
Effects of Mortgage Interest Rate on Real Estate Investment in Kenya

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Authors' contributions

This work was carried out in collaboration between all authors. Author KR designed the study, Performed the statistical analysis, wrote the protocol, wrote the manuscript, managed the analyses of the study and managed the literature searches. Authors Dr. RR Dr.UM and Prof JB supervised the author KR.

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Abstract

As an investment and consumer good, real estate is significant. Like many developing countries, Kenya has struggled to give its citizens access to decent housing that is also affordable. More people are in need of housing due to urbanization, fast population growth, and rural-to-urban migration. Housing supply is less than demand as a result of several of macroeconomic and financial issues that affect real estate investment and, consequently, housing. This study looked into the impact of mortgage interest rates on real estate investment. The study, which covered the 11-year period from 2010 to 2020, used a causal research design and regression analytic research methods based on the Vector Error Correction Model. Data on real estate investments in Kenya The Kenya National Bureau of Statistics (KNBS) and Cytonn quarterly investments reports were obtained from the Central Bank of Kenya. The Ministry of Finance's database on national budgets (KNBS) provided information on mortgage interest rates, A pre-estimation test was run to verify the outcomes. The variables were stationary on the first difference. The VIF test result of 1.62 indicated that there was no multi-collinearity. The 1.9122 Durbin test value suggested that there was no serial correlation. Pairwise Correlation analysis showed a moderate correlation between mortgage interest rate on real estate investment (0.578). The report suggests that in order to incentivize real estate investment, the government should offer mortgage loans at reasonable rates, control property tax rates, and promote public-private partnerships in infrastructure development.

Keywords: Real Estate, Mortgage interest rates, infrastructural development

1 Introduction

The Real estate sector plays a crucial role in the growth of a country's GDP through its monetary role and promotion of various factors of production (Galati, 2011). This sector is recognized globally for its improvement of socio-economic status of the people through creation of jobs and provision of better housing to the people (Cytonn, 2020) Real estate is a category of property that includes land, things permanently affixed to it, and any natural resources found there, including minerals or water. Commercial and residential properties are constructed, rented, franchised, and preserved as part of real estate activities (New York Times, 2016). As businesses attempt to accommodate the increased demand for housing, both house prices and real estate investment increase to stay current (Knight Frank, 2018).

Asia Pacific accounted for 40% of the global real estate market in 2020, followed by Western Europe with 24% of the market, according to global real estate industry reports from (2020). Given the rapid pace of urbanization and increased market transparency, private equity and institutional investors' confidence in the country's investment opportunities has been a major factor in India's rising demand for and supply of quality Grade A office space and residential premises over the years. In China and Japan, meanwhile, corporations have increasingly turned to property disposals in the residential sector in particular, investors chasing high returns.

Both local and foreign investors have steadily increased their real estate investments in Africa (Otwoma, 2013). To satisfy the demands of future generations, the government, in partnership with local and foreign investors, has boosted funding for the creation of sustainable modern housing and other social services. In nations such as Nigeria, Cameroon, and Egypt, rapid population growth rates and rising rural-urban migration have put pressure on the available infrastructure, social amenities, and housing units (Henderson, 2006). This has increased the expansion of the real estate industry in those nations (Andrea, 2010). Similar to Tanzania, where cities like Arusha, Dodoma Dar es Salaam, and Tanga have witnessed fast urbanization in their surrounding areas, the country's real estate market has seen rapid growth (Kasidi& Said 2013). Real estate investment returns in Africa's quickly developing economies are much higher than those possible in almost all developed markets. Forecasts of 20% net yearly returns on investments in office buildings, industrial complexes, and shopping centers across Africa continue to entice new investors (PWC, 2020)

Real estate has continued to be a popular investment in Kenya and has regularly outperformed other asset markets over the past few years, with annual returns averaging 24.3 percent compared to other assets' annual returns of 13.2 percent. 2020 (Kenya Housing Finance). As part of its Big 4 Agenda, the government is implementing an ambitious Affordable Housing Programme (AHP) in relation to a shortage of housing of 2 million (80 percent), which is estimated to increase by 200,000 every year. However, the annual increase housing supply is only 50,000 units, whereas the annual housing demand is 250,000 units (Knight Frank, 2018). Therefore, this study looked at how investments in Kenya's real estate market are impacted by mortgage interest rates, infrastructural development, property tax rates, and inflation-moderating impacts

