# ANALYSIS OF INFLATION, INTEREST RATE, EXCHANGE RATE AND FINANCIAL PERFORMANCE OF REAL ESTATE INVESTMENT, KENYA

**BY**

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**DEPARTMENT OF ACCOUNTING AND FINANCE**
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## DECLARATION

**Declaration by the Candidate**

This research project is my original work and has not been presented for any other purpose apart from as a partial fulfillment for the award of Master of Science in Finance

**Austine Odhiambo Ogutu** **Sign** **Date**
**(MSC/BE/00067/020)**

**Declaration by the Supervisor**

This research project has been submitted for examination with my approval as university supervisor.

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## DEDICATION

This project is dedicated to my wife Laurine, my daughter Angela and my parents George and Bernadette Ogutu for giving me an opportunity in life and their support, inspiration, and understanding for the time I could not be there for them while working on this Study.

## ABSTRACT

Real estate as an investment has continued to form an important part of investments held by both retail and institutional investor's portfolio over the years. This has been attributed to its ability to generate continuous income streams as well as capital appreciation of the underlying asset. Notwithstanding these benefits, real estate investments in Kenya have been faced with challenges such as increased cost of credit through fluctuating interest rates owing to real estate being mostly financed by debt hence unstable interest rates can affect their performance. Real estate as an investment has been susceptible to booms and bust 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 glut. Over the years inflation has been rising steadily with each investor becoming more interested on 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 It is upon this that the study was conducted to establish the state of connection between the performance of real estate investment from a price and return perspective. The study concentrated on inflation, the interest rate regime and the state of exchange rate and drew conclusions based while referencing finance and economic theory. The study focused on the weighted interest rates used in lending by commercial banks, inflation rates exchange and the existing relationship with the financial performance of real estate investments. The study was anchored on the four quadrant model to show how real estate sector demand and supply works out. The study used Arbitrage Pricing theory to show how real estate performance is influenced by macro-economic factors. Lastly the study used the Efficient Market Hypothesis to show that real estate prices and market is efficient. The research adopted a post positivist research philosophy and was guided by a correlational research design. The target population for the study was 40 quarters of interest rates, housing price index from Kenya Bankers, inflation rate, exchange rate and growth of real estate sector in Kenya. The macro economic data for the study was retrieved from Kenyan National Bureau of Statistics between 2012Q1 and 2021Q4. The results from the study showed that in the long run, inflation had a significant influence ($b$=2.058), exchange rate had a significant negative influence ($b$= -2.017), interest rate had a significant positive influence ($b$=8.166) respectively on real estate residential property prices. On the same note in the long run exchange rate had a significant negative influence ($b$= - 0.0043), inflation had a significant positive influence ($b$=0.001268), and interest rate had a significant positive influence ($b$=0.0043) respectively on real estate sector growth. The short run relationship showed that interest rate, exchange rate and inflation had a significant relationship with real estate residential prices. The study however established that there was no significant short run relationship between exchange rate, inflation and interest rate with real estate sector growth. The speed of correction back to equilibrium for real estate residential and real estate growth were negative and significant at 46.4% and 31.4% respectively. The study recommended investors to have their portfolios diversified by investing in real estate to hedge against inflation. Since real estate was established to be interest rate sensitive, the study recommended investors to limit bonds which are also interest rate sensitive in portfolios that have real estate. Lastly the study recommended investors to protect their portfolios from exchange rate risk through investing in futures contracts which cancel out any adverse changes in the exchange rate regime in the country.

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## ABBREVIATIONS

**ARDL** Autoregressive –Distributed Lag

**CAPM** Capital Asset Pricing Model

**CBK** Central Bank of Kenya

**CPI** Consumer Price Index

**EMH** Efficient Market Hypothesis

**FOREX** Foreign Exchange Rate

**GDP** Gross Domestic Product

**HPI** Housing Price Index

**MSCI** Morgan Stanley Capital International

**N-REIT** Nigerian Real Estate Investment Trust

**OLS** Ordinary Least Squares

**REG** Real Estate Growth

**REIT** Real Estate Investment Trust

**US** United States

**USD** United States Dollar

**VAR** Vector Auto Regressive

**VECM** Vector Error Correction Model

## OPERATIONAL DEFINITION OF TERMS

**Real Estate:** Real estate refers to investments made on the physical land and improvements that have been constructed on the land and there are ownership rights that can be associated with real estate referred.

**REITs** : REIT is real estate security floated by a public traded company whose core business is to own, develop and manage a variety of properties.

**Inflation**: This refers to the gradual rise in price in an economy over time.

**Interest Rate:** This refers to the cost of borrowing funds from banks or any other financial institution.

**Exchange Rate**: The value of one currency (quote) in terms of another currency (base).

**Mixed asset portfolio:** This refers to a combination of different investment asset classes by an investor to diversify risk and optimize overall return

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# CHAPTER ONE: INTRODUCTION

## 1.1 Introduction

This makes presentation of the background of the study, covering the main theme for this research and its constructs. It also presents the problem statement, objectives of the study, the questions raised in research, why the study is important and the range to be covered. Therefore in essence it sets the tone for the whole research.

## 1.2 Background of the Study

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, superiority of real estate as an investment has gone a notch higher which subsequent led to its increasing importance as one of the intangible assets. Real estate has continued to dominate investor portfolio in the insurance and pension sector in the last century to the present (Hossein, Keith, & Donald, 2016). However old real estate might be, it is surprisingly still an important part of investor's diversified portfolios. Nevertheless this trend has changed with real estate now being considered an alternative asset class alongside private equity, timberland and commodities such as gold due to their unique characteristics and diversification potential. The evolution of real estate as an investment changing and transforming from an old-style asset to an alternate asset has raised questions in regard on 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 establish and ascertain their diversification and return potential in a portfolio with mixed assets. Just like any other investment, investors are interested in establishing 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 high interest rate volatility and whether or not real estate investments respond to changes or shocks in exchange rates.

These macro-economic factors are especially important while looking at investments from a mixed asset portfolio perspective because they affect both the value of investment made and the expected and actual returns the investment will be able to raise. Hossein, Keith, & Donald (2016) also point

out that macro-economic variables are important because asset allocation in a portfolio using top down approach usually starts at the macro level where each asset class is evaluated based on macro-economic variables. Bruggeman, Chen, & Thibodeau (1984) note that real estate as an alternative investment asset class is no exception, it also falls under the influence of macro-economic performance indicators. Therefore, while looking at it as an investment, it is imperative to establish the existing relationship and characteristics of real estate in regards to inflation, interest rates and exchange rate relative to other asset classes such as fixed income securities, equity and commodities to enable investors establish the unique characteristics that real estate investment possesses to enable them come up with a well-diversified portfolio.

Real estate in Kenya has been characterized by fluctuating prices attributed to periods of boom and bust as well as fluctuating interest rates, unpredictable inflation regimes and erratic exchange rate regime making the determination of real estate prices hectic hence making it important to analyze how these factors relate with each other (Cytonn, 2019). This is mostly important in the long run where portfolio diversification comes into play where each allocation to a mixed asset portfolio looks at these characteristics relative to other asset classes therefore enabling investors to come up with both efficient tactical and strategic asset allocations. Real estate investments come in two forms, this can be through investing in property real estate composed of both commercial and residential real estate through ownership of stock in publicly traded equity in form of Real Estate Investment Trusts (REITs) which are exchange rate traded or investors can alternatively invest in the latter illiquid real estate properties such as direct ownership of real estate residential or commercial properties as noted by Case & Watcher (2011).

The property real estate markets composed of both commercial and residential units are usually characterized by the fact that they are heterogeneous. The properties being sold usually have different characteristics and are usually not the same in quality or standards. Therefore, there are no similar transactions in this market; each transaction is unique and often, information is also asymmetrical. The value of transactions are also large since most of the time real estate properties are indivisible (Lee, 2010). The property prices are not standardized because the pricing process is usually based on negotiation. The property real estate sector is characterized by capital intensive investments in mixed used properties such residential and commercial buildings consisting of

malls, offices, apartments and warehouses. These types of investments are usually capital intensive and are usually mostly carried out by institutional investors in the life and pension business. To solve these issues, the Kenyan Government sought to introduce a modern reengineered real estate type that would be liquid, homogenous, low transaction cost and divided into smaller units. The government did this through the (Capital Markets Collective Investment Scheme Act, 2013) introducing Real Estate Investment Trusts (REIT) which signifies the important position real estate holds in the Kenyan economy further compounding the need to analyse the relationship it has with interest rate regime, inflation regime and exchange rate regime .

The demand for affordable housing and decent living environment has remained on an upward trend supported by the increasing urban population as well 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 big demand for affordable housing (Mwathi 2013). This will in essence magnify the important role held by real estate as an investment in most investors' portfolios which means that investors will need a deeper understanding of the macro-economic environment while making investments. With all this increased investment there is need to establish how real estate as an investment is influenced by exchange rate, inflation regime and interest rate regime. 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 while on the other hand most investments in the sector are financed by remittances from abroad whose value depends on the prevailing exchange rates hence there is need to look at how fluctuating interest rates and erratic exchange rates interact with real estate financial performance.

The returns generated by real estate have been more impressive when 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. From the above results it's evident that in the Kenyan market, real estate has been the best performing

asset class. In 2019 the Kenyan economy grew by 5.4 %. This 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 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 increased cost of investing in real estate. Further according to a report from Central Bank Quarterly Statistics (2021) exchange rate and interest rates have not been stable as shown by the drastic depreciation of the Kenyan currency as well as erratic interest rates after the repeal of the Interest rate Cap in 2016.

The instability in these macro-economic variables has resulted in instability in the real estate sector whereby there are periods and cycles of booms and bust (Smith, 2010). Price booms usually refer to when real estate sector rise uncontrollably occasioned with plummeting prices in between. The Kenyan real estate sector is an important sector that has also been affected by these uncontrollable and fluctuating residential prices. This research intends to establish how real estate investment financial performance is affected by the movement or fluctuations in the macro environment such as inflation regime, exchange rate and interest rate regime. Real estate as an investment requires significant capital outlay which is not easily accessible from investor's equity, this has to be supported by debt from financial institutions. The cost of this financing from financial institutions is determined by interest rates set by banks and micro finance institutions. Whenever inflation rises to uncontrollable levels, the government is usually forced to adjust interest levels by a few basis points to ensure that investor's risk free rate is able to give a better return to beat inflation. This situation becomes even more challenging to governments operating in budget deficit and rely on the debt market to fund the deficits in their budgets like Kenya. Peyton (2011) points out that when the government uses fiscal policy in excess together with expansive monetary policy, there is a high chance that this might induce demand that can't be satisfied by the economic dynamics which might in essence result in inflationary tendencies in the long run. This underscores the importance

of the interest rate regime and inflation state in the economy and in the performance of investments made in the real estate sector in Kenya.

Inflation can be defined as the general increase in prices of a basket of goods and services in an economy, this increase is measured by changes in the bundle of goods and services contained in an index referred to as Consumer Price Index (Romer, 2009). Inflation is usually measure through the use of a Consumer Price Index or in some instances the Gross Domestic Product (GDP) indicator. Nduri (2013) states that inflation is a harmful phenomenon that impacts the efficient workings and mechanisms in an economic environment. Therefore, from an investment perspective, there is always need to ensure that an investment is able to give a higher return than the rate of inflation to protect the shareholder wealth and purchasing power.

Macro-economic variables such as inflation play an important role in the performance of any investment with real estate being no exception. This is because returns can be classified in two ways, either nominal or in real terms. Nominal return is the return without adjusting for inflation while real return is the actual return after accounting for inflation (Bodie, Kane, & Marcus, 2014). In this sense, real estate just like any other asset class in an investment portfolio is also subjected to this adjustment when looking at the actual return for a given holding period. According to Romer (2009) inflation comes in two forms, demand push and cost push. In this regard, The Kenya National Housing Corporation (NHC) initiated a programme aimed at providing decent housing for the increasing urban population in the year 2018. This will be aided by 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 when there is uncontrollable inflation.

There is rich literature on the role inflation plays on the role inflation plays on the performance of investments made in the real estate sector, this has however resulted in conflicting and inconclusive results. For instance, earlier studies in the global level such as Fama & Schwert (1977) established that of the sub classes of real estate, only residential real estate hedged against inflation. The findings can be corroborated by (Hartzell, Hekman, & Miles,1987), (Ibbotson & Siegel,1984) and

(Bruggeman, Chen, & Thibodeau ,1984) who establish that real estate is and inflation hedge in comparison with other investments. These findings establish that real estate has a positive and significant relationship with the inflation regime in an economy hence acted as an inflation hedge.

Studies in global markets reveal that real estate is a good inflation hedge (Dabara, 2014). This assertion has been substantiated in studies such as Leung, (2010); Lee (2012), Wainaina (2020) and Mulekyo (2020). Results from these studies were however observed to be conflicting and inconsistent. There are some studies conducted in Kenya which resulted in conflicting results and argue that real estate as an investment does not protect investors' portfolios from adverse effects of inflation and is not a significant factor in the performance of real estate investments. These include Bor (2018), Kibunyi & Wagura (2017), Lee, Lai, Yang, & Lee (2011) and Zermeño, Martínez, & Preciado (2018). In South Africa there are also some studies such Ntuli & Omokolade Akinsomi (2017) who found that South African REITs were good inflation adjusted return-enhancers. From the aforementioned literature there were mixed results in the findings hence making the actual relationship uncertain. The inflation hedging ability of an investment is usually considered as one of the most important factors in assessing an investment asset performance especially for investors. The literature does not point out whether or not real estate investment financial performance will lead inflation in the long or short run. It is therefore imperative to ascertain the long run and short run influence inflation has on real estate investment performance.

Interest rate refers to the cost of finance from financial institutions such as banks (Ahmed, Rehan, Chhapra, & Supro, 2018).Similarly Interest rates could be defined as obligations payable to lenders for advancing credit (Faure, 2014). Bodie, Kane, & Marcus (2014) state that declining interest rates are associated with increase in value of bonds while increasing interest rates are associated with decreasing values in the fixed income market. In the real estate investment market, increasing interest rates in the savings market might crowd out investments in the real estate sector since yields in other investments products such as bonds and treasury bills become more attractive. On the other hand if the savings interest rates fall below the yield in real estate sector then more investment will be made in the real estate sector. But the type of interest rate is aslo important, lending rates however behave differently because they represent cost not yield for real estate investors. Lending rates especially those linked to mortgage market usually makes it expensive for

investors to acquire or make developments (Wanjiku, Bosire , & Matanda, 2021). High lending rates are synonymous with increased cost of property development. On the same note in line with economic theory, high interest rates and inflation rates are an indication of increased economic activities (Chan, Erickson, & Wang, 2017). This is however not the case in all markets, each market is unique in its own way as noted by Kola (2016) who argued that different markets are impacted differently by interest rate regimes.

Interest rates are extremely important in the stability of the economy that 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 Central Bank Rate from 7 percent to 18 percent, this 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 but 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 are not felt immediately but later or after a few periods or lags. This is extremely important for real estate investors more so those who engage in capital intensive real estate developments since it will affect their returns and value of their investments when completed. In this regard real estate investors consider this relationship extremely important.

There are a numerous studies which have examined the association between real estate investment returns visa vis interest rates over a number of years. The results from the studies are inconclusive and inconsistent, while some support the notion that real estate investment is sensitive to interest rates changes. For instance, Shulman (2015) found out that Equity REITs are highly sensitive to interest rate changes. Allen & Sirmans (1987) in a similar fashion established that Equity REITs were sensitive to long run and short run interest rate sensitivity. In a similar fashion, the study by Muriuki (2018), Alhodiry, Rjoub, & Samour (2020), Chen & Tzang (1988), Giliberto & Shulman (2017), Wong & Reddy (2018) and Ito (2016) established that interest rates played an important role in the overall performance of real estate investments in an economy.

There were however studies which gave conflicting results and established that real estate investments were not sensitive to interest rate changes. For instance, Glascock, Lu, & So (2000) found out that real estate investment were only affected by stocks with low capitalization but not the interest rate regime. Similarly, Swanson, Theis, & Casey (2002), Clayton & MacKinnon., (2001) and He, Webb, & Meyer ( 2003) found that real estate investments only exhibited sensitivity to term structure of interest rates but not the actual lending percentages. There are also studies carried out that corroborate these findings and establish that indeed real estate investments are not significantly associated with interest rate regime in the country. These include Irandu,(2017) and Alain & Hoesli (2010). The conflicting results as well as the susceptibility of interest rate to monetary policy intervention create the need to truly establish how real estate investments relate to the interest rate regime in Kenya in order to give investors a clear understanding on how to include real estate investments in their portfolio.

According to Madura (2011) exchange rates refer to the price of a currency in form of another currency. Thus, the exchange rate of any currency visa Vis the Kenyan currency refers to the rate at which it can be exchanged for the Kenyan Shilling. According to Kenya National Bureau of Statistics Economic Survey (2020) total earnings from imports in Kenya stood at Ksh 643 billion in the year 2020 while the total remittances from Kenyans living in diaspora stood at Ksh 3 trillion in the same year. This means that diaspora remittances result in more inflows than exportation hence plays is significant in ensuring the economic wheel is stable and growth is sustained. Juma (2014) notes that growth in the Kenyan real estate market to a great extent 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 in 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 theses inflows in real estate investments and development. Therefore, appreciation in the Kenyan Shilling visa vis remittances will lead to reduction in investment made in the real estate sector while on the other hand depreciation in the Kenyan Shilling visa vis foreign currencies will lead to increased value

of investments. Therefore, in this regard exchange rates become extremely important in real estate investment, hence there is need to establish the existing relationship to enable both retail and institutional investors make informed investments on real estate while looking at the existing exchange rate regime. This is frequently because the exchange rate regime will determine the value of real estate investments made from diaspora remittances. Exchange rates have been erratic over the years with the Kenyan shilling depreciating against the dollar over the years making cost of importation quite expensive, most industries and construction materials are imported hence depreciating currency makes 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 man.

There has been a myriad of studies on the association between real estate investment and exchange rate regime. The studies however yielded mixed results with no clear relationships being established due to the inconsistencies. For instance Njangi (2021) established that real estate investments had a significant negative relationship with exchange rate regime in Kenya. These results were corroborated by (Ijasan, Ijasan, Tweneboah, Oyedokun, & Adam, 2021) who established that real estate investments in form of REITS in Nigeria had a positive association with to exchange rate regime in the Country. Contrary to this, studies such as Mallick and Mahalik (2015) and Wanjiku (2021) draw contrary results where real estate investments don't have any significant relationship with the exchange rate regime. Therefore in this regard, faced with mixed results from different economies as well as the important contribution of remittances in supporting growth in the real estate sector, it becomes imperative to establish how real estate investments relate to exchange rate regime in Kenya from an investment lens in order to enable investors make well informed decisions as to the allocation and optimal weight in a mixed asset portfolio.

An investment refers to forgoing immediate value or benefits for future uncertain returns while being rational in relation to the risk and return as well as liquidity constraints (Gao & He, 2018). Real estate on the other hand refers to the improvements made on land that have been put up on the land, it also entails ownership privileges (Bruggeman & Fisher, 2011). Therefore, real estate investment is characterized by real estate that can generate an expected return for the investor. Real estate entails steady flow of cash flow in form of the net operating income in form of housing rent

or leases, and the latter refers to the capital gains experienced on the property (Turner, & Thomas, 2001). Additionally, it heterogeneous in regards to the liquidity profile; Investors usually refer to these two types as property real estate investment in form of both commercial and residential properties and listed investments in real estate. This is referred to as Real Estate Investment Trust (REIT).

According to Central Bank of Kenya (2020) financial performance is the level of efficiency in converting raw materials in a production process be it physical or service sector to the final output. It basically means that the level of performance depends on how much wastage is avoided while increasing wealth. For investment purposes it would mean how efficiently the value of investment will increase with minimal operation and opportunity cost. According to Bodie, Kane, & Marcus (2014), the financial performance of an investment can be analyzed using the return of the investment. The investment return refers to the change in value of investment from one time to another. This study will use the growth of the whole real estate sector over different quarter to proxy the financial performance of the market for real estate sector in the whole country. The second measure of financial performance will be the Kenya Bankers residential housing price index to show how the prices of residential units change over time.

The choice of the variables inflation, interest rate and exchange rate and their relationship with the performance of real estate investments is guided by the relationship that exists between inflation and interest rates as established in the Fisher Effect theory (1930). This relationship is further extended to another level when capital inflows come into play through exchange rate impacts on remittances from abroad. In this sense inflation and interest rates are related in that nominal interest rates are a function of the present or current interest rates plus a portion of expected inflation. The productivity of output or in this case the value of new real estate development is determined by the expected portion, this in essence is affected by money in circulation mostly from remittances mostly directed towards real estate investments. Hence there is an interplay in these three factors making it valuable to conduct this study will considering the important interplay.

Therefore the issue of concern is that most studies have extensively concentrated on the emerging economies and developed economies but not on the Kenyan market. In Kenya most studies have

yielded mixed and inconsistent returns making a general conclusion not practical. These studies have also focused on real estate in general without looking at it from an investment perspective while looking at numerous factors to aid in establishing which factors contribute to real estate growth which is by nature dynamic and affected by different financial an socio economic factors. This study however takes a different path with the main aim of analyzing the significance of the three important economic indicator factors impacting real estate as an investment in order to aid investors make better informed decisions as to the most effective and most efficient asset allocation in a portfolio with mixed factors.

### 1.3 Statement of the Problem

The outlook of investments made in the real estate sector has changed in the recent past form 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 policy 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 investments in the country will relate with different macro-economic factors in the long run and short run. This is mostly important because from an investment perspective asset allocation in a mixed asset portfolio using the top down approach starts at the macro level before moving to subtle factors such as individual characteristics. The study will adopt exchange rate, inflation and the exchange rate regime as the most important macro-economic factors and acknowledge the fact that the performance 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 the financial performance of real estate investment still remain debatable from a theoretical and empirical point of view. Proponents of Arbitrage Pricing Theory (APT) argue that investment returns are a usually a function of specific macro-economic beta factors with real estate investment being no exception. However, only a few studies quantitatively examine how financial performance of the real estate sector is affected by inflation, exchange rate regime and interest rate. For instance a large proportion of remittances from Kenyans living abroad are directed towards real estate investment market. 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 interest rate regime in the country because it is one of the tools of monetary policy and controlled

by government intervention. The increased development and growth in real estate sector might also be affected by escalated and uncontrollable inflation regimes in the country which directly and indirectly impacts the labour, 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 but only a few have concentrated on real estate as an investment that might be included in a portfolio, studies also give mixed and inconsistent results both in Kenya and in other economies It is upon this foundation that, it becomes important to establish how real estate investments perform in a macroeconomic set up.

