THE INTERNATIONAL JOURNAL OF **BUSINESS & MANAGEMENT**

Analysis of Inflation, Interest Rate, Exchange Rate and Real **Estate Residential Property Prices, Kenya**

Ogutu Austine Odhiambo

Masters Student, Department of Finance, School of Business and Economics, Maseno University, Kenya Dr. Benjamin Ombok Lecturer, Department of Finance, School of Business and Economics,

Maseno University, Kenya

Abstract:

Real estate as an investment has continued to form an important part of investments held by both retail and institutional investors over the years. This has been attributed to its ability to generate continuous income streams and capital appreciation of the underlying asset. The Kenvan population is expected to hit 60 Million in 2030, with more than 50% expected to reside in urban areas. This, compounded by the higher-than-average returns experienced in the real estate sector, makes real estate an important investment for investors' portfolios. For instance, one Million invested in 2017 in the real estate sector would have been worth 9.61 Million in 2021, which is higher than that for bonds and equities. Notwithstanding this impressive return component, real estate investments in Kenya have faced challenges such as increased cost of credit through fluctuating interest rates owing to residential real estate being mostly financed by debt. Hence, unstable interest rates affect their market prices. Real estate residential investment has been susceptible to booms and busts and erratic exchange rates, which affect the value of investments made by both local investors and remittances from abroad from time to time which results in either inflated property prices which get out of reach of common retail investors or lack of demand for investors in a market facing a glut. Over the years, inflation has been rising steadily, with each investor becoming more interested in how this might affect their real return. Real estate, which is heavily leveraged, has also been prone to changes in the interest regime in the economy, which affects the cost of borrowing. The study concentrated on inflation, the interest rate regime, and the state of the exchange rate and drew conclusions while referencing finance and economic theory. The study established that a percentage increase in inflation results in a 2.248% increase in real estate residential property prices. On the other hand, a percentage increase in interest rate results in a 9.630% increase in real estate residential property prices. The study also establishes that real estate residential property prices have a negative relationship with exchange rates. Whereby a percentage increase in exchange rate results in a -1.995% decrease in real estate residential property prices in the long run. The study, therefore, recommends the inclusion of real estate investments in investors' portfolios to hedge against inflation and, at the same time, ensures that investors limit interest-sensitive asset classes such as fixed-income securities in portfolios containing residential real estate exposures. Lastly, the study recommends that investors use derivative securities such as futures contracts to hedge against adverse exchange rate movements in real estate residential properties that have exposures in the foreign exchange markets either through foreign-denominated leases or rental contracts.

Keywords: Real estate, residential property prices, inflation, interest rate, exchange rate

1. Introduction

For a long time, real estate has been considered a traditional asset held in investors' portfolios and formed a large and essential portion of wealth. In the recent past, the superiority of real estate as an investment has gone a notch higher, which subsequently led to its increasing importance as one of the intangible assets. Real estate has continued to dominate investor portfolios in the insurance and pension sector from the last century to the present (Hossein, Keith, & Donald, 2016). The evolution of real estate as an investment changing and transforming from an old-style asset to an alternate asset has raised questions regarding risk, return, and diversification in relation to other asset classes, such as bonds and equities. This, therefore, makes it essential to establish their relationship with various macro-economic performance measures, for instance, exchange rate, inflation, and interest rate regime, to enable investors to establish and ascertain their diversification and return potential in a portfolio with mixed assets. Just like any other investment, investors are interested in establishing the following:

- Whether real estate investments can give a real return greater than the rate of inflation,
- Whether or not the highly leveraged structure of real estate affects its financial performance in seasons of highinterest rate volatility, and
- Whether or not real estate investments respond to changes or shocks in exchange rates

In Kenya, the demand for affordable housing and a decent living environment has remained on an upward trend, supported by the increasing urban population and economic growth. It is projected that the Kenyan population will be over 60 million in 2030, with more than 50% expected to live in urban areas. This will create a huge demand for affordable housing hence more investments in the residential real estate market (Mwathi, 2013). With all this increased investment, there is a need to establish how the exchange rate, inflation regime, and interest rate regime influence real estate as an investment. This is because increased demand with limited supply results in inflated property prices. Real estate is capital-intensive and mostly relies on debt financing from financial institutions. At the same time, most investments in the sector are financed by remittances from abroad whose value depends on the prevailing exchange rates hence creating a need to look at how fluctuating interest rates and erratic exchange rates interact with the real estate growth rate in Kenya.