1.2 Mortgage Interest rate on Real Estate investment

According to Kenya Mortgage refinance business (KMRC, 2021), a mortgage interest rate is the amount of interest imposed on a mortgage loan and is regulated by the lender. This might be fixed, gradually increasing during the mortgage's duration, or variable, fluctuating with a benchmark interest rate. Mortgage interest rates vary based on a debtor's credit history, can change with interest rate cycles, and have a substantial impact on the housing market. When evaluating how to finance the purchase of a new home with a mortgage loan, homeowners should emphasize on the mortgage interest rate (KMRC, 2021). Globally, despite the COVID-19 pandemic, countries like New Zealand, the U.S., Sweden, Austria, Canada, and the U.K. have had the highest rate of home price gain in 2020; this is all due to an increase in real mortgage interest rates. However, house prices declined from 2019 to 2020 in a few other significant nations with low mortgage rates, including Spain, Malaysia, and India (2021, Knight Frank).

In Africa the interest rates on mortgage loans still remains high with Zambia, Guinea and Zimbabwe recording the highest mortgage interest rates of 32%, 26% and 25% respectively (Laurens, 2018). According to Kuttner (2012) the high mortgage rates are linked to low rates of home ownership in Zambia, Guinea and Zimbabwe which is still less than 20% in urban areas. In Many of African countries, cities are expanding quickly. By 2025, the populations of Nairobi, Kinshasa, and Dar es Salaam, for instance, are predicted to increase by more than 70%. (PWC, 2020). The cost of prime urban real estate per square meter and mortgage interest rates will increase as prosperous cities continue to draw more and more people. As affordability declines, urban density will rise and apartment sizes will decrease (World Bank, 2019).

In Kenya, the mortgage interest rates have been steadily been increasing from 2010 to 2016 following an increase in lending interest rates by the commercial banks from 11% to about 25%. These effects are still currently felt in the real estate sector even after intervention by the CBK in 2016 (Vitallis, 2016). In 2020, bank's interest rates have remained at 12% over the review period due to the current COVID-19 effects on the economic situation and to cushion the adverse effects of the economy (CBK,2020).To increase the availability and affordability of mortgages, the Kenyan government has strengthened the Kenya Mortgage Refinance Company (KMRC), a capital market-based solution that provides mortgage refinance products and promotes capital market access (GoK, 2021). According to reports on Cytonn real estate investments, this will improve the diversity of local capital markets while also promoting the growth of the primary mortgage market and property ownership (2022). Additionally, it will aid in standardizing mortgage financing practices to increase efficiency.

1.3 Statement of the Problem

In recent years, the real estate industry has been expanding at a rapid rate as a crucial pillar. It is seen as a key component of a strong and growing economy. They are regarded as essential for the promotion of an entrepreneurial culture and the generation of jobs in the economy. This industry has attracted the interest of numerous investors. It is considered that the real estate industry contributes to the economic growth of developing nations and their significance is getting universal acknowledgment. According to the Kenya National Bureau of Statistics (KNBS, 2020) 8% of Kenya's Gross Domestic Product is contributed by real estate investment. Real estate prices in Kenya have increased nearly every year. The increasing demand for both residential and commercial housing is behind the growth of this sector. Overpopulation is encountered in urban areas, especially Nairobi due to rural-urban migration increasing housing shortage. Breakdown of infrastructure, water shortage and poor sewage systems have increased due to slums occupied by the poor in urban areas. Demand for housing is still higher than its supply. Vision 2030 estimates that Kenya requires 250,000 new housing units per year but only 50,000 units each year have been accomplished as by the National Housing Corporation (NHC) leaving a deficit of about 80% by 2019. Given the prominence that housing in Kenya's development effort, its inability to meet demand has been a matter of concern in the last few years. This record is a function of several factors including infrastructure development and the macroeconomic situation in the country. Since housing and by extension, the real estate sector is so important to the economy. However, house price inflation outweighs housing supply. Vision 2030 estimates