## 1.4 Research Objectives

### 1.4.1 General Objective

The main aim of the study is to assess the association between inflation, interest rates, exchange rate and the financial performance of real estate investment in Kenya

### 1.4.2 Specific Objectives

The research objectives are to:

1. To establish the association between inflation, interest rates and exchange rate with real estate investment financial performance in Kenya.
2. To establish the effect of inflation, interest rates and exchange rate on real estate residential property prices in Kenya
3. To establish the effect of inflation, interest rates and exchange rates on real estate sector growth rate in Kenya.

## 1.5 Research Hypothesis

1. $\mathbf{H_{01}}$: There is no association between inflation, interest rates and exchange rate with real estate investment financial performance in Kenya.
2. $\mathbf{H_{02}}$: There is no effect of inflation, interest rates and exchange rate on real estate residential property prices in Kenya.
3. $\mathbf{H_{02}}$: There is no effect of inflation, interest rates and exchange rates on real estate sector growth rate in Kenya.

## 1.6 Justification of the Study

The study will help in provide evidence-based findings on the association between inflation, interest rates, exchange rate and the financial performance of real estate investment. It will inform financiers and investors on how to optimally allocate their resources to real estate investment in a mixed asset portfolio while paying keen attention to its inflation hedging opportunity, interest rate sensitivity and exchange rate volatility from time to time. The findings from this study will encourage uptake of real estate investment by both large institutional investors and retail investors resulting from increased familiarity. The increased understanding and awareness would increase uptake and spur the real estate sector and in essence lead to the realization and attainment of one of the pillars of the big four agenda specifically affordable housing for all the country's citizenry through increased investment in housing by real estate developers and investors. The study will have an impact on investment decisions of investment analysts, property analysts, property developers, real estate firms, policy makers and academics through extraction of experiences of the developed market and detailed empirical analysis that may be used in their future endeavors in this important subsector of the economy.

## 1.7 Conceptual Framework

Conceptual framework is the foundation on which the entire research project is based (Mathooko, 2011). It is conceptualized in this study that the real estate investment financial performance has an association with the exchange rate regime, inflation regime and interest rate regime in Kenya. The study will use a correlational approach as the methodology for the study. **Independent Variables** **Study Dependent variables** (Financial Performance)

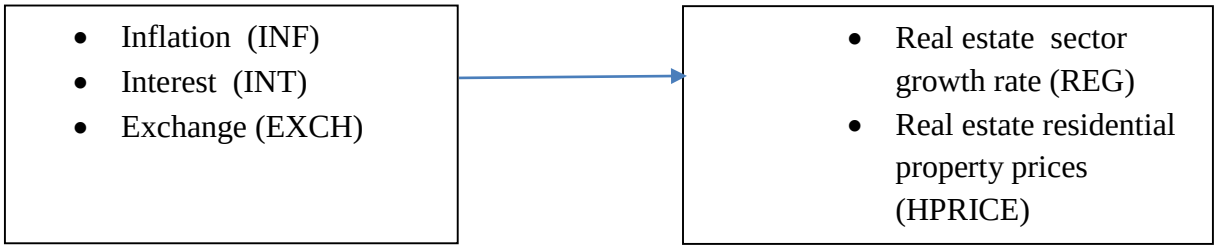



***Figure 1* : *Conceptual Framework***

## 1.8 Scope of the Study

The study will cover quarterly values of The Kenya Bankers Housing Price Index (HPRICE), quarterly lending interest rates by commercial banks, quarterly exchange rate between Kenyan Shilling and US dollar, quarterly real estate sector growth (REG) and the quarterly inflation rate from 2012Q1 to 2021Q4 period.

# CHAPTER TWO: LITERATURE REVIEW

## 2.1 Introduction

This part will carry out a detailed review of the major theories that act as the baseline for understanding the relationship that exists in this study. This part will also look at the previous empirical literature carried out over the years and lastly a summary of the findings from this study as well as the research gap.

## 2.2 Theoretical Review

This study will be guided by the Arbitrage pricing theory, the four quadrant model and the efficient market hypothesis (EMH).

### 2.2.1 Efficient market hypothesis

This theory was proposed by Fama (1965). It was generally developed from the Random Walk Hypothesis and the initial ideas were inspired from Bachelier (1900) PhD thesis on The Theory of speculation postulating that share prices are random by nature. The EMH has been developed and expanded to fit various assets operating in open market (Mutwiri, Omagwa, & Wamugo, 2021). This theory postulates that all available and anticipated information in the value of a stock has already been include in its current price (Fama,1970). Therefore, in this regard the asset price is efficient as perceived by investors hence it's close to impossible to beat the market, trying to predict the next move the market will make is regarded as a loser's game. This theory enables us understand how asset prices are determined in an efficient market (Ejem, Ogbonna, & Okpara, 2020). For retail and institutional investors, the market forces of supply and demand should be a precise representation of the fundamental value of a given firm, this is mostly because the theory hypothesizes that investors are rational and that the information is represented in the share price of a firm. Brealey & Myers (2011) establish that in an efficient market, there is tradeoff between risk and return. There are three forms of market efficiency which include weak, semi strong and strong. This in essence means that investors cannot get a return higher than the rate already available in the market because of this efficiency (Fama & French, 1996). This theory is relevant and in line with this study since it enables us understand how investors make investment decisions, therefore when extended it points out that prices and returns of investments in real estate are actually determined by demand and supply. The theory can be extended and linked to arbitrage pricing theory to explain market efficiency and the law of one price and how it is close to

impossible to predict and take advantage of relative mispricing of share prices since no arbitrage opportunities exist. Therefore it enables us the price setting mechanism for different asset classes in the investment universe.

### 2.2.2 Arbitrage pricing theory

This theory was proposed Ross (1976) as a reasonable substitute to the Capital Asset Pricing Model (CAPM). It is an asset pricing model which 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 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 universal plus as specific asset risk free rate.

In the Arbitrage Pricing Theory, by merging the different factors in the model, the investor is able to value the assets price. 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 investment growth and prices can be explained in the APT framework.

## 2.3 Empirical Literature Review

This part covers a review of previous empirical studies on how inflation, exchange rate and interest rates are related to financial performance of real estate investments.

### 2.3.1 Relationship between inflation and real estate investment

Using Irish data Stevenson & Murray (1999) carried out an investigation on the inflation hedging ability of 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 models that were static which had a number of difficulties, the researchers decided to adopt the use of more robust causality and cointegration tests but these too resulted in similar results that inflation didn't granger cause real estate returns and that there was no long run relationship. The study was however conducted in a developed country with generally stable inflation rates as well as low interest rates. This study will be carried out in Kenya a developing country and compared to the developed economies to draw similarity and contrasts.

Using the empirical data from Singapore markets, Sing & Swee Hiang (2000) carried out an empirical study to test the belief that real estate investments provided a hedge against expected and unexpected inflation. The researchers carried out the investigation on sub classes of the real estate market including real estate industrial properties and shops. The study established that for both sub classes, real estate provided an effective hedge against both expected and unexpected inflation. They also established that the returns on these real estate investments also increased at a faster rate than the rate of inflation. They however established that for different sub periods, the real estate investments had different coefficients some positive others negative mostly in the shop segment hence giving mixed conflicting results. The industrial properties however provided complete hedge across all periods. This therefore meant that real estate investments can provide inflation protection for themselves and for the whole portfolio. The study however gave out mixed results in different sub periods, this study will therefore try and reconcile this inconsistency through Vector Error Correction Model to test the results in both the short run and long run.

Using multiple regression analysis Bor (2018) carried out a study to investigate the relationship between real estate sector and a number of macro-economic variables in Kenya between 2007 and 2016. The researcher adopted a correlational research design while making use of a static multiple regression model. The proxy for the real estate sector was the Hass Consult residential Index. The researcher established that inflation had a significant influence on the performance of real estate investments in Kenya. The results were corroborated by Kibunyi & Waguru (2017) who established the existence of a relationship between real estate sector and inflation. The study however didn't carry out robust time series checks such as unit root stationarity test and cointegration analysis considering the data was time series in nature. This study will bridge this

gap by carrying out cointegration tests to ascertain the existence of both short run and long run relationships.

Using Kenyan residential real estate data collected from Hass Property Index. Mulekyo (2020) carried out a study to investigate factors that influence the performance of residential real estate in Kenya. Among a number of economic factors, the study first established that the data was stationary through the use of various unit root tests. The researcher then carried out multiple regression analysis and established that inflation was one of the factors that had a significant influence on the prices of residential real estate units in Kenya. The study however didn't look at the long run relationship between the study variables hence there was no way to ascertain for sure the nature of the relationship considering the study variables were all time series in nature.

Using Kenyan real estate data Wainaina (2020) carried out a study to investigate which factors contributed to the performance of the real estate sector in Kenya. While adopting correlational research design and making use of real estate residential data collected from Hass Consult and other government agencies such as Kenya National Bureau of statistics and the Central Bank of Kenya between 2007 and 2016, the researcher made use of a static multiple regression model. The researcher carried out diagnostic tests such as normality and serial correlation tests to ensure the data respected assumptions of the Classical Linear Regression Model. The results from their study led to the conclusion that there was a significant relationship between real estate residential market and inflation. The study however failed to explain if the dynamics were present both in the short run and in the long run. This study will solve this gap through the adoption of more robust methods of analysis in cointegration and Vector Error Correction Model to try and integrate the short run and long run relationship and the speed of adjustment back to equilibrium.

Using USA data, Youguo & Webb (1996) carried out a study to examine the hedging role played by real estate investments in a mixed asset portfolio. Using hedged equity REIT returns to represent commercial real estate, the authors illustrated that hedged REITs played a significant role in a mixed asset portfolio composed of U.S bonds, U.S hedged equity REITs, stocks and international equity stock. They noted that an investor investing in the above mixed asset portfolio could obtain the same expected return but lower instability by allocating,26% in U.S bonds, estate, 17% in U.S.A common stock, 48% in U.S real and 9% in international stock contrary to putting

investments in the conservative portfolio of forty percent stock sixty percent bonds. The authors concluded that investors should seek to diversify their portfolios by including hedged REITs as part of their asset allocation. Therefore, REITs act as a hedge to inflation in the long run, this characteristic contributes positively by increasing real returns and lowering risk when the REIT is included in the asset allocation of a mixed asset portfolio. The study however focused only on the developed USA market and only focused on REITs not the residential real estate.

There was a study by Mukesh, Rohan, & Webb (2010) who investigated the diversification benefits of making REITs part of a mixed asset 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 one hand, there appeared to be a strong indication of cointegration between energy-related assets and REITs, while on 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 relationship 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.

Using Hong Kong data, Lee (2013) carried out OLS regression examining the long run and short run hedging possibilities of various asset classes over inflation over the period 1980 to 2008. The regression output showed that only residential properties provided an actual hedge against inflation in form of expected, actual or unexpected. The researcher confirmed that the asset classes being investigated alongside real estate were actually cointegrated with inflation through the ARDL bounds test. Therefore in the long run, real estate and these four asset classess had returns higher than the rate of inflation hence could hedge against inflation. Similarly the returns of real estate were higher than those of the other asset classes signaling that in the short and long run, real estate was a better hedge. The study however only looked at inflation and REIT returns in isolation and was carried out in a developed economy. This study will however look at exchange rate, inflation

rate and interest rate and will focus on the Kenyan real estate market to draw similarities and contrasts with the developed economies.

Making use of panel data collected from 84 countries between the years 1980 to 2010, Zermeño, Martínez, & Preciado, (2018) carried out an investigation on the impact of inflation on financial sector performance using standard and fixed effects quantile regression. They found out that the expected coefficients showed a high degree of randomness at different quintiles of the distribution. Secondly, the study established that there was a heterogeneous influence of inflation on financial intermediaries in the developed world. According to an estimator used in their model, the preferred country fixed effects estimator, for developing countries the impact of inflation lower than for those of developed economies. The impact of inflation on these developed countries was found to be insignificant. Therefore inflation had a higher impact on financial sector in developed countries which have well developed capital and financial markets compare to developing countries with relatively young nascent capital and financial markets. The study however only focused on the relationship between inflation and the financial sector. To draw similarities and contrasts, this study will study the relationship between exchange rate, interest rates and inflation focusing only on the real estate investment market as opposed to the whole financial sector.

While carrying out a study on how economic shocks affect the returns of REITs in Turkey Malaysia and Taiwan with a major focus on the direction of the existing relationship. Maina (2021) used data collected from 2009 to 2019 collected or retrieved from the REIT markets in the respective stock markets in the countries being covered. Among other macro-economic factors the study analyzed. The research design was correlational research design and anchored on the Arbitrage Pricing Theory and based on the static OLS for analysis. The study established that in the markets being analysed, it was only GDP and exchange rate regime that had significant influence on the performance of REITs, inflation didn't have any significant relationship with REIT performance. The study however only looked at three countries, Taiwan, Malaysia and Turkey which have more developed capital markets and dynamics affecting operations. This study will specifically focus on the Kenyan real estate residential property market as well as on both long run and short run dynamics.

While examining how REIT market (N-REIT) perform 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 and Schwert model (1977) as the baseline model guiding their study, this theory is an extension and improvement of the Fisher Hypothesis. There results established that N-REIT that was investigated showed poor inflation hedging relationship with inflation at different levels of inflation being expected, unexpected and actual. Their results which were based on the Engle Granger causality implied that real estate investments through REITs had important and significant impact on investors in the Nigerian Market, 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 contrast while looking at the residential real estate market as well as the whole real estate sector as contribution to GDP in Kenya.

### 2.3.2 Relationship between interest rates and real estate investment

Using Kenyan quarterly data between 2007 and 2016 Irandu (2017) sought to establish how real estate performance is influenced by macro-economic factors. The researcher made use of descriptive research design. Secondary data for the study was collected from Hass Consult, Kenya Bureau of statistics and the Central Bank of Kenya. The study used a static multiple regression model to quantitatively test the existing relationship. The study used the level of significance of the independent variables to test the relationship: these include money supply growth rate, interest rate, inflation rate and GDP growth rate and control factors: credit growth rate and capital. The results indicated that the coefficients of interest rate were positive indicating a positive but insignificant relationship between inflation rates. In this regard the study established that real estate investments were not sensitive to interest rate changes as shown by the insignificant coefficient for interest rate. The study however didn't carry out stationarity test on the data making it uncertain whether or not the data was stationary. This study will however carry out stationarity test on the time series data before carrying out more robust cointegration analysis.

Carrying out a research on the determinants of real estate financing by micro finance institutions using survey research design Muriuki (2018) surveyed responses from respondents from the twelve micro finance firms in Kenya with the respondents being segmented into the male and

female gender The dependent variable was access to real estate finance while the independent 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 on property developers and investors invariably resulting in the cost of financing being higher. Therefore, in this regard, interest rates are an imperative determining factor of the performance of investments in real estate. The study however focused on micro finance institutions, this study will focus on the whole real estate investment market through real estate growth rate and residential real estate prices.

Carrying out a research to establish the influence interest rate volatility has on the development of the real estate market in Kenya, Murage (2013) sought to show how interest rate volatility affected real estate investments. Real estate as an investment is capital intensive and requires financing from banks and deposit taking financial institutions which might be out of reach of ordinary retail investors. The study adopted the static multiple linear regression model as the quantitative model to test the relationship between real estate and interest rate volatility. The data used was collected between 2008 to 2012. The findings from the study established that the impact of interest rate volatility on real estate sector was insignificant. Therefore, according to the study, interest rates have an insignificant effect on the development and performance of the real estate sector. The study however only looks at interest rates, this study at other macro-economic factors such as exchange rate, interest rate and inflation on the performance of real estate.

While examining the influence of interest rate among other factors on residential real estate prices in Nairobi, Kosgei & Rono (2018) applied an explanatory research design to attempt to explain the influence of the independent variables on residential real estate prices for the study period 2004-2016. The data used was quarterly between 2004 and 2016 of the Hass Consult House Price Index (HPI) and subsequently observations on a quarterly basis of the study variables. The data on quarterly residential real estate prices was fetched from Hass Property Consult Ltd a real estate research company whereas that on the independent variables was retrieved from Central Bank of Kenya and The Kenya National Bureau of Statistics. The study made use of the Vector Error Correction Model (VECM) to establish the short-run and long run relationship between the determinants and residential house prices. Results confirmed the presence of a short-run and long

run association among variables in the model. The researcher established a negative but significant relationship between interest rate and the performance of real estate.

Carrying out a study to investigate at the influence of interest rate capping on performance of Real Estate Investment Trusts in Kenya, Kinyanjui (2021) aimed at measuring the effect of interest rates on the REIT performance; determining the influence of the economy on REIT performance; and assessed the effect of government policies on the performance of REITs. The research sample comprised of licensed REIT Managers in Kenya which were registered with the Capital Markets Authority. The study made use of a descriptive research design to analyze the impact of interest rate capping on the performance of REITs. The study used descriptive research to determine the influence of the specific variables. The study used data collected from information on REITs performance collected from the respective REIT Managers. The study also carried out quantitative analysis on data. The study implemented a census approach and included all the 7 firms with the respondents being drawn from top management. The research established that interest rates had significant impact on the performance of REITs in Kenya. The study however only looked at listed real estate not the whole real estate market. This study will however look at the whole real estate market.

Using data from MSCI Equity Index from 1994 to 2016, Gilberto & Shulman (2017) studied the interest rate sensitivity of REITs. They carried out regression analysis on the data and found out that there was no consistent long-run projecting rule of thumb for how REITs actually responded to changes interest rates. They also point out that it is not possible to make a general statement about how an interest rate change will affect REIT returns, but noted that REITs might be sensitive interest rate changes in the short run. On the same note Shulman (2015) while examining the inconsistency in the performance of the price only version of the MSCI REIT Index in comparison to Standard and Poor's 500 Index acting as function of the ten-year U.S. Treasury note yield 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 rate without putting inflation into consideration. This study will however look at additional variables including interest rate and exchange rate.

Using Nigerian data collected for the period 2008-2017, Olanrele, Adegunle, & Fateye (2018) examined how macro-economic factors predicted performance of Nigerian REITs. The variables used in the study included inflation rate, interest rate, exchange rate, the all-share index and market capitalization. The researcher made use of a quantitative research design and acquired secondary data from numerous financial statements published by the government in Nigeria. The researchers made use of the Autoregressive-distributed lag (ARDL) and Bound tests. They established that returns of REITs had a long run relationship with Interest rate and all share indexes. The other factors u. The study considered REITs in Nigeria; the current study will focus on the whole real estate sector in Kenya.

Carrying out a study to determine how interest rates relate with the performance of the real estate sector in Kenya, Kamweru & Ngui (2017) implemented a descriptive survey design tand retrieved data from registered developers in Nairobi. The results showed that real estate investment was negatively affected by lending interest rates. On the other hand interest rates on deposits with financial institutions had an insignificant impact on the performance of the real estate sector. The researchers also noted that in both the short run and long run, interest rates on overdraft facilities had a significant influence on the performance of real estate investments. In the same note inflation was established to significantly reduce real estate growth in Nairobi. The study focused on real estate developers who are affected by only one component of real estate market dynamics, this study sought to look at the other aspects such as the asset value through residential real estate prices and also through demand and supply of the units.

Carrying out a study on Stanlib Fahari I REIT, Kipkurui (2019) sought to establish how REIT financial performance was affected by various macro-economic variables. These included foreign exchange rates, interest rate regime and the inflation regime. The author anchored the study on the efficient market hypothesis, arbitrage pricing theory and the purchasing power parity theory. The study was based on data collected for three years from Hass Consult a real estate research company as well as from the Central bank of Kenya databases. Therefore the results established that interest rates had an insignificant positive impact on REITs while exchange rate had an insignificant negative impact on the financial performance of REITS. The study however used only one company as a representation of the whole real estate market and analyzed data for a three-year

period using SPSS. This study will try and bridge that gap by looking at the whole real estate market thought data collected from an all-inclusive real estate research firm and will analyze data collected for a 11-year period as well as making use of a more robust econometric methodology in cointegration.

Carried out a study to establish the factors that determine the performance of real estate sector in Nairobi, Bor (2018) examined the impact demographics, interest rates. Government policies, the economy had on the real estate sector in Kenya. The scope of the study entailed REITs in the Kenyan real estate sector. The price theory, interest rate and classical theory guided the study with the research adopting a descriptive research design. The target population entailed managers working with real estate investment trusts in Kenya. The study determined that the relationship between economy, government policies and demographics and financial performance of REITs on the other was positive and significant. It was also established that there existed a positive and reasonably strong and significant association between interest rates and financial performance of REITs. The study however only concentrated on REIT managers not the whole real estate market, this study will look at both the long run and short run relationship between real estate market and interest rates.

### 2.3.3 Relationship between exchange rates and real estate investment

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 adoption of 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 stationary test on the time series data that was collected and analyzed therefore making it uncertain whether or not the data was stationary. The data also analyzed one facet of investments made in the real estate market making use of one single company as a representation for the whole real estate investment which is not statistically significant. This study will however use a cointegration methodology namely Vector Error Correction Model and Vector Autoregressive Model to analyze both the short run

and the long run relationships. This study will also analyze data that is representative of the whole real estate market collected from Kenya Bankers property index.

Similarly, Wanjiku (2021) sought to establish the impact of selected macro-economic on factors on registered REIT managers making use of data that was time series in nature collected from 2016 to 2021. The data was collected from 13 registered REIT managers and went through diagnostic tests such as test for normality, multicollinearity and serial correlation in order to establish whether or not the model specified was statistically significant. The author established that there was no significant relationship between registered REIT managers and the exchange rate regime in the country. The researcher however only focused on registered real estate investment trust managers which are not necessarily involved in the real estate investment management only, they might also engage in the management of other asset classes such as equity and commodities hence their performance is not representative of the real estate investment sector. This study will therefore look at on the whole real estate market through use of data collected from an all-inclusive real estate index.