Real estate growth has been more impressive compared to other investment asset classes, further compounding its importance to any investor's portfolio. For instance, according to HassConsult Real Estate Index (2021), Ksh. 1 million invested at the end of 2007 would have been worth:

- Ksh. 9.61M if invested in land in Nairobi Satellite,
- Ksh. 6.32M if invested in land in Nairobi Suburbs,
- Ksh. 2.46M if invested in property,
- Ksh. 3.13M if invested in bonds and
- Ksh. 1.48M if invested in savings, and
- Only Ksh. 0.35M if invested in Equities

In 2019 the Kenyan economy grew by 5.4 %, which represented a reduction from 6.3% growth recorded in 2018. Most sectors in the economy, however, recorded decelerated growth. This was, however, different in the real estate industry, which grew by 5.3% and was among the few sectors of the economy that provided support to the economy, indicating its resilience, as noted by Kenya National Bureau of Statistics, Economic Survey (2020). This growth has, however, been impeded in the recent past by a rise in construction costs in the country attributed to inflation. The Kenya National Bureau of Statistics, Construction Index (2021) points out that input costs in the construction of real estate investments and properties increased by 0.11% in the fourth quarter of 2021, signaling an increased cost of investing in real estate. Further, according to a report from Central Bank Quarterly Statistics (2021), exchange rates and interest rates have not been stable, as shown by the drastic depreciation of the Kenyan currency and erratic interest rates.

According to Romer (2009), inflation comes in two forms: demand-pull and cost-push. The Kenya National Housing Corporation (NHC) initiated a programme aimed at providing decent housing for the increasing urban population starting in 2018. This is expected to affect the demand and supply of residential real estate units in the country, leading to inflationary tendencies in the sector. This initiative will be aided by the transformation in the economy, such as fiscal and monetary policy, which might lead to inflation (Osiemo, Obere, & Odada, 2021). Therefore, in this regard, investors who are invested in real estate or who wish to invest will need to safeguard their investments and protect their wealth from expected uncontrollable inflation in the future.

Interest rates are extremely important in the stability of the economy, and it is used from time to time as a tool of monetary policy to tame runaway inflation by the Central Bank of Kenya. For example, in the year 2011, the Kenyan government had to make changes to its monetary policy where the Central Bank of Kenya increased the base lending Rate from 7 percent to 18 percent, which subsequently forced commercial banks to follow suit and increase the average lending rates from 11 percent to 25 percent (Murage, 2013). Government intervention has immediate effects on the economy. However, in the case of investments made in the real estate sector, the response is lagged and takes some time to be felt because the impact of higher interest rates is not felt immediately but later or after a few periods. This is extremely important for real estate investors, especially those who engage in capital-intensive real estate developments since it will affect their returns and the value of their investments when completed. In this regard, real estate investors consider this relationship extremely important.

According to Kenya National Bureau of Statistics Economic Survey (2020), total earnings from imports in Kenya stood at Ksh 643 billion in 2020, while the total remittances from Kenyans living in the diaspora stood at Ksh 3 trillion in the same year. Juma (2014) notes that, to a great extent, growth in the Kenyan real estate market is supported by diaspora remittances. This means that since most real estate investment projects are funded by remittances, any adverse change in the exchange rates would have a negative effect on the overall growth of the real estate market. Remittances from Kenyans living and working abroad have to be converted to Kenyan shillings from foreign currencies in order to make investments in Kenya. Mbataru (2014) states that a huge part of remittances from abroad go into the real estate sector, where relatives invest these inflows in real estate investments and development. Exchange rates have been erratic over the years, with the Kenyan shilling depreciating against the dollar, making the importation cost quite expensive. Most industries and construction materials are imported; hence depreciating currency makes the cost of construction materials, which are mostly imported, quite expensive. This results in costly development expenses, hence leading to expensive and inflated prices out of reach of the common people.

1.1. Statement of the Problem

The outlook of investments made in real estate has changed in the recent past from a traditional asset class to a more sophisticated alternative asset class while still experiencing higher-than-average returns when compared to other forms of investments such as bonds, equity, and commodities. The increasing importance given to real estate, especially with government policies such as affordable housing, will only lead to increased development and growth in the sector in years to come. This makes it important to analyze how real estate residential property prices in the country will relate to different macro-economic factors. This is mostly important because, from an investment perspective, asset allocation in a portfolio using the top-down approach starts at the macro level before moving to subtle factors such as individual characteristics of an investment asset class. The study will adopt exchange rate, inflation, and the interest rate regime as the most important macro-economic factors and acknowledge the fact that the growth of real estate investment is also influenced by many macro-economic factors, including:

- The existing state of inflation,
- Exchange rate, and
- Interest rate regimes in the country

The specific influence these factors have on prices or residential real estate properties still remains debatable from a theoretical and empirical point of view. Proponents of Arbitrage Pricing Theory (APT) argue that investment returns are usually a function of specific macro-economic beta factors, with real estate investment being no exception.

