DETERMINANTS OF RESIDENTIAL HOUSE PRICES IN NAIROBI CITY COUNTY, KENYA

BY

MARGARET KOSGEI

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DECLARATION

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Signature……. Date…….

Margaret Kosgei

SBE/DPHIL/117/12

Declaration by the Supervisors:

This thesis has been submitted for examination with our approval as the university supervisors.

Dr. Joel Tenai

Department of Accounting and Finance

School of Business and Economics,

Moi University

Signature……..…… Date……..

Dr. Lucy Rono

Department of Accounting and Finance

School of Business and Economics,

Moi University

Signature……..…… Date……..

DEDICATION

This work is dedicated to the Almighty God for enabling me come this far. Special dedication goes to my dear parents Mrs. Leah T. Makerer and my late father, Mr. John Kosgei Borborei for always believing in me and providing me with education. To my husband Jonathan Birech, my daughter Sherry Anne Birech and son Allan Birech for their love, patience, understanding and moral support during the period of the study. To my siblings, Emily, Zippie, Sarah, Sharon, Lily, Nicholas, Ken, Jay and Stella for their support and encouragement. God bless you abundantly.

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ABSTRACT

House prices have been the main focal point of economic and social debate in recent times in many developing countries. House prices in Kenya have been rising in the past ten years and the latest findings have shown that the trend will continue into the foreseeable future. There are many factors affecting house prices, their influence however has to be established over time. The general objective of the study was to evaluate the determinants of house prices in Nairobi County, Kenya. The specific objectives examined the effect of; mortgage rate, exchange rate, interest rate, population, number of houses, inflation and GDP on house prices. The study adopted an explanatory research design in explaining the effect of mortgage rate, exchange rate, interest rate, population, number of houses, inflation and GDP on houses and covered the period 2004-2016. The target population consisted of 1,874,181 residential houses in Nairobi City County. Quarterly observations (2004Q1-2016Q4) of the House Price Index (HPI) from the Hass Property Consult Ltd and the quarterly observations of the independent variables from Kenya National Bureau of Statistics and Central Bank of Kenya was used. Vector Auto-regressive (VAR) model estimates were used to get variance decomposition and impulse response functions results. Variance decomposition results indicated that in the long run, exchange rate caused the largest randomness in house prices. Impulse response results indicated that mortgage rate, interest rate, inflation and GDP had a positive relationship with the house prices in the short run whereas exchange rate, population and new houses had a negative relationship in the short run. To determine the long-run relationship between the determinants and house prices, Vector Error Correction Model (VECM) estimates were used. Results confirmed the existence of a long-run equilibrium relationship among variables in the model. The size of the coefficient of the error correction term (β = - 0.397, p = 0.0122) suggested a relatively higher speed of adjustment from the short-run deviation to the long-run equilibrium. VECM coefficients specifically revealed that in the long-run, exchange rate (β= 0.174, p = 0.0428), population (β= 0.829, p = 0.0286), inflation (β= 0.039, p = 0.0015), mortgage rate (β= 0.658, p = 0.000), new houses (β = 0.367, p = 0.000 had a positive significant effect on house prices. Interest rate (β = - 0.444, p= 0.0025),) had a negative effect on house prices which was highly significant. Though having a negative relationship with house prices, the study failed to identify any long-run relationship between GDP (β= - 0.011, p = 0.8174) and house prices. The study concluded that exchange rate is the most important predictor of house price changes in Nairobi City County. The study recommends that Central Bank of Kenya should use expansionary monetary policies so as to induce development in the housing market thus enabling market participants. The government should also enhance remittance policy to target appropriate groups to grow the housing market. Consequently, the government should increase its budgetary allocation to housing so as to increase the supply of houses hence check the house prices. Further, there is need to check on urban population growth so as to match the number of houses available with the increase in population.

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ABBREVIATIONS AND ACRONYMS

ADF	Augmented Dicker-Fuller
ARMA	Autoregressive Moving averages Model
ASCA	Accumulating Savings and Credit Association
CBK	Central Bank of Kenya
DCLG	Department of Community and Local Government
ECM	Error Correction Model
ERR	Error Reduction Ratio
EU	European Union
GDP	Gross Domestic Product
HPI	House Price Index
KBA	Kenya Bankers Association
KNBS	Kenya National Bureau of Statistics
KSH	Kenya Shillings
NHC	National Housing Corporation
OLS	Ordinary Least Squares
PP	Phillips-Perron
RMB	Ren Min Bi
USA	United States of America
US	United States
VAR	Vector Autoregressive Model
VECM	Vector Error Correction Model
REITs	Real Estate Investment Trusts

OPERATIONAL DEFINITION OF TERMS

Exchange Rate:	Price of a nation's currency in terms of another currency.
Fundamental variables:	These are factors that drive house prices by either causing a shift in demand or supply of houses
Gross domestic product:	Total value of goods and services produced by a country over a specific period, usually annually.
Housing bubble:	A situation in which increase in house prices is not justified by macroeconomic fundamentals or variables and other underlying factors.
House prices:	Asset prices of residential houses and the land associated with.
House Price Index	A measure of changes in price, which is not caused by changes in the quality or quantity of the goods
Inflation:	This is a sustained increase, in general price levels for goods and services that are given as an annual percentage increase. It is measured using annual percentage rate.
Interest rate:	Rate of return required by the financiers.
Macroeconomic variables:	Factors pertinent to a broad economy at regional or national level and affect a large population rather than a few individuals.
Mortgage Rate:	Rate of return required by the financiers of house purchase loans.
New houses:	This refers to the residential capital stock in any period. It is determined by the existing stock in the previous period and the flow of new residential construction investment.
Population:	This refers to the total or aggregate of all the objects, subjects or members that conform to a set of specifications.