Using REIT data collected from various developed economies (Ijasan, Ijasan, Tweneboah, Oyedokun, & Adam, 2021) carried out a study on the relationship between exchange rates and global REITs from 2012 to 2019. The study employed the Intrinsic Mode Functions (IMFs) and Ensemble Empirical Mode Decomposition (EEMD) method to additionally carry out an examination of 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 term and short term, currency depreciation and appreciation have a straight 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. Making use of the Vector Auto Regressive model as well as Augmented Dickey Fuller and Granger causality test. The authors established that the REIT index return rate was influenced by exchange rates, contrary to this the housing price index return rates was not affected by 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 behavior of the same variables in the Kenya as well as the contrasts.

Using quarterly data between 2010Q1 and 2013Q4 Mallick & Mahalik (2015) sought to explain the factors 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 a fundamental results that implied that the effective exchange rate regime had no significant influence on housing prices in India, implying that exchange rate was not on of the factors influencing 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 meaning very few foreign investors had investments in the India real estate sector or that the remittances from Indians living abroad didn't go towards real estate development and investments but rather on things like basic needs and school fees . The study however only focused on the Indian sub-continent, this study will however concentrate in the Kenyan case to draw similarities and differences.

Using Kenyan residential real estate prices, Njoroge, Muturi and Oluoch (2019) carried out an extensive research on the association between the returns of real estate investment and the exchange rate regime in the country. They adopted cointegration methodology to investigate the association that exists between the two study variables. They looked at the long run and the short run relationship between the variables. Using the Vector Error Correction Model they established that exchange rate had a positive effect on the performance of the residential property market in Kenya in the long run. The authors argue that gradual devaluation of the Kenyan shilling leads to growth of the residential real estate investments market mostly because housing priced become cheaper for those who hold foreign currencies especially those abroad who invest in Kenya. The study however only looked at exchange rate in isolation without looking at other variables such as

inflation and interest rate. This study will seek to bridge that gap by including inflation and interest rate.

Using Ghanaian data from 1986 to 2017 collected from Ghana Real Estate Developers, Jack, Okyere and Amoah investigated the effects of exchange rate instability on real estate prices in developing countries with their focus being on the real estate market in Ghana. They made use of an explanatory research design to enable them establish the existing association between various factors and real estate. The researchers adopted the Autoregressive Distributed Lag (ARDL) since it was the most statistically significant econometric model over a small sample size which was used in their study, additionally the model can also be used in both I (1) and I (0) hence avoids the pretesting problems that are associated with cointegration techniques, lastly the ARDL model they adopted was even suitable in cases where there is unit root uncertainty in the data being tested. In their econometric analysis, the authors established that the real estate market in Ghana which was mostly composed of semi-detached residential housing, exchange rate was insignificant in influencing residential real estate prices. They however established that remittances had a positive impact on real estate prices while inflation and past real estate prices had an insignificant influence on the real estate prices in Ghana. This could mean that the exchange rate regime in Ghana is more or less stable hence the value of remittances are not affected by exchange rate which is stable. The study was however focused on the Ghana market hence this study will carry out the investigation in the Kenyan market while using all-inclusive real estate data that represents the whole Kenyan real estate market.

Using real estate data collected from Hass Consult and Central Bank of Kenya between the years 2000 to 2014, Bioreri (2014) sought to analyze real estate residential prices were affected by a number of macro-economic variables. The researcher adopted descriptive research design. The population for the study included large real estate developers to small scale retail investors and involved data collected from 42,180 registered real estate firms. The researcher adopted the Classical Linear Regression approach in its data analysis, she carried out a number of diagnostic tests to determine the credibility of the models as well as the data used in the study to ensure there were no cases of multicollinearity and Heteroscedasticity and that the data was normally distributed as required in the Classical Linear Regression Model. Data on macro-economic variables was all collected from the Central bank of Kenya. The results from the research implied

that exchange rate had a significant influence on residential real estate prices in Kenya. The study however didn't carry out stationarity test on the data collected for a 14-year period hence there is some uncertainty whether or not the data was actually stationary. Secondly the author only looked at the short run relationship. This study will however carry out various stationarity tests on the data to ensure stationarity, after which the study will adopt a more robust cointegration methodology including Vector Auto regression (VAR) and Vector Error Correction Model (VECM) to test the significance or presence of any relationship.

### 2.4 Conclusion on Literature review

From the empirical review, it is clear that there exists rich literature on real estate investments, regionally and locally. From the results of the previous studies carried out, it is evident that there have been a number of inconsistencies where the same study using the same methodology has resulted in totally different results. The importance of research is replicability in different markets or environments, therefore if the same study using the same variables yields different results in different environments, then there exists uncertainty on the actual relationship that exists. Secondly the literature reveals that in Kenya mostly registered REIT managers were being analyzed instead of the whole real estate market which is subject to open market operations and to investor sentiment and expectation. Registered REITs are allowed to manage REIT investments but their operations might also include other asset classes therefore their performance is not wholly attributed to real estate hence would not give a true reflection of the real estate sector. Lastly most studies in Kenya have not carried out diagnostic tests such as unit root tests to test for stationarity, this is not reliable because by nature real estate investment property prices and macro-economic variables are time series in nature and might be prone to spurious regression hence the need to ensure that the data is stationary before carrying out analysis and drawing conclusions.

# CHAPTER THREE: RESEARCH METHODOLOGY

## 3.1 Introduction

This chapter is a presentation of the research methods to be used in the study. These research methods comprise of the research design, study sample, data analysis, and data presentation. This study will adopt a post positivist philosophical worldview. According to Creswell (2014) in post positivist worldview, 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. The knowledge which is discovered through this philosophical view is derived from the cautious reflection and collection of data on the reality that is in existence which has to be objective in nature. In this methodology, the knowledge search starts from an initial theory, collection of genuine data which leads the researcher to support or refute the theory.

## 3.2 Research Design

The study will adopt a correlational research design to carry out an investigation on the influence of inflation, interest rates and exchange rate the financial performance of real estate investments. Since the data used is times series in nature, the study will adopt the unit root methodology to test whether or not the data is stationary or non-stationary after which there will be implementation of cointegration analysis to investigate the association between the variables in the model. The study period will be from 2012Q1 to 2021Q4. This is aimed at achieving comprehensive coverage and will in essence give accurate results. This is an appropriate sample and will give a true reflection of the actual situation in the economic environment with all the data points being taken into consideration. Since data being used in the analysis is time series in nature, the study adopted unit root test followed by Johansen cointegration methodology after which Vector Auto regression model (VAR) was used. Variables are said to be co-integrated when there exists long run equilibrium relationship. In the event two variables, dependent and independent are non-stationary but their residuals are stationary, those variables are said to have a long run relationship and hence carrying out unit root diagnostic test for cointegration helps to determine if the model being developed is empirically meaningful (Gujarati, 2004).

## 3.3 Study Area

The study will be carried out in Kenya which is a country located in East Africa. The country has a number of countries bordering it with Uganda bordering it to the West, while Ethiopia is found

towards the north, Tanzania is found in the south, Somalia is found in the east, lastly Sudan being located in northwest.

### 3.4 Data Sources and Measurement

The study will adopt time series analysis. Quarterly real estate investment return data will be collected from Kenya Bankers Housing Price Index a financial sector research firm which carries out research on real estate as well as development of indexes to measure the prices of residential real estate prices. This Index along with the growth of real estate as contribution to Gross Domestic Product will be used as proxies for real estate financial performance in Kenya. The growth in the real estate sector proxied as overall percentage change in the real estate contribution to GDP. The property index is a Laspeyres- index and is composed of real estate residential property values computed from the base year 2013 and has been collected quarterly each year with property prices being made up of data collected from Suburbs in Nairobi, Mombasa, Kisumu, Eldoret, Nyeri and Thika. The residential property types include apartments, semi-detached and detached properties with the number of bedrooms ranging from 1 to 6, the properties range from commercial, apartments and mixed-use developments. Therefore, it will provide a reliable outlook and view of the performance of the real estate sector in Kenya. The study will use quarterly Consumer Price Index as proxy for inflation which is availed by Kenya National Bureau of Statistics (KNBS) which is a reliable source of macroeconomic data in Kenya. The study will use exchange rate between the Kenyan Shilling and the US dollar which forms the major currency in which remittances from abroad are received in Kenya and will be retrieved from the Central Bank of Kenya database. Lastly the proxy for interest rates in the Kenyan market will be the quarterly weighted lending rates of all commercial banks fetched from Central Bank of Kenya (CBK) database and is usually responsible for the interest rate regime in the country through different policies hence is the most reliable source for interest rate data in the Kenyan economy

### 3.5 Model specification

The following model in this section will be specified based on the conceptual framework. The model will include the variables analyzed in literature review. The regression model specification (3.1a) and (3.1b) will be based mainly on the conceptual framework as given in 1.7 and theoretical review. The model will denote the predicted value of $\mathbf{HPRICE_t}$ representing real estate property prices from Kenya Bankers Housing Price Index while $\mathbf{REG_t}$ relates to the percentage growth of

real estate sector in the economy will form the other equation (3.1b). From equation (3.1a) and (3.1b) the study will derive through estimation coefficients of the equations respectively.

$$\mathbf{HPRICE_t} = \beta_0 + \beta_1 INF_t + \beta_2 INT_t + \beta_3 EXCH_t + \mu_t \quad \textit{(3.1a)}$$

$$\mathbf{REG_t} = \beta_0 + \beta_1 INF_t + \beta_2 INT_t + \beta_3 EXCH_t + \mu_t \quad \textit{(3.1b)}$$

Where:

**$HPRICE_t$** - the index of residential real estate prices

**$REG_t$** – The growth in real estate sector

**$INF_t$** -Consumer Price Index (CPI)

**$INT_t$** -weighted average lending rates by commercial banks.

**$EXCH_t$** -Exchange rate between Kenyan Shilling and the US dollar.

**$u_t$** - the error term.

### 3.6 Data Analysis

The study will implement cointegration techniques in data analysis. The study will utilize a wide range of descriptive statistics in analysis. These will include the mean, the median, the Standard Deviation, Skewness, Kurtosis and lastly Jarque-Bera statistic in its analysis. Correlation matrix will be used to conduct an initial analysis of existence of likely relationship between inflation, the interest rates, exchange rate and performance of real estate investment. The study will also carry out rolling correlation and rolling inflation and interest rate graphs to investigate variable-pair relationships. The study will use EViews statistical software as an aid in the analysis of the data and carry out stationarity tests, long run relationship cointegration, Normality tests, and VAR and Vector Error Correction estimation.

#### 3.6.1 Descriptive statistics

Descriptive statistics will be used in the study to present a preliminary outlook of the viability of the data adopted for the study to establish whether it is suitable for parametric and non-parametric tests as well as for quantitative research. Descriptive statistics test is also important in initial stages since it enables us determine if the data is normally distributed in order to make necessary adjustments before using the data for further analysis. It also enables us establish whether or not outliers exist in the data , state of and reliability of central tendency measurements, state of dispersion in data and lastly state of normality.

The study will use the standard deviation results along with the measures of central tendency such as the mean and median to show how data has been dispersed to check whether there might exists some outliers. The study will look at skewness as well as kurtosis of the data in order to establish whether or not the data is normally distributed and significant for the study. Gujarati (2009) notes that data with skewness of 0 and kurtosis of +3 is normally distributed. While on the other hand the probability density function (pdf) of data with kurtosis of 3 shows that the data obeys mesokurtic relationship while that with a kurtosis of less than +3 is plurtykurtic and lastly that with kurtosis of more than 3 is leptokurtic. Mesokurtic kurtosis is normally distributed.

The study will also test for normality by making use of the Jarque Bera (JB) statistic. Jarque & Bera (1987) notes the JB test follows a chi square distrubution with two degrees of freedom with the null hypothesis being that the data follows a normal distribution. Gujarati (2009) states that when P-value of the Jarque-Bera statistic is smaller than five percent the null hypothesis is rejected.

### 3.6.2 Correlation Analysis

Correlation analysis was conducted to enable us determine to what extent the study variables are associated. In unison with the first objective of the study, the null hypothesis is that correlation does not exist between real estate investment and the independent variables at 5% significance.

$$r_{xy} = \frac{\sum x_i y_i}{\sqrt{\sum x_i^2 * \sqrt{\sum y_i^2}}} \quad \textbf{(3.2)}$$

Where $\mathbf{x_i}=X_i - \bar{X}$ and $\mathbf{y_i} = Y_i - \bar{Y}$

### 3.6.3 Unit Root Test

In the field of finance data that is generally non-stationary. Regression of one time series variable on another variable can often lead to spurious regression. Therefore, it becomes important for researchers to carry out a preliminary test to ensure that the results won't be spurious Nyongesa (2016). Spurious regression is a type of regression whereby the $R^2$ is significant but there is not relationship in real sense. In respect of this phenomena inherent in most time series data, the study will implement a quantitative approach to test for non-stationarity. Therefore, the study will carry out a robust unit root test as well as preliminary tests by using four dissimilar methods. The graphical analysis as proposed by (Gujarati, 2009) , Ordinary Least Squares (OLS) test as proposed by (Granger & Newbold ,1974) ,the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test, Phillips

Perron (PP) and Augmented Dickey-Fuller (ADF) test, will be used to test for unit root in the data used in the study.

#### 3.6.3.1 Graphical analysis

This study will also use graphical analysis, according to Gujarati (2009) it is important to carry out graphical analysis of the data before carrying out formal robust tests on the data to get initial clues of the nature of data. When a plotted data trends upwards or downwards, it might be a sign that the mean is not constant and is changing hence might be a sign of non-stationarity.

#### 3.6.3.2 Ordinary Least Squares test

The study will carry out ordinary least squares regression (OLS). This will then be followed with comparison of $R^2$ statistic to Durbin Watson statistic (d). According to Granger & Newbold (1974), an $R^2$ greater than the (d) statistics indicates that there might be a case of spurious results which means that the data used in the study might be non-stationary.

#### 3.6.3.3 Augmented Dickey Fuller Test

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

$$\Delta y_t = a y_{t-1} + \sum_{i=1}^{n} q_i \, \Delta y_{t-i} + \varepsilon_t \quad \textbf{(3.3a)}$$

$$\Delta y_t = \beta_1 + a y_{t-1} + \sum_{i=1}^{n} q_i \, \Delta y_{t-i} + \varepsilon_t \quad \textbf{(3.3b)}$$

$$\Delta y_t = \beta_1 + \beta_{2t} + a y_{t-1} + \sum_{i=1}^{m} q_i \, \Delta y_{t-i} + \varepsilon_t \quad \textbf{(3.3c)}$$

The above equations imply the presence of deterministic elements $a$ and $q$ (3.3a) which involve arbitrary random walk model, where (3.3b) comprises an intercept and (3.2c) comprises an intercept and a trend.

#### 3.6.3.4 Kwaitowski-Phillips-Schmidt-Shin (KPSS)

The study will make use of the Kwiatkowski, Phillips, Schmidt, & Shin, (1992) test to test the null hypothesis that the data is stationary. Gujarati (2004) states that this test is a higher power test which takes care of serial correlation in the error terms hence suitable for testing unit root.

#### 3.6.3.5 Phillips Perron (PP)

The Phillips & Perron (1988) stationarity test will also be performed on levels and first difference to test. Just like the ADF test, the null hypothesis for this test is non stationarity of the data.

Together with the KPSS, these tests takes care of serial correlation in the error terms by utilizing non-parametric methods while leaving out lagged differenced terms.

### 3.6.4 Cointegration Test

The study will make use of the Johansen (1988) cointegration methodology to test the presence of long run relationship between the study variables. Johansen cointegration approach is an autoregressive method which makes use of the maximum eigenvalue likelihood ratio tests and the trace test and is able to test more than one cointegrating vector (Gujarati, 2004).

The study will adopt the use of this method because of the presence of more than two variables in the model being used. However for the adoption of Johansen's procedure, the study will establish the following as noted by Mukras (2012); first carry out 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 to establish the number of cointegrating vectors presence which the calls for estimating coefficients of the Error Correction term. Making use of this procedure first VAR of order *p* will be developed as shown in (3.4) after which it is reparametrized and presented in (3.5) as well as (3.5.1) through a cointegrating transformation resulting in a Vector Error Correction Model (VECM) which will be able to estimate short run and long run relationship changes in the variables in the vector $\Delta Z_t$ through the coefficient matrices $\boldsymbol{\pi}$ and $\boldsymbol{\Gamma_i}$

$$Z_t = A_1 Z_{t-1} + A_2 Z_{t-2} + \cdots + A_p Z_{t-p} + \mu_t \quad \textbf{(3.4)}$$

Where:

$Z_t = 3X1\ Vector\ of\ variables\ that\ are\ integrated\ of\ order\ one$

$u_t = 3X1\ Vector\ of\ innovations\ or\ disturbance\ terms$

$Z_{t-p} = 3X1\ Vector\ of\ p\ \ lagged\ variables\ of\ Z_t$

$A = 3X3\ matrix\ of\ coefficients\ of\ \ Z_{t-p}$

$$\Delta Z_t = \pi Z_{t-1} + \sum_{i=1}^{p} \Gamma_1 \Delta Z_{t-i} + u_t \quad \textbf{(3.5)}$$

$$\Delta Z_t = \pi Z_{t-1} + \Gamma_1 \Delta Z_{t-1} + .. + \Gamma_{p-1} \Delta Z_{t-p+1} + u_t \quad \textbf{(3.5.1)}$$

Where:

$$\pi = -\sum_{j=1}^{p} (I - A_J)\ and\ \Gamma_i = -\sum_{j=i+1}^{p-1} A_j \quad \textbf{(3.6)}$$

$\pi$ = 3x3 Matrix of coefficients of $Z_{t-1}$

$\Gamma_i$ = 3x3 Matrix of coefficients of $\Delta Z_{t-p}$

$\pi Z_{t-1}$ =3x1 the error correction term

The hypothesis will be as follows;

$H_0$: There is no cointegrating equation

$H_1$: The null hypothesis is not correct

The study will reject the null hypothesis if the values of the Trace and Max statistics are greater than the 5 percent critical value else we accept that there is no cointegrating equation

### 3.6.5 Vector Autoregressive Model (VAR)

The first step in cointegration analysis will be by first estimating the VAR model of order 1. The equations in the VAR model will entail having the dependent variable being in a function in which its vale is determined by lagged values from independent variables in the study as well as from its specific lagged values. This is shown below;

#### 3.6.5.1 Vector Autoregressive Model with $HPRICE_t$ as dependent variable

$$\boldsymbol{HPRICE_t} = \sigma + \sum_{i=t}^{k} \beta_i \boldsymbol{HPRICE_{t-i}} + \sum_{i=j}^{k} \theta_j INF_{t-j} + \sum_{i=m}^{k} \varphi_m INT_{t-m} + \sum_{i=n}^{k} \rho_n EXCH_{t-n} + \mu_{1t}$$

(3.7a)

$$\boldsymbol{INF_t} = a + \sum_{i=t}^{k} \beta_i HPRICE_{\boldsymbol{t-i}} + \sum_{i=j}^{k} \theta_j \boldsymbol{INF_{t-j}} + \sum_{i=m}^{k} \varphi_m INT_{t-m} + \sum_{i=n}^{k} \rho_n EXCH_{t-n} + \mu_{2t}$$

(3.7b)

$$\boldsymbol{INT_t} = d + \sum_{i=t}^{k} \beta_i HPRICE_{\boldsymbol{t-i}} + \sum_{i=j}^{k} \theta_j INF_{t-j} + \sum_{i=m}^{k} \varphi_m \boldsymbol{INT_{t-m}} + \sum_{i=n}^{k} \rho_n EXCH_{t-n} + \mu_{3t}$$

**(3.7c)**

$$\boldsymbol{EXCH_t} = y + \sum_{i=t}^{k} \beta_i HPRICE_{\boldsymbol{t-i}} + \sum_{i=j}^{k} \theta_j INF_{t-j} + \sum_{i=m}^{k} \varphi_m INT_{t-m} + \sum_{i=n}^{k} \rho_n \boldsymbol{EXCH_{t-n}} + \mu_{4t}$$

**(3.7d)**

#### 3.6.5.2 Vector Autoregressive Model with $REG_t$ as dependent variable

$$\boldsymbol{REG_t} = \sigma + \sum_{i=t}^{k} \beta_i \boldsymbol{REG_{t-i}} + \sum_{i=j}^{k} \theta_j INF_{t-j} + \sum_{i=m}^{k} \varphi_m INT_{t-m} + \sum_{i=n}^{k} \rho_n EXCH_{t-n} + \mu_{1t} \quad \textbf{(3.8a)}$$

$$\boldsymbol{INF_t} = a + \sum_{i=t}^{k} \beta_i REG_{\boldsymbol{t-i}} + \sum_{i=j}^{k} \theta_j \boldsymbol{INF_{t-j}} + \sum_{i=m}^{k} \varphi_m INT_{t-m} + \sum_{i=n}^{k} \rho_n EXCH_{t-n} + \mu_{2t}$$

**(3.8b)**

$$\boldsymbol{INT_t} = d + \sum_{i=t}^{k} \beta_i REG_{\boldsymbol{t-i}} + \sum_{i=j}^{k} \theta_j INF_{t-j} + \sum_{i=m}^{k} \varphi_m \boldsymbol{INT_{t-m}} + \sum_{i=n}^{k} \rho_n EXCH_{t-n} + \mu_{3t}$$

**(3.8c)**

$$\boldsymbol{EXCH_t} = y + \sum_{i=t}^{k} \beta_i REG_{\boldsymbol{t-i}} + \sum_{i=j}^{k} \theta_j INF_{t-j} + \sum_{i=m}^{k} \varphi_m INT_{t-m} + \sum_{i=n}^{k} \rho_n \boldsymbol{EXCH_{t-n}} + \mu_{4t} \quad \textbf{(3.8d)}$$

### 3.6.6 Vector Error Correction Model (VECM)

According to Kiganda (2018) it is important to relate and integrate long run and short run and long run dynamics in a cointegrating model. Therefore the study will establish the short run and long run equilibrium as well as the speed of adjustment through the VECM model. VECM will only be conducted if the results of the Johansen Procedure results in at least one cointegrating vector.