However, only a few studies quantitatively examine how real estate residential property prices are affected by inflation, exchange rate, and interest rate. Real estate investment is also capital intensive and mostly relies on debt financing leading to interest rate-related costs. However, it is impossible to predict the interest rate regime in the country because it is one of the tools of monetary policy and is controlled by government intervention. The increased development and growth in the real estate sector might also be affected by escalated and uncontrollable inflation regimes in the country, which directly and indirectly impacts the labour cost, and the construction and material costs to rise to extreme levels resulting in high costs in the market for real estate investments.

Numerous studies have been conducted on the real estate sector. However, only a few have concentrated on real estate residential property prices as an investment that might be included in a portfolio. Studies also give mixed and inconsistent results both in Kenya and in other economies. Upon this foundation, it becomes important to establish how real estate investments perform in a macroeconomic setup.

1.2. Research Objectives

1.2.1. Main Objective

The focal aim of the study is to assess the relationship between inflation, interest rates, exchange rate, and real estate residential property prices in Kenya.

1.2.2. Objectives

- To establish the influence of inflation on real estate residential property prices in Kenya.
- To establish the influence of interest rate on real estate residential property prices in Kenya.
- To establish the influence of exchange rate on real estate residential property prices in Kenya.

1.3. Hypotheses

- H₀₁: There is no influence of inflation on real estate residential property prices in Kenya.
- H₀₂: There is no influence of interest rate on real estate residential property prices in Kenya.
- H₀₂: There is no influence of exchange rate on real estate residential property prices in Kenya.

2. Literature Review

2.1. Theoretical Review

2.1.1. Arbitrage Pricing Theory

This theory was proposed by Ross (1976) as a reasonable substitute for the Capital Asset Pricing Model (CAPM). It postulates that the expected return of an asset is a function of various macro-economic variables or other fundamental factors, but no arbitrage opportunities exist. Arbitrage opportunities only exist when the market is still not t equilibrium. Contrary to this, if the market is efficient, it will not produce arbitrage, and as a result, the investment income and other factors have a close linear relationship. Chen, Huang, & Lin (2021) state that APT is depicted under the equilibrium state of the market, with several factors to measure investment returns for assets. CAPM model is a special case of APT because the CAPM makes pure use of the factor market excess returns for measuring assets investment income, which is under the effect of a single factor of APT model. In the model, the return of any specific security is a function of specific factors that may be a universal plus as a specific asset risk-free rate. In the Arbitrage Pricing Theory, the investor can value the asset's price by merging the different factors in the model. The factors can range from fundamental factors about the company and economic factors like inflation, Interest rates, exchange rate, or even Gross Domestic Product. The model can be used to estimate how real estate investment would behave in an efficient market. The theory is appropriate for the study because of the nature of the independent variables being used. Since these independent variables are macroeconomic in nature, the association with real estate residential property prices can be explained in the APT framework.

2.2. Empirical Literature Review

Using Irish data, Stevenson & Murray (1999) carried out an investigation on the inflation hedging ability of the real estate market. The study was first carried out during a period of stability in inflation rates and also on time series data that covered longer durations. They established similar results in both that real estate could not act as an inflation hedge.

The initial analysis was through the use of static models with a number of difficulties. The researchers decided to adopt the use of more robust causality and cointegration tests. However, these, too, resulted in similar results that inflation did not granger because real estate returns. The study was, however, conducted in a developed country with generally stable inflation rates and low-interest rates. This study will be carried out in Kenya, a developing country, and compared to the developed economies to draw similarities and contrasts.

A study by Mukesh, Rohan, & Webb (2010) investigated the role REITs played in the diversification of a portfolio using monthly REIT futures data soft commodities from 1987 to 2002. The futures data included energy and soft commodities. Similar to previous literature on cointegration, the study established that most assets comprised in this study showed non-stationarity. Therefore, cointegration was important. Autocorrelations were removed using appropriate lag lengths and then used to study cointegration between REITs and several asset classes. The results lead to conflicting findings. On the one hand, there appeared to be a strong indication of cointegration between energy-related assets and REITs. On the other hand, no evidence of cointegration between some assets and REITs was identified. Since the commodity market, such as copper, gold, and crude oil, are influenced by inflation, any cointegration relationship between REITs and the commodity markets implies a positive connection between inflation and the REIT market. Therefore, REITs can be used as an inflation hedge. The study, however, concentrated on REITs. This study will look at residential real estate alongside inflation.