that Kenya needs 250,000 new housing units every year, however the National Housing Corporation (NHC) has only producing 50,000 units annually, leaving a gap of almost 80% by 2019. Given the importance of housing in Kenya's development efforts, its inability to satisfy demand has been a source of concern in recent years. This record is the result of various factors, including infrastructure development and the country's macroeconomic climate. Given the importance of housing and, by extension, the real estate sector to the economy, it is necessary to understand its link with these economic elements, knowledge of its relationship with these factors in the economic environment is crucial.

1.4 Objective of the study

The overall objective of the study was to determine effects of macroeconomic factors and infrastructure development on real estate investment in Kenya. Specifically the study sought to examine the effect of mortgage interest rates on Real estate investment in Kenya. The study was based on the following hypothesis.

Ho1 There is no strong correlation between lending rates and real estate investment in Kenya.

1.5 Significance of the Study

The real estate industry, particularly housing, is a cornerstone of Kenya's development plan and the government plays a significant role in ensuring the success of real estate investment in the country. The study could assist the government and policymakers in determining the critical causes of Kenya's low housing supply and serve as a vital tool for maintaining housing affordability in Kenya.

The study is intends to promote the body of knowledge by giving information on specific factors that influence real estate investment. In addition, the study gives information that future scholars may find relevant for comparative study reasons.

Good performance in the real estate sector could entice local and foreign investors to participate in the industry, resulting in a greater GDP and less severe economic conditions.

1.6 Scope of the Study

The study focused on real estate investors in Kenya. Kenya has experienced considerable real estate development over the last couple of years. The study used data for a ten-year period (2010 to 2020). The year 2010 was selected as it was the turning point of Kenya's economy after Kibaki's rule and it is the period Kenya experienced political upheavals that had huge impact on real estate sector, whereas 2020 was selected as the end year as it is the period where the globe was hit by COVID -19 pandemic and had shocks on the real estate sector.

1.7 Literature Review

Bouchellal (2010) analyzed the relationship between the margins applied to credit granted for real estate investments and the impact of lending interest rates on credit margin in a sample of 277 French individuals between 2006 and 2010. Similar to this, a 2011 study by Demenzel on how interest rates effect changes in home values in Sweden found a negative correlation between home prices and interest rates, implying that a decline in interest rates would result in an increase

in real estate prices. The previous researchers revealed a negative association between increased interest rates and investment in the real estate sector and proposed that financial institutions implement interest rate caps to manage the interest rates on mortgage loans. This study aimed to determine whether the same holds true for Kenya, hence the period 2010-2020 was chosen as this is when interest rate capping was implemented in Kenya.

Gordon (2011) conducted research in Ghana on the impact of interest rates on real estate investment and discovered that the real estate sector is negatively impacted by an increase in interest rates. According to the report, a rise in interest rates leads to a rise in mortgage costs, which reduces the number of potential purchasers who can get credit to purchase homes, hence diminishing housing demand. Similarly, Liow & Ibrahim (2009) concluded in their study on the effects of interest rate on real estate investment in South Africa that interest rates are influenced by the supply and demand for capital and, consequently, the rate of return for investors. By influencing the return on investment, interest rates influence the housing supply. When interest rates are high, consumers tend to save more in order to profit from the high rates, hence lowering all investments, including real estate investments. This study focused on the impact of mortgage interest rates on real estate investments in Kenya in order to provide specific policy recommendations to the government and potential investors in this sector.

In his study on the effect of interest rates on property prices in the Kenyan real estate market, Otwoma (2013) found that the relationship between interest rates and real estate investment was inconsistent. During a period of low interest rates, an increase in interest rates leads to an increase in housing demand as potential purchasers rush to obtain mortgages in anticipation of more interest rate increases, establishing a positive connection between the variables. The preceding research demonstrated an uneven association between interest rates and real estate growth. In order to get at solid evidence about the effect of mortgage interest rates on real estate investment in Kenya, it was required to conduct additional study incorporating a moderating component. Therefore, this analysis incorporated inflation as a moderating variable between mortgage interest rates and real estate development.