#### 3.6.6.1 VECM for $HPRICE_t$ with different dependent and independent variables

**Model 1**: VECM with Real estate investment as a dependent variable

$$\Delta \boldsymbol{HPRICE_t} = \sigma + \sum_{i=t}^{k-1} \beta_i \Delta \boldsymbol{HPRICE_{t-i}} + \sum_{i=j}^{k-1} \theta_j \Delta INF_{t-j} \sum_{i=m}^{k-1} \varphi_m \Delta INT_{t-m} \sum_{i=n}^{k-1} \rho_n \Delta EXCH_{t-n} + \pi_1 ECT_{t-1} + u_{1t} \quad (3.9a)$$

**Model 2**: **VECM with Inflation as a dependent variable**

$$\Delta \boldsymbol{INF_t} = a + \sum_{i=t}^{k-1} \beta_i \Delta HPRICE_{t-i} + \sum_{i=j}^{k-1} \theta_j \Delta \boldsymbol{INF_{t-j}} \sum_{i=m}^{k-1} \varphi_m \Delta INT_{t-m} \sum_{i=n}^{k-1} \rho_n \Delta EXCH_{t-n} + \pi_2 ECT_{t-1} + u_{2t} \quad (3.9b)$$

**Model 3**: VECM with interest rate as a dependent variable

$$\Delta \boldsymbol{INT_t} = d + \sum_{i=t}^{k-1} \beta_i \Delta HPRICE_{t-i} + \sum_{i=j}^{k-1} \theta_j \Delta INF_{t-j} + \sum_{i=m}^{k-1} \varphi_m \Delta \boldsymbol{INT_{t-m}} \sum_{i=n}^{k-1} \rho_n \Delta EXCH_{t-n} + \pi_3 ECT_{t-1} + u_{3t} \quad (3.9c)$$

**Model 4**: VECM with exchange rate as a dependent variable

$$\Delta \boldsymbol{EXCH_t} = \gamma + \sum_{i=t}^{k-1} \beta_i \Delta HPRICE_{t-i} + \sum_{i=j}^{k-1} \theta_j \Delta INF_{t-j} \sum_{i=m}^{k-1} \varphi_m \Delta \boldsymbol{INT_{t-m}} \sum_{i=n}^{k-1} \rho_n \Delta \boldsymbol{EXCH_{t-n}} + \pi_3 ECT_{t-1} + u_{4t} \quad (3.9d)$$

Where;

***K-1*** = Lag length where VAR is reduced by one lag.

$\boldsymbol{ECT_{t-1}}$ = The error correction term. It guides the dependent variable back to equilibrium.

$\boldsymbol{u_{1t}}$ , $\boldsymbol{u_{2t}}$, $\boldsymbol{u_{3t}}$, $\boldsymbol{u_{4t}}$ = residual.

$\boldsymbol{\beta_i}$ , $\boldsymbol{\theta_j}$ ,$\boldsymbol{\varphi_m}$, $\boldsymbol{\rho_n}$ = Short run dynamic coefficients..

$\boldsymbol{\pi_3}$ = Speed of adjustment parameter with a negative sign

$\Delta$ = F**irst** difference operator.

$\boldsymbol{HPRICE_t}$ = Dependent variable real estate residential prices.

$\boldsymbol{INF}$ =Inflation

$\boldsymbol{INT}$ =Interest rate

$\boldsymbol{EXCH}$ =Exchange rate

### 3.6.6.2 VECM for $REG_t$ with different dependent and independent variables

**Model 1**: VECM with Real estate investment as a dependent variable

$$\Delta \boldsymbol{REG_t} = \sigma + \sum_{i=t}^{k-1} \beta_i \Delta \boldsymbol{REG_{t-i}} + \sum_{i=j}^{k-1} \theta_j \Delta INF_{t-j} \sum_{i=m}^{k-1} \varphi_m \Delta INT_{t-m} \sum_{i=n}^{k-1} \rho_n \Delta EXCH_{t-n} + \pi_1 ECT_{t-1} + \mu_{1t} \quad (3.10a)$$

**Model 2**: VECM with Inflation as a dependent variable

$$\Delta \boldsymbol{INF_t} = a + \sum_{i=t}^{k-1} \beta_i \Delta REG_{t-i} + \sum_{i=j}^{k-1} \theta_j \Delta \boldsymbol{INF_{t-j}} + \sum_{i=m}^{k-1} \varphi_m \Delta INT_{t-m} \sum_{i=n}^{k-1} \rho_n \Delta EXCH_{t-n} + \pi_2 ECT_{t-1} + \mu_{2t} \quad (3.10b)$$

**Model 3**: VECM with interest rate as a dependent variable

$$\Delta \boldsymbol{INT_t} = d + \sum_{i=t}^{k-1} \beta_i \Delta REG_{t-i} + \sum_{i=j}^{k-1} \theta_j \Delta INF_{t-j} + \sum_{i=m}^{k-1} \varphi_m \Delta \boldsymbol{INT_{t-m}} \sum_{i=n}^{k-1} \rho_n \Delta EXCH_{t-n} + \pi_3 ECT_{t-1} + \mu_{3t} \quad (3.10c)$$

**Model 4**: VECM with exchange rate as a dependent variable

$$\Delta \boldsymbol{EXCH_t} = \gamma + \sum_{i=t}^{k-1} \beta_i \Delta REG_{t-i} + \sum_{i=j}^{k-1} \theta_j \Delta INF_{t-j} \sum_{i=m}^{k-1} \varphi_m \Delta \boldsymbol{INT_{t-m}} \sum_{i=n}^{k-1} \rho_n \Delta \boldsymbol{EXCH_{t-n}} + \pi_3 ECT_{t-1} + \mu_{4t} \quad (3.10d)$$

Where;

$\boldsymbol{\mu_{1t}}$ , $\boldsymbol{\mu_{2t}}$ , $\boldsymbol{\mu_{3t}}$ ,$\boldsymbol{\mu_{4t}}$ = residual.

***K-1*** = Lag length where VAR is reduced by one lag.

$\boldsymbol{\beta_i}$ , $\boldsymbol{\theta_j}$ ,$\boldsymbol{\varphi_m}$, $\boldsymbol{\rho_n}$ = Short run dynamic coefficients.

$\boldsymbol{\pi_3}$ = Speed of adjustment parameter with a negative sign.

$\boldsymbol{ECT_{t-1}}$ = The error correction term. It guides the dependent variable back to equilibrium.

$\Delta$ = F**irst** difference operator.

$\boldsymbol{REG_t}$ = Dependent variable real estate growth rate

$\boldsymbol{INF}$ =Inflation

$\boldsymbol{INT}$ =Interest rate

***EXCH*** =Exchange rate

### 3.6.7 Diagnostic Test for VECM

This study will carry out two tests to test how well the models generated can draw meaningful and conclusive results. These will include the goodness of fit through the $R^2$ and the stability through an inverse root polynomial.

#### 3.6.7.1 Goodness of fit

This study will use the F statistic and $R^2$ to test for the goodness of fit in the slope of the model.

#### 3.6.7.2 Stability of VECM

The study will investigate the stability of the model through the use of the Autoregressive polynomial to test whether any of the unit roots will fall outside circle. If none of the roots falls outside the circle then the model is stable.

#### 3.6.7.3 Lag length determination for VAR

Lag length determination is an important aspect of VAR analysis. This prevents problems that might arise in misspecification. The study will use the lag length that is supported by most of the criterions from a list containing Akaike information criterion (AIC), Schwarz information criterion (SC) and Log Likelihood ratio (LR).

### 3.6.8 VECM Residual Diagnostic Test

#### 3.6.8.1 Normality Test of the Residuals

The stochastic variables or error terms are assumed to be normally distributed. Therefore, in this regard it is important to test for normality in the model to truly confirm that the residuals follow a normal distribution. The study will adopt the Jarque-Bera (JB) statistic to test normality. Jarque & Bera (1987) is based on two degrees of freedom and follows chi square distrubution with the null hypothesis stating that residuals are normally distributed. Gujarati (2009) states that should the probability value of the statistic be smaller than five percent the null hypothesis that the error terms are normally distributed is rejected.

#### 3.6.8.2 Heteroscedasticity

In the event that the stochastic variable doesn't have a constant variance then implies that the model does not hold or conform to assumption of Classical Linear Regression (CLRM). Therefore, it is imperative to test the model for constant variance to assure ourselves that the model will hold and the results of the analysis will represent a true picture of the existing relationship. The White's

general test for Heteroscedasticity will be used to test for Heteroscedasticity. The study will use White's Test to test for Heteroscedasticity, where the null hypothesis is that the data is homoscedastic.

#### 3.6.8.3 Serial Correlation

Serial correlation refers to a case in which there is correlation between members of a times series observation ordered in times. (Kiganda, 2015) notes that an assumption of Classical Linear regression is not existence of serial correlation. This study make use of the Breusch-Godfrey (LM) test where the null hypothesis is absence of serial correlation at a significance level of 5 percent.

### 3.7 Data Presentation

The study will use tables, graphs and charts.

# CHAPTER FOUR : RESULTS AND DISCUSSION

## 4.1 Introduction

This part presents results of the study carried out as well as a detailed discussion of the results and the implications from an investment point of view. This part entails results and discussions of correlation, cointegration and Vector Error Correction. The discussion is based on both the residential Housing Prices derived from Kenya Bankers Residential Housing Index (HPRICE) and the growth in real estate sector (REG) derived from real estate contribution to GDP

## 4.2 Descriptive Statistics Analysis

Descriptive statistics give a preliminary outlook of the viability of the data used in a study to establish whether the data is suitable for parametric and non-parametric tests. This analysis is important in the initial stages since it enables us determine if the data is normally distributed in order to make necessary adjustments before using the data for further analysis and also to satisfy assumptions of the quantitative models that are used in the study. It also enables us establish presence of outliers whether or not there are outliers. Table 1 below is a presentation of the results:

**Table 1: Presentation on Descriptive Statistics**

| | REG | HPRICE | INF | EXCH | INT |
|---|---|---|---|---|---|
| **Mean** | 1.3412 | 109.6242 | 90.26575 | 98.10525 | 14.94900 |
| **Median** | 1.4347 | 108.4400 | 90.37000 | 101.5350 | 13.68500 |
| **Maximum** | 2.9106 | 124.7800 | 117.3800 | 111.8967 | 20.21000 |
| **Minimum** | -0.1056 | 100.0000 | 67.10000 | 84.12000 | 11.89000 |
| **Std. Dev.** | 0.0680 | 6.661417 | 15.55908 | 8.693254 | 2.629504 |
| **Skewness** | -0.9340 | 0.578780 | 0.094533 | -0.431557 | 0.425909 |
| **Kurtosis** | 2.8145 | 2.474166 | 1.772977 | 1.788979 | 1.892525 |
| **Jarque-Bera** | 0.115529 | 2.424672 | 2.568887 | 3.685894 | 3.253493 |
| Probability | 0.943872 | 0.297502 | 0.276805 | 0.158350 | 0.196568 |
| **Sum** | 0.536468 | 3946.470 | 3610.630 | 3924.210 | 597.9600 |
| **Sum Sq. Dev.** | 0.001806 | 1553.106 | 9441.319 | 2947.334 | 269.6574 |
| **Observations** | 40 | 36 | 40 | 40 | 40 |

***Source**: Author (2022).Note that INT and REG in % while HPRICE, EXCH and INF proxied as CPI in absolute terms.*

The results show that the mean Consumer Price Index (INF) was 90.27, with a minimum CPI of 67.10 points and a maximum CPI of 117.38 points. CPI had a positive deviation of 15.56 indicating that inflation has been on a gradual increase over the years. Additionally CPI distribution seemed to be slightly positive skewed to the right 0.0945 showing presence of an almost perfect normal distribution and kurtosis coefficient (1.77) of CPI is *plurtykurtic* in nature which indicates that data is distributed around the mean.

The results show that the mean Exchange rate for the Ksh/Usd (EXCH) was 98.11, with a minimum EXCH of 84.12 Kenyan Shilling against one unit of the US dollar and a maximum EXCH of 111.90 Kenyan Shilling against one unit of the US dollar. EXCH had a positive deviation of 8.69 indicating that the Kenyan Shilling has been depreciating gradually against the US dollar. Additionally EXCH distribution seemed to be slightly negatively skewed to the left (-0.43) showing an almost perfect normal distribution and kurtosis coefficient (1.79) of EXCH is *platykurtic* in nature which indicates that data is distributed around the mean.

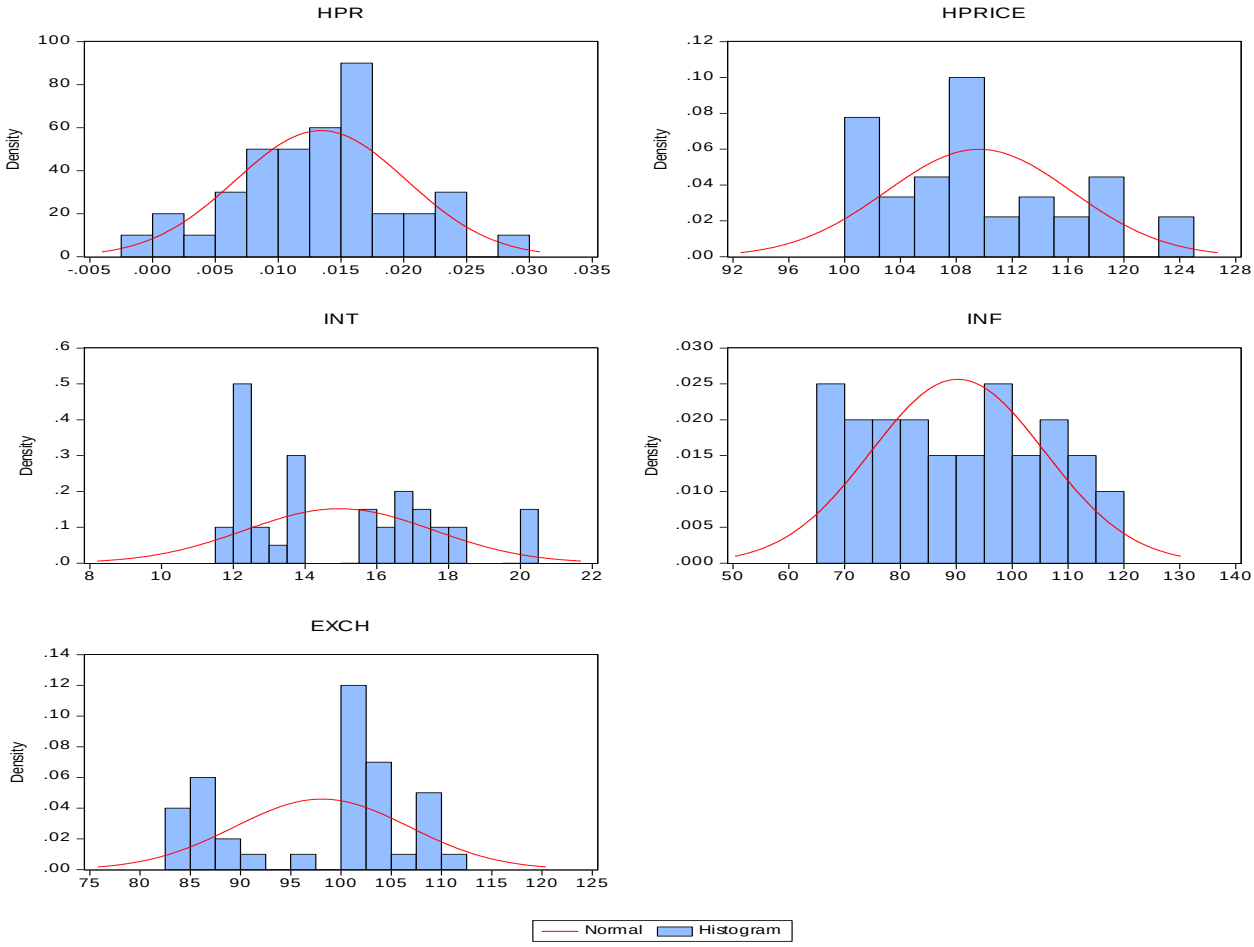
The results show that the mean commercial bank quarterly lending rate (INT) was 14.95%, with a minimum INT of 11.89 % and a maximum INT of 20.21%. INT had a slight positive deviation of 2.63% showing that the lending rates have more or less maintained a tight range. Additionally INT distribution seemed to be slightly positive skewed to the right (0.43) showing an almost normal distribution and kurtosis coefficient (1.89) of INT is *platykurtic* in nature which indicates that data is distributed around the mean.

The results show that the mean real estate property price index (HPRICE) was 109.62 points, with a minimum value of 100 points and a maximum of 124.78 and had a slight positive deviation of 6.66. In addition HPRICE distribution appeared to be slightly positively skewed to the right (0.58) depicting an almost perfect normal distribution and kurtosis coefficient (2.47). HPRICE is *platykurtic* in nature which indicates that the probability mass is concentrated around the mean.

The results show that the mean real estate sector growth rate (REG) of real estate sector was 1.34%, with a minimum of -0.1056 and a maximum of 2.91% and had a slight positive deviation of 0.068%. Additionally REG distribution seemed to be slightly negatively skewed to the left -0.934% showing an almost perfect normal distribution and kurtosis coefficient 2.8145. HPR is *platykurtic* in nature which indicates that data is distributed around the mean.

Lastly 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. This also means that the variables are suitable for autoregressive analysis since one of the assumptions of Vector autoregressive (VAR) model has been satisfied that is assumption of normality. The distribution of the variables in **Figure 2** shows that the variables are normally distributed hence will provide useful results in line with the assumptions of normality in investment return and asset prices as put forth in finance theory.

**Figure 2: Theoretical probability density and histogram for study variables**




*Source: (Author 2022) where the y-axis depicts the probability densities of the normal distribution curve imposed on the histograms. INF, INT, REG, EXCH and HPRICE all appear to be normally distributed.*

### 4.3 Correlation Analysis

The study carried out Pearson correlation at five percent significance as computed in (3.2) to test the level of association of the variables under study as a preliminary step before further analysis. This analysis is in conducted to fulfil the first objective of the study which was to establish association between Interest rate, Inflation and Exchange rate and real estate investment financial performance.

**Table 2: Correlation Matrix for real estate financial performance**

| Correlation<br>t-Statistic<br>Probability | REG | HPRICE | INT | INF | EXCH |
|---|---|---|---|---|---|
| REG | 1.0000<br>-----<br>----- | | | | |
| HPRICE | 0.3939<br>[2.4991]<br>(0.0174*) | 1.0000<br>-----<br>----- | | | |
| INT | 0.0722<br>[0.4222]<br>(0.6755) | -0.4588<br>[-3.0107]<br>(0.0049*) | 1.0000<br>-----<br>----- | | |
| INF | 0.0989<br>[0.5795]<br>(0.5661) | 0.4241<br>[2.7307]<br>(0.0099*) | -0.9109<br>[-12.8742]<br>(0.0000*) | 1.0000<br>-----<br>----- | |
| EXCH | 0.3657<br>[2.2914]<br>(0.0283*) | 0.5423<br>[3.7640]<br>(0.0006*) | -0.7361<br>[-6.3403]<br>(0.0000*) | 0.8874<br>[11.2231]<br>(0.0000*) | 1.0000<br>-----<br>----- |

***Source**: Author (2022). Parentheses ( ) show p-values, [ ] show t statistic and * Pearson correlation $[r]$ at 5 percent significance where REG (Real estate growth), HPRICE (Residential Property prices) INT (Interest Rate) EXCH (Exchange Rate) INF (Inflation)*

### 4.3.1 Correlation Analysis for real estate residential property prices ($HPRICE_t$)

Table 2 is a presentation of correlation coefficients and probability-values of r = -0.4588 (0.0049), r=0.5423 (0.0006), r =0.4241 (0.0099) associating Real estate property prices (HPRICE) in Kenya to quarterly weighted average lending rates by commercial banks (INT), Kenya Shilling USD exchange rate (EXCH) and Inflation rate (INF) respectively. The correlation coefficients were all found to have probability values less than 0.05 hence were all found to be significant at the 5 percent significance level as noted by Jarque Bera statistic. This therefore means that the variables EXCH and INF positively significant with the real estate residential prices (HPRICE). This therefore means that real estate residential prices have a significant positive association with inflation rate regime and exchange rate regime. While on the other hand residential real estate property prices (HPRICE) have a negative but significant relationship with Interest rate regime.

A plausible explanation for this is that increase in the levels of inflation rate in the economy is related to increased real estate residential prices while decrease in inflation leads to lower real estate residential prices. Inflation in an economy not only effects utilities, commodities and consumer goods but also the raw materials used in the construction and development of real estate property and investments. This extra cost incurred as a result of inflation is normally passed on to investors in real estate ranging from retail investors by way of higher acquisition prices as well as indirectly through scarcity in which high inflation discourages excess investment in the sector hence the few properties developed are also sold at a premium due to shortage.

On the other hand interest rate used in lending by commercial banks have a significant negative relationship with the real estate residential prices (HPRICE) which shows that when interest rates increase it results in a decrease in residential real estate prices while falling interest rates leads to increases in real estate residential prices in Kenya. When there is an increase in interest rates, the cost of borrowing funds for financing real estate residential investment through acquisition and development goes up, this leads to fewer investments in the residential property market which depresses the market hence leading to fewer local and institutional investors showing interest in investing in real estate for either regular income streams or for capital appreciation going down. Consequently a decrease in interest rates results to the following, the cost of acquisition of real estate residential units for investments goes down hence more investors take part in acquisition and development of real estate. This increased activity leads to increased demand for real estate which is known for regular income streams as well as capital appreciation which is higher than other asset classes such as bonds and equity.

Exchange rate has a significant positive association with real estate property prices in Kenya as indicated in **Table 2** below. This can be attributed to the important role played by the exchange rate regime especially the Ksh/Usd rate which is the most important exchange for importation. Numerous materials used in development of real estate projects and construction such as steel are imported from outside the country as raw materials by manufacturers before being converted to the required form such as iron sheets for roofing and metal for property construction and to support high intensity structures. Therefore when exchange rates move up or when the US dollar appreciates against the Kenyan shilling in which case more units of the Kenyan shilling are required for every unit of the USD. This makes imported raw materials for the real estate sector

expensive to acquire by manufacturers ultimately leading to higher production costs which is passed on to the property developers and subsequently to the final real estate investor in either retail or institutional form. In this regard property prices become expensive from the increased input costs which is attributed to the exchange rate changes.

### 4.3.2 Correlation Analysis for Growth of real estate sector ($REG_t$ )

Table 2 is a presentation of p-values and correlation coefficients of r = 0.0722 (0.6755), r=0.3657 (0.0283), r =0.0989 (0.5661) associating Real estate growth (REG) in Kenya to quarterly weighted average lending rates by commercial banks (INT), Kenya Shilling USD exchange rate (EXCH) and Inflation (INF) respectively. From the p values in the result it is evident that only exchange rate is significant since it has p-value less than 0.05 while interest rate and inflation both have insignificant coefficients with probability values greater than the 5 percent significance level.