CHAPTER ONE

INTRODUCTION

1.1 Overview

This chapter presents an overview of the study. This includes the background information of the study, the housing market in Nairobi City County, the statement of the problem, objectives of the study and respective research hypotheses. The chapter proceeds to the significance of the study before concluding with a presentation of the study's scope.

1.1.1 Background of the Study

From the onset of the 2007/2008 financial crunch that turned out to be a global crisis and which has often been referred to as the great recession, it is now widely acknowledged by empiricists and practitioners that the role played by house prices in generation of business cycles and financial dynamics is greatly significant (Valadez, 2012; Shi & Jou, 2013). It was also noted that the housing market predicted eight out of the ten recessions that took place after the World War II (Learner, 2007 cited in Plakandaras, Gupta, Gogas & Papadimitriou, 2015). More interestingly, Learner (2007) went ahead to proclaim that "Housing is the Business Cycle". Davis and Heathcode (2003) asserted that house prices play a key role by leading the business cycle, an assertion supported by Beltratti and Morana (2010) and Ghent and Owyang (2010). It also follows that fluctuations in the price of housing amplify business cycles and that investment in houses leads the business cycle (IMF, 2009). It has also been illustrated vividly that business cycles are influenced by house prices. This influence is via the house price effect on total spending and financial systems (Tsatsaronis & Zhu, 2004). Large cyclical variations in house prices have been witnessed in many industrialized nations, often having a sudden price hike after which a financial crash

follows whereby investors lose out on their investments hence affecting their returns adversely (Nneji *et al.,* 2013a).

Excess liquidity coupled by record low levels of interest rates for instance were considered as the leading factors that were behind the hatching of the supper financial bubble that took place within the US housing sector (Zhang *et al.,* 2012). This housing bubble started innocently just like other bubbles but its bursting led to the famous financial crunch in the US which since its onset in 2007 until the time that came to its end around 2009, had destroyed financial assets estimated at around $20 trillion owned by households in the US (Harris, 2014). The effect of the crisis was also witnessed in the rise of unemployment rate in the US from around 4.7 percent to roughly 10 percent, representing approximately a 5.3 percent rise.Even after the end of the crisis, its reeling effects were still being felt (Harris, 2014; Beltratti and Morana, 2010). In 2010 for example, college graduates who could luckily get employment opportunities were averagely taking home a salary of at least 17.5 percent lower relative to what their counterparts were earning during the pre-crisis era, and experts were making speculation that such a fall in earnings would go on for at least a decade (Harris, 2014). Though the bubble is believed to have been hatched in the US, its effect went global resulting to an approximate decline in global Gross Domestic Product by 2 percent in 2009 (Nneji *et al.,* 2013). This scenario is just but one of the evidence of how significant the housing market can influence economic functioning.

The exceptionally low rates of mortgage were particularly critical since they lured people into extraordinarily rush to purchase real estate (Harris, 2014). The federal government in the US had set both the funds rate and interest rates at generally

historic low levels. Even individuals who typically had little hope of securing a mortgage could easily access the same. Consumers purchased homes and investment properties at a rate hardly seen before a situation that caused an increase in housing prices. It never crossed the mind of most people particularly realtors that prices of houses could ever decline once more (Harris, 2014; Nourzad and MCGibanny, 2012). In a slightly earlier era, during Spain's expansionary period of 1990s and mid-2000s, the Spanish housing market witnessed a fundamental rise in the household debt levels and a massive resource concentration within the house sector, a situation that affected investments adversely (Gimeno & Carrascal, 2010).

According to Otrok and Terrones (2005), several factors have led to the increased studies on house price dynamics. First, a house is noted to be the greatest single asset owned by most households and its value accounts for a significant component of total portfolio of financial intermediaries (Guo, Chen & Huang, 2011). Second, housing contributes a large proportion towards the gross domestic product of many economies. For example, in the US, the aggregate contribution of investments in the housing service as well as the residential fixed investments as a percent of her real Gross Domestic Product was estimated at around 18 percent. This figure was slightly much higher at around 18.75 percent before the meltdown that took place in September 2005. By around the year 2011, residential fixed investment and housing services were jointly accounting for about 15.5 percent of the US GDP (Valadez, 2011).

Thirdly, housing expenditure takes a great proportion of the entire expenditure of households. For instance, during the year 2017, the average annual expenditure on housing by the US consumers was estimated at around 37.5 percent of the entire expenditure (United States Department of Labor, Bureau of Labor Statistics, 2018). In

the year 2016, the biggest proportion of member countries within the European Union (EU) had the greatest share of the households' expenditure directed to housing, water, electricity, gas and other fuels (Eurostat, 2017). In particular, households in the EU had about one quarter of their entire consumption expenditure directed to housing (Eurostat, 2017). During the year 2016, countries in the European Union which devoted the greatest share of their entire expenditure to housing are Denmark, Finland, United Kingdom, France, Sweden and finally Czech Republic with respective proportions being 29.1 percent, 28.4 percent, 27.1 percent, 26.2 percent, 26.0 percent and 25.6 percent (Eurostat, 2017). In the extreme end, the lowest proportion of household expenditure directed to housing among the EU nations ordered starting with the least of them all was recorded in Malta, Lithuania, Cyprus, Estonia and Portugal with respective proportions being 10.3 percent, 15.6 percent, 15.9 percent, 17.6 percent and 18.8 percent.