While examining how REIT market (N-REIT) performed in relation to changes in inflation from 2008 to 2019, Dabara, Gbadegsin, Amidu, Oyedokun, & Chiwuzie (2021) carried out a study on the Nigerian REIT market while making use of data collected from active REIT firms listed operating in the Nigerian Market. The researchers used the Fama & Schwert (1977) model as the baseline model guiding their study. This theory is an extension and improvement of the Fisher Hypothesis. Their results established that N-REIT that was investigated showed a poor inflation hedging relationship with inflation at different levels of inflation being expected, unexpected and actual. Their results, based on the Engle-Granger causality, implied that real estate investments through REITs had an essential and significant impact on Nigerian market investors, mostly because they could not use REITs for hedging against portfolio risk. The study was, however, concentrated on the REIT market in Nigeria. This study will try and draw similarities and contrasts while looking at the residential real estate market and the whole real estate sector as contributions to GDP in Kenya.

Carrying out research on the determinants of real estate financing by microfinance institutions using survey research design, Muriuki (2018) surveyed responses from respondents from the twelve microfinance firms in Kenya, segmenting the respondents into the male and female gender. The predicted variable was access to real estate finance, while the other study variables were lending policies, interest rates, and borrower characteristics. Using multiple regression analysis, the researcher established that interest rates were a significant parameter in real estate financing and development. The high transaction costs of real estate loans affected the access to real estate development loans of property developers and investors, invariably resulting in higher financing costs. Therefore, in this regard, interest rates are an imperative determining factor of the performance of investments in real estate. The study, however, focused on microfinance institutions. This study will focus on the whole real estate investment market through real estate growth rate and residential real estate prices.

Using data from MSCI Equity Index from 1994 to 2016, Giliberto & Shulman (2017) studied the level of sensitivity of REITs to interest rates. They carried out regression analysis on the data and found out that there were no particular ways interest rates affected REIT. They also point out that it is impossible to predict exactly how interest rates affect the returns of REITs but note that REITs might be sensitive to interest rate changes in the short run. On the same note, Shulman (2015), while examining the inconsistency in the performance of the MSCI REIT Index in comparison to S&P 500 Index acting on the yield of the 10-year Treasury note, found out that Equity REITs in 2013 and 2014 were highly sensitive in the data analysed. The study was, however, conducted in a developed country and only looked at interest rates without considering inflation. However, this study will look at additional variables, including exchange and interest rates.

Using REIT data collected from various developed economies (Ijasan, Ijasan, Tweneboah, Oyedokun, & Adam, 2021) investigated the association between exchange rate and global REITs from 2012 to 2019. The study employed the Intrinsic Mode Functions (IMFs) and Ensemble Empirical Mode Decomposition (EEMD) method to additionally examine the asymmetrical relationship between REITs indices in select countries and the corresponding exchange rates (dollar denominated) using Quantile-in-Quantile Regression (QQR) methods and Quantile Regression Analysis (QRA). The study discovered the effect exchange rates had on REITs' investment sector and how they affected decision-making by investors. They established that in the medium and short term, currency depreciation and appreciation have a positive association with REIT financial performance in various countries. However, the study only focused on the developed economies and only focused on listed real estate, not the whole real estate market. This study will, however, put its focus on the Kenyan real estate market while looking at all facets of the residential real estate sector.

Using Turkish real estate data collected from 2004 to 2016, Sumer & ÖZorhon (2020) carried out a study on how exchange rates impacted the REIT index as well as the property index using the Vector Auto Regressive model, Granger causality test, and the Augmented Dickey-Fuller. The authors established that exchange rates influenced the REIT index return rate. Contrary to this, the housing price index return rates were not affected by the exchange rate. The study, however, only focused on the Turkish real estate market. This study will, however, focus on the Kenyan residential real estate market to try and draw similarities in the behaviour of the same variables in Kenya as well as the contrasts.

Using quarterly data between 2010Q1 and 2013Q4, Mallick & Mahalik (2015) investigated the dynamics influencing housing prices in India. The researchers carried out the study in different regions in which the sample was 15 major cities and urban areas. They established fundamental results that implied that the effective exchange rate regime had no significant influence on housing prices in India, implying that the exchange rate was not one of the factors

influencing the movement in prices and supply and demand of housing unit prices in the Indian economy. This could have only implied one thing, that the Indian real estate market was not globalized. It means that very few foreign investors had investments in the Indian real estate sector or that the remittances from Indians living abroad did not go towards real estate development and investments but rather to things like basic needs and school fees. The study, however, only focused on the Indian sub-continent. This study will, however, concentrate on the Kenyan case to draw similarities and differences.

Using Kenyan-listed REIT data collected from The Nairobi Securities Exchange (NSE), Njangi (2021) sought to analyze how various macro-economic variables affected the performance of Stanlib Fahari REIT. There was an adoption of a descriptive research design with data being sourced from Central Bank of Kenya from 2016 to 2022. Diagnostic tests such as normality, Heteroscedasticity, and serial correlation test was carried out. The results from the study pointed out that the exchange rate regime had a weak but significant impact on the level of performance of listed real estate investments. The study, however, did not carry out a stationary test on the time series data that was collected and analyzed, making it uncertain whether or not the data was stationary. The data also analyzed one facet of investments made in the real estate market, using one single company to represent the whole real estate investment, which is not statistically significant. This study will, however, use a cointegration methodology. This study will also analyze data that is representative of the whole real estate market collected from Kenya Bankers property index.

3. Research Methodology

3.1. Introduction

3.1.1. Research Design

The study adopted a correlational research design to investigate the influence of inflation, interest rates, and exchange rate on real estate residential prices. The study also adopted a post-positivist research philosophy, as pointed out by Creswell (2014), whereby foundations usually determine effects or outcomes. Therefore, the research gaps studied by this research philosophy usually establish the need to recognize and test the causes that affect results.

3.2. Study Area

The study will be carried out in Kenya. The country has a number of countries bordering it, with Uganda to the West, Ethiopia to the north, Tanzania to the south, Somalia to the east, and lastly, Sudan to the northwest.

3.3. Data Sources and Measurement

The study will adopt a time series analysis. Quarterly real estate residential price data were collected from Kenya Bankers Housing Price Index, which is a laspeyres-index and is composed of real estate residential property values computed from the base year 2013 to 2021 in which data is collected quarterly each year with property prices being made up of data collected from Suburbs in Nairobi, Mombasa, Kisumu, Eldoret, Nyeri, and Thika. The study also used the quarterly Consumer Price Index as a proxy for inflation, the exchange rate between the Kenyan Shilling and the US dollar, and quarterly weighted lending rates of all commercial banks retrieved from Central Bank of Kenya and Kenya National Bureau of Statistics (KNBS).

3.4. Model Specification

The following model in this section was specified based on the Arbitrage Pricing theory. The model included the variables analyzed in the literature review. The model denoted the predicted value of **HPRICE**_t representing real estate property prices from Kenya Bankers Housing Price Index. From equation (3.1a), the study derived through estimation coefficients of the equations respectively.

$$\label{eq:HPRICE} \begin{split} \text{HPRICE}_{\text{t}} &= \beta_0 + \beta_1 INF_t + \beta_2 INT_t + \beta_2 EXCH_t + \mu_t \\ \text{Where:} \end{split}$$

(3.0)

 $\begin{array}{l} \text{HPRICE}_t \mbox{-} \text{Real estate residential property prices} \\ \text{INF}_t \mbox{-} \text{Consumer Price Index (CPI)} \\ \text{EXCH}_t \mbox{-} \text{weighted average lending rates by commercial banks.} \\ \text{INT}_t \mbox{-} \text{weighted average lending rates by commercial banks.} \\ u_t \mbox{-} \text{the error term.} \end{array}$

3.5. Data Analysis

3.5.1. Descriptive Statistics

Descriptive statistics were used to present a preliminary outlook of the viability of the data adopted for the study to establish whether it was suitable for parametric and non-parametric tests and quantitative research. A descriptive statistics test was also crucial in the initial stages since it enabled us to determine if the data were normally distributed.

3.5.2. Unit Root Test

3.5.2.1. Augmented Dickey-Fuller Test

This test has the null hypothesis that the data is non-stationary, which implies that the alternative hypothesis is stationery of the data set being tested. The ADF (p) test is generally based on the following:

$\Delta y_t = a y_{t-1} + \sum_{i=1}^n q_i \Delta y_{t-i} + \varepsilon_t$	(3.1a)
$\Delta y_t = \beta_1 + ay_{t-1} + \sum_{i=1}^n q_i \Delta y_{t-i} + \varepsilon_t$	(3.1b)
$\Delta y_t = \beta_1 + \beta_{2t} + ay_{t-1} + \sum_{i=1}^m q_i \Delta y_{t-i} + \varepsilon_t$	(3.1c)

The above equations imply the presence of deterministic elements a and q (3.1a), which involve an arbitrary random walk model, where (3.1b) comprises an interception and (3.1c) comprises a trend and intercept.

3.5.3. Cointegration Test

The study also made use of the Johansen (1988) cointegration methodology. This cointegration approach is an autoregressive method that uses the maximum eigenvalue likelihood ratio tests and the trace test (Gujarati, 2009). However, for the adoption of Johansen's procedure, the study established the following, as noted by Mukras (2012). First, carry out a cointegration test to establish whether or not there is cointegration. If this is the case, then carry out the maximum eigenvalue likelihood ratio tests and the trace test.

The hypothesis will be as follows:

- H₀: There is no cointegrating equation
- H₁: The null hypothesis is not correct

4. Results and Discussion

4.1. Descriptive Statistics Analysis

	HPRICE	INT	EXCH	СРІ
Mean	109.6242	14.42722	99.61380	92.77361
Median	108.4400	13.67000	101.8533	93.61000
Maximum	124.7800	18.15000	111.8967	117.3800
Minimum	100.0000	11.89000	84.61000	69.84000
Std. Dev.	6.661417	2.199232	7.794866	14.31897
Skewness	0.578780	0.334476	-0.648289	0.051470
Kurtosis	2.474166	1.500346	2.274504	1.807316
Jarque-Bera	2.424672	4.044689	3.311186	2.149636
Probability	0.297502	0.132345	0.190979	0.341360
Sum	3946.470	519.3800	3586.097	3339.850
Sum Sq. Dev.	1553.106	169.2817	2126.598	7176.153
Observations	36	36	36	36

Table 1: Presentation of Descriptive Statistics

Source: author (Eviews output) INT in % while HPRICE, EXCH and INF proxied as CPI in Absolute Terms

The Jarque-Bera statistics for all the series in the summary statistics had a probability of more than 0.05, indicating that all the variables follow and mirror a normal distribution at 5% significance; hence the data can be used to draw meaningful conclusions in our study.

4.2. Stationarity Analysis

4.2.1. Augmented Dickey-Fuller Test (ADF)

LOG		HPRICE	INF	EXCH	INT	
First Difference	ADF test statistic	-3.9406	-9.4053	-3.717	-4.291	
	(p-values)	0.0046	0.0000	0.0084	0.0019	
	Critical Values(5% level)	-2.9511	-2.9540	-2.954	-2.954	
Table 2: ADF Unit Root Test						

Source: Author (Eviews output)

From table 2, the results indicated that rejected of the null hypothesis of non-stationarity.

4.3. Optimal Lag Length Selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-362.6809	NA	52661.95	22.22308	22.40448	22.28412
1	-201.2340	273.9704	7.893329	13.40812	14.31510*	13.71329
2	-183.5014	25.79293	7.450262	13.30311	14.93567	13.85242
3	-155.1076	34.41663*	3.977252*	12.55198*	14.91011	13.34542*
Table 3: Optimal Lag Criterion						

Source: author (Eviews Output)

*shows the selected lag by criterions

The results in table 3 show that LR, AIC, FPE, and HQ advocate the selection of 3 as the optimal lag. The lag 3 was adopted as the optimal lag length.

4.4. Cointegration Test

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.726278	83.50241	47.85613	0.0000
At most 1 *	0.553955	42.04189	29.79707	0.0012
At most 2 *	0.252624	16.20714	15.49471	0.0390
At most 3 *	0.193689	6.889152	3.841466	0.0087

Table 4: Johansen's Trace Test Source: Author (Eviews Output)

* Denotes Rejection of the Hypothesis at the 0.05 Level

Johansen's trace test in table 5 showed that there was the presence of 4 cointegrating vectors. The null hypothesis of no cointegration was rejected at the 5% significance level.

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.726278	41.46052	27.58434	0.0005
At most 1 *	0.553955	25.83475	21.13162	0.0101
At most 2	0.252624	9.317988	14.26460	0.2606
At most 3 *	0.193689	6.889152	3.841466	0.0087

Table 5: Johansen's Maximum Eigenvalue Test Source: Author (Eviews Output) * Denotes Rejection of the Hypothesis at the 0.05 Level

Johansen's Max-eigenvalue test in table 5 showed that there was the presence of 2 cointegrating vectors. The null hypothesis of no cointegration was rejected at the 5% significance level.

4.4.1. Cointegration Equation (Long-Run) Equation

Therefore from the results, there exists a long-run cointegrating relationship. The existence of a long-run relationship when variables are combined long-term. Table 6 shows the long-run equation for the relationship and the respective estimates for the variables.

1 Cointegrating Equation(s):		Log-likelihood	-141.4004
Normalized Cointegrating Coefficients (Standard Error in Parentheses)			
HPRICE	INT	EXCH	INF
1.000000	9.630117	-1.995363	2.247921
	(0.87512)	(0.15579)	(0.18768)
	[11.004]	[-12.808]	[11.977]

Table 6: Normalized Cointegrating Coefficients Source: author (Eviews output). Standard error and t-statistics in () and [] respectively, While Lag Length 1-3

(4.1)

The study estimated the long-run equation as shown below:

HPRICE t +1.995EXCHt- 2.248INF t- 9.630INT t =0 [12.808] [-11.977] [-11.004]

The parameter estimates for equation (4.2) for INF and an INT are all positive, while that for EXCH is negative. The absolute values of the t-statistic are also larger than 2.0; hence are all significant. Therefore in this regard, and in reference to the first, second, and third objectives, the null hypothesis that real estate residential property prices are not influenced by interest rate, inflation, and the exchange rate is rejected.

4.4.2. Discussion and Interpretation of Cointegration Results

4.4.2.1. Relationship between Real Estate Residential Property Prices and Inflation Rate

The first objective of the study was tested in this section. The results on real estate sector growth and inflation imply that a one percent increase in the level of inflation in the preceding period increases the real estate growth rate in Kenya by **2.248%**. These findings on inflation imply that, *ceteris paribus*, an increase in inflation in the economy, generally leads to increases in the growth rate of the real estate sector in Kenya. Therefore in this regard, the study rejected the null hypothesis of no relationship between inflation and real estate residential property prices. The findings in this study are similar to the one carried out by Liang & Webb (1996) in the US market. The researchers established that real estate investment through Real Estate Investment Trusts was able to give real returns higher than the rate of inflation when examined from a mixed asset portfolio framework.

4.4.2.2. Relationship between Real Estate Residential Property Prices and Interest Rate

This section tested the second objective of the study. The results on interest rate imply that a percentage increase in the interest regime in Kenya results in a **9.630%** increase in real estate residential property prices in Kenya. These findings on interest rate imply that, *ceteris paribus*, an increase in lending interest rate in the economy, generally goes in tandem with the growth rate of real estate investments. The study, therefore, rejected the null hypothesis of no relationship between interest rate and real estate residential property prices. These findings are validated by Muriuki (2018), who established that interest rates were an important factor influencing the performance of real estate development and barriers to entry through higher construction costs. A low supply of real estate units subsequently leads to higher demand which leads to increases in the value of the real estate through higher rents and leases. Similarly, Olanrele, Adegunle, & Fateye (2018) established that real estate investments in Nigeria were sensitive to interest rate changes but mostly dependent on the property life remaining.

4.4.2.3. Relationship between Real Estate Growth Rate and Exchange Rate

This section tested the third objective of the study. The results on exchange rate and real estate sector growth rate imply that a percentage point increase in the exchange rate regime in the previous period results in a **-1.995%** reduction in the real estate sector growth rate. The findings on exchange suggest that *ceteris paribus*, an increase in exchange regime in the economy generally results in a reduction in the growth rate for real estate investment. Therefore, the study rejected the null hypothesis of no relationship between the exchange rate regime and real estate residential property prices. The results in this study conform to Njangi (2021), who established the existence of a long-run relationship between real estate investments and the exchange rate regime in the economy.

5. Summary of Findings, Conclusions, and Recommendations

5.1. Conclusion

From the cointegration analysis, it is established that real estate residential property prices in Kenya have a significant positive association with inflation and interest rate. Therefore, a one percent increase in inflation results in a 2.248% increase in real estate residential property prices. Similarly, a one percent increase in interest rate leads to a 9.630% increase in real estate residential property prices. The study also establishes that real estate residential property prices have a negative relationship with exchange rates. Whereby a one percent increase in exchange rate results in a - 1.995% decrease in real estate residential prices in the long run.

5.2. Recommendations

5.2.1. Influence of Inflation on Real Estate Residential Prices

The study established that real estate investments can hedge against inflation; hence when included in an investor's portfolio, it has the ability to hedge the whole portfolio against inflationary trends. However, when the portfolio also consists of commodities or other related investments such as Exchange Traded Funds (ETF) pegged on commodities

such as gold and silver, the investors should balance between the two since both are inflation hedges and including both in similar proportions might lead to highly correlated risk and returns making the portfolios less efficient and optimal. These portfolios might be slightly off the efficient frontier.

5.2.2. Influence of Interest Rate on Real Estate Residential Prices

The study established that real estate investments are interest rate sensitive; hence when included in a portfolio of mixed assets, they should limit the proportion of other interest rates sensitive assets such as bonds and other fixed-income securities. The study recommends that since real estate shares the same similarities as bonds, both have income streams in the form of coupons and rents or leases, while both have a capital appreciation and hence are more or less similar. Hence the study recommends that investors should allocate real estate to a portfolio of mixed assets while limiting the proportion of fixed-income securities such as bonds in order to provide risk and return diversification.

5.2.3. Influence of Exchange Rate on Real Estate Residential Prices

Lastly, the results of this study established the existence of exchange rate sensitivity in real estate investments. This is an essential factor to put into consideration since globalization in capital markets means that financial markets in the world are interconnected, with the Kenyan capital market being to exception. Hence in this regard, investors should diversify their investments not just locally but also internationally. The study, in his regard, recommends investors holding real estate investments linked to international markets through either foreign currency rental or lease contracts and foreign-denominated debt financing to hedge against an exchange rate or currency exposure through derivative contracts such as futures contracts to protect the value of their investments as well as their cash flows.