The significance of this is that of all the independent variables in the study only EXCH has a positive and significant relationship with the growth of real estate sector which means that real estate sector growth rate is positively associated with exchange rate. Increase in the levels of exchange rates goes hand in hand with increased growth rate in real estate sector. A plausible explanation for the lack of significant association between interest rate and inflation with real estate sector growth rate would be that the real estate growth as proxied in this study does not react to short term changes in these macro-economic variables since real estate investments have long lead times and are highly illiquid with longer processes to initiate initial investments hence by the time the project is up and running it would be a long term project hence only long term outcomes will be expected.

### 4.3.3 Conclusion on correlation analysis for real estate investment financial performance

The results in this section enable us to accept or reject our null hypothesis. Since our results indicate that the independent variables have on average more significant p- values than insignificant p values, the results establish that there exists an association between the variables hence we reject the null hypothesis which states that there is no association between our independent and dependent variables used in the study.

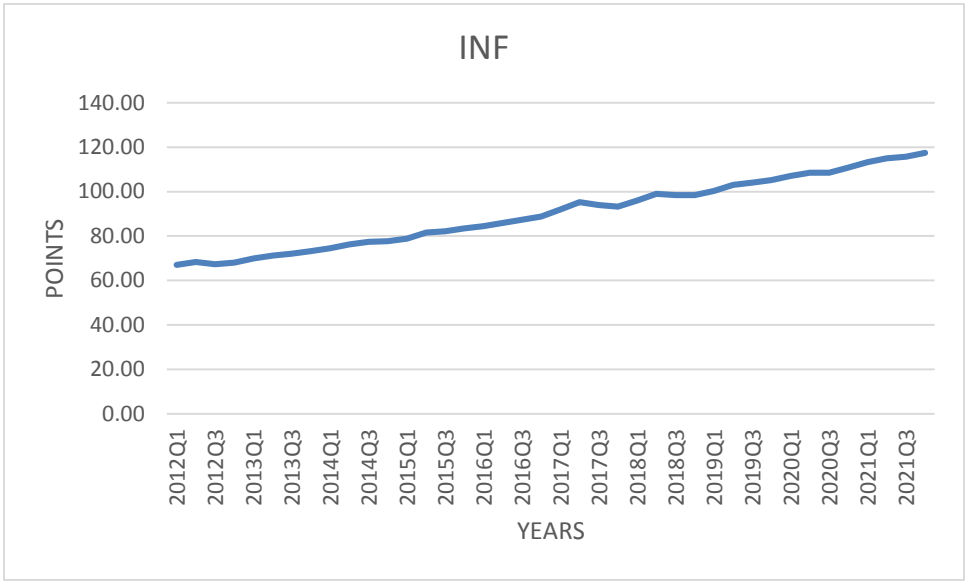
### 4.3 Stationarity Analysis

The first step adopted in the study for testing existing relationship in time series data was stationarity test to establish whether or not the data is stationary before carrying out cointegration and subsequently Vector Error Correction Model analysis to integrate the long run to the short run operating aspects. The study made use of the Kwaitowski-Phillips-Schmidt-Shin KPSS test (1988), Phillip Perron (PP) test and Augmented Dickey Fuller test (1979) to test unit root of the time series namely: real estate residential prices proxied as Kenya Bankers House estate house price index, growth in the real estate sector, interest rate, exchange rate and the inflation rate. This study includes additional tests because of the reasons outlined in 3.6.2. However before carrying out the tests, the study first plotted the levels versions of the data to get a look and feel of the movement and direction of data through graphical analysis as proposed by Gujarati (2009) as well as .

#### 4.3.1 Graphical analysis of data

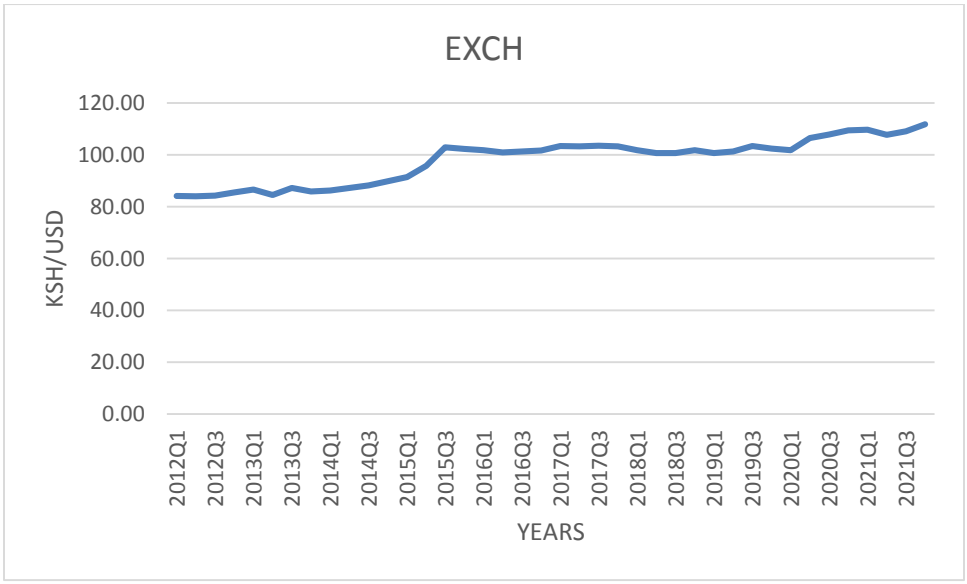
According to the line and symbol graph in **Figure 3**, the plot of the values of the variables in the study yields upward slopping graphs with the plots for inflation ,exchange rate, real estate growth rate (REG) and real estate residential prices (HPRICE) moving in the same direction and trending upward, an indication that the variables might be stationary. On the other hand interest rate plot showed existence of a downward trend. According to Gujarati (2009) when a time series data trends upwards or downwards, it might be a sign that the mean is not constant and is changing hence might be a sign of stationarity. Therefore from a visual analysis of the graphs plotted below, all the variables used in the study seem to be trending either upwards or downwards hence indicates that they are non stationarity.

**Figure 3: Line & symbol graph to visually check stationarity in Consumer Price Index**



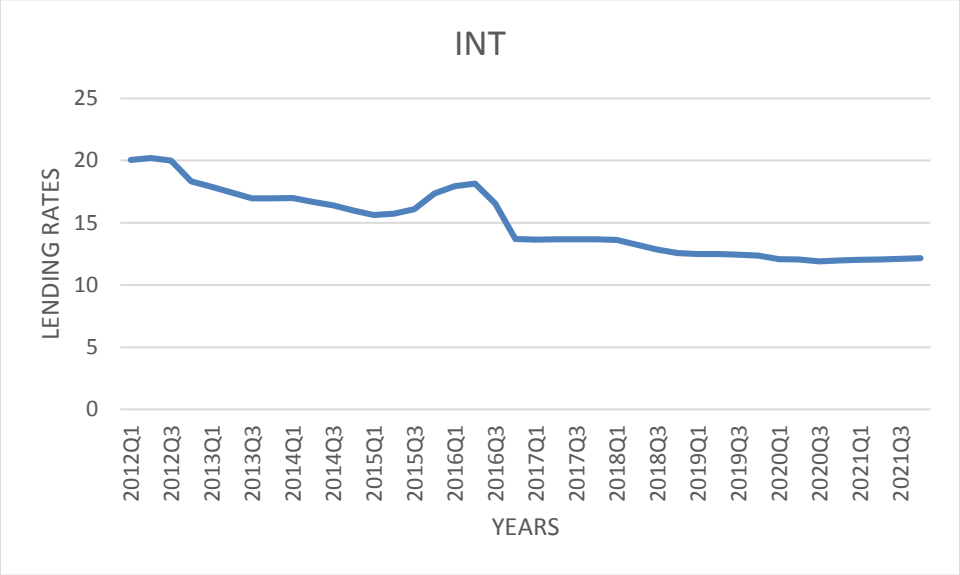

*Source: (Author 2022). The plot is of raw data (CPI) values of the variables in the study*

**Figure 4: Line and symbol graph to visually check stationarity in Exchange Rate**



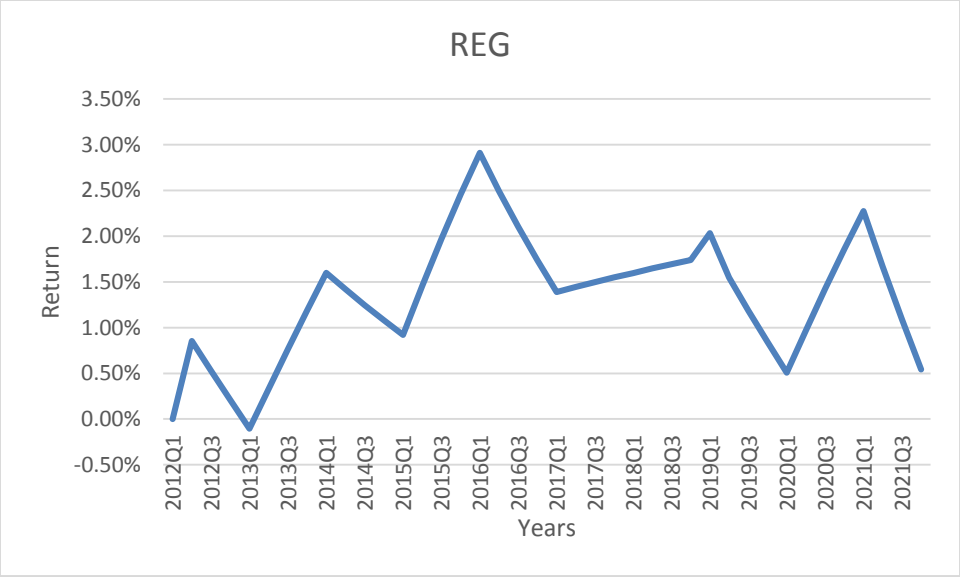

*Source: (Author 2022).*

**Figure 5 Line and symbol graph to visually check stationarity in Interest Rate**



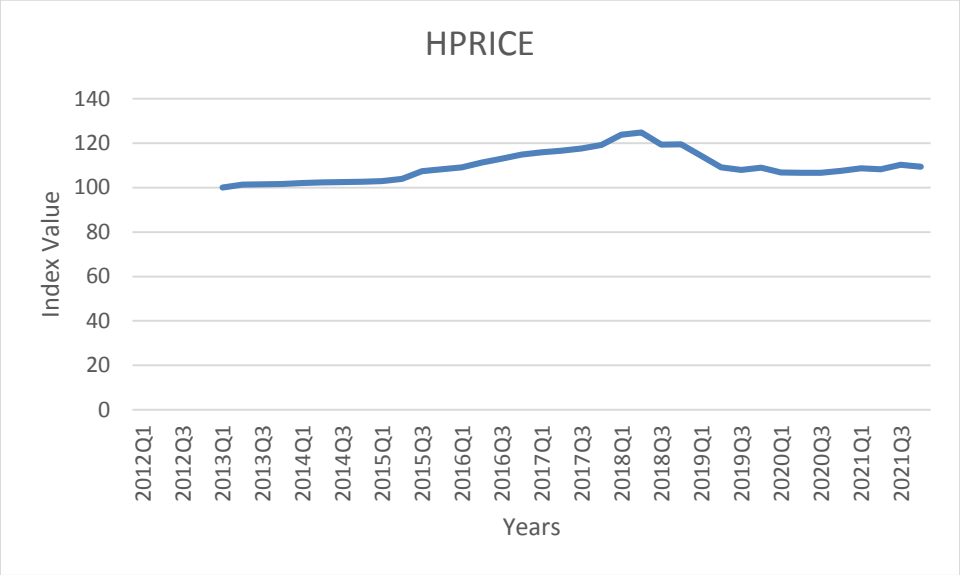

*Source: (Author 2022)*

**Figure 6 Line and symbol graph to visually check stationarity in real estate growth rate (REG)**




*Source: (Author 2022).*

**Figure 7: Line and symbol graph to visually check stationarity in real estate residential prices**




*Source: (Author 2022)*

### 4.3.2 Granger & Newbold (1974) Ordinary Least Squares (OLS) preliminary check for stationarity

**Table 3: OLS Regression results for $HPRICE_t$ as the dependent variable**

| Variables | Coefficients | Std. Error | t-Statistic | Probability. |
|---|---|---|---|---|
| INT | -2.681139 | 1.065224 | -2.516972 | 0.0170 |
| EXCH | 0.924660 | 0.268948 | 3.438066 | 0.0016 |
| INF | -0.624483 | 0.240216 | -2.599671 | 0.0140 |
| C | 114.1323 | 27.87194 | 4.094881 | 0.0003 |

| | | | |
|---|---|---|---|
| R-squared | 0.423618 | Mean dependent var | 109.6242 |
| Adjusted R-squared | 0.369582 | S.D. dependent var | 6.661417 |
| S.E. of regression | 5.289089 | Akaike info criterion | 6.273608 |
| Sum squared resid | 895.1828 | Schwarz criterion | 6.449555 |
| Log likelihood | -108.9249 | Hannan-Quinn criter. | 6.335018 |
| F-statistic | 7.839574 | Durbin-Watson stat | 0.376199 |
| Prob(F-statistic) | 0.000463 | | |

*Source: (Author 2022)*

From the OLS results in **Table 4** the $R^2$ is 0.423 on the other hand Durbin Watson statistic is 0.376199 for real estate property prices (HPRICE) which shows that the variables in the model in Table 4 for HPRICE might be non-stationary since the $R^2$ is higher than the Durbin Watson statistic

hence shows potential signs of spurious regression if the data was to be quantitatively analyzed interpreted at levels. The next step will now involve carrying out more robust stationarity tests after getting a preliminary view of the data, how the data moves and trends.

**Table 4: OLS Regression results for $REG_t$ as the dependent variable**

| Variables | Coefficients | Std. Errors | t-Statistics | Probability. |
|---|---|---|---|---|
| INT | 0.000180 | 0.000867 | 0.207680 | 0.8366 |
| EXCH | 0.001133 | 0.000248 | 4.573179 | 0.0001 |
| CPI | -0.000418 | 0.000211 | -1.983280 | 0.0550 |
| C | -0.062739 | 0.026319 | -2.383776 | 0.0225 |
| R-squared | 0.439834 | Mean dependent var | | 0.013412 |
| Adjusted R-squared | 0.393154 | S.D. dependent var | | 0.006804 |
| S.E. of regression | 0.005301 | Akaike info criterion | | -7.547319 |
| Sum squared resid | 0.001012 | Schwarz criterion | | -7.378431 |
| Log likelihood | 154.9464 | Hannan-Quinn criter. | | -7.486255 |
| F-statistic | 9.422225 | Durbin-Watson stat | | 0.653105 |
| Prob(F-statistic) | 0.000099 | | | |

*Source: (Author 2022)*

From the OLS results in **Table 5**, the $R^2$ is 0.439834 on the other hand the Durbin Watson statistic is 0.653105 for real estate growth (REG) which shows that the variables in the model in Table 5 for REG show that the model might be stationary because $R^2$ is less than the Durbin Watson statistic. The next step will now involve carrying out more robust stationarity tests after getting a preliminary view of the data, how the data moves and trends.

### 4.3.4 Kwaitowski-Phillips-Schmidt-Shin (KPSS)

From Table **6**, the results indicated that the null hypothesis of existence of stationarity for study variables HPRICE, REG, INF, EXCH and INT was rejected at $\alpha = 0.05$ significance level at levels. The study accepted the null hypothesis of stationarity at the = 5 percent level of significance at first difference since for all the study variables critical values at 5% level of significance was

greater than the KPSS test statistic. The results show that at first difference *I* (1), the study variables are all stationary. The results are as shown in **Table 6** below:

**Table 5: Kwaitowski-Phillips-Schmidt-Shin (KPSS)**

| LOG | | HPRICE | REG | INF | EXCH | INT |
|---|---|---|---|---|---|---|
| **Null Hypothesis: Series is stationary** | | | | | | |
| **First** | KPSS test statistic | 0.202 | 0.233 | 0.367 | 0.090 | 0.129 |
| **Difference** | Critical Values ( 5% level) | 0.463 | 0.463 | 0.463 | 0.463 | 0.463 |

*Source: (Author 2022)*

### 4.3.5 Augmented Dickey Fuller Test (ADF)

From **Table 7**, the results indicated that rejected of the null hypothesis of non-stationarity at $\alpha = 0.05$ level of significance at first difference for all the study variables HPRICE, REG, CPI, EXCH and INT. Therefore all study variables are stationary at first difference at the 5 percent significance level since the statistic of the ADF test is bigger than the critical value as shown in **Table 7** below:

**Table 6: ADF Unit Root Test**

| LOG | | **HPRICE** | **REG** | **INF** | **EXCH** | **INT** |
|---|---|---|---|---|---|---|
| **Null Hypothesis: Series is non -stationary** | | | | | | |
| **First** | ADF test statistic | -3.9407 | -4.0247 | -9.741 | -5.112 | -4.345 |
| **Difference** | (p-values) | 0.0046 | 0.0037 | 0.0000 | 0.0002 | 0.0014 |
| | Critical Values ( 5% level) | -2.95112 | -2.9511 | -2.943 | -2.941 | -2.943 |

*Source: (Author 2022)*

### 4.3.6 Phillips Perron Test (PP)

From **Table 8**, the results indicated that rejected of the null hypothesis of non-stationarity at $\alpha = 0.05$ level of significance at first difference for all the study variables HPRICE, REG, CPI, EXCH and INT. Therefore all study variables are stationary at first difference at the 5 percent significance level since the absolute statistic of the PP test is bigger than the critical value as shown in **Table 8** below:

**Table 7: Phillips Perron Test (PP)**

| LOG | | HPRICE | REG | INF | EXCH | INT |
|---|---|---|---|---|---|---|
| **Null Hypothesis: Series is non -stationary** | | | | | | |
| **First** | PP test statistic | -4.01747 | -4.2116 | -6.5005 | -5.111 | -3.651 |
| **Difference** | (p-values) | 0.0038 | 0.0020 | 0.0000 | 0.00002 | 0.0091 |
| | Critical Values( 5% level) | -2.9511 | -2.9411 | -2.9411 | -2.9411 | 2.9411 |

*Source: (Author 2022)*

### 4.4 Lag Length Selection

The selection of lag order is an important part of VAR analysis , this is important since increase in lag orders can significantly lead to reduction in the degrees of freedom leading to misspecification errors (Nyongesa, 2017). As a consequence Mukras (2012) asserts that in VAR modelling, the most important issues involve how many variables to include, how many lag lengths to include based on a researchers' preset criteria. For this study, the criteria will be to choose the lag that is supported by majority of the criterions such as sequential modified LR test statistic, Akaike Information Criteria (AIC), Hannan-Quinn information criterion (HQ),Final prediction error (FPE), , sequential modified LR test statistic (LR) and Schwarz information criterion (SC)

#### 4.4.1 Lag Length selection where real estate residential price (HPRICE) is the dependent variable

Therefore taking holding period of the real estate property prices (HPRICE) as the dependent variable the study establishes an optimal lag to include. The results on table 9 show that FPE, AIC, and HQ advocate the selection of 4 as the optimal lag while SC advocates for 1 as the optimal lag. On the other hand LR shows optimal lag of 3. The lag 4 was adopted as the optimal lag length because it got support from most number of criterions.

**Table 8: Optimal Lag criterion where real estate residential price (HPRICE) is dependent variable**

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 0 | -350.8081 | NA | 50215.62 | 22.17551 | 22.35873 | 22.23624 |
| 1 | -195.0087 | 262.9115 | 8.140580 | 13.43805 | 14.35413* | 13.74170 |
| 2 | -176.5782 | 26.49382 | 7.366505 | 13.28614 | 14.93509 | 13.83272 |
| 3 | -146.3825 | 35.85742* | 3.477430 | 12.39891 | 14.78073 | 13.18841 |
| 4 | -120.3795 | 24.37787 | 2.477596* | 11.77372* | 14.88841 | 12.80615* |

* shows lag order selected by the criterion

LR: The sequential modified LR test statistic (each test at 5% level)

FPE: The Final prediction error

AIC: The Akaike information criterion

SC: The Schwarz information criterion

HQ: The Hannan-Quinn information criterion

### 4.4.1 Lag Length selection where real estate growth rate (REG) is dependent variable

Therefore real estate growth rate (REG) as the dependent variable the study establishes an optimal lag. The results on table 9 show that LR, AIC, SC, FPE and HQ advocate the selection of 3 as the optimal lag. The lag 3 was adopted as the optimal lag length because it got support from most number of criterions.

**Table 9: Optimal Lag criterion where REG is dependent variable**

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 0 | -145.8223 | NA | 0.048413 | 8.323461 | 8.499407 | 8.384871 |
| 1 | 5.112021 | 259.9424 | 2.71e-05 | 0.827110 | 1.706843 | 1.134160 |
| 2 | 30.74408 | 38.44809 | 1.64e-05 | 0.291995 | 1.875514 | 0.844686 |
| 3 | 63.30616 | 41.60710* | 7.19e-06* | -0.628120* | 1.659185* | 0.170210* |
| 4 | 75.73004 | 13.11409 | 1.06e-05 | -0.429447 | 2.561645 | 0.614524 |

*shows lag order selected by the criterion

LR: The sequential modified LR test statistic (each test at 5% level)

FPE: The Final prediction error

AIC: The Akaike information criterion

SC: The Schwarz information criterion

HQ: The Hannan-Quinn information criterion

### 4.5 Cointegration test

The study established that the variables were stationary at first difference *I (1),* subsequently the study carried out a lag length test to establish the optimal lag length for both measures of real estate financial performance where real estate residential prices (HPRICE) is the dependent variable and also where real estate growth (REG) is the dependent variable. In the previous section on lag length results, the first series real estate residential price HPRICE established an optimal lag of 4 while real estate growth rate (REG) established an optimal lag of 3 based on the studies criterion of the most number of criterions supporting the lag selected and most specifically Akaike Information Criterion. The next step involved carrying out Johansen Cointegration to determine existence of long run relationship.

### 4.6 Johansen Cointegration test for real estate residential prices (HPRICE) as dependent variable

This section tests the second hypothesis of the study through the Johansen Cointegration methodology .Johansen's trace test in Table 11 and Johansen's Max-eigenvalue test in Table 12 showed that there was presence of 4 cointegrating vectors and 2 cointegrating vectors respectively detected in the cointegrating equation for real estate residential prices as dependent variable. The Trace statistics usually considers looks at all the lowest eigenvalues and usually holds greater power compared to Maximum Eigenvalue statistic. The null hypothesis of no cointegrating relationship was rejected at the 5% significance level. Therefore implying no long run relationship between real estate residential prices (HPRICE) and the variables interest rate regime (INT), inflation regime (INF) and the Kenya Shilling US dollar exchange rate regime (EXCH).

**Table 10: Johansen's Trace test for Real estate residential prices (HPRICE)**

| Hypothesized No. of CE(s) | Eigenvalue | Trace Statistic | 0.05 Critical Value | Prob.** |
|---|---|---|---|---|
| None * | 0.855312 | 106.1998 | 47.85613 | 0.0000 |
| At most 1 * | 0.629403 | 46.27143 | 29.79707 | 0.0003 |
| At most 2 * | 0.256322 | 15.49960 | 15.49471 | 0.0499 |
| At most 3 * | 0.184408 | 6.319054 | 3.841466 | 0.0119 |

Trace test shows 4 cointegrating equation (s) at the 0.05 level
* signifies rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) probability-values

**Table 11: Johansen's Maximum Eigenvalue for real estate residential prices (HPRICE)**

| Hypothesized No. of CE(s) | Eigenvalue | Max-Eigen Statistic | 0.05 Critical Value | Prob.** |
|---|---|---|---|---|
| None * | 0.855312 | 59.92835 | 27.58434 | 0.0000 |
| At most 1 * | 0.629403 | 30.77184 | 21.13162 | 0.0016 |
| At most 2 | 0.256322 | 9.180542 | 14.26460 | 0.2714 |
| At most 3 * | 0.184408 | 6.319054 | 3.841466 | 0.0119 |

The Max-eigenvalue test shows 2 cointegrating equation(s) at the 0.05 level

* signifies rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) probability-values

### 4.6.1 Cointegration equation (long-run) equation for real estate residential price (HPRICE)

Therefore from the results, there exists long run cointegrating relationship. The existence of a long-run relationship when variables are linearly combined which means that deviations in the short run are usually corrected in the long term. Table 13 shows the long run equation for relationship as well as the respective estimates for the variables.

**Table 12: Normalized cointegrating coefficients for real estate residential prices (HPRICE) as dependent variable**

| 1 Cointegrating Equation(s): | | Log likelihood | -113.4630 |
|---|---|---|---|
| KBINDEX | INT | EXCH | CPI |
| 1.000000 | 8.166092 | -2.017007 | 2.057661 |
| | (0.53282) | (0.06848) | (0.10287) |
| | [15.32617] | [29.45396] | [20.002537] |

*Source: Author (2022). T-statistics in [ ] and Standard error in ( ) while the lag length 1-3*

The study estimated the long run equation from the cointegrating coefficients above. The model is shown below.

$$\mathbf{HPRICE_t + 2.017EXCH_t - 2.058INF_t - 8.166INT_t = 0} \quad \mathbf{(4.0)}$$

$$\mathbf{[29.454] \quad [-20.003] \quad [-15.326]}$$

When we make $HPRICE_t$ the subject (4.0) transforms to equation (4.1). The t-statistic is in parentheses

$$\mathbf{HPRICE_t = 2.058INF_t + 8.166INT_t - 2.017EXCH_t} \quad \mathbf{(4.1)}$$

$$\mathbf{[20.003] \quad [15.326] \quad [-29.454]}$$

The parameter estimates for equation (4.1) for INF and an INT are all positive in conformity to empirical studies while that for EXCH is negative which also conforms to empirical studies analyzed. The absolute values of the t-statistic are also larger than 2.0 which means they are all significant hence the equations represent significant relationships. Therefore in this regard, and in reference to the second objective, the null hypothesis that real estate financial performance through real estate residential prices is not influenced by interest rate, inflation and exchange rate. The next section 4.6.2 looks at the detailed analysis and discussion of the parameter estimates in relation to empirical studies, economic and financial theory.

### 4.6.2 Discussion and interpretation of cointegration results

This section carries out a detailed analysis and discussion of the results in the previous section. This section tested the second objective for the study. Results summarized in models 4.1 showed coefficients of **2.058**, **8.166** and **– 2.017** for inflation, interest rate and exchange rate respectively. The t-statistic for the coefficients in the study were all greater than 1.98 at 5 percent level of significance. This shows that inflation and interest rate have a positive and significant long run

influence on real estate residential prices in Kenya. On the other hand exchange rate had a negative and significant long run influence on real estate financial performance Kenya. Therefore in this regard the null hypothesis that inflation, interest rate and exchange rate don't influence real estate residential prices is rejected.

#### 4.6.2.1 Relationship between real estate residential prices and inflation rate

The results on the relationship between real estate residential property prices and inflation imply that a when inflation increases by one percent in the previous period increases real estate residential property prices in Kenya by **2.058%**.These findings on inflation imply that, *ceteris paribus*, increase in inflation in the economy generally leads to increases in real estate residential property prices. Inflation in an economy not only leads to increased prices in consumer items but also to increased prices in the raw materials and products used in the construction and development sector. This increase in price is passed on to both retail and institutional investors who purchase real estate residential properties for investment purposes or partake in the actual development of residential properties.

When we compare the results with previous studies we establish that indeed residential property real estate can act as a hedge against inflation. This is in line with the findings of Sing & Swee Hiang (2000) who established that various classes of real estate property investment in Singapore not only beat inflation in the whole market but aslo their own inherent inflation. They also assert that real estate was a better inflation hedge compared to other asset classes such as bonds and stocks. Similarly Wainaina (2020) also established that inflation influenced real estate performance in the Kenyan market. A plausible explanation to this would be that real estate as an investment is special in that investors can control the Net operating income from their investments through leases and rents that are adjustable meaning when there is expectation of higher inflation the rents can be increased to cater for this.

This relationship between inflation and residential property prices is important from an investment perspective because it means that residential property prices lead inflation in Kenya, this implies that real estate as an investment is able to give real return greater that the rate of inflation hence preventing loss or erosion in the value of investments made by both retail and institutional investors. This kind of relationship makes real estate an important alternative investment to be

considered in each investor's portfolio alongside traditional asset classes such as bonds and equity investments.

#### 4.6.2.2 Relationship between real estate property prices and interest rate

The results on the relationship between real estate residential property prices and interest rate imply that a when interest rate increases by one percent in the previous period increases real estate residential property prices in Kenya by **8.166% .**The findings on interest rate imply that, *ceteris paribus*, increase in interest rate in the economy generally leads to increases in real estate residential property prices. Increased Interest rates used in lending by commercial banks in an economy leads to increased cost of financing for the real estate sector which is highly leveraged and dependent on debt financing. Hence even a basis point change in the lending rates has a substantial influence on the actual interest paid to service loans with financial institutions. This increased cost of financing is passed on to the investors who acquire real estate residential properties for investment purposes hence leading to on average higher prices for real estate residential property hence making it expensive to acquire more property for investment for either capital appreciation or regular income streams as returns.

The findings are similar to Ouma (2015) who established that indeed the Kenyan real estate market performance was influenced by interest rates in which the author states that it determines the demand for real estate. A plausible explanation to this would be that increases in interest rates lead to increased cost of financing and development for real estate which leading to high property prices. Higher rates also increases the demand through fall in supply hence making property prices expensive. Contrary to this Murage (2013) etablished that the real estate market in Kenya had an insignificant interest rate volatility. A plausible explantation to this would be that in the Kenyan market, the Central Bank of Kenya has more or less maintained a stable monetary policy with a a few basis poit increases now and then , since interest rates are pegged on the Cental Bank Rate hence there would be minimal deviations leading to more or less stable interest rates which don't have adverse effects on the real estate market which by nature is highly leveraged.

This relationship is important from an investment perspective because it means that real estate residential property prices are interest rate sensitive, this implies that real estate as an investment responds to slight shocks in changes in interest rates hence both institutional and retail investors need to be aware of this before making investment decisions in order to protect their capital and

be prepared for any adverse changes in the lending rates or even take advantage of the rates if they move in their favour. This is also important from a mixed asset portfolio framework because it enables investors limit the proportion of real estate in a portfolio with other interest rate sensitive investments such as fixed income securities in form of treasury bills and both corporate and government bonds.

#### 4.6.2.3 Relationship between real estate residential property prices (HPRICE) and exchange rate

The results on the relationship between exchange rate and real estate residential property prices imply that a percentage increase in the level of exchange rate in the previous period results in a **-– 2.017 %** reduction in real estate residential property prices in the long run. The findings on exchange rate imply that, *ceteris paribus,* increase in exchange rate in the economy generally leads to a reduction in residential property prices. The Kenya Shilling United States of America dollar (Ksh/Usd) is an important exchange rate because most of the imports and exports in the country come by way of these two , this is also important because Kenya's foreign reserves are held in terms of USD and lastly remittances in Kenya from abroad come through the USD.

The results in this study conformed to Njangi (2021) who established that Real Estate Investment Trust have a negative significant relationship with the exchange rate regime in Kenya. On the other hand (Ijasan, Ijasan, Tweneboah, Oyedokun, & Adam, 2021) established that REITs had a significant positive long run relationship with exchange rate regime in the Nigerian REIT market. Contrary to the results in this study, Wanjiku (2021) established that registered real estate managers don't have a significant relationship with exchange rate regime in the Kenyan market which can be attributed to linkage between REIT managers and the overall real estate market since the performance of REIT managers in essence does not represent the real estate market only since REIT managers undertake investments in different asset classes.

The long run relationship established in the results can be explained as follows. From our literature we noted that most remittances from abroad are used for real estate investment. Therefore changes in the exchange rate determines the value of money in Kenya Shillings that enters the country, this also determines the actual value of the investment made in the real estate sector. Hence any appreciation in the base currency (USD) against the Kenyan shilling will lead to more units of the Kenyan shillings in exchange for one unit of the USD. Hence remittances in USD will be converted

to more Kenyan Shillings hence more money will be available for real estate development. The law of supply and demand applies in this case which means that more real estate units or properties will be developed leading to a glut in the economy hence depressing property values leading to a fall in the real estate property prices. On the same note appreciation of the base currency (USD) against the (Ksh) will also result in unfavorable exchange rates for importation of construction material used in the development of the real estate sector which makes real estate development expensive leading to barriers in form of cost and reducing margins for developers who have to sell the units to retail or institutional investors in a market where wages don't rise in proportion to the increased cost of living and stagnant wages. This therefore leads to lower prices in the real estate residential property prices.

This relationship between exchange rate and real estate residential property prices is important from an investment perspective because it means that residential property prices are exchange rate sensitive, this implies that real estate as an investment responds to slight shocks in changes in exchange rates hence both institutional and retail investors need to be aware of this before making investment decisions in order to protect their capital and be prepared for any adverse changes in the exchange rates or even take advantage of the rates if they move in their favour.

### 4.7 Johansen Cointegration test for real estate growth rate (REG) as dependent variable

This section tested the third objective for the study on the influence of inflation, interest rate and exchange rate on real estate growth rate. Johansen's trace test in Table 14 and Johansen's Max-eigenvalue test in Table 15 showed that there was presence of 1 cointegrating vectors for both the Trace test and Max eigenvalue test respectively which. The Trace statistics usually considers all of the smallest eigenvalues and usually holds more power than the Maximum Eigenvalue statistic. Therefore in this regard the study rejected the null hypothesis of no cointegrating relationship at the p=0.05 significance level. This in essence implied that there was presence of long run cointegrating relationship between real estate growth rate (REG) and the variables inflation, interest rates (INT) and the Kenya Shilling US dollar exchange rate (EXCH). The results are in line with the third objective for the study which sought to establish if real estate holding period return is influenced by inflation interest rate and exchange rate.

**Table 13: Johansen's Trace test for real estate growth rate (REG)**

| Hypothesized No. of CE(s) | Eigenvalue | Trace Statistic | 0.05 Critical Value | Prob.** |
|---|---|---|---|---|
| None * | 0.552793 | 55.59086 | 47.85613 | 0.0079 |
| At most 1 | 0.342652 | 26.62044 | 29.79707 | 0.1113 |
| At most 2 | 0.249355 | 11.51694 | 15.49471 | 0.1816 |
| At most 3 | 0.032551 | 1.191320 | 3.841466 | 0.2751 |

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

**Table 14: Johansen's Maximum Eigenvalue test for real estate growth rate (REG)**

| Hypothesized No. of CE(s) | Eigenvalue | Max-Eigen Statistic | 0.05 Critical Value | Prob.** |
|---|---|---|---|---|
| None * | 0.552793 | 28.97042 | 27.58434 | 0.0330 |
| At most 1 | 0.342652 | 15.10350 | 21.13162 | 0.2817 |
| At most 2 | 0.249355 | 10.32562 | 14.26460 | 0.1914 |
| At most 3 | 0.032551 | 1.191320 | 3.841466 | 0.2751 |

Max-eigenvalue 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

### 4.7.1 Cointegration equation (long-run) equation

Therefore from the results, there exists long run cointegrating relationship. The existence of a long-run relationship when variables are linearly combined which means that deviations in the short run are usually corrected in the long term. Table 16 shows the long run equation for relationship as well as the respective estimates for the variables.

**Table 15: Normalized cointegrating coefficients for real estate growth rate (REG) as dependent variable**

| 1 Cointegrating Equation(s): | | Log likelihood | 62.41982 |
|---|---|---|---|
| REG | INT | EXCH | INF |
| 1.000000 | 0.004332 | -0.001271 | 0.001268 |
| | (0.00120) | (0.00021) | (0.00026) |
| | [3.6100] | [-6.05238] | 4.87692 |

*Source: Author (2022). Standard error and t-statistics in ( ) and [ ] respectively while lag length 1-3*

The study estimated the long run equation from the cointegrating coefficients above. The model is shown below

$$\mathbf{REG_t + 0.0043EXCH_t - 0.001268INF_t - 0.0043INT_t = 0} \quad \textbf{(4.2)}$$

**[6.0523] [-4.8769] [-3.6100]**

When we make $\mathbf{REG_t}$ our subject (4.2) transforms to equation (4.3). The t-statistic is in parentheses

$$\mathbf{REG_t = 0.001268INF_t + 0.0043INT_t - 0.0043EXCH_t} \quad \textbf{(4.3)}$$

**[4.8769] [3.6100] [-6.0523]**

The parameter estimates for equation (4.3) for INF and an INT are all positive in conformity to empirical studies while that for EXCH is negative which also conforms to empirical studies analyzed. The absolute values of the t-statistic are also larger than 2.0 which means they are all significant hence the equations represent significant relationships. Therefore in this regard, and in reference to the third objective, the null hypothesis that real estate financial performance through real estate growth rate is not influenced by interest rate, inflation and exchange rate. The next section 4.7.2 looks at the detailed analysis and discussion of the parameter estimates in relation to empirical studies, economic and financial theory.

### 4.7.2 Discussion and interpretation of cointegration results

This section carries out a detailed analysis and discussion of the results in the previous section. This section tested the third objective for the study. Results summarized in models 4.1 showed coefficients of **0.001268, 0.0043** and **-0.0043 for** inflation, interest rate and exchange rate respectively. The t-statistic for the coefficients in the study were all greater than 1.98 at 5 percent

level of significance. This shows that inflation and interest rate have a positive and significant long run influence on real estate residential prices in Kenya. On the other hand exchange rate had a negative and significant long run influence on real estate financial performance Kenya. Therefore in this regard the null hypothesis that inflation, interest rate and exchange rate don't influence real estate growth rate is rejected.

#### 4.7.2.1 Relationship between real estate growth rate and inflation rate

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 real estate growth rate in Kenya by **0.001268%.** These findings on inflation imply that, *ceteris paribus,* increase in inflation in the economy generally leads to increases in growth rate of real estate sector in Kenya. Inflation in an economy not only leads to increased prices in consumer items but also to increased prices in the raw materials and products used in the construction and development sector. This increase in price is passed on to both retail and institutional investors who purchase properties for investment purposes or partake in the actual development of real residential properties. From an investment point of view, investors are forced to charge higher rates on rents and leases to enable them cover the cost of acquisition and construction as well as opportunity cost during the long lead time in real estate development. Increase in development cost results in fewer units being developed hence lower supply but the demand still remains the same or increases resulting in scarcity in real estate units. This shift in supply results in more demand and in essence values of real estate properties increase which is accompanied by higher rents and leases hence increasing returns of real estate investors.

The findings in this study are similar to the one carried out by Youguo & Webb (1996) in the US market. The researchers established that rela estate investment through Real Estate Investment Trusts were able to give real returns higher than the rate of inflation when examined from a mixed asset portfolio framework. When comapred to other asset classes it was a better hedge hence improved a portfolios diversification potenial. Similarly Mukesh, Rohan, & Webb (2010) established that Real estate Investment Trust in the US market had a significant long run relationship with commodities such as gold, silver and copper which are highly cointegrated with inflation implying that real estate investments also have a long run significant relationship with inflation. A plausible expalanation to this would be that increased cost of construction materials is passed on in the final value of the properties being developed to enable investors get a real retun on their investments.

This relationship between inflation and real estate sector growth rate is important from an investment perspective because it means that the growth rate for real estate sector leads inflation, this implies that investments in real estate are able to give real return greater that the rate of inflation hence preventing loss or erosion in the value of investments made by both retail and institutional investors. This kind of relationship makes real estate an important alternative investment to be considered in each investor's portfolio to hedge against inflation and to diversify risk.

#### 4.7.2.2 Relationship between real estate growth rate and interest rate

The results on the relationship between interest rate and real estate growth rate imply that a percentage increase in the level of interest rate in the previous period leads to increased real estate growth rate in Kenya by **0.0043%.** These findings on interest rate imply that, *ceteris paribus,* increase in lending interest rate in the economy generally goes in tandem with the growth rate of real estate investments. Interest rates used in lending by commercial banks in an economy leads to increased cost of financing for the real estate which is highly leveraged and dependent on debt financing. This increase in cost of real estate development has a two pronged impact on the real estate market. First it leads to a reduction in construction or development of new real estate properties in the market due to increased barrier to entry by way of increased costs. This has a long run effect of reducing the available real estate space for investment purposes hence it induces demand since supply is falling. In this sense, investors who already have real estate investments experience increases in the value of their real estate investments as a result of this increasing demand. These investors therefore due to the dynamics of the market are able to charge higher rents on their properties as well as higher priced lease contracts. This in essence leads to increase in their Net operating incomes proxied as the rents and leases in their properties. This becomes the new equilibrium. The percentage growth in the real estate sector in Kenya which is just the increase in stock of real estate development in Kenya. From our literature, the study pointed out that real estate investments are illiquid in nature with long lead times which means that development of new properties to take advantage of disruption of equilibrium caused by increases in rents and leases usually takes time. Therefore in this regard, lending interest rate has a significant long run influence on real estate sector growth rate.

These findings are corroborated by Muriuki (2018) who established that interest rates were an important factor influencing performance of real estate investments in Kenya. A plausibe explanation to this is that it leads to increased cost of financing real estate development and barriers to entry through higher construction costs. Low supply of real estate units subsequently leads to higher demand which leads to increases in the value of real estate through higher rents and leases.Similarly Alain & Hoesli (2010) established that real estate investments in Switszerland were sensitive to interest rate changes but mostly dependent on the property life remaining. A plausible expalnation to this would be that the return of each real estate investment is the dicounted cash flow on the net operating income which in essence depends on the property value and the life of the property. Newer properties will have more years to generate income hence will have higher returns as well as lower operating cost because of minimal depreciation and obsolescence.

This relationship between interest rate and growth rate for real estate investments is important from an investment perspective because it means that growth rate for real estate investments are interest rate sensitive, this implies that real estate as an investment responds to slight shocks in changes in interest rates hence both institutional and retail investors need to be aware of this before making investment decisions in order to protect their capital and be prepared for any adverse changes in the lending rates or even take advantage of the rates if they move in their favour.

#### 4.7.2.3 Relationship between real estate growth rate and exchange rate

The results on exchange rate and real estate sector growth rate imply that a one percent increase in the level of exchange rate in the previous period results in a **-0.0043%** reduction in real estate sector growth rate. The findings on exchange suggest that, *ceteris paribus*, increase in exchange regime in the economy generally results in a reduction in the growth rate for real estate investment. The Kenya Shilling United States of America dollar (Ksh/Usd) is an important exchange rate because most of the imports and exports in the country come by way of these two , this is also important because Kenya's reserves are held in terms of USD and lastly remittances and foreign exchange in Kenya from abroad come through the USD.

The results in this study conform to Njoroge, Muturi and Oluoch (2019), Bioreri (2014) and Njangi (2021) who established existence of a long run relationship between real estate investments and the exchange rate regime in the economy. Contrary to this Wanjiku (2021) and Sumer & ÖZorhon (2020) establish that real estate investments don't have a significant relationship with the exchange

regime in an economy. A plausible explanation for the results as noted in literature was that most remittances from abroad are used in real estate investment. Therefore changes in the exchange rate determines the value of money in Kenya Shillings that enters the country, this also determines the actual value of the investment made in the real estate sector. Hence any appreciation in the base currency (USD) against the Kenyan shilling will lead to more units of the Kenyan shillings in exchange for one unit of the USD. Hence remittances in USD will be converted to more Kenyan Shillings hence more money will be available for real estate development. The law of supply and demand applies in this case which means that more real estate units or properties will be developed leading to a glut in the economy hence depressing lease and rental prices in the real estate market leading to a fall in the growth rate of real estate investments in Kenya in the long run.

This relationship between exchange rate and the growth rate of real estate investment is important from an investment perspective because it means that the growth rate for real estate investments are exchange rate sensitive, this implies that real estate as an investment responds to slight shocks in changes in exchange rates hence both institutional and retail investors need to be aware of this before making investment decisions in order to protect their capital and be prepared for any adverse changes in the exchange rates or even take advantage of the rates if they move in their favour.

### 4.8 Vector Error Correction Models (VECM)

The study set forth to establish the both the long and short run effects of the variations in the explanatory variables inflation, exchange rate and interest rate on real estate residential property prices and real estate sector growth rate as well as the adjustment speed from short run to long run equilibrium. The study looked at the impact of lagged residual on the short run changes in both real estate residential property prices as well as the real estate sector growth rate through the use of the vector error correction model (VECM). The VECM was chosen in this study over the VAR because it was able to estimate the short run coefficients as well as the error correction estimate or term on long term real estate financial performance when there exists a cointegrating relationship.