More so, it is worthwhile noting that the major liability faced by most households is the mortgage debt which has an influence on affordability (Gimeno & Carrasal, 2010). According to Pew Research Centre Report of 2012, approximately 80 percent of Americans have some form of debt; out of this debt, mortgage accounts for the largest fraction which is estimated at around 44 percent (West, 2018). In particular, lending portfolios not only for commercial banks but also for other financial institutions are adversely affected by substantially huge fall in house prices. The adverse effect is felt on the profitability of those financial institutions and may lead to failures in these institutions (Wheelock, 2006). For instance, the housing bubble of the US that eventually plummeted into a total global banking crunch is blamed for the collapse of the Lehman Brothers, an investment that occurred on 15th of September 2008 (Williams, 2010). Apart from leading to eventual collapse of some financial

institutions, the financial crunch also led to the decline in credit availability and ruined confidence of the investors with the end results being adverse effects on the global market for securities leading to huge losses recorded in market for securities during the year 2008 as well as at the beginning of 2009. Furthermore, it has been made clear that houses play a key role in mortgage transactions, whereby financial institutions often use houses as collateral to grant loans (Ansah, 2012). Likewise, Shiller *et al.* (2001) argued that the borrowing capacity of owner of homes for both consumption and production is greatly affected by change in housing prices. These effects are then transmitted to the financial system. All these scenarios clearlysignal the economic centrality of the housing market and why the same topic has continued to attract the attention of many researchers.

Today, investment institutions and individual investors have started to appreciate the significance of residential housing which is considered as a fundamental requirement in the aggregate wealth of a household and this has made them allocate a proportion of their savings towards owning a house as income increases (Shuid, 2003). In support of this proposition, Benjamin, Chinloy and Jud (2004) asserted that an empirical observation of the US households had revealed that generally, these households concentrate their wealth in housing and that their holding level for financial assets is relatively limited. In particular, the 2001 survey of the consumer finances conducted by the Federal Reserve showed that about 65.5 percent of the entire net wealth owned by a median US household was in single-family residential housing. Through comparison, separate from retirement accounts as well as insurance accounts, the average material endowment in form of wealth of a household in the United States was estimated at just around 22.5 percent of household wealth in 2001. This wealth comprised of cash endowment, bonds as well as mutual funds. In South

Africa, the aggregate value of investment in residential housing by households in 2010 was estimated at R1.6 trillion. This figure was a reflection of approximately 25 percent of total assets owned by households and 31 percent of South Africa's households' sector net wealth (South African Reserve Bank, 2011).The housing market serves as a critical element of households' portfolio, an appreciation in house prices translates to an increase in wealth (Ansah, 2012). A house is treated in a manner similar to any other asset which includes being valued based on the net present value of future revenue flows or services created (Antipa & Lecat, 2010). To the investors, owning a house has an advantage since it is part of an investment which is likely to last long enough leading to accumulation of wealth (Atterhog, 2005).

Housing markets are important given the role they play in investments and the capital market. Houses are given a treatment similar to financial assets and housing agents are perceived as real estate investors (Chang *et al.,* 2011). Generally, housing accounts for a significant proportion of aggregate assets of a household. Consequently, variations in the house prices has an effect on the wealth of households as well as their expenditure which eventually has the influence on how the real economy performs (Shiller *et al.,* 2001). A similar contention was amplified by Granziera and Kozicki (2015) who argued that house price fluctuations can strongly impact the real economic activities. Given that housing is normally the most crucial component of the wealth of households, variations in prices of houses has an effect on wealth and expenditure. More so, house price movements can have an impact on the real side of the economy via their influence on financial system (Granziera & Kozicki, 2015). In particular, the housing market assists investors in their portfolio diversification, investment choices and investment returns (Beltiatti & Morana, 2009). Since early 1990s, global investors have been in search of opportunities in emerging

housing markets with the aim of increasing their portfolio return and attain investment diversification (Xu & Chen, 2011).

With the emergence of Real Estate Investment Trusts (REITS), investors on the securities markets have taken to use of real estate investment trusts as a way of diversifying their portfolios in a mixed-asset portfolio. This is because house price returns are based on residential house price index (Chang *et al.*, 2011). Some investors also view REITS as partial substitutes for conventional real estate investments (Gyourko, 1992). Existing empirical works have indicated that reduction of risks can be made possible through portfolio holdings of Real Estate Investment Trusts (Kuhle, 1987;Grissom, Kuhle, & Walther, 1987; Chen, Ho, Lu & Wu, 2005)among others. However, Bhuyan, Kuhle, Al-Deehani and Mahmood (2015) pointed out that with the global financial crunch in 2007/2008 that led to a historic crisis in the financial markets around the globe principally when the housing market was marked with the bursting of the bubble, individuals have become curious as to whether there is still a potential role played by mortgage and assets related to real estate in portfolio risk reduction.

House price variabilities can strongly influence the real economic activities since housing is noted as the most significant element in the wealth of households (Beltratti & Morana, 2010). The real side of an economy can be influenced by variations in housing prices. Financial system provides channels through which this effect is transmitted, a phenomenon associated with the US financial crisis of 2007-2008 (Kozicki, 2012). In nearly all economies, household wealth is one of the major factors driving the total consumption, making the housing market have a significant influence on the rates at which economies grow. A probable effect that follows a decline in

house prices is a fall in consumption levels of households which may end up having a negative effect on the rates at which an economy would grow (Case *et al.,* 2001). The subprime crisis of 2008 for instance, made China's house prices fall once but in the aftermath of the crisis, house prices kept rising and became one of the key factors that promoted growth of the China's economy (Yang & Zhiang, 2012). The fall in house prices led to the contraction of household investments, increase in number of house loans not being serviced and lack of credit by financial institutions for real estate loans (Sivitanides, 2015). Lately, various authors (Gupta & Das, 2010; Das, Gupta, & Kabundi, 2011; Gupta, & Hartley, 2013) among others, have empirically shown that house prices can be critical in output forecasting. More so, the housing construction sector accounts for a great proportion of the overall economic activity measured by the gross domestic product. As a result, it mirrors a substantial portion of the total wealth of an economy and consequently fluctuations of house prices can be used to indicate how GDP is evolving. Gupta and Kabundi (2010) further argued that just like is the case for other assets, house price movements can as well be an indicator of the direction inflation is likely to take in future. Overall, house prices can serve as the best indicator for both levels of inflation and output. This makes it a key variable in the determination of the direction of the real economy. Generally, house prices fall significantly whenever contractionary monetary policies are instituted. More so, upward trends in the house prices have the likelihood of fueling inflation (Hartley, 2013; Simo-Kengne *et al.,* 2013). Plakandaras *et al*. (2015) maintained that if the evolution paths of house prices are accurately forecasted, then it can serve as an instrumental tool to participants in the housing market as well as to monetary policy authorities.