The influence of mortgage interest rates on real estate investments and the economy as a whole is not evident from an examination of the selected articles. While one study demonstrates a beneficial relationship, another demonstrates an inconsistent one, resulting in contradicting conclusions. In order to provide conclusive proof of the effect of mortgage interest rates on real estate investment in Kenya, additional study was required.

1.8 Theoretical framework

The study was guided by Structural Model of Housing Demand. This model was developed by Pottow (2007). It expounds on mortgage financing in developing countries in Sub Saharan Africa together with the steps needed to provide mortgage loans to those in the middle class therefore making them able to afford residential real estate. According to this theory there are numerous factors affecting real estate investment among the middle class. These factors include macroeconomic instability, antagonistic regulatory and institutional conditions, lack of basic infrastructure and inaccessibility to long term financing (Struzenegger & Levy, 2011).

According to Denzin & Lincoln (2014), real estate investment societies are brought down by insufficient sources of long term funds, poor management and fluctuation in the macroeconomic sector including changes in interest rates and inflation. In relation to this study, this theory was relevant in postulating how mortgage interest rates and inflation affect the real estate sector and that there is need to study these factors and introduce legislation that would enable middle income earners achieve affordable housing.

2. Methodology

2.1 Study Area

The study was conducted in Kenya for a period ranging from 2010 to 2020. Kenya is located approximately between latitudes 5°N and 4°40'S, estimated at 580,367Km² with a population of 53,771,300 (UN, 2019). Longitudinally it extends from longitude 33°53' East of Greenwich Meridian and is almost bisected by the equator horizontally into almost two halves and vertically by 38°E longitude. Kenya was chosen as a study area because it's among the largest and fastest growing economy in Africa and it is strategically located in East Africa.

2.2 Data collection Methods

The study used secondary data. Quarterly time series data on mortgage interest rates, property tax rates, infrastructure development and inflation were obtained from World Bank statistics, Central Bank of Kenya, Kenya Revenue Authority (KRA), Ministry of Finance data on National Budgets, and Kenya National Bureau of Statistics (KNBS) using triangulation method for the period 2010-2020. Secondary data on real estate investment indexes were obtained from Hass Consultant and Knight Frank Indexes quarterly reports.

2.3 Estimation procedures

Data analysis technique is a method employed by the researcher in converting the raw data into meaningful statistics (Cox & Hassard, 2010). The study data that is quantitative in nature was analyzed using inferential statistics, which include the estimation of multivariate regression variables.

Data was first tested using the pre-diagnostic tests to check for outliers (Mukras, 2014). Secondly, unit root tests were carried out to check for the presence of stationarity by using Augmented Dickey Fuller test (ADF) statistics. The study variables were found to contain unit root at levels since the test statics values for each variables were more than 1%, 5% and 10% critical values (Cooper, Schindler & Sun, 2013). However upon first differencing, they all become stationary with all p value being less than 0.05 ($P < 0.05$) Thirdly, linear relationships between the explanatory and explained variables were tested using the Vector error correlation matrix method whereas the regression analysis was used to find out the regression coefficients and the moderation effects of inflation on the relationship between the explained and the explanatory variables of the study.

Other significant tests that were employed during the research for diagnosis include; autocorrelation using Durbin Watson d- statistic, the Jarque –Bera test for normality of the

residuals and the Heteroscedasticity test. Running of tests and data was analyzed using STATA. This software was used because it has the ability to analyze time series data (Wiśniewski, 2017).