6. References

- i. Central Bank of Kenya [CBK]. (2020). Annual Report. Retrieved from
- https://www.centralbank.go.ke/uploads/cbk_annual_reports/1456103982_annual%20report%202020%20post ed%20on%20website.pdf
- ii. Chen, C., Huang, X., & Lin, R. (2021). Chen, C. X., What does China's REITs market tell us?-an application of Fama-French three factors model. Harbin Institute of Technology (Shenzhen), 10-20.
- iii. Creswell, J. W. (2014). Research Design. Nebraka: Sage. Retrieved Fourth.
- iv. Dabara, D., Gbadegsin, J., Amidu, A., Oyedokun, T., & Chiwuzie, A. (2021). Do REITs Hedge against Inflation? Evidence from an African Emerging Market. African Real Estate Society (AfRES), 33.
- v. Fama, E., & Schwert, G. (1977). Asset Returns and Inflation. Journal of Financial Economics, Vol. 5(No. 2), 115-46.
- vi. Giliberto, M., & Shulman, D. (2017). On the Interest Rate Sensitivity of REITs Evidence from Twenty Years of Daily Data. The Journal of Real Estate Portfolio Management, 23(1), 7-20.
- vii. Gujarati, D. N. (2009). Basic Econometrics (Fourth ed.). Boston: McGraw Hill.
- viii. Hass Consult Real Estate Index. (2021, December). Hass Consult Real Estate. Retrieved from Hass Index: https://www.hassconsult.com/_files/ugd/1bb245_36122cea8633408889d69c03d57459e3.pdf
- ix. Hossein, B. K., Keith, H. B., & Donald, R. C. (2016). Alternative Investments. Hoboken, New Jersey: Wiley and Sons.
- x. Ijasan, K., Ijasan, P., Tweneboah, G., Oyedokun, T., & Adam, A. (2021). Analysing the relationship between global REITs and exchange rates: Fresh evidence from frequency-based quantile regressions. Advances in Decision Sciences, 25(3), 58-91.
- xi. Johansen, S. (1988). Statistical analysis of cointegration vectors. Journal of Economic Dynamics and Control, 231-254.
- xii. Juma, M. (2014). The Effect of Macro-Economic Variables on Growth in Real Estate Investment in Kenya. Unpublished Master's Project University of Nairobi.
- xiii. Kenya National Bureau of Statistics. (2020). Economic Survey.
- xiv. Liang, Y., & Webb, J. (1996). The hedged REIT index and mixed-asset portfolios. Journal of Real Estate Portfolio Management. Journal of Real Estate Portfolio Management, 55-61.
- xv. Mallick, H., & Mahalik, M. (2015). Factors determining regional housing prices: evidence from major cities in India. Journal of Property Research, 123-146.
- xvi. Mbataru, P. (2014, January 30). Why Kenya's property market will not tumble any time soon. Daily Nation, p. 20.
- xvii. Mukras, M. (2012). Fundamental Principles of Time Series Econometrics Vol II, Theory and Applications. Lambert Academic Publishing, Deutschland, Germany.
- xviii. Murage, N. M. (2013). The effect of interest rates volatility on the growth of real estate market in Kenya. Doctoral dissertation, University of Nairobi.
- xix. Muriuki, T. M. (2018). Determinants of real estate financing by microfinance institutions in Kenya. Doctoral dissertation, United States International University-Africa.
- xx. Njagi, B. N. (2021). Effects of Macroeconomic variables on the performance of real estate investment Trusts in the Nairobi Securities Exchange. Master's Thesis, University of Nairobi.
- xxi. Olanrele, O., Adegunle, T., & Fateye, O. (2018). Causal relationship of NREITs dividend yield and money market indicators: A case study of Skye Shelter REITs. In Proceedings of the 18th African Real Estate Society (AFRES) Annual Conference.
- xxii. Osiemo, D. A., Obere, J. A., & Odada, J. E. (2021). Long-run relationship between inflation rate and real estate investment in Kenya. International Journal of Social Sciences and Information Technology.
- xxiii. Romer, D. (2009). Advanced Macroeconomics. New York: McGraw-Hill.

- xxiv. Ross, S. (1976). The arbitrage theory of capital asset pricing. Journal of Economic Theory. Journal of Economic Theory, 13(3), 341-360.
- xxv. Shulman, D. (2015). Recent Evidence on the Interest Rate Sensitivity of REITs. UCLA Economic Letter, Ziman Center for Real Estate.
- xxvi. Stevenson, S., & Murray, L. (1999). An Examination of the Inflation Hedging Ability of Irish Real Estate. The Journal of Real Estate Portfolio Management, 5(No 1(1999)), 59-69.
- xxvii. Sumer, L., & ÖZorhon, B. (2020). The exchange rate effect on housing price index and REIT index return rates. Finansal Araştırmalar ve Çalışmalar Dergisi, 12(22), 249-266.