### 4.9 Vector Error Correction Model for real estate residential property prices (HPRICE)

In order to obtain the VECM model used in our short run analysis in the study, the Vector Autoregressive Model (VAR) specified in section was differenced to obtain the short run relationship equation. Table 17 below shows the estimates for the VECM short run model with the insignificant variables being eliminated and also gives us a summary of the VECM estimates for

the model with the respective variables as well as the corresponding standard errors and t-statistics in parentheses and brackets respectively. In a VAR analysis study the variables Real estate property prices (HPRICE), exchange rate (EXCH), inflation (INF) and interest rate (INT) are all taken as endogenous. But for VECM used in this study, the variable Real estate residential property price (HPRICE) is to be considered an exogenous variable while the others will be endogenous. The variables have been regressed at levels by the lag order 1 to 3 losing one lag after differentiation from the optimal lag of 1 to 4 stated earlier in the lag length selection criteria. The results of the estimates and summary statistics are shown in the table below. Since the standard errors and t-statistics don't show the significance level of the variables, the study went further and generated the p-values of the t-statistics to show us which coefficients are significant and should be included in the model and which ones are not and should subsequently be eliminated from the model to enable us make meaningful analysis and conclusions in our study.

**Table 16: Summary of Vector Error Correction Model estimates for real estate residential property prices (HPRICE) for 1 to 3 lag lengths**

| Error Correction: | D(KBINDEX) | D(INT) | D(EXCH) | D(CPI) |
|---|---|---|---|---|
| CointEq1 | -0.464346** | -0.067998 | -0.157108 | 0.024635 |
| | (0.14608) | (0.03970) | (0.14980) | (0.05443) |
| | [-3.17871] | [-1.71279] | [-1.04879] | [ 0.45263] |
| D(KBINDEX(-1)) | 0.262372 | 0.011012 | -0.445930** | 0.071623 |
| | (0.20798) | (0.05652) | (0.21328) | (0.07749) |
| | [ 1.26151] | [ 0.19483] | [-2.09084] | [ 0.92430] |
| D(KBINDEX(-2)) | 0.307687 | -0.037198 | 0.381876 | -0.063938 |
| | (0.25825) | (0.07018) | (0.26482) | (0.09622) |
| | [ 1.19145] | [-0.53001] | [ 1.44202] | [-0.66453] |
| D(KBINDEX(-3)) | 0.341188 | 0.043118 | 0.029927 | -0.114241 |
| | (0.20635) | (0.05608) | (0.21161) | (0.07688) |
| | [ 1.65341] | [ 0.76886] | [ 0.14143] | [-1.48593] |
| D(INT(-1)) | 1.927471 | 0.625097** | 0.118151 | -0.329091 |
| | (1.00471) | (0.27305) | (1.03029) | (0.37433) |
| | [ 1.91844] | [ 2.28931] | [ 0.11468] | [-0.87915] |
| D(INT(-2)) | 2.635275** | -0.045371 | 1.154160 | -1.052355** |
| | (1.08907) | (0.29598) | (1.11680) | (0.40576) |
| | [ 2.41974] | [-0.15329] | [ 1.03345] | [-2.59355] |
| D(INT(-3)) | 2.053432** | 0.049127 | 0.924850 | 0.264801 |
| | (0.91951) | (0.24989) | (0.94292) | (0.34258) |
| | [ 2.23318] | [ 0.19659] | [ 0.98084] | [ 0.77295] |

*Source: (Author 2022) where D(n) represents the coefficients of study variables for the 1st 2nd and 3rd lags in the VECM model with respective columns for the coefficient estimates, standard error( ), T-statistics [ ].. T-statistics is at 5% significance where t>2.0 are significant while t< 2 are not significant. ** indicates coefficients that are significant.*

**Table 17: Summary of Vector Error Correction Model estimates (HPRICE) for 1 to 3 lag lengths Continued…..**

| Error Correction: | D(KBINDEX) | D(INT) | D(EXCH) | D(CPI) |
|---|---|---|---|---|
| D(EXCH(-1)) | -0.659688 | -0.105232 | 0.292134 | -0.010289 |
| | (0.37005) | (0.10057) | (0.37947) | (0.13787) |
| | [-1.78269] | [-1.04636] | [ 0.76984] | [-0.07463] |
| D(EXCH(-2)) | -0.769040** | -0.011082 | -0.438922 | 0.095936 |
| | (0.36081) | (0.09806) | (0.36999) | (0.13443) |
| | [-2.13143] | [-0.11302] | [-1.18629] | [ 0.71366] |
| D(EXCH(-3)) | -0.429067 | 0.028672 | -0.18824 | 0.171766 |
| | (0.29858) | (0.08115) | (0.30619) | (0.11124) |
| | [-1.43701] | [ 0.35333] | [-0.61479] | [ 1.54405] |
| D(CPI(-1)) | 1.465939** | -0.046634 | 1.192510 | -0.231255 |
| | (0.71123) | (0.19329) | (0.72933) | (0.26498) |
| | [ 2.06114] | [-0.24126] | [ 1.63506] | [-0.87272] |
| D(CPI(-2)) | 0.171643 | 0.102873 | -0.271781 | -0.555399** |
| | (0.38724) | (0.10524) | (0.39709) | (0.14427) |
| | [ 0.44325] | [ 0.97751] | [-0.68442] | [-3.84963] |
| D(CPI(-3)) | 1.126958 | -0.107433 | 0.670529 | -0.22885 |
| | (0.58318) | (0.15849) | (0.59803) | (0.21728) |
| | [ 1.93243] | [-0.67785] | [ 1.12123] | [-1.05326] |
| C | -1.327321 | 0.067081 | -0.687046 | 2.427452** |
| | (1.41477) | (0.38449) | (1.45079) | (0.52710) |
| | [-0.93819] | [ 0.17447] | [-0.47357] | [ 4.60527] |

*Source: (Author 2022) where D(n) represents the coefficients of study variables for the 1st 2nd and 3rd lags in the VECM model with respective columns for the coefficient estimates, standard error( ), T-statistics [ ].. T-statistics is at 5% significance where t>2.0 are significant while t< 2 are not significant. ** indicates coefficients that are significant.*

**Table 17: Summary of Vector Error Correction Model estimates (HPRICE) for 1 to 3 lag lengths Continued…..**

| Error Correction: | D(KBINDEX) | D(INT) | D(EXCH) | D(CPI) |
|---|---|---|---|---|
| R-squared | 0.545619 | 0.618771 | 0.364132 | 0.757621 |
| Adj. R-squared | 0.217455 | 0.343438 | -0.095105 | 0.582570 |
| Sum sq. resids | 67.74785 | 5.003784 | 71.24152 | 9.404098 |
| S.E. equation | 1.940044 | 0.527246 | 1.989438 | 0.722807 |
| F-statistic | 1.662640 | 2.247358 | 0.792906 | 4.328001 |
| Log likelihood | -57.40694 | -15.71737 | -58.21147 | -25.81259 |
| Akaike AIC | 4.462934 | 1.857336 | 4.513217 | 2.488287 |
| Schwarz SC | 5.104193 | 2.498595 | 5.154476 | 3.129546 |
| Mean dependent | 0.241250 | -0.150625 | 0.812187 | 1.381562 |
| S.D. dependent | 2.193091 | 0.650692 | 1.901089 | 1.118744 |

*Source: (Author 2022) where D(n) represents the coefficients of study variables for the 1st 2nd and 3rd lags in the VECM model with respective columns for the coefficient estimates, standard error( ), T-statistics [ ].. T-statistics is at 5% significance where t>2.0 are significant while t< 2 are not significant. ** indicates coefficients that are significant.*

### 4.9.1 Discussion and interpretation of Vector Error Correction Model (VECM) results

In line with the second objective for the study, this section carries out a detailed analysis and discussion of the short run relationship between the study variables real estate residential property price (HPRICE), inflation (INF), exchange rate (EXCH) and interest rate (INT). Each of these study variables is treated as both an endogenous and exogenous variable hence the study generates 4 VECM model equations with each variables having 3 lags. One lag is lost while transforming VAR into a VECM. Therefore in total the study has 52 coefficients including 4 constants. The study goes ahead to discuss the significance and the influence each variable has on itself as well as on the other lagged variables. This analysis will be in line with the second objective of this study which was to establish the influence of inflation, interest rate and exchange rate on real estate residential property prices in Kenya.

#### 4.9.1.1 Short run relationship between real estate residential property prices (HPRICE) and interest rate.

Based on table 17 above, weighted average lending rates by commercial banks have a significant positive consequence on real estate property prices in the short-run. The results reveal that a 1% increase in interest rate in the previous quarter will result a 1.92%, 2.64% and 2.05% increase in

real estate residential property prices in the first, second and third lags respectively in the current quarter. Only lag two and three have significant t-values hence will be included in the VECM model.

The findings on interest rate imply that, *ceteris paribus,* increase in interest rate in the economy generally leads to increases in real estate residential property prices in the short run. Increases in interest rates used in lending by commercial banks in an economy leads to increased cost of financing for the real estate sector which is highly leveraged and dependent on debt financing. Hence even a basis point increase in the lending rates has a significant impact on the actual interest paid to service loans offered by financial institutions. This was confirmed by Kosgei & Rono (2018) who established that the real estate market in Nairobi was significantly influenced by interest rates in the short run .A plausible explanation to this would be that interest rates lead to increases in the cost of developing or constructing new real estate residential properties which means that the stock of available real estate residential properties will remain the same in the short run since development can only be completed in the long run. This has the effect of inducing increased demand as supply falls due to fall in supply. This increased demand leads to increase in the value of real estate residential properties which is reflected in the increases in rents and leases of real estate properties.

This association between real estate residential property prices and interest rate is important from an investment perspective because it means that real residential property prices are interest rate sensitive, this implies that real estate as an investment responds to slight shocks in changes in interest rates in the short run hence both institutional and retail investors need to be aware of this before making investment decisions in order to protect their capital and be prepared for any adverse changes in the lending rates or even take advantage of the rates if they move in their favour. This is also important from a mixed asset portfolio framework because it enables investors limit the proportion of real estate in a portfolio with other interest rate sensitive investments such as fixed income bonds while rebalancing and allocating assets in their portfolios in the short run.

#### 4.9.1.2 Short run relationship between real estate residential property prices (HPRICE) and exchange rate

Based on table 18, Kenya Shilling USD exchange rate has a negative and insignificant effect on real estate residential property prices in the short-run in the first lag and third lags while the second

lag is negative but significant. The results on the association between real estate property prices and exchange rate imply that a 1% percentage increase in the level of exchange rate in the previous period results in a -0.66%, -0.77% and -0.43% reduction in real estate residential property prices in the short run in lags one, lag two and lag three respectively with lag two being the only lag with its coefficient being significant in the short run. The findings on exchange rate imply that, *ceteris paribus,* increase in exchange rate in the economy generally leads to a reduction in real estate residential property prices. The Kenya Shilling United States of America dollar (Ksh/USD) is an important exchange rate because most of the imports and exports in the country come by way of these two , this is also important because Kenya's foreign exchange reserves are held in terms of USD and lastly remittances in Kenya from abroad come through the USD

The results are consistent with previous studies such as Njangi (2021) who established that there exists both a short run and a long run significant negative relationship between real estate investment and the exchange rate regime in Kenya. Bioreri (2014) also established that there was a significant relationship between real estate investment and exchange rate but positive which cannot be ascertained because the proxy for real estate was REIT managers which not only invests in real estate but also other asset classes such bonds and equity which also reacts with exchange rate changes in different ways .

The short run relationship between real estate holding period return and exchange rate can be explained in the sense that most remittances from abroad are mostly used for real estate investment. Therefore variations in the exchange rate determines the value of money in Kenya Shillings that enters the country, this also determines the actual value of the investment made in the real estate sector. Hence any appreciation in the base currency (USD) against the Kenyan shilling will lead to more units of the Kenyan shillings in exchange for one unit of the USD. Hence remittances in USD will be converted to more Kenyan Shillings hence more money will be available in the economy for real estate development. The law of supply and demand applies in this case which means that more real estate residential properties will be developed leading to a glut in the economy hence depressing property values leading to a fall in the real estate property prices.

This nexus between real estate residential property prices and exchange rate is important from an investment perspective in the short run because it means that residential property prices are exchange rate sensitive in the short run, this implies that real estate as an investment responds to

slight shocks in changes in exchange rates hence both institutional and retail investors need to be aware of this before making short term investment decisions in order to protect their capital and be prepared for any adverse changes in the exchange rates or even take advantage of the rates if they move in their favor.

#### 4.9.1.3 Relationship between real estate residential property prices (HPRICE) and Inflation.

The results on the relationship between real estate residential property prices and inflation implies that a percentage increase in the level of inflation in the previous period results in an increase in real estate residential property prices in Kenya by 1.47%, 0.17% and 1.14% in the first, second and third lags with the first lag being the only significant coefficient.

These findings on inflation imply that, *ceteris paribus,* increase in inflation in the economy generally leads to increases in real estate residential property prices in the short run. Inflation in an economy not only leads to increased prices in consumer items but also to increased prices in the raw materials and products used in the real estate construction and development sector. Since real estate investors are subject to the same inflationary trends in their daily business or individual activities, it is only rational that they adjust their Net operating incomes which come by way of rents and leases. In this regard real estate investors can increase rents and the lease structures in their investments to compensate for increase in inflation which also leads to increased operating costs of their real estate residential properties.

The results are in line with findings from Sing & Swee Hiang (2000) who establish that real estate investments in Singapore have a relationship with inflation in different periods, both long run and short run periods hence suppporting the results on our shortrun relationship.This can be explained by the four quadrant model in which case in the short run, investors can respond to decreases in supply occassioned by increased cost of property development by adjusting the prices of their existing properties without having to develop new properties. These findings are corraborated by Lee (2013) who also established that real estate investments in Hong Kong have both a long run and short run hedge againts inflation.

This relationship between inflation and real estate residential property prices is important from an investment perspective because it means that real estate property prices lead inflation in Kenya in

the short run, this implies that real estate as an investment is able to give real return greater that the rate of inflation in the short run hence preventing loss or erosion in the value of investments made by both retail and institutional investors. This kind of relationship makes real estate an important alternative investment to be considered in each investor's portfolio alongside traditional asset classes such as bonds and equity investments which don't lead inflation in the short or long run.

#### 4.9.1.4 The Error Correction Term (ECM).

The error correction term coefficient is 0.464 established to be significant and also negative as per VECM theory. This means that any disequilibrium of real estate residential prices (HPRICE) in the short run will be corrected by 46.4% in each subsequent period hence meaning that in this case the disequilibrium is corrected in approximately two periods. The short-term deviation results above could be explained by deviation in real estate residential property prices from their equilibrium occasioned by unique features of real estate residential property investments such as illiquidity in the real estate market, long lead times for real estate investment deals occasioned by due diligence and stringent government regulations and procedures such as processing of stamp duty and legal requirements for charge documents on mortgaged properties.

### 4.10 Vector Error Correction Model for real estate growth rate (REG)

In line with the second objective of the study, this part looks at the influence of inflation, interest rate and exchange rate on real estate sector growth rate. In order to obtain the VECM model used in our long run and short run analysis in the study, the Vector Autoregressive Model (VAR) specified in section was differenced to obtain the short run relationship equation. Table 19 below shows the estimates for the VECM short run model with the insignificant variables being eliminated. The table also gives us a summary of the VECM estimates for the model with the respective variables as well as the corresponding standard errors and t-statistics in parentheses and brackets respectively. In a VAR analysis study the variables Real estate holding period return (HPR), exchange rate (EXCH), inflation (INF) and interest rate (INT) are all taken as endogenous. But for VECM used in this study, the variable real estate sector growth rate (REG) is to be considered an exogenous variable while the others will be endogenous. The variables have been regressed at second difference by the lag order 1 to 2 losing one lag after differentiation from the optimal lag of 1 to 3. Since the standard errors and t-statistics don't show the significance level of

the variables, the study went further and generated the p-values of the t-statistics to show us which coefficients are significant and should be included in the model and which ones are not and should subsequently be eliminated from the model to enable us make meaningful analysis and conclusions in our study.

**Table 18: Summary of Vector Error Correction Model estimates real estate sector growth rate (REG) for 1 to 2 lag lengths**

| Error Correction: | Coefficient | Std.Error | t. statistic | Prob |
|---|---|---|---|---|
| CointEq1 | -0.314842 | -0.10497 | [-2.99922] | 0.0034** |
| D(HPR(-1)) | 0.396522 | -0.11287 | [ 0.17090] | 0.011** |
| D(HPR(-2)) | 0.112870 | -0.1709 | [ 0.66045] | 0.5104 |
| D(INT(-1)) | 0.001220 | -0.00085 | [ 1.44280] | 0.6825 |
| D(INT(-2)) | 5.95E-05 | -0.00096 | [ 0.21444] | 0.4937 |
| D(EXCH(-1)) | 7.59E-05 | -0.00087 | [0.27813] | 0.7814 |
| D(EXCH(-2)) | 0.000114 | -0.00028 | [0.41199] | 0.6812 |
| D(CPI(-1)) | -0.00019 | -0.00046 | [0.41021] | 0.152 |
| D(CPI(-2)) | -0.000283 | (0.00041) | [ -0.68684] | 0.9544 |
| C | 0.000205 | -0.00096 | [ 0.21444] | 0.8306 |

*Source: (Author 2022) where c(n) represents the coefficients of study variables for the 1st and 2nd lags in the VECM model with respective columns for the coefficient estimates, standard error, t-statistics and the p-value. P-value is at 5% significance where p<0.05 are significant while p>0.05 are not significant. ** indicates coefficients that are significant.*

**Table 18: Summary of Vector Error Correction Model estimates for real estate sector growth rate (REG) 1 to 2 lag lengths Continued…**

| | |
|---|---|
| R-squared | 0.626181** |
| Adj. R-squared | 0.501575 |
| Sum sq. resids | 0.000191 |
| S.E. equation | 0.002658 |
| F-statistic | 5.025280 |
| Log likelihood | 172.7506 |
| Akaike AIC | -8.797331 |
| Schwarz SC | -8.361948 |
| Mean dependent | 3.39E-06 |
| S.D. dependent | 0.003764 |

*Source: (Author 2022)*

### 4.10.1 Discussion and interpretation of Vector Error Correction Model (VECM) results

This section carries out a detailed analysis and discussion of the short run relationship between the study variables real estate sector growth rate (REG), inflation (INF), exchange rate (EXCH) and interest rate (INT). Each of these study variables is treated as both an endogenous and exogenous variable hence the study generates 4 VECM model equations with each variables having 2 lags resulting in 36 coefficients including 4 constants. One lag is lost while transforming VAR into a VECM. The study goes ahead to discuss the significance and the effects each variable has on itself as well as on the other lagged variables. This analysis will be in line with the third objective of this study which was to establish the influence of inflation, interest rate and exchange rate on real estate real estate sector growth rate (REG) in Kenya. For the sake of this study, the concentration is on the relationship between all other variables and real estate holding period return.

#### 4.10.1.1 Short run relationship between real estate sector growth rate and interest rate.

The results on the relationship between interest rate and real estate real estate sector growth rate (REG) imply that a percentage increase in the level of interest rate in the previous period leads to increase in real estate sector growth rate (REG) in Kenya by 0.001220% and 0.0000% in lag one and lag two respectively both of which are insignificant. These findings on interest rate imply that, *ceteris paribus*, increase in interest rate in the economy generally does not lead to increases in real estate sector growth rate (REG) in the short run.

These findings are similar to Irandu (2017) who established that the Kenyan real estate market financial performance is not affected by interest rates in both the long run and short run. Similarly the results in this study which adopted real estate holding period return proxied as the percentage growth of real estate sector in Kenya and which represents real investments in terms of property development concluded that in the short run the increase in interest rates does not affect the growth in the real estate sector since real estate development takes a long time and is highly illiquid with long lead times resulting in no change or minimal insignificant growth in the real estate sector. Hence from a mixed asset portfolio real estate sector growth rate (REG) is not interest rate sensitive in the short run. These findings are corroborated by Kipkurui (2019) who established that the Kenyan REIT market is not significantly influenced by the interest rate regime in the country. This can be explained by the fact that REITs are a new asset class in the real estate sector but has not been fully accepted by retail and institutional investors as well as poor regulation by the Capital Markets Authority to advertise and educate investors on its inherent advantages such as liquidity and less costly acquisition costs.

#### 4.10.1.2 Relationship between real estate sector growth rate (REG) and exchange rate

The results on the association between real estate sector growth rate (REG) and exchange rate imply that a one percent increase in the level of exchange rate in the previous period results in a 7.59E-05% and 0.000114 % reduction in real estate sector growth rate (REG) in the short run but the coefficients are not significant.

These findings on exchange imply that, *ceteris paribus*, increase in exchange rate in the economy generally does not have any significant impact on the real estate sector growth rate (REG) in the short run since real estate development is long term and cannot be developed in short notice. Results from previous studies such Mallick & Mahalik (2015) which established that real estate investments are not affected by exchange rate changes and hence corroborate this study results which can be explained by the long lead time in real estate investment which is longer than the short run dynamics. In essence in the short run remittances from abroad mostly used for real estate usually get utilized for real estate investment after proper due diligence and even if the projects commence immediately, it takes time to complete them This therefore means that in the short run real estate real estate sector growth rate (REG) is not sensitive to changes in exchange rates in Kenya.

#### 4.10.1.3 Relationship between real estate sector growth rate (REG) and Inflation.

The results on the relationship between inflation and real estate sector growth rate (REG) imply that a one percent increase in the level of inflation in the previous period increases real estate sector growth rate (REG) in Kenya by 0.00019% and 0.000283% in lag one and two respectively but are not significant hence can't be included in the model. .

These findings on inflation imply that, *ceteris paribus*, increase in inflation in the economy generally does not lead to increases in real estate sector growth rate (REG) of real estate investments in Kenya in the short run hence it's not an important factor while analyzing the performance of real estate sector growth rate (REG) in the short run. The real estate sector growth rate (REG) proxy in the study is the growth in the real estate sector which only occurs over a longer time frame. Hence from a mixed asset portfolio real estate holding period return does not lead inflation in the short run hence needs to be substituted with other investments that lead inflation in the short run.