2.4 Description and measurement of the Variables

Table 1: Description and Measurement of Variables

Variable	Indicator/Measurement
Real Estate Investment	Annual capita investment index
Property Tax Revenue rates	Actual tax revenue collected (2010-2020)
Mortgage Interest Rates	Percentage of the Principal amount
Infrastructure Development	Infrastructure Development Index
Inflation	CPI OR GDP Deflator

Source: (Author, 2022)

2.5 Research Design

When creating and assessing the interaction of variables as defined in the study's problem statement, a research design is a set of methods and procedures used (Mugenda, 2013). Because it is believed that variation in the independent variable is what causes the change in the dependent variable, this study used a causal research design. The quarterly time series data collected throughout the study period were examined using the Vector Error Correction Model (VECM), regression, and correlation techniques. The causation between real estate development and the understudied macroeconomic aggregates was then examined using the Granger causality test. This study's methodology demonstrates the nature and magnitude of the association between the variables (Gray & Groove, 2016).

2.6 Model Specification

The study adopted a stochastic model as shown in equation 3.1 below.

The model was modified as;

$$REI_t = f(MINR_t) \dots \dots \dots 3.2$$

In expansion equation 3.1 becomes

$$REI_t = \beta_0 + \beta_1 MINR_t + \dots \dots \dots 3.3$$

Where, REI_t is the Real estate investment

β_0 is the intercept

$MINR_t$ is the mortgage interest rate

ε_t the stochastic error term, t is the time, B_1 is the regression estimate parameters.

3. Results Findings and Discussion

In order to check potential exceptions, descriptive data were determined to be present in the study. Various statistical metrics, including mean, standard deviation, minimum and maximum values, were used to describe the data. In contrast to the standard deviation, which indicates the range of a set of data, the mean locates the center of the relative frequency distribution. According to the data shown in table 2, the respective means of real estate investment (RES) and

mortgage interest rate (MINTR) were (7.07263) and (13.41073). Each had a standard deviation of (1.3461) and (2.2753).

Table 2: Descriptive statistics results

Variable	Observation	Mean	Std. Dev	Min	Max
RES	44	7.07263	1.3461	2.781	8.59375
MINR	44	13.41073	2.2753	9.01	18.5

Source: Author’s Computation based on STATA (2022)

Normality Test

The normality test determines the probability that the random variable underlying the data sets is regularly distributed. The Jarque Bera test was performed to assess the skewedness and peaks of the data in order to examine the data's conformity distribution. Skewness assesses the degree to which the distribution of a variable is symmetrical, whereas Kurtosis measures the distribution's peakiness. (Hair et al., 2017)

Table 3: Jarque Bera Test for Skewness and kurtosis

Equation	pr(skewness)	pr(kurtosis)	Adj.Chi2	Prob>chi2
RES	0.7684	0.374	0.91	0.6337
MINR	0.8730	0.645	0.015.	0.0962

Source: Author’s Computation based on STATA (2022)

Table 3 above showed that the probability chi2 values for skewness and kurtosis for all variables were higher than 0.05. The results for skewness and kurtosis ranged from -1 to 1. This demonstrates that the distribution of variables around their means was asymptotically normal with regard to skewness and kurtosis. Consequently, the null hypothesis HO was accepted rather than the alternative hypothesis H1, which asserted that the data did not fit asymptotic normal distribution.

3.2 Correlation Matrix Analysis

There was a correlation between the dependent variable (Real Estate) and the explanatory variables (Mortgage interest rates, property tax rate and infrastructural development). Investment in real estate (REI) and its own correlation (1.000). According to table 4 below, a moderately positive correlation existed between real estate investment and mortgage interest rate (0.578). This clearly indicates how mortgage rates influence real estate investment decisions. Even though interest rates are high, investors are still willing to spend since real estate is viewed as a long-term investment and Kenya, a developing nation, still has a high housing demand.

Additionally, banks will be more willing to make loans than they would be if interest rates were low or were capped. Results with a p-value of 0.05 are indicated by the **.

Table 4 Correlation Results

Variables	RES	MINTR	PTR	IFDI	INFL
RES	1.000				
MINR	0.578** 0.0074	1.0000			

Source: Author’s Computation based on STATA (2022)

3.3 Unit Root Tests

Time series data that have a unit root, are non-stationary, according to Green (2005). This suggests that mean and variance are dynamic quantities. Until they reach this stationarity feature, series with unit roots are differenced in any order. In this investigation, the Augmented Dickey & Fuller (1979) Dickey-Fuller unit root test and the Phillips - Perron (1988) test were both employed.

Table 5: Dickey-Fuller Unit Root Test at levels

Number of observations = 42						
At Levels						
Variables	Z(t)	Prob> t	Critical values			Conclusion
			1%	5%	10%	
RES	0.087	0.9652	-3.6280	-2.950	-2.6080	Unit root
MINR	-2.371	0.1501	-3.628	-2.950	-2.6080	Unit root
At first difference						
Number of observations = 42						
First difference						
Variables	Z(t)	Prob> t	Critical values			Conclusion
			1%	5%	10%	
RES	-3.676	0.0045	-3.634	-2.952	-2.610	Stationary
MINR	-7.650	0.000	-3.634	-2.952	-2.610	Stationary

Source: Author’s Computation based on STATA (2022)

Table 6: Philips –Perron Unit root test at first difference

Number of observations = 42						
At levels						
Variables	Z(rho)	Prob> t	Critical values			Conclusion
			1%	5%	10%	
RES	-10.33	0.245	-18.424	-13.08	-10.56	Unit root
MINR	-7.650	0.589	-18.42	-13.08	-10.56	Unit root

Source: Author’s Computation based on STATA (2022)

At first difference						
Number of observations = 42						
First difference						
Variables	Z(rho)	Prob> t	Critical values			Conclusion
			1%	5%	10%	
RES	-43.75	0.000	-18.424	-13.08	-10.56	Stationary
MINR	-46.65	0.010	-18.42	-13.08	-10.56	Stationary

Source (Stata computation, 2022)

The alternative hypothesis for the ADF test is that the time series data are stationary, and the null hypothesis for the test is that the series have a unit root. RES (p-value 0.9652>0.0500), MINTR (p-value 0.150>0.0500), showed unit root. This suggested that both the alternative hypothesis of stationarity and the null hypothesis that the data are unit roots were accepted. This demonstrated the levels at which the variables included unit root. However, as evidenced by the probability values in table 4.4 below, they all became stationary following the first difference. P-values for each variable were less than 0.0500.

It is clear from the phillips-Perron results in table 4.4 that all the variables had unit root at levels, as demonstrated by the (p-values > 0.0500) and the z(rho) larger than 1% and 5% critical values at levels. However, after first differencing, the variables became stationary as evidenced by p-values of 0.05 and z(rho) values of 1%, 5%, and 10%. Therefore, the alternative hypothesis that the series have no unit root was accepted in place of the null hypothesis that they do, and it was concluded that the series were stationary at first difference.

Table 1 Vector Error correction model results

Sample 3-44

No. of obs = 42

R-Square = 0.7048

	Coef.	Std. Err	Z	P > z	(95% Conf. Interval)	
D_RES						
_cel	-.1489652	.0486393	-3.06	0.002	-.24429	-.053633
L1						
_cel	-.1528726	.07163365	-2.148	0.000	-0.7514	-0.3856
L2						
LD dRES	0.80896	0.1423	4.98	0.0000	0.42974	.98750
LD dMINR	0.61279	0.24861	2.46	0.014	0.1255	1.10059

Source: Author's Computation based on STATA (2022)

The first cointegrating equation's error correction term was -.1489652, indicating a long-term association between real estate investment and mortgage interest rates,. Additionally, it showed that inaccuracies or departures from the long-term connection from past years were adjusted within the current year at a convergence speed of 14.897 percent. The absolute value demonstrated that lagged time of error shocks modified 14.897 percent of long-run

disequilibrium. Additionally, it demonstrated that in the near term, the variables' prior values had an impact on their current values (P-value 0.0020 <0.05). The cointegrating equation was found to be statistically significant. According to the second cointegrating (_ce2) equation's significant results (p-value 0.000 <0.05) and coefficient value of (-0.1528726), it takes one year for 15.29% of the error terms from prior years to be adjusted. These cointegrating equation results made it clear that real estate investment and mortgage interest rates had a substantial long-term relationship.