The volatility of house prices has similarly been documented in Africa. South Africa for instance, has had its home values appreciating rapidly (Das *et al.,* 2011). Specifically, in the last three decades, the residential property market of South Africa was marked by a rapid increase in house price. For example, the real price measured at constant 2008 prices rose to R901 812 in 2011 from barely R517 971 in 1980. The change reflected an annualized growth of about 1.8 percent during the period. It is also worthwhile noting that the just mentioned rise could be estimated to a cumulative surge in house prices by a record 74.1 percent during the period 1980 to 2011 (Absa Bank, 2012 cited in Ocran & Anyikwa, 2013).

Kenya in particular has registered significant house price changes within a short time. According to Hass consult (2015), by the year 2015, an apartment within Nairobi, Kenya sold at an average value of KSH 11.58M, this was almost a double increase from KSH 5.2M in the last month of 2000. More so, by 2015, a formal market had no home valued at less than KSH 2M.However, exact statistics show that these houses traded at about KHS 14M by the first quarter of 2016. According to Mwanza (2017), based on the data released by Kenya Bankers Association (KBA) on 3rd of November 2017, house prices in Kenya recorded a slowed increase during the 2017 third quarter as the real estate market reeled from an environment that was then politically charged and kept away investors. This effect by a politically charged environment was augmented by effects of interest rate capping that was put in place in September 2016 which had resulted into declined growth in credit within the country. The KBA data also showed that by 2017 third quarter, growth of house prices in Kenya had hit the lowest rate in three years. In particular, the KBA Housing Price Index which tracks the dynamics of the sector and movement of prices quarterly since 2015 indicated that house prices in Kenya barely went up during the three months that elapsed by end of

September 2017, rising by only 0.42 percent (Mwanza, 2017). The housing financial system of Kenya has experienced rapid growth during the recent past, an occurrence largely attributed to the mortgage market. This growth has been seen both in the number of loans as well as their total value. In the Sub-Saharan, the Kenya's mortgage market has been ranked as the third most developed with mortgage assets estimated at 2.5 percent of the Gross Domestic Product of Kenya(World Bank, 2011a).

Levels of homeownership in Kenya are high and can be compared to those of developed economies such as Europe or North America (World Bank, 2011b). However, this ownership trend is characterized with a division into house ownerships in rural and urban centers. Most people in Kenya (approximately 69 percent) own houses they live in. Nevertheless, this ownership is not uniform across regions; 82 percent of home owners are found within the rural areas of the country with the remaining 18 percent home owners being in Kenya's urban centers. Those who do not own homes are either in rentals or lodges (World Bank, 2011b). The 2009 survey by FinAccess made several key observations on housing market in Kenya which were summarized by the World Bank (2011b) as: first, approximately 33 percent of house-owners in Kenya inherited their homes whereas just 1.5 percent acquired their homes through formal or other credit facilities. Secondly, nearly 50 percent of home owners based in Nairobi acquired their homes through house purchase but this proportion in all other regions (former provinces) is substantially lower at barely 2 percent. Thirdly, only 23.7 percent of home owners are will to homes as collateral to acquire financial credit; Nairobi has the highest proportion of around 33.6 percent while the former Eastern province has the lowest proportion of approximately 17.3 percent. Fourth, about 70.3 percent of houses in Nairobi are permanent houses; a common feature for

dwellings along the Kenyan Coast where approximately 54.2 percent of dwellings are of this nature. Finally, traditional dwellings are rampant in the North Eastern and accounts for 55.1 percent whereas those in the Coastal region of Kenya account for 23.2 percent (World Bank, 2011b).

The Kenya's housing market has become an attractive venture for a great number of investors, both individuals and institutional among them private developers who are seeking to diversify their portfolios (Hass consult, 2011). Cytonn (2018) pointed out that, Kenya's real estate market has experienced exponential growth for the last two decades. This growth has been evidenced by its increased contribution towards the country's gross domestic product which grew to 12.6 percent in 2012 and 13.8 percent in 2016 from 10.5 percent in 2000. This growth was linked to a number of factors which include: development in infrastructure such as improved roads; connection of utilities; upgrade of key airports; a generally stable growth in GDP which has averagely been at 5.4 percent for the last five years exceeding the sub-Saharan average GDP growth of 4.1 percent; trends in Kenya's demographic aspects such as rapid urbanization estimated at 4.4 percent which is high relative to the global rate of 2.5 percent; the annual growth in population averaging at around 2.6 percent and finally, the high total returns from housing market estimated to be on average 25.0 percent yet the traditional classes of assets yield an average return of 12.4 percent (Cytonn, 2018). These factors have therefore been responsible for the development of unique trends across the various themes of real estate as investors were determined to realize maximum returns and buyers were in search of aspirational lifestyle and quality products (Cytonn, 2018).

Kenya's revised National Housing Policy of 2004 directed higher attention to Nairobi County in the move to curb the shortfall in supply of houses and initiatives to upgrade slums. Both the government of Kenya and private property developers have partnered with the mortgage financiers to make it cheap and convenient to buy houses. In the year 2007, the Ministry of Housing developed incentives geared towards encouraging greater private sector participation. However, based on the 2014 report published by Knight Frank, for the past 10 years, the Kenyan market for real estate has been booming and there is expectation for the persistence of this trend for unpredictable time frame. Despite this, the housing supply continues to lag far below the demand. The Kenya's vision 2030 plan envisaged an annual housing requirement of approximately 200,000 units, yet the production level is estimated at barely 30,000 housing units. Ruitha (2010) pointed out that Kenya faces low rate of home ownership estimated at barely 16 percent.

Available statistics show that Kenya has thirty percent of its population living in urban areas. In its 2016 year book publication, the Center for Affordable Housing Finance in Africa (CAHF) noted that estimated projection suggests an expected annual increase in Kenya's urban population at a rate of 4.2 percent. Maintaining this population trajectory will undoubtedly exert more and more pressure on housing demand. This is partly caused by the rapid urban population growth due to rural-urban migration, which has exerted pressure on urban housing stock, leading to informal settlements housing for close to sixty percent of the urban population (Kagochi & Kiambigi, 2012). Of this 60 percent in urban Centre's, seventy three percent are living below the poverty line of 1US$ a day (NACHU, 2004). With such low per capita income, high prevalence of poverty and unemployment, it is still not clear as to what really drives house prices significantly. Authors such as Zhang *et al.* (2012)

have found mortgage rate, producer price, broad money supply and real effective exchange rate to determine house prices positively. However, other African countriessuch as South Africa, Nigeria and Ghana have not recorded such a growth in house prices. South Africa for instance has two sub-markets; the upper market registers steady growth compared to the lower market which is largely government facilitated and registers growth in prices despite limited private investment (CAHF, 2015). In Nigeria, economic insecurity has curtailed the growth of higher income housing (CAHF, 2016).

According to the National Housing Corporation (2009), housing demand has been increasing at a rate higher than the number of houses being made available, a phenomena that is likely to have accounted for the rise in housing price. Although estimates show that nearly 200,000 housing units are needed in Kenya annually, the sector performs dismally recording just about 30,000 actual units of houses constructed annually, attaining about 15 percent of the target ((National Housing Survey, 2013).In spite of the move by the CBK in June 2013 to lower interest rate to about 8.5 percent, the move towards owning houses has not been satisfactory with not more than 200,000 Kenyans having mortgage facilities and only 3 out of every 50 Kenyans (6%) being home owners. This trend clearly indicates that only a minority are still able to access mortgage lending. The 2012 estimates showed that in that year, only 1.1 percent of the Kenya's top 60 percent income earners had mortgage facilities (Knight Frank, 2012).Low rate of mortgage ownership in Kenya compounded with her current economic growth is likely to keep the housing prices in the country on the persistent increase path. Out of the entire Kenyan urban dwellers, only 8 percent have access to housing finance and by 2011, there were only 22,000 active mortgages across the country (World Bank, 2011a). Understanding the determinants of house

prices therefore is important so as to help monetary authorities know how to stimulate housing finance and demand.

A survey conducted by Central Bank of Kenya on the development trend of the Kenya's mortgage market for residential housing in the country in 2012 revealed that the country recorded a rise in average mortgage loan size to Ksh 6.4 million in December 2012 from Ksh 5.6 million exactly a year earlier. However, following the enforcement of the law which took place in September 2016 that led to interest rate capping which consequently led to the average interest rate charged on mortgage declining from 18.7 percent in 2015 to 13.46 percent in 2016 in the aftermath of interest rate capping, the uptake of home loans reduced for the first time in a decade as banks tightened access to house financing through mortgage (Mwaniki, 2017). Lenders also shunned longer term loans, where mortgage belongs in favor of short term credit. Banks declined to offer credit to mortgage borrowers even as demand went up as an increasing number of Kenyans sought to capitalize on lower lending rates to purchase homes. In its report that had just been released before the end of August 2017, the CBK reported that the number of active mortgage accounts had dropped by 373 (approximately 1.5 percent) to 24,085 at the end of December 2016 (CBK,2017; Mwaniki, 2017). This was a significant reversal from where it had stood during the previous periods. Specifically, the number of loan accounts increased from 7,275 in 2006 to 24,458 in 2015; a compounded annual growth rate that was estimated at 12.9 percent (Mwaniki, 2017). Despite these changes, house prices still continue to rise prompting the question what could be causing the increase. Could it be caused by expectations on future house prices? According to Stiglitz (1990), rise in assets prices results from investors forming expectations that in future, prices of these assets will rise and therefore be able to resell them at higher prices (Blanchard & Fisher, 1989).

Little is known about what causes house prices to surge so high given that the US financial crisis did not affect Kenya significantly as well as the political instability witnessed in the year 2007-2008 (World Bank, 2011a; Hass consult Report, 2011).

Literature has shown that there are numerous determinants of house prices. These determinants can be widely categorized as either economic, monetary or demographic variables. Economic determinants in China include producer price and income (Zhang *et al.,* 2012), whereas other determinants in Cyprus are construction costs, total employment, consumer price index, real GDP and nominal GDP (Sivitanides, 2014). In Malaysia, major determinants include stock market, inflation, consumer sentiment and business condition (Pillaiyan, 2015). Other determinants include unemployment rate and disposable income growth (Nneji *et al.,* 2013a); stock of houses and wealth (Berglund, 2007); current account and consumer price index (Syricha, 2013); hot money flow (Xu & Chen, 2011); labor income (Gimeno & Carrasal, 2010); rate of change of real house price and real effective exchange rate (Beltratti & Morana, 2010) and unemployment (Gustafson *et al.,* 2016).

Income variations especially the affordability of down payment among young households have an effect on price levels. Indeed, it was concluded by Glaeser, Gyourko and Saks (2005) as well as by Taltavull and Paz (2003) that there was a relationship between increasing income and the upward trend witnessed in house prices.

Monetary variables include mortgage rate, broad money supply and real effective exchange rate which were found to be significant in China (Zhang, Hua & Zhao, 2012) as well as mortgage rate in Cyprus (Sivitanides, 2014). In Malaysia for instance, money supply and the bank lending rate determine house prices (Pillaiyan,

2015). Other monetary variables include: interest rate (Nneji *et al.,* 2013a; Gustafson *et al.,* 2016; Berglund, 2007); credit regulation (Syricha, 2013); rates of interest charged on bank loan, supply of money, indicator of mortgage credit policy (Xu & Chen, 2011); house purchase loans and nominal interest rates (Gimeno & Carrasal, 2010); levels of short term and long term nominal interest rates (Beltratti & Morana, 2010). Australia for instance, uses monetary policy to check on house prices and despite the pursuit of a contractionary monetary policy which has significantly reduced housing activity, house prices have not been affected significantly (Wadud *et al.,* 2012).

Several demographic factors have been documented among them housing permits, number of households and total population being significant in Cyprus (Sivitanides, 2014). Others include the number of housing loans approved in Malaysia (Pillaiyan, 2015); new construction of housing (Berglund, 2007); private consumption (Beltratti & Morana, 2010) and household consumption (Gustafson *et al.,* 2016). The long-run demographic change in developed countries have been known to affect house price developments. Hiller and Lerb (2015) noted that population in particular shapes the rate at which prices of local houses grow in various market segments. The relationship between population and housing is two sided; population change leads to change in housing demand whereas housing supply influences the opportunities for population increase through migration (Mulder, 2006). It is expected that the higher housing prices drives up the number of new housing in the market (Miregi & Obere, 2014). Major housing stock contributors are; self-contracted houses, government agencies, public private partnership and private developers (CAHF, 2016). Housing needs on the other side include; construction of new houses to supply new households,

replacement of units already in stock through demolition and construction of additional units required to relieve current overcrowding (Schiller, 2007).

Available empirical evidence (Miregi & Obere, 2014; Kagochi & Kiambigi, 2012; Moko & Olima, 2014; Sila & Olweny,2014; Nneji *et al.,* 2013a; Valadez, 2012; Zhang *et al.,* 2012; Beltratti & Morana., 2010 and Wadud *et al.,* 2012) have shown the impact of various determinants on house prices. In general, their results revealed that there is uniqueness is every market and varying factors may drive house price in such markets. From the reviewed empirical literature, it is evident that there are several inconsistencies in evidence, and hence, it was a worthwhile endeavor to use an explanatory approach to identify key determinants of house prices in Nairobi County, Kenya.

1.1.2 Housing Market in Nairobi City County, Kenya

The housing market is that market where the allocation of housing services is based on the demand and supply framework. The inelastic nature of the housing market is one of the factors that distinguishes this market from the goods market where other goods and services are traded (Alonso, 1964).A period of nearly ten years to 2014 was marked by a booming Kenya's housing market, the trend which was predicted to persist until the unknown future(Knight and Frank, 2014). Luxurious homes located in Nairobi and those along the coastal region of Kenya especially in Mombasa, Malindi and Lamu were among the leading global residential property market for recording highest price hike among those properties surveyed globally. The 25% price rise reported for Nairobi was the highest rate of growth among the top-notch residential properties. Following Nairobi were the Kenyan coastal properties in

Mombasa, Malindi and Lamu with 20% price growth in house price (Knight Frank and Citi Private Bank, 2011).

In 2010, growth was higher than expected at 5.6 percent, and this rate was expected to be maintained over the medium term and make Kenya a Middle Income Economy by the year 2019 (Hass, 2011). East Africa is perceived to be a region with highest rate of urbanization than any other region across the world. This is in accordance with the UN Habitat statistics which had estimated that its urban population was to double between 2007 and 2017 (UN Habitat, 2013). Nairobi falls among the fastest growing cities globally. In its recent report, KNBS has shown that the level at which real estate is demanded in urban areas especially during the past 10 years was at least five times more than the market could supply. Population shapes the growth rate of local house prices (Hiller & Lerbs, 2015). Projection estimates show that Kenya is likely to record an approximate annual increase in its urban population by 4.2 percent, an increase attributed to rural urban migration and the natural growth rate of the population (CAHF, 2016).

According to World Bank (2011), Kenya's housing finance system majorly through the mortgage market has experienced rapid growth for years now. In fact, it is ranked at position three among the most developed in Sub-Saharan Africa. The national housing policy of 2004 advocated for public private partnerships by partnering with mortgage financiers to increase supply of houses and make it cheap and convenient to buy them. The interest rate capping was introduced in September 2016, and was expected to increase the uptake of house purchase loans among other credit facilities. The mortgage financiers however, tightened access to mortgage loans (CBK Report, 2016).

1.2 Statement of the Problem

After the global economic crunch of 2007/2008 which is believed to have started in the US housing market,house prices have attracted much attention in recent years (Beltratti & Morana, 2010). Generally, in markets characterized by trade liberalization especially where the flow of information is free to house buyers as well as to sellers, it is basically the demand and supply forces that are fundamental in setting prices. However, the response of demand of house is inelastic to its prices. This implies that actual rise in house prices does not trigger increase indemand but such increase in demand arise from expectations that future periods keep experiencing upwards trends in house prices (Mckenzie & Betts, 2006). Excess shortage in the formal housing units resulting from chronic undersupply when demand is high is a common feature characterizing the housing market in Kenya. House prices are greatly impacted by this situation (AFDB, 2013).

Demand for housing, which has possibly led to increase in house prices, has been on the rise at a faster rate than the number of houses available or under construction (National Housing Corporation, 2009). National Housing Corporation (2009)noted that housing demand which is the likely force behind the house price hike witnessed has been increasing at a rate higher than the quantity of housing units available or those under construction. Expectations of capital gains from housing investments would affect house prices by increasing demand for housing which would cause high volatility in house prices (Selim, 2009). Annual housing units constructed is estimated at 30,000 against the annual demandof 200,000 units (National Housing Survey, 2013). According to Hass consult (2016), the average price of an apartment in Nairobi was KSH 11.58 in December 2016 from KSH 5.2 exactly 6 years earlier (December 2000) and no single home was valued at less than KSH 2M in the formal market. In

particular the upward cycle has recorded a 14.6 per cent increase over the year, the first double digit annual growth rate since 2011 and a 2.26 times since 2007.The 2011 report by World Bank acknowledges that Kenya has experienced a rapid growth in her housing finance system especially in recent past. This growth is majorly in the mortgage market and involves expansion on loans both in number and in their value. In the entire of Sub-Saharan Africa, Kenya's market for mortgages is ranked as third most developed with her mortgage asset estimated at around 2.5 percent of her GDP (World Bank, 2011a). In spite of the fact that the mortgage market is seen to be the most developed in Sub- Sahara Africa, access to mortgage finance for a majority of the population is still a major challenge.

Low supply of houses can be attributed to high construction costs, rural-urban migration, population growth, lack of resources and borrowing constraints (Tipple, 1994 & Matteo, 2005). Statistics show that 22 percent of Kenyans live in cities and that the urban population is growing at an annual rate of 4.2 percent. With this level of growth, 200,000 new houses are required every year to meet the demand (National Housing Survey, 2013; KNBS, 2016; CAHF, 2016). The appreciation of house prices in future as determined by expectations formed by households is fundamental as it tremendously drives the demand of houses (Coleman, 2008). It is for this reason that a speculative builder only construct houses based on demand (Tipple, 1994) which could be attributed to supply not matching demand. Empirical studies (Nneji *et al.*, 2013a; Valadez, 2012; Zhang *et al.*, 2012; Beltratti & Morana., 2010; Wadud *et al.*, 2012), have shown the impact of various determinants on the house prices.

The Kenyan market is unique and the drivers of house prices might not necessarily be replicated in another market. Changing house prices have been of concern to both

individuals, investors and government since they influence affordability of houses. For instance Nneji and Ward (2013) found house prices to be responsive to changes in short term interest rate and GDP only which contradicts Zhang *et al.,* (2012) who found GDP not to be significant. The housing market in Kenya has been given relatively low research focus and those empirical studies on this sector have given much focus to factors that determine cost of house construction (Moko & Olima, 2014). Land, building materials and infrastructure were found to influence construction costs and that initiatives to reduce costs like Private-Public-Partnership, Government intervention and alternative building technology could be explored. Sila and Olweny (2014), found cost of land and interest rates being the main determinants of the cost of houses and no influence of building materials on cost of houses contradicting the study by Moko and Olima (2014). Expected income from real estate was found to influence prices in Meru Municipality (Messah & Kigige, 2011). Miregi and Obere (2014), in their study of fundamental variables and property prices using the unrestricted Vector Autoregressive (VAR) model, found that interest rates and inflation rates affect prices whereas building cost and stock prices had no significant effect.

Most buyers have little understanding of what really drives house prices, instead of using supply and demand information, they use the recent house price trends and project them forward (Shiller, 1989). The reviewed empirical literature have shown mixed results in different markets. Most of the studies have focused on one or two explanations by regressing a few variables and hence may suffer from 'missing variables' or 'variable selection biases'. This study filled this gap and complimented literature by evaluating the relationship between the determinants of house prices in Nairobi City County, Kenya by running various estimation tests. The study also

extended the model used by Miregi and Obere (2014). Adopting the unrestricted Vector Autoregressive (VAR) model, the researchers failed to conduct test for both long-run and short-run dynamics. This study used Vector Error Correction Model (VECM) to establish the short-run dynamic as well as long-run dynamics. In addition, the study also established the speed at which short-run equilibrium adjusts to the long-run equilibrium. This is a very timely study conducted at the time when the Kenyan government is committed to the big four agenda, one of them being Affordable Housing for all.

1.3 Objectives of the study

1.3.1 General Objective

The general objective of the study was to evaluate the determinants of house prices in Nairobi City County, Kenya

1.3.2 Specific Objectives

The study endeavored to achieve the following specific objectives:

i. To determine the effect of mortgage rate on house prices in Nairobi City County, Kenya
ii. To evaluate the effect of exchange rate on house prices in Nairobi City County, Kenya
iii. To determine the effect of interest rate on house prices in Nairobi City County, Kenya
iv. To evaluate the effect of population on house prices in Nairobi City County, Kenya
v. To establish the effect of the number of houses on house prices in Nairobi City County, Kenya
vi. To determine the effect of inflation on house prices in Nairobi City County, Kenya
vii. To establish the effect of Gross Domestic Product on house prices in Nairobi City County, Kenya

1.4 Research Hypotheses

The following research hypotheses guided this study;

H_{01}: Mortgage rate has no significant effect on house prices in Nairobi City County, Kenya

H_{02}: Exchange rate has no significant effect on house prices in Nairobi City County, Kenya

H_{03}: Interest rate has no significant effect on house prices in Nairobi City County, Kenya

H_{04}: Population has no significant effect on house prices in Nairobi City County, Kenya

H_{05}: Number of houses has no significant effect on house prices in Nairobi City County, Kenya

H_{06}: Inflation has no significant effect on house prices in Nairobi City County, Kenya

H_{07}: GDP has no significant effect on house prices in Nairobi City County, Kenya

1.5 Significance of the Study

This study makes contributions to real estate finance discipline and practice in several ways. First, it contributes to the finance theory in terms of explaining how the various determinants affect house prices and in particular which determinants have a greater influence on house prices. Second, the findings of this study contributes to the wealth of knowledge and theory for researchers by expanding on the available literature on housing market in developing countries and particularly in Kenya. The study also contributes to finance practice since practitioners will be able to identify the particular determinants which have a significant influence on house prices. In particular, the findings of this study is useful to National Housing Corporation and Ministry of

Housing charged with housing market to better understand the market and thus guide the delivery of right products to the right people by formulating policies concerned with the housing sector of the economy.

Market participants are also potential beneficiaries of this study. Mortgage financiers in particular, stand to gain from the study since they will be able to design mortgage products in order to get satisfaction in the desire for greater yield mainly in new house development. Property developers would gain knowledge on which specific determinants to watch out for as they seek to deliver products to the market. In particular, the study equips real estate investors like Hass Consult Ltd, Knight and Frank among others to make informed choices in property investment. The findings would enable construction companies plan whether to increase production or otherwise. Investors, both the new real estate entrants and those intending to expand may be able to make evaluation based on information of what exactly drives the variations in house prices. To the financial analysts, this study will provide information crucial to them while offering advisory services to their clients on the best portfolio choices. Devoid of such information, their decisions would be impaired.

1.6 Scope of the Study

The study focused on the determinants of house prices in Nairobi County, Kenya. In Kenya, property markets are categorized into residential, commercial, industrial, agricultural, recreational, resort and hotels. The focus of this study was residential houses. The study used quarterly secondary data from 2004Q1 to 2016Q4. The study used this period because of data availability especially on the endogenous variable, house price index (HPI) which was extracted from the data base of Hass Consult Ltd. The HPI by Hass Consult Ltd is the only index available in the public domain and it is

computed with 2000 as the base year. Hass Consult Ltd has also computed the index consistently since 2000.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview

This chapter provides a review of both theoretical and empirical literature. It is organized into the following sections; concept of residential house prices, the determinants of house prices, theoretical review, empirical literature review, conceptual framework and summary of gaps from literature.

2.2 Residential House Prices

According to Schulz and Werwatz (2004), banks, policy formulators as well as individuals and institutions involved in real estate development including the general public have great interest in the house prices. Ideally, in a well-functioning market, demand for houses should be equated to its supply by house price. Hilbers *et al.* (2001) considers the key equilibrium price to be that price at which both the existing house inventory and replacement house inventory are equal. It follows therefore that, theoretically, growth in demand which translates into market growth are indicated by growth in price. According to Leung and Chen (2006), a number of factors are responsible for demand trends observed in the housing market both in the short run and long run. From a short term perspective house prices can show deviations from their critical values based on some distinctive features of the market for houses. Such features include requirements for down payment, absence of information and supply lags. On the other hand, from long-term viewpoint, there should be equality between the equilibrium price which the household is willing to pay for a house and the present value of future services obtained from the house after discounting. These services include discounted rents and resale value. A model developed by Wheaton (1999) and Davis and Zhu (2004) shows lagged supply response within the housing

market but the lending decisions by the bank is a factor of the present market values for houses. They showed that in an attempt to respond to variations in key values, residential house prices have the option of converging to a new equilibrium value or oscillate around this value.

Changes in house prices are measured by a house price index (HPI).The HPI measures variations in the price, which is not associated to variations in quality and/or quantity of goods captured by the index (Lum, 2004). It can be computed and published on a regular basis, often on a quarterly, semi-annual or annual basis. A change in the house price index may be partly due to price movement and partly due to changes in the quality of the house in the market. The house price indexes are important in analysis of factors determining house prices, efficiency of house markets, analysis of housing affordability and checking whether house bubbles do exist (Bourassa *et al.*, 2004). House price indexes are computed in three ways: repeat sales method, hedonic regression method and the hybrid method.

Baily *et al.*, (1963) originally proposed the repeat sales approach. The method measures temporary variations in house prices. It estimates price trends from transactions for properties that have been sold more than once over a sample period of time. Its main advantage is reproducibility. The method however has some disadvantages among them; use of information on housing units that sold more than once during the sample period, does not deal adequately with depreciation of the housing structure, housing units that have undergone major repairs or renovations and does not allow for changes in the implicit price of particular housing attributes over time. The method yields biased estimators if appreciation rate for excluded houses differ from appreciation rates for houses that sell repeatedly (Case & Shiller, 1989).

The repeat sales method has also been criticized because housing markets generally, are segmented by location. This means that appreciation rates of prices vary substantially depending on location. Some locations may not have repeat sales due to lack of desirable characteristics to sell repeatedly. In this case, the method will exclude these types of houses (Bourassa *et al.,* 2004). The housing market is also characterized by different type of houses. Appreciation rates vary across the different types yet the house price index should keep the house characteristics fixed between the pricing periods over time Griliches (1961).

The hedonic regression method proposed by Griliches (1961) assumes that price is a function of a set of characteristics which are expressed in a linear function. The coefficients of the characteristics can be interpreted as their implicit prices. The overall price change that is not interpreted by characteristics is interpreted as pure price change. The main advantage of the method is that it uses all of the information on housing sales in each sample period, it can adjust for the effects of depreciation if the age of the structure is known at the time of sale as well as adjusting for the effects of renovations and repairs if expenditures on renovation and extensions are known at the time of sale.

The hybrid method combines the repeat sales method and the hedonic regression model and help to alleviate the sample selection bias of repeat sales method and specification issues of hedonic regression method (Bourassa *et al.,* 2004). Specifically, the hybrid method combines the advantages of hedonic regression and repeat sales method (Case and Quigley, 1991). Shao *et al.*, (2013) developed a new hybrid hedonic repeat sales house price model using three inputs. One of the input was a modified hedonic house price regression on houses that transacted only once in

a sample period. Secondly, houses that transacted more than once but excluding the last sale of each house and thirdly, the differenced log house prices with respect to time dummy variables and their interactions terms with house price characteristics. However, according to Hