest rates are low on the other hand, many people qualify for mortgages which in return increase the demand for houses (Thomsett & Kahr, 2007; Otwoma, 2013). According to Rangel and Pilay (2007) a decrease in interest rate would result to a reduction in mortgage payments which in effect would result to higher property prices due a surge in demand. Despite the intensified research on the effect of interest rate on house prices, there is still no consensus since previous studies seem to conflict on the elasticity of house prices to interest rate fluctuations in the short-run.

2.3 Population and House Prices

Population is the total number of humans currently living. As the Kenyan population continues to increase rapidly, it will exert more pressure on the demand for affordable housing which will in effect increase prices for houses. Population growth is either caused by natural population growth of higher births and low mortality or non-natural causes which consists of immigration, all of which are highly responsible for the current shortage of affordable housing and burgeoning property prices. If population growth exceeds the supply of houses to match the higher demand for affordable accommodation, market forces will increase house prices to restore equilibrium. Louise (1982), portends that population growth drives house price appreciation. With natural growth of population, home construction reacts to market demands by providing more supply so as to offset the anticipated demand which in turn drives up house prices. Mankiw and Weil (1989) found that an increase in number of new-borns would lead to an increase the demand for new houses twenty years later.

Cvijanovic, Favilukis and Polk (2010) analysed the relationship between expected and realized house price appreciation and demographic changes for 23 cities in 17 states in USA for the period 1975 and 2009. The data used were house prices, house rents, and GDP. A pooled regression was used. The coefficient of population growth was positive and statistically significant, with a value of 1.1073. The authors further identified two components of expected population growth: natural component due to fertility and mortality rate changes and a non-natural component as a result of immigration. The findings indicated that only the natural component of expected population growth forecast house price appreciation.

3.Methodology

In order to achieve the objective of this study, the researcher adopted an explanatory research design. This research design is considered more appropriate especially in studies where the researcher seeks to gain insight for future investigation like it was the case with the present study. By adopting this approach, the researcher sought to establish the relationship between the independent variables (GDP, population, interest rate) and the dependent variable (house prices). Explanatory research design is also deemed more appropriate in cases where a study uses secondary data like it was the case with this study.

3.1 Data Analysis

In this study, the researcher adopted the vector autoregressive (VAR) model to determine the relationship between the dependent and the independent variables. According to Sims (1980), this model is preferred where all the variables in a system are assumed to be endogenous with each other and are regressed on a predetermined number of lags which is also applied to all variables within a system. Secondly, this model is crucial especially if a researcher is interested in studying the joint behaviour of variables since it provides empirical evidence on the response of determinants of a variable (house prices) to any exogenous shocks to the others. Vector Autoregressive model also makes it possible for one to scrutinize the individual role of each of the determinants of house prices for informed policy recommendations. A major advantage of this approach when compared to other models is that it treats all the variables of the model as endogenous and allows both contemporaneous and dynamic relationships between all the variables of interest. Sims also notes that this model can be included in the set and be estimated using the ordinary least squares method.

The model that was used in this study was specified as follows;

$$HPIt = \beta 0 + HPIt - 1 + \beta 1\ GDPt - 1 + \beta 2\ UP0PGt - 1 + \beta 3\ INTRt - 1 + \varepsilon t \quad \ldots\ldots \ (1)$$

Where HPI t is the house price index at time t while HPI t-1, GDPt-I, UPOPGt-1 and INTRt-I represents the respective lagged house prices, GDP, urban population and interest rates respectively, i represents the number of lags with an underlying assumption that it is free and can take on any value. The $\beta 0$, $\beta 1$, $\beta 2$, $\beta 3$ in the equation represent the coefficients to be estimated in the model while the εt represents the random error term. The other objective of this study was to determine the long-run relationship between house prices, GDP, population and interest rate. This objective was achieved using the VECM as recommended by Panagiotidis & Printzis (2016) in their study to examine macroeconomic determinants of the housing market using a VECM approach.

The VECM model used in this study was given as;

$$\Delta HPI_t = \beta_o + \varphi ECT_{t-1} + \sum_{i=1}^{p} \beta_1 \Delta HPI_{t-1} + \sum_{i=1}^{p} \beta_2 \Delta GDP_{t-1} + \sum_{i=1}^{p} \beta_3 \Delta UPOPG_{t-1} + \sum_{i=1}^{p} \beta_4 \Delta INTR_{t-1} + \varepsilon_t \quad \ldots\ldots \ (2)$$

Where; $ECT_{t-1}$is the Error Correction term that works to restore equilibrium in case of any deviations from the long-run equilibrium path, φ is the correction coefficient which captures the short-run dynamic or adjustment of the variables towards their equilibrium values (Wooldridge, 2009).

3.2 DATA, ESTIMATION AND EMPIRICAL RESULT

3.2.1 Descriptive statistics

Descriptive statistics gives summaries about the sample and they form a fundamental basis for every quantitative data analysis. The most common measures include: the mean, median, standard deviation, skewedness, kurtosis and the Jacque-Bera statistics. The summary of the statistical characteristics of all the variables are shown in appendix A.1. All the variables in this study have a mean and median that is almost equal which means that the data is normally distributed. Using skewedness, all variables in this study are normally distributed since all the variables have values close to zero. The kurtosis also confirmed normal distribution since the values are all below 3. The Jarque-Bera test was also used to test for normality of the series. The null hypothesis (HO) for this test was that residuals are normally distributed and the decision criteria was to reject the null if $p< 0.05$. For this study, $p>0.05$ which implied that the researcher failed to reject the null hypothesis and as a result conclude that the variable series were normal.

3.2.2 Unit root tests

The study employed the Augmented Dickey- Fuller (ADF) as the standard test for unit root. This test is performed so as to avoid spurious results. The null hypotheses tested in the study were that H0: p = 0 and H1: p < 0. The decision rule was to reject the null hypothesis that the series was non-stationary if it followed that $p<0.05$. The unit root properties of the variables were analysed at level and at first difference using the ADF unit root test at both the intercept only and for intercept and trend and the results are as shown on table A.1 and table A.2 below.

Table A.1: ADF Unit Root Test Results (At levels)

Variable	Level		Remarks
	Intercept Only	Intercept and trend	
LnHPI	-1.090 (0.7127)	-1.0445 (0.9278)	Non-stationary
LnQGDP	-0.376 (0.9052)	-2.0728 (0.5481)	Non-stationary
LnUPOPG	-0.3763 (0.9052)	-2.0728 (0.5481)	Non-Stationary
LnINTR	-2.827 (0.0617)	-2.7183 (0.2340)	Non-stationary

Source: Researcher 2017

Table A.2: ADF Unit Root Test Result (at first difference)

Variable	First Difference		Remarks
	Intercept Only	Intercept and trend	
LnHPI	-5.1163 (0.0001)***	-5.1102 (0.0007)***	Stationary
LnQGDP	-7.1289 (0.0000)***	-7.0702 (0.0000)***	Stationary
LnUPOPG	-7.6414 (0.0000)***	-8.1494 (0.0000)***	Stationary
LnINTR	-3.2062 (0.0256)**	-3.1567 (0.0140)**	Stationary

Source: Researcher 2017

*Note: The values are t-statistic values while the values in brackets () are their corresponding p values. '***', '**' represent significance at 1 per cent and 5 per cent respectively.*

The results indicated that all the variables in this study were stationary at first difference I (I) at a 5 per cent significance level. This therefore means that the variables in this model all had a time varying mean or a time-varying variance at levels. As a result, this study went ahead to use the VAR and VECM models for non-stationary data which analyse the data at first differences making them stationary and thus giving meaningful results.

3.3.3 Determination of Lag Length

The application of the VAR model involves the selection of appropriate lag intervals for the endogenous variables. This is necessary so as to avoid the problem of over or under parameterization occasioned by inappropriate lag selection (Mahalik & Mallick, 2010 and Shahbaz, 2015). The lag length can be determined using Akaike Information Criterion (AIC), Schwarts Information Criterion (SIC), Likelihood Ratio Test (LRT), Final Prediction Error (FPE) and Hannan-Quinn Information Criterion (HQ). an optimal lag length was selected based on the minimum of their values. Results of the lag length selection criteria are presented in table A.3.

Table A.3: Lag Length Selection Criteria for VAR

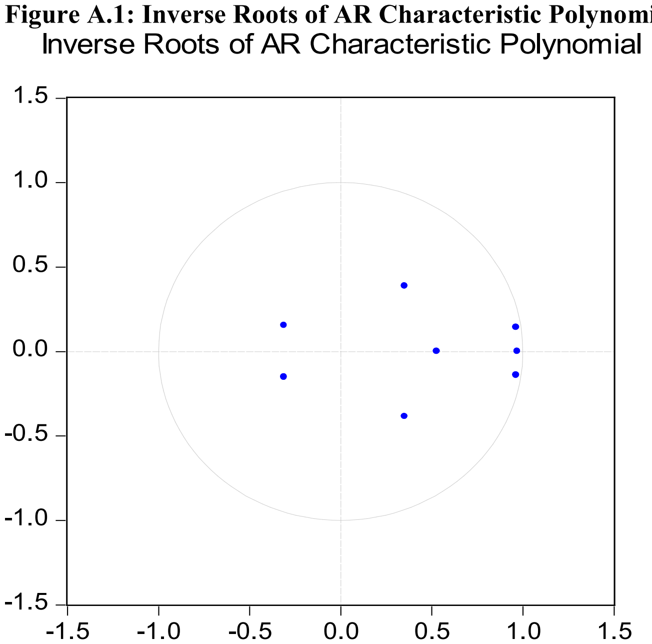
Lag	LogL	LR	FPE	AIC	SC	HQ
0	450.2344	NA	6.66e-14	-18.98870	-18.83124	-18.92945
1	710.3356	464.8616	2.06e-18	-29.37598	-28.58869	-29.07972
2	744.9080	55.90439*	9.49e-19*	-30.16630*	-28.74916*	-29.63302*
3	757.9601	18.88386	1.12e-18	-30.04086	-27.99388	-29.27057
4	773.7839	20.20055	1.22e-18	-30.03336	-27.35655	-29.02606

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Source: Researcher 2017

From the findings on table A.3, all the lag selection criterions selected lag 2. Besides, two lags were appropriate because they reduced the loss of degrees of freedom and minimised information criterion. To confirm the stability of the VAR model with one lag a stability test using the AR roots table was carried out. The results are displayed in figure A.1:

Figure A.1: Inverse Roots of AR Characteristic Polynomial



Source: Researcher 2017

From the results above, the VAR is stable as none of the roots lie outside the unit circle: all the moduli of the roots of the characteristic polynomial are less than one in magnitude. A conclusion is made that VAR satisfies the stability condition.

3.3.4 Cointegration Test Results

From the unit root test results, the study concludes that the data series is multivariate. The study therefore adopted Johansen's cointegration test as opposed to Engel- Granger's test to test whether the variables were cointegrated. Johansen's test has two major advantages as compared to Granger's test. One is the ability to test for a number of co integration vectors when N>2 and the joint procedure of testing the maximum likelihood estimation of the vector error correction model and long run equilibrium relationship. The results of trace test are indicated in table A.4.

Table A.4: Cointegration Results using trace test

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.425480	53.70575	47.85613	0.0128
At most 1	0.294088	27.10319	29.79707	0.0991
At most 2	0.193569	10.38650	15.49471	0.2522
At most 3	0.001247	0.059903	3.841466	0.8066

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

Source: Researcher 2017

From the findings in table A.4, the null hypothesis that there was no cointegrating equation was rejected since the $p<0.05$. These findings indicate that the study had one cointegrating equation. The study therefore concluded that there was a stable long-run cointegrating relationship between independent variables and house prices in Nairobi County, Kenya.

3.3.5 Vector Error Correction Model (VECM)

The presence of co integration among variables provides support for the use of an error correction model mechanism (ECM) representation in order to investigate the short run dynamics. The precondition for the VECM is that the variables be integrated of order one (I(1)) and be cointegrated or rather have a long run relationship. Since the variables in this study met this condition then the coefficients were estimated using VECM approach. The estimation results of the long run coefficients and the VECM model, based on the Schwartz Bayesian information criteria, are presented in table A.5 and table A.6 respectively.

Table A.5: Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNINTR	-17.99673***	3.74195	4.80945	0.0009
LNUPOP	-0.534097	0.61940	-0.86228	0.4562
LNGDP	-0.606732***	0.19524	-3.10756	0.0071
C	-16.53583	0.90152	-18.3421	0.0000

Source: Researcher 2017

*Note: ***, **, * represent significance at 1 %, 5% and 10 % significance level*

Table A.6: Vector Error Correction Estimates

	Coefficient	Std. Error	t-Statistic	Prob.
ECT(-1)	-0.000454	0.005827	-0.077981	0.0383
LnHPI (-1)	0.697810	0.149572	4.665392	0.0000
LnHPI(-2)	-0.375944	0.158168	-2.376869	0.0226
LnINTR(-1)	-0.004954	0.119985	-0.041290	0.9673
LnINTR(-2)	0.050926	0.088495	0.575466	0.5684
LnUPOP(-1)	10.03091	4.616212	2.172974	0.0481
LnUPOP(-2)	99.57433	145.0329	0.686564	0.4965
LnGDP(-1)	-0.019140	0.039370	-0.486156	0.6296
LnGDP(-2)	0.028333	0.035351	0.801482	0.4278
C	0.016384	0.005312	3.084578	0.0038

R-squared	0.446880	Mean dependent var	0.023736
Adjusted R-squared	0.315877	S.D. dependent var	0.020157
S.E. of regression	0.016672	Akaike info criterion	-5.167129
Sum squared resid	0.010562	Schwarz criterion	-4.777296
Log likelihood	134.0111	Hannan-Quinn criter.	-5.019811
F-statistic	3.411237	Durbin-Watson stat	1.733206
Prob(F-statistic)	0.003674		

The results in the long run model in table A.5 can be expressed in a summarized equation as:

$$LNHPI = 16.53 - 0.61\, LNGDP - 0.53 LNPOP - 17.99 LNINTR$$

These results show that in the long-run GDP, population and interest rates had a negative effect on house prices in Kenya. However, it is only GDP and interest rates that had a significant effect on house prices at 5 percent level of significance while population had insignificant effect with a p-value of 0.4562.

The short run coefficients and the error correction term were estimated using VECM model represented in table A.6 and can be summarized in the following equation:

$$(\Delta\, LNHPI_t) = 0.0163 + 0.6978\, (\Delta \text{LN}HPI_{t-1}) - 0.0191(\Delta LNGDP_{t-1}) \\ + 10.0309(\Delta \text{LN}POP_{t-2}) - 0.0049(\Delta \text{LN}INTR_{t-1}) - 0.0004 ECM_{t-1}$$

The findings in table A.6 indicate that R2 was 0.45 implying that close to 45 percent of variations in the dependent variable were explained by the model while the remaining 55 percent were explained by other factors that were not captured in the model. The sign of the coefficient of the error correction (-0.0004) was in line with the expectations of the study and was highly significant ($p<0.05$). This suggests that the model converges back towards the long run equilibrium at a speed of 0.04% in one quarter after an economic shock in the short run and that it takes long to eliminate disequilibrium. From the findings, the negative parameter of the error correction term helps strengthen the findings of long-run equilibrium relationship among the variables captured in the model. However, the relatively low size of the coefficient of the error correction term (-0.0004) suggests a slow speed of adjustment from the short-run deviation to the long-run equilibrium.

3.4 Post Estimation Diagnostic Tests

3.4.1 Autocorrelation Test Results

Autocorrelation indicates the extent to which a given time series may be similar to a lagged version of itself given iterative time intervals. Serial correlation is present if residuals of one period are related to the residuals of the previous period. The null hypothesis for serial correlation test was stated that there is no serial correlation. Breusch Godfrey serial correlation test used for this study. Results for both tests under the null hypothesis of no serial correlation are shown on table A.7. From the results in table A.7 we do not reject the null hypothesis of no serial correlation since the p value (0.3005) is greater than 0.05.

Table A.7: Breusch Godfrey Serial Correlation LM test results

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	1.243485	Prob. F(2,36)	0.3005
Obs*R-squared	3.101688	Prob. Chi-Square(2)	0.2121

Source: Researcher 2017

3.4.2 Heteroskedasticity

This study used the White's test as specified by (White, 1980). The decision rule is to reject the null hypothesis that the variance of the error term is homoskedastic if the joint probability test is less than 0.05. The results are presented in table A.8. From the findings on table A.8, the null hypothesis of homoscedasticity is not rejected since the probability value (0.7710) is greater than 0.05. Therefore a conclusion was made that there is no heteroscedasticity.

Table A.8: Heteroskedasticity Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey

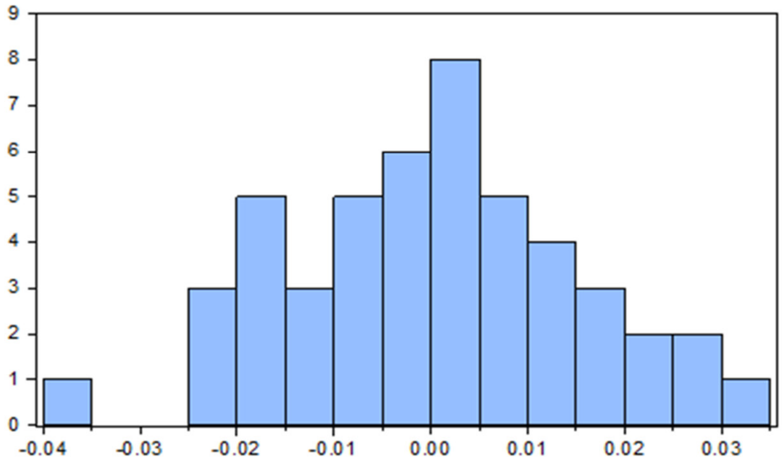
F-statistic	0.599060	Prob. F(12,35)	0.8279
Obs*R-squared	8.178930	Prob. Chi-Square(12)	0.7710
Scaled explained SS	4.446721	Prob. Chi-Square(12)	0.9740

Source: Researcher 2017

3.4.3 Vector Error Correction Residual Normality Tests

The study adopted the multivariate extension for the Jarque- Bera test. The null hypothesis was that the data was normally distributed. The normality test results are presented in figure A.2. From the results, the Jarque-Bera statistic was 0.921546 which is greater than 0.05 and therefore the error term was normally distributed.

Figure A.2: VEC Residual Normality Tests



Series: Residuals	
Sample 2005Q1 2016Q4	
Observations 48	
Mean	-5.24e-14
Median	0.000455
Maximum	0.031045
Minimum	-0.036811
Std. Dev.	0.014991
Skewness	-0.053514
Kurtosis	2.734957
Jarque-Bera	0.163406
Probability	0.921546

Source: Researcher 2017

4. Discussion of findings

4.1 Effect of House Prices on House prices

The Vector Error Correction Model short run coefficient for house prices was significant for both the previous two periods at 5 per cent level of significant with coefficients of 0.6978 and -0.3759. This implied that in the short run a 1 per cent increase in house prices in the previous quarter would lead to a 0.69 per cent increase in current quarter house prices and a one per cent increase in the house prices two periods behind would lead to a 0.3759 per cent decrease in the current house prices. The interpretation of these results is traceable to the rational expectation hypothesis which portends that in the short run, demand for houses is a function of expectations of future prices and other fundamental variables (Muth, 1961).

4.2 Effect of GDP on House Prices

The VECM coefficient of GDP growth rate in the long run model was -0.6067 with a p value of 0.0071 which was statistically significant at 5% level of significance. This implied that in the long run a 1 per cent increase in

GDP would lead to 0.606 per cent decrease in house prices. This meant that the decision rule was to reject the null hypothesis and conclude that there was a negative and significant relationship between GDP and house prices in the long-run. However, in the short run, GDP was insignificant in explaining house prices in the first and second lagged periods. This meant that in the long run GDP had a negative and significant effect on house prices with no effect in the short run. These results are consistent with past studies (Valadez, 2012; Zhang et al., 2012 and Nneji et al., 2013) which found GDP to be a long term driver of house prices.

4.3 Effect of Population Growth rate on House prices

The long run coefficient for population is -0.5340 with a p value of 0.4562 which implied statistically insignificant in the long-run. In addition, short run dynamics indicate a coefficient of 10.03 with a p value of 0.0481 for population variable in the previous quarter, which indicated a statistical significant effect at 5 per cent level. This implied that in the short run a 1 per cent increase in population in the previous quarter would lead to a 10.03 per cent increase in house prices in the current quarter, all other factors affecting prices of houses held constant. This therefore implied that in the short run population had a statistically positive relationship with house prices. These results are consistent with those of Case & Shiller (2003) and Li (2014) who had also reported a positive relationship between population and house prices in the long run and short run. Li (2014) found a coefficient of 0.027 which was positive and significant and concluded that an increase in working age population has a significant effect on appreciation of house prices.

However, other researchers (Caldera, A., & Johansson, 2013) have noted that addressing population growth is a necessary though not a sufficient condition to tackling the housing crisis in the short-run. According to Caldera and Johansson, addressing population growth is beneficial for long-term housing planning and policy-making.

4.4 Effect of Interest rates on House Prices

The long run coefficient for interest rate was -17.99 with a p value of 0.0009 which indicated a negative and highly significant relationship existed between the prevailing rates of interest and house prices in the long-run. This implies that in the long run a 1 per cent increase in interest rate would lead to decrease in house prices by approximately 17.99 per cent. The short run dynamics indicates coefficient values of -0.004 and 0.05 with a p value of 0.96 and 0.56 for interest rate lagged one and two periods behind respectively which was statistically insignificant at 5 and 10 per cent level. This therefore implied that there was no significant relationship between interest rates and house prices in the short run. These results are consistent with past studies (Miregi & Obere 2014; Pillaiyan, 2015; Tsatsaronis and Zhu, 2004; Zhang et al., 2012) who found that interest rate had a significant and negative effect on house prices in the long run. The researchers attributed this to the fact that interest rate impacts on house prices via its effect on the supply of new houses. These findings however contradicted those of (Sutton, Mihaljek & Subelyte, 2017) who in a study to estimate the response of house prices to changes in short-term and long-term interest rates in 47 advanced and emerging market economies reported that changes in short-term interest rates greatly influence present and future expectation of house prices.

5. Conclusion

The objective of the study was to determine the effect of GDP, Population ad interest rate on residential house prices in Nairobi County, Kenya.

Gross Domestic Product was found to have a negative effect on residential house prices in Nairobi City County in the long –run. Generally, it is expected that when income increases, demand for houses increase and this leads to construction of more houses thus increasing supply which has an effect of reducing house prices in the long run.

Population is one of the key drivers of house price increase. A larger population leads to a higher demand of housing and eventual increase in house prices. It was therefore expected that the relationship would be positive. Study findings indicate that there is a positive relationship between population and house in the short run. Study findings conform to this expectation and indicate a positive relationship between population and house prices.

Study findings on the effect of interest rate on house prices conform to expectation and indicate a long-run negative relationship between interest rates and house prices. The study however failed to make any inference in the short run. This can be attributed to the fact that demand may increase during the impact period if it is perceived to be a sign of further increase in interest rates.

5.1 Recommendations

Gross domestic Product: The government should strive to have a stable macroeconomic environment with stable inflation which in turn translates to positive GDP.

Population: Based on rational expectation hypothesis, it is generally expected that growth in population would drive demand for housing and thereby increase the house prices. Unlike economic variables which can be regulated, Kenya has no direct influence on the growth of population. Policies to address population growth need to be considered so as to tackle the housing crisis by reducing the demand side of the market equation and hence the prices in the long run. For instance, the government should implement vision 2030 and create the resort cities identified among them Isiolo so as to decongest Nairobi. The advent of devolution may discourage rural-urban migration since most people will seek employment opportunities at the county level. The government should therefore create polices that enables the county governments provide affordable housing to the urban population.

To fully tackle the housing crisis in Nairobi county and achieve meaningful reduction in the demand side of the market equation, the Kenyan government needs to formulate policies that are geared towards addressing population growth in the county. In addition, authorities will need to consider population trends as fundamental to planning through effective representation at various government departments.

Through the devolved government system, the central government needs to devolve more resources to the counties to foster their development which will in effect help reduce increased migration into Nairobi county in search of job opportunities. This will not only reduce population growth in Nairobi, but also help in achieving one of the major four economic pillars of the government which is to provide affordable housing for all.

Interest rate: Kenya is a developing economy and like other developing economies has a less mature financial market which is borrowing constrained. The CBK manipulates the base lending rate to influence the interest rate on loans from commercial banks. The Kenya government can therefore attempt to match the credit cycles, using its selective credit control policy, with the housing pricing cycles so as to stabilize the house prices. This can be achieved by intervening in the supply of new houses. In addition, the government can help ensure that there is sufficient supply of affordable housing for its citizens by devoting more funds towards construction of low-cost houses and by providing incentives to real-estate developers. This is because private developers are focused on high-end housing development due to a higher demand from Kenya's increasing middle-income earners which in effect leads to shortage of low-cost and affordable houses for majority of the low-income earners. The Central Bank should also consider adopting modest cuts in its policy rates since they have been found to be effective in reducing rapid increases in house prices (Sutton, G., Mihaljek, D., & Subelyte, 2017).

Research: This study used quantitative data. Mixed methods approach was used to analyse house prices. A combination of qualitative and quantitative approaches was preferred due to its advantage of producing a richer and elaborate picture of the housing crisis in Nairobi county.

REFERENCES

Apergis N, Rezitis A (2003) Housing prices and macroeconomic factors in Greece: prospects within the EMU. 8*Appl Econ Lett 10* (9), 561–565.

Beltratti, A., & Morana, C. (2009). International house prices and macroeconomic Fluctuations. *Journal of Banking and Finance, 34*, 533-545.

Cvijanovic,D., Favilukis, J., and Polk, C. (2010). Immigration and the Price of Real Estate. Available at:*personal.lse.ac.uk/POLK/research/HousingDemographics_20100404.pdf*

Davis, E. P., & Zhu, H. (2004). Bank Loans of Commercial Property Cycles; Some-cross evidence. *Bank for International Settlements Working Pape*r*No 150,*

Dickey, D., Fuller, W., (1981). Likelihood ratio statistics for autoregressive time series with a Unit Root. Econometrica

Hass Consult Ltd (2013). Base figures – Sales and letting monthly changes.

Kagochi, M., & Kiambigi, M., (2012). Remittances' Influence on Housing Construction Demand in Sub-Saharan Africa: The Case of Kenya. *African Development Review*, Vol. 24, No. 3, 2012, 255–265

Knight Frank & Citi Private Bank (2012). The Wealth Report 2011

Knight, F. P., Global Rental Index (2012). Emerging Markets saw Strongest Rental Growth in 2012. 4th Quarter Report

Li, Q., & Chad, S. (2013). House prices and market fundamentals in urban China. *Habitat International 40* (2013) 148-153.

Mankiw, G., & Weil, D. (1989). The baby boom, the baby bust, and the Housing market. *Regional Science and Urban Economics 19 (1989*) 235-258.

Muth, R.F (1960). "The Demand for Non- Farm Housing," in A. C. Harberger, ed., the Demand for Durable Goods, Chicago, pp. 29-96

Muth, R.F. (1986). The Supply of Mortgage Lending. *Journal of Urban Economics,* 19, 88-106.

Nneji, O., Brooks, C., and Ward, C. forthcoming. Intrinsic and rational speculative Bubbles in the US housing market: 1960–2011, *Journal of Real Estate Research.*

Otwoma, F. (2013). The effect of interest rates on property prices in the Kenyan real estate market. *Unpublished MBA Project. University of Nairobi*.

Panagiotidis, T., & Printzis, P. (2016). On the macroeconomic determinants of the housing market in Greece: A

VECM approach. *International Economics and Economic Policy*, *13*(3), 387-409.
Rangel, G.J., & Pillay, S.S. (2007). Evidence of bubbles in the Malaysian stock market: Interpretation and Challenges. *International Finance Review,* 175-202.
Riddel, M. (1999). Fundamentals, Feedback trading, and Housing Market Speculation: Evidence from California. *Journal of Housing Economics,* 8, 272-284.
Shi, S., Jou, J., & Tripe, D. (2013). Policy Rate, Mortgage Rate and Housing Prices: Evidence from New Zealand.
Shiller, R.J., (2005). Irrational Exuberance. Princeton University Press, Princeton
Shiller, R. J., (2007). "Understanding Recent Trends in House Prices and Home Ownership", Yale University, http://www.nber.org/papers/w13553.pdf, 2015-01-24
Sims, C. A. (1980a). Macroeconomics and reality. *Econometrica,* 48(1), 1-48.
Sutton, G., Mihaljek, D., & Subelyte, A. (2017). Interest rates and house prices in the United States and around the world.
Tsatsaronis, K., & Zhu, H. (2004). What Drives Housing Price Dynamics: Cross-Country Evidence. *Bank of International Settlement Quarterly Review,* (March, 65-78)
Vladez, M. (2012). The housing bubble and the GDP: a correlation perspective. *Journal of Case Research in Business and Economics, 3*(1)
White, H., (1980). A heteroskedastic-consistent covariance matrix estimator and a Direct test for Heteroscedasticity. *Econometrica* 48, 817–838.
Wooldridge, J. M. (2009). *Introductory econometrics: A modern approach*. Mason, OH: South Western, Cengage Learning.
World Bank (2011). Turning the Tide in Turbulent Times: Making the Most of Kenya's Demographic Change and Rapid Urbanization. © Washington, DC.
Zhang, Y., Hua, X., & Zhao, L., (2012). Exploring determinants of housing prices: A case study of Chinese experience in 1999–2010. *Journal of Economic Modelling* 29 (2012) 2349–2361

APPENDICES

A.1: Descriptive Statistics results for the variables

	HPI	LNQGDP	LNUPOP	LNINTR
Mean	268.5872	13.11938	16.06754	2.705238
Median	271.0754	12.82345	16.06733	2.670116
Maximum	439.3879	13.89186	16.34213	3.006342
Minimum	139.9944	12.51530	15.79240	2.501709
Std. Dev.	92.30754	0.533684	0.163601	0.137415
Skewness	0.076222	0.423455	-0.000316	0.556070
Kurtosis	1.771411	1.318642	1.795296	2.258439
Jarque-Bera	3.320784	7.679145	3.144510	3.871331
Probability	0.190064	0.051503	0.207577	0.144328
Sum	13966.53	682.2079	835.5121	140.6724
Sum Sq. Dev.	434554.8	14.52573	1.365036	0.963021
Observations	52	52	52	52

Source: Researcher 2017