The second section of the VECM model describes how the lagging values of mortgage interest impacts real estate investments in Kenya. Table 7 reveals that the coefficient of the first lagged difference in mortgage interest rates was 0.61279 which is statistically significant at the 5% confidence level (p-value <0.014). This indicates that 1% change in the lagged difference between the mortgage interest rate would result in a 0.61279 unit increase in the current performance of investment in the real estate sector in Kenya. These findings are comparable to those of Gordon (2011), Demenzel (2011), Otwoma (2013), and Ajayi (2014), who discovered a positive and statistically significant long-term association between mortgage interest and real estate development.

4. Results Discussions as per study objective

Examining the impact of macroeconomic aggregates on real estate investment in Kenya from 2010 to 2020 was the study's main goal. Mortgage interest rates was the macroeconomic aggregate of concern. Real estate investment was the dependent variable. In accordance with the goals of the study, the data was subjected to analysis and the necessary diagnostic tests of the time series variables were completed. The outcomes of a regression analysis were as shown in table 8 below. The model had a goodness of fit and overall significance based on the regression results, with a (R²) of 0.7461 and a probability value of 0.0000. This means that the model's explanatory variables account for 74.61 percent of the variation in real estate investment, while the remaining 25.39 percent is explained by other variables not taken into account in this study. At a 5% of significance, the model's variables are implied to be jointly significant by a probability value of (0.0000).

The key objective of this paper was to establish the effects of Mortgage interest rates on real estate investment. The necessary diagnostic tests were carried out, and the logarithmic model showed that there exists a relationship between the independent and the dependent variable. The following is the regression equation that was obtained;

$$dRES = .0319441 + .3152402dMINTR_t + e_t$$

Where dRES = the first difference of real estate investment

dMINR = the first difference of Mortgage interest rates

e = the error term.

t = Time series data

The above estimating model shows that ,holding constant all the explanatory factors in this study the rate of real estate investment in Kenya will still increase at 3.194%

Table 2: Regression results

Dres	Coefficients	Std. Err.	t	P> t	[95% Conf. Interval]	
dMINR	.3152402	.0898944	3.51	0.001	.1335569	.4969236
Cons	.0319441	.0099041	3.225	0.000	.0248441	.0390441

Number of obs = 42	Prob> F = 0.0000	Adj R-squared = 0.7127	Root MSE = 1.0469
F(4, 37) = 25.93	R-squared = 0.7461		

Source: Author’s Computation based on STATA (2022)

From the regression results in table 8, the coefficient results for the mortgage interest rate is (0.3152) and a p value $0.001 < 0.05$ hence the effect of mortgage interest rate on real estate investment is statistically significant and did not exhibit a negative sign as expected. From the regression results, holding other factors constant, an increase in mortgage interest rate by 1% will cause an increase in the investments in the real estate sector by 0.31524 units. This observation can be explained by the fact that housing is in great demand yet supply is limited. According to Kenya National Housing Corporation (KNHC) 2019 statistics, Kenya needs an additional 250,000 housing units annually, but only 50,000 are supplied on average. Consequently, when interest rates on loans rise, investors will continue to engage in the housing and real estate sector in Kenya due to the high demand for both commercial and residential housing (Cytonn, 2021). The Kenya National Bureau of Statistics Census Report 2019 indicates that Kenya's population expanded from 38.6 million in 2009 to 47.6 million in 2019, with anticipated growth rates for population and urbanization of 2.6% and 4.4%, respectively coupled with a rising middle class. Middle class with additional disposable money increases real estate demand. In contrast to low interest rates and interest rate caps, lending institutions boost lending rates as interest rates rise due to high interest returns on loans.