The results in our study are supported by the findings by Dabara, Gbadegsin, Amidu, Oyedokun, & Chiwuzie (2021) who established that the Nigerian REIT market had no relationship with inflation exposures both actual and expected inflation. The plausible explanation to this in the short run is that holding period return which in this case repesents signifianct growth in the stock of real estate in the economy can not change singninfianctly in the short run because real estate by nature is bulky and has long lead time for development hence new stock in real estate can not increase at a faster pace than inflation which increases in short durations based on demand and supply of commodities in the economy or based cost of production. The results are supported by Maina (2021) who estblished that REIT returns in Malaysia, Taiwan and Turkey don't have any significant relationship with infation.

#### 4.10.1.4 The Error Correction Term (ECM).

The error correction term coefficient is 0.3148 established to be significant and also negative as per VECM theory. This means that any disequilibrium of real estate growth rate (REG) in the short run will be corrected by 31.4% in each subsequent period hence meaning that in this case the disequilibrium is corrected in approximately three periods. The short-term results above could be explained by deviation in real estate sector growth rate (REG) from their equilibrium occasioned by unique features of real estate property investments such as illiquidity in the real estate market,

long lead times for acquisition of new tenants and also real estate investment deals occasioned by due diligence and stringent legal requirements especially for drafting lease contracts and bargaining by both parties which usually takes time. This can also be occasioned by information asymmetry where landlords and potential tenants are not able to contact each other or access relevant information on vacant units.

### 4.11 VECM diagnostic test

#### 4.11.1 VAR stability test.

Figures 8 and 9 show that all the inverse roots of real estate residential property prices fell inside the unit root which was a clear indication that the VECM models for both were stable.

**Figure 8: Inverse root polynomial for real estate residential property price (HPRICE)**

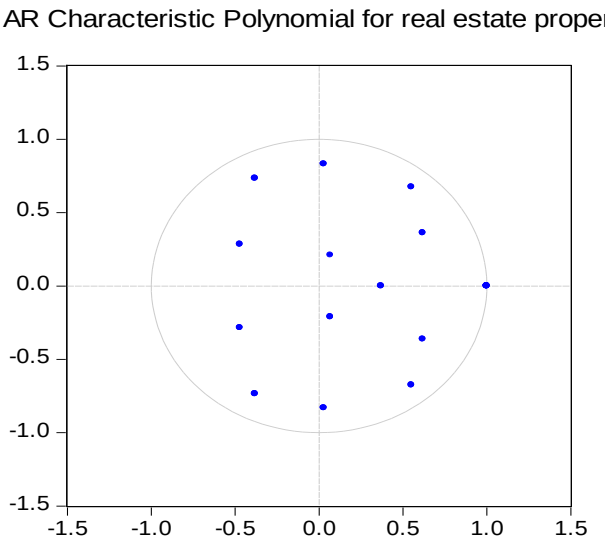
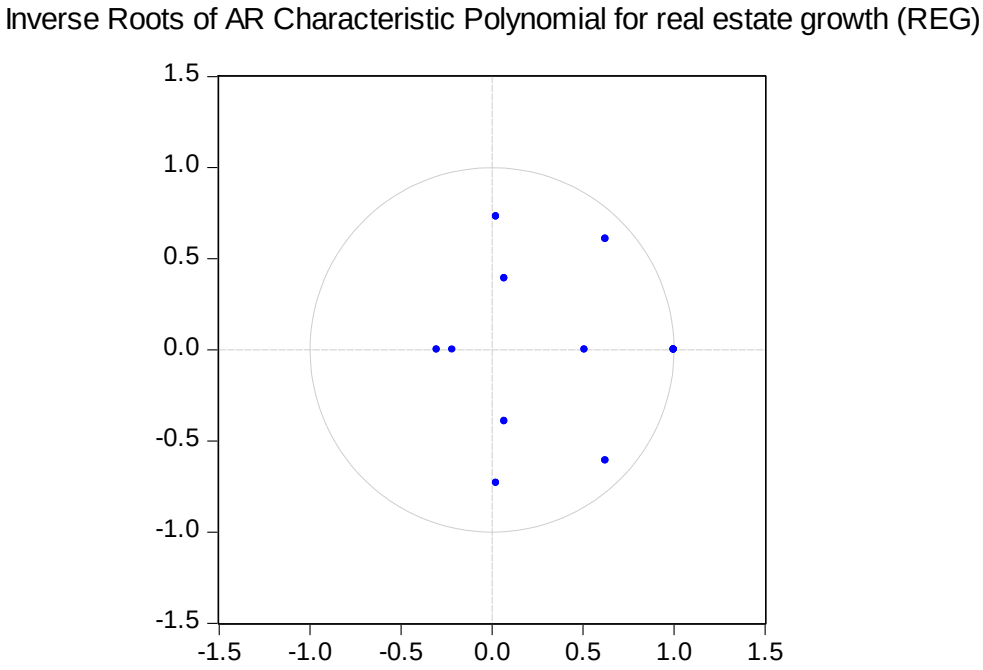


**Figure 9: Inverse root polynomial for real estate growth rate (REG)**




### 4.11.2 VAR lag length determination

Table 22 under real estate residential property prices (HPRICE) indicated that lag 4 had the most number of criterions supporting it as the optimal lag, these are AIC, FPE and HQ thus the optimal lag length. The study settled on 4 s the optimal lag because it was supported by a majority of the criterions used in the study.

**Table 17: Optimal Lag criteria for HPRICE**

| Lag Length | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 0 | -350.8081 | NA | 50215.62 | 22.17551 | 22.35873 | 22.23624 |
| 1 | -195.0087 | 262.9115 | 8.140580 | 13.43805 | 14.35413* | 13.74170 |
| 2 | -176.5782 | 26.49382 | 7.366505 | 13.28614 | 14.93509 | 13.83272 |
| 3 | -146.3825 | 35.85742* | 3.477430 | 12.39891 | 14.78073 | 13.18841 |
| 4 | -120.3795 | 24.37787 | 2.477596* | 11.77372* | 14.88841 | 12.80615* |

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

**Table 18: Optimal Lag criteria for REG**

| Lag Length | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 0 | -145.8223 | NA | 0.048413 | 8.323461 | 8.499407 | 8.384871 |
| 1 | 5.112021 | 259.9424 | 2.71e-05 | 0.827110 | 1.706843 | 1.134160 |
| 2 | 30.74408 | 38.44809 | 1.64e-05 | 0.291995 | 1.875514 | 0.844686 |
| 3 | 63.30616 | 41.60710* | 7.19e-06* | -0.628120* | 1.659185* | 0.170210* |
| 4 | 75.73004 | 13.11409 | 1.06e-05 | -0.429447 | 2.561645 | 0.614524 |

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

Table 23 under real estate sector growth rate (REG) indicated that lag 3 had the most number of criterions supporting it as the optimal lag, these are AIC, FPE and HQ thus the optimal lag length. The study settled on 3 s the optimal lag because it was supported by a majority of the criterions used in the study.

### 4.11.3 VECM Goodness of Fit test

The study results on VECM on Table 17 and Table 18 based on both real estate sector growth rate and real estate residential property prices showed that approximately 62.6% and 54.56% of variations in residential prices for real estate and the growth rate in the real estate sector in Kenya could be explained at the 5% significance level by the variations in inflation, exchange rate and interest rate respectively. The results established the statistical significance of the $R^2$ real estate growth rate (REG) by comparing the F-critical ( 5.02) $_{40,4}$ to the F-computed (21) in which case F-calculated is established to be larger than F-critical suggesting of the VECM for growth rate (REG). On the other hand when we compare F-critical and F-computed for the VECM for real estate residential property prices (HPRICE) we establish that the F-computed (14.41) was greater than the F-critical $(1.663)_{40,4.}$ Hence from the test it's evident that slope coefficients of the VECM for both models are significant. Hence goodness of fit is established for both REG and HPRICE VECM models in the study.

### 4.12 VAR residual diagnostic test

The unrestricted VAR model is developed under several assumptions that determine whether or not the results will be reliable. Therefore the study carried out various diagnostic tests before carrying out interpretation of the VECM results. On top of this the study carried out stability checks for the models estimated.

#### 4.12.1 Normality test.

This test was used to establish whether the estimated parameters and their confidence intervals were robust. The results were as follows;

**Table 19: Normality test for real estate growth rate (REG)**

| Components | Jarque-Bera statistic | df | Probability |
|---|---|---|---|
| 1 | 0.154779 | 2 | 0.9255 |
| 2 | 4.216973 | 2 | 0.1214 |
| 3 | 7.671202 | 2 | 0.0216 |
| 4 | 1.293247 | 2 | 0.5238 |
| Joint | 13.33620 | 8 | 0.1008 |

*Source: (Author 2022)*

Table 24 shows a joint Jarque-Bera statistic has a p-value of 0.1008 which is greater than 0.05. This therefore means that that the VECM residual for REG are normally distributed at 5 percent significance level. We accept null hypothesis of normality.

**Table 20: Normality test for real estate residential property prices (HPRICE)**

| Components | Jarque-Bera statistic | df | Probability |
|---|---|---|---|
| 1 | 2.594916 | 2 | 0.2732 |
| 2 | 0.697337 | 2 | 0.7056 |
| 3 | 0.827763 | 2 | 0.6611 |
| 4 | 0.662086 | 2 | 0.7182 |
| Joint | 4.782102 | 8 | 0.7806 |

*Source: (Author 2022)*

Table 25 shows a joint Jarque-Bera statistic has a p-value of 0.7806 which is greater than 0.05. This therefore means that that the VECM residual for HPRICE are normally distributed at 5 percent significance level. The null hypothesis of normality is accepted.

### 4.12.2 Serial correlation test

The study tested for serial correlation to ensure that the OLS estimates were efficient. The results were as follows;

**Table 21: Serial correlation test (LM) for real estate residential property prices (HPRICE)**

| Lags | LM-Statistic | Probability |
|---|---|---|
| 1 | 17.39845 | 0.3603 |
| 2 | 7.203377 | 0.9691 |
| 3 | 9.045490 | 0.9115 |

*Source: (Author 2022)*

Table 26 shows the serial correlation LM test results with p-values of 0.3603, 0.9691 and 0.9115 for lag one, lag two and lag three of real estate property prices respectively. The null hypothesis at the 5 percent significance level was rejected since the probability values were greater than 5% significance level. Hence there was no serial correlation in the model.

**Table 22: Serial correlation test (LM) for real estate sector growth rate (REG)**

| Lags | LM-Statistic | Probability |
|---|---|---|
| 1 | 18.14799 | 0.3153 |
| 2 | 18.88646 | 0.2746 |

*Source: (Author 2022)*

Table 26 shows the serial correlation LM test results with p-values of 0.3153 and 0.2746 for lag one and lag two of real estate sector growth rate respectively. The null hypothesis at the 5 percent significance level was rejected since the p values were greater than 0.05 level of significance. Hence there was absence of serial correlation in the model.

### 4.12.3 Heteroscedasticity.

**Table 23: White test for Heteroscedasticity for real estate residential property prices (HPRICE)**

| Joint tests: | | |
|---|---|---|
| Chi-square | df | Probability. |
| 275.3429 | 260 | 0.2454 |

*Source: (Author 2022)*

Table 28 shows that p –value of 0.2454 for real estate property prices were greater than 0.05. The study therefor accepted the null hypothesis of absence of Heteroscedasticity at the 5 percent significance.

**Table 24: White test for Heteroscedasticity for real estate sector growth rate (REG)**

| Chi-square | df | Probability. |
|---|---|---|
| 191.8959 | 180 | 0.2583 |

*Source: (Author 2022)*

Table 28 shows that p –value of 0.2583 for real estate sector growth rate were greater than 0.05. The study therefor accepted the null hypothesis of absence of Heteroscedasticity at the 5 percent significance.

# CHAPTER FIVE: SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

## 5.1 Introduction

This chapter is a presentation of the findings of the study, conclusions made in this regard and recommendations made for policy actors as well as investors.

## 5.2 Summary of Findings

### 5.2.1 Real estate sector growth rate (REG)

This study carried out an investigation of the influence interest rate, exchange rate and inflation has on the financial performance of real estate as an investment. The growth rate of the real estate sector was the first measure of performance adopted by the study. The study looked at the value of overall investments in the sector between 2012Q1 to 2021Q4 making use of cointegration and Vector Autoregressive methodologies. From the study, it is established that real estate sector growth rate in Kenya has a significant positive relationship with inflation and interest rate. The study also establishes that real estate growth has a negative relationship with exchange rates specifically the Kenya Shilling US dollar exchange rate in the long run. Concerning correlation between real estate holding period return and explanatory variables in the study, the results show that there is a strong positive correlation between real estate holding period return and all explanatory variables. The correlation coefficient real growth rate and inflation was established to be 0.36, 0.0.0722 and 0.0989 respectively for exchange rate, interest rate and inflation. Only exchange rate was significantly associated.

The study established that in the long run there exists a significant positive relationship between inflation, interest rate and real estate sector growth. However when we look at the short run dynamics the study established that there exists a significant negative relationship between exchange rate and real estate sector growth rate in the long run. On the short-run effects, inflation and interest rate have a statistically insignificant positive relationship real estate sector growth rate. In the same extent, exchange rate also has a statistically insignificant negative relationship with real estate sector growth rate in the short run. As a final point, the findings from the study indicated that the speed of adjustment back to equilibrium was 31% pointing out that there exists a long run relationship.

### 5.2.2 Real estate residential property prices (HPRICE)

The second objective of the study examined the influence of inflation, interest rate and exchange rate on the real estate residential property prices. These macroeconomic indicators include inflation, interest rate and exchange rate. The second measure of financial performance of real estate investment was the index of real estate residential property prices of real estate investments which was proxied as Kenya Bankers Housing Price Index on real estate residential property prices. The study looked at the value of overall investments in the sector between 2012Q1 to 2021Q4 adopting the use of cointegration and Vector error correction methodology. The study establishes that real estate residential property prices in Kenya has a significant positive long run relationship with inflation and interest rate while at the same time having a negative relationship with exchange rates specifically the Kenya Shilling US dollar exchange rate. Concerning correlation between real estate residential prices and explanatory variables in the study, the results show that there is a significant positive association between real residential property prices with the explanatory variables in the study. For example, the coefficient of correlation between real estate property prices and exchange rate, interest rate and inflation was at the 5% significance level estimated to be 0.5423, -0.4588 and 0.4241 respectively. All of which had a significant association with real estate residential prices.

The study established a significant positive relationship between real estate residential prices and the interest rate regime and inflation regime in the long run. Contrary to this, the results from the study established that the exchange rate regime was a significant negative influence on real estate residential prices. The study also established that in the short run, real estate residential property prices was significantly positively influenced by the interest rate regime, exchange rate regime and inflation regime. Lastly the error correction term was established to be 46.4% which meant that residential real estate prices adjusted from disequilibrium to equilibrium at 46.4% which meant that the adjustment takes approximately 2 periods to adjust back to equilibrium.

## 5.3 Conclusions

Therefore in conclusion there exists both short run and long run association between interest rate, exchange rate regimes and inflation and the prices of real estate units in Kenya. These results imply that real estate investments specifically residential property prices are positively sensitive to

changes in interest rate and exchange rate in the economy. Similarly real estate residential property prices are negatively sensitive to exchange rate in the long run and the short run.

The study established that for real estate sector growth rate, there existed only long run relationship with the independent variables used in the study. While in the short run there existed no significant relationship with the independent variables put forth in the study. This in essence implied that real estate sector growth rate only responded to changes in the exchange rate regime, interest rate regime and inflation regime in the country in the longer duration while in the short run this response was not significant to affect the growth rate of the sector.

### 5.4 Recommendations

From the results and findings, investors should focus on strategies to include real estate investments in their portfolios while paying close attention to asset allocation and diversification dynamics. From literature, real estate acts as a special investment since investors it can invest in through various ways such as through real estate property or both listed and unlisted REITs securities. On top of this each individual real estate investment is different from the next and have different dynamics in their operations such as demographic, social and geographic elements. From this it is evident that real estate investments are highly diversifiable compared to other traditional asset classes such as equity and bonds. Therefore the study recommends that real estate investments should form part of an investor's portfolio for diversification of risk and enhancement of returns.

The study established that real estate investments acts as an inflation hedge in the long run and short run, 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 related such as Exchange Traded Funds (ETF) pegged on commodities such as gold, 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 not 100% optimal. These portfolios might be slightly off the efficient frontier.

The study established that real estate investments are interest rate sensitive hence when included in a portfolio of mixed assets should limit the proportion of other interest rate sensitive assets such as bonds and other fixed income securities. The study recommends that since real estate shares the

same similarities as bonds in that both have income streams in form of coupons and rents or leases while both have capital appreciation hence are more or less similar. Hence the study recommends investors to 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.

Lastly the results of this study established existence of exchange rate sensitivity in real estate investments. This is an important 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 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.

To conclude the study established existence of a significant long run relationship between exchange rate, inflation and interest rate and growth of the real estate sector, on the other hand in the short run there was no significant relationship. From an investment perspective this means that investors cannot take advantage of short run adjustments in the macro-economic environment by making use of long term strategies such as initiating capital intensive capital projects or investments which take long periods to be completed, the study recommends that investors take advantage of short term changes in macro-economic variables by making use of available stock of real estate properties through adjustments in property prices and Net operating Income through adjustment of leases and rents.

### 5.5 Contribution to research

The study contributed to the existing literature and information on investments in the real estate market as well as on the modern portfolio theory specifically asset allocation in the Kenyan market in regards to real estate investments visa vis other investment asset classes.

### 5.6 Limitations of the study

The study was only able to look at real estate investments from 2012 due to absence or lack of enough real estate indices to measure performance of the sector. These was in essence insufficient

data on the real estate investment sector as a consequence of information asymmetry present in the market for real estate.

### 5.7 Suggestions for further research

Research on listed real estate investment could be carried out to establish how inflation impacts their performance in both the short run and long run. In addition, this can be extended to study how real estate investments affect the performance of a mixed asset portfolio composed of different asset classes.

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## APPENDIX

**Table 25 Raw Data**

| Year | EXCH | INT (%) | GDP REAL | REG(%GDP REAL) | HPRICE | CPI |
|---|---|---|---|---|---|---|
| 2012Q1 | 84.14 | 20.05 | 141613 | 0.00% | | 67.10 |
| 2012Q2 | 84.12 | 20.21 | 142820 | 0.85% | | 68.26 |
| 2012Q3 | 84.28 | 20 | 143574 | 0.53% | | 67.31 |
| 2012Q4 | 85.58 | 18.32 | 143874 | 0.21% | | 68.11 |
| 2013Q1 | 86.72 | 17.9 | 143722 | -0.11% | 100 | 69.84 |
| 2013Q2 | 84.61 | 17.43 | 144195 | 0.33% | 101.42 | 71.24 |
| 2013Q3 | 87.25 | 16.95 | 145294 | 0.76% | 101.46 | 72.02 |
| 2013Q4 | 85.91 | 16.96 | 147019 | 1.19% | 101.63 | 73.17 |
| 2014Q1 | 86.33 | 17 | 149371 | 1.60% | 102.13 | 74.57 |
| 2014Q2 | 87.25 | 16.68 | 151490 | 1.42% | 102.29 | 76.25 |
| 2014Q3 | 88.24 | 16.4 | 153379 | 1.25% | 102.44 | 77.45 |
| 2014Q4 | 89.88 | 15.98 | 155035 | 1.08% | 102.71 | 77.69 |
| 2015Q1 | 91.53 | 15.62 | 156461 | 0.92% | 102.97 | 78.91 |
| 2015Q2 | 95.85 | 15.73 | 158737 | 1.45% | 103.88 | 81.58 |
| 2015Q3 | 102.97 | 16.08 | 161863 | 1.97% | 107.34 | 82.20 |
| 2015Q4 | 102.38 | 17.35 | 165840 | 2.46% | 108.19 | 83.40 |
| 2016Q1 | 101.91 | 17.93 | 170667 | 2.91% | 109.08 | 84.51 |
| 2016Q2 | 101.04 | 18.15 | 174919 | 2.49% | 111.28 | 85.95 |
| 2016Q3 | 101.34 | 16.54 | 178595 | 2.10% | 113.05 | 87.41 |
| 2016Q4 | 101.73 | 13.69 | 181696 | 1.74% | 114.91 | 88.82 |
| 2017Q1 | 103.41 | 13.65 | 184222 | 1.39% | 115.92 | 91.92 |
| 2017Q2 | 103.36 | 13.66 | 186886 | 1.45% | 116.67 | 95.22 |
| 2017Q3 | 103.52 | 13.68 | 189687 | 1.50% | 117.59 | 93.98 |
| 2017Q4 | 103.35 | 13.68 | 192625 | 1.55% | 119.19 | 93.24 |
| 2018Q1 | 101.83 | 13.61 | 195701 | 1.60% | 123.83 | 96.04 |
| 2018Q2 | 100.76 | 13.24 | 198924 | 1.65% | 124.78 | 99.02 |

| Year | EXCH | INT (%) | GDP REAL | REG(%GDP REAL) | HPRICE | CPI |
|---|---|---|---|---|---|---|
| 2018Q3 | 100.70 | 12.85 | 202293 | 1.69% | 119.38 | 98.40 |
| 2018Q4 | 101.91 | 12.56 | 205810 | 1.74% | 119.48 | 98.47 |
| 2019Q1 | 100.72 | 12.49 | 209991 | 2.03% | 114.3 | 100.24 |
| 2019Q2 | 101.30 | 12.48 | 213239 | 1.55% | 109.17 | 102.99 |
| 2019Q3 | 103.42 | 12.44 | 215771 | 1.19% | 108.02 | 104.02 |
| 2019Q4 | 102.52 | 12.35 | 217588 | 0.84% | 109.04 | 105.21 |
| 2020Q1 | 101.87 | 12.07 | 218690 | 0.51% | 106.87 | 107.05 |
| 2020Q2 | 106.50 | 12.06 | 220812 | 0.97% | 106.66 | 108.45 |
| 2020Q3 | 107.94 | 11.89 | 223955 | 1.42% | 106.63 | 108.50 |
| 2020Q4 | 109.49 | 11.97 | 228118 | 1.86% | 107.6 | 110.75 |
| 2021Q1 | 109.75 | 12.02 | 233302 | 2.27% | 108.69 | 113.26 |
| 2021Q2 | 107.73 | 12.05 | 237190 | 1.67% | 108.19 | 114.95 |
| 2021Q3 | 109.18 | 12.1 | 239782 | 1.09% | 110.33 | 115.75 |
| 2021Q4 | 111.90 | 12.14 | 241078 | 0.54% | 109.35 | 117.38 |

*Source: author (2022) INT and REG in % while CPI, EXCH and HPRICE in absolute terms*