In accordance with Cyonn's (2020) research on real estate bubbles, property bubbles are typically brought on by the lending institutions' availability of mortgages, which are subsequently invested in real estate with the expectation of ever-increasing returns. These findings are congruent with those of Otwoma (2013), who did a similar study in Kenya and discovered that the association between interest rates and real estate investments in Kenya was inconsistent. During a period of low interest rates, an increase in interest rates causes an increase in housing demand, as potential purchasers and investors rush to obtain mortgages in anticipation of more interest rate increases, demonstrating a positive association. This conclusion contrasts the findings of Bouchellal (2010), Demenzel (2011), and Gordon (2011), who discovered that low mortgage interest rates enhance investment rates in the real estate industry by making the purchase of a home more affordable. As a result, home sales increase as more people qualify for low-cost loans. Customers who already have mortgages may try to refinance them, which involves exchanging

their present loan for a new, more affordable one. As demand increases during times of low interest rates, more homes are frequently developed. Development businesses can fund the building by borrowing money at a lower interest rate.

4.2. Post Estimation tests

Test for serial correlation/Auto correlation

In time series data, autocorrelation emerges when an error term from one period crosses into another. It may also occur when the error term for one observation is affected by the error term for another observation. The linear regression requires that the following values of the error term be sequentially independent (Mukras, 1993). This inquiry utilized the Durbin Watson statistical test to detect the presence of autocorrelation. Based on the Durbin Watson statistics, which were found to be (2.311), which lie between 1.5 and 2.6, there was no evidence of autocorrelation.

4.2.1 Test for heteroscedasticity

Heteroscedasticity is present when the variance of the error term swings across all values of the independent variables. Since the error term might vary from one observation to the next, its variance is proportional to the magnitude of the independent variables. Heteroscedasticity reduces the effectiveness of the OLS estimator, but has no influence on its objectivity. This is because the OLS estimator is asymptotically inefficient with large samples and does not have the minimum variance within the set of unbiased estimators with small samples. This inquiry applied the Breusch-Pagan test to evaluate whether there was heteroscedasticity (Gujarati, 2004). The result is shown in Table 4.11 below.

Table 4.11: Breusch- Pagan/Cook-Weisberg test for Heteroscedasticity

Chi 2 (1)	3.10
Prob> chi 2	0.0821
Ho: Constant variance	
Variables: fitted values of Dltxr	

Source: STATA Computation (2022)

The Prob> chi 2 value is used to examine heteroscedasticity. If the null hypothesis (Ho-error variance are equal) is rejected, the alternative hypothesis (H1-error variance are multiplicative of one or more variables) is accepted. The Prob> chi 2 value is 0.0821, which is greater than 0.05 and shows that heteroscedasticity is absent, as can be seen from table 4.11, hence the null hypothesis is accepted and the alternative hypothesis is disproved.

5. Summary, Conclusion and recommendations

From the data and subsequent discussions, it was determined that there is a positive relationship between mortgage interest rates and real estate investment, The null hypothesis that mortgage interest rates have no statistically significant impact on real estate investment was therefore rejected.

In conclusion, substantial investments must be made in the real estate sector for the Kenyan government to achieve its goal of affordable housing as outlined in the Big 4 agenda and Vision 2030. This can be achieved through collaboration with both foreign and domestic enterprises. The government must execute a public-private partnership (PPP) strategy to promote investor interest, give incentives for building materials, and reduce taxes on land and other critical resources needed in the construction industry. Similarly, mortgage interest rates should be reduced so that more individuals can own their own homes. This would encourage home builders to construct more homes at reasonable prices.

There is a statistically significant correlation between mortgage interest rates and real estate investment, according to the study's findings. It was discovered that mortgage interest rates positively and marginally effect real estate investment in Kenya. Therefore, the report advises that the Kenyan government collaborate with private investors to provide mortgage loans at reasonable rates. To attract more foreign investors, especially in the real estate sector, the government should promote tax-free holidays, the provision of free land to potential investors, and lower industrial taxes. The government must ensure that borrowers have access to home loans with affordable interest rates. This would encourage more people to buy homes, so driving the growth rate of real estate investment in the nation.

Implementation of the policies advocated in this study necessitates the identification and in-depth comprehension of elements that significantly influence the growth of the Kenyan real estate industry. Future research may also examine evaluating the market for real estate development in Kenya using disaggregated data from other specific industries, such as the manufacturing industry.

This analysis is unable to identify which counties in Kenya have the quickest real estate development rates. This factor in future research would assist the nation in identifying the counties with the greatest potential for real estate expansion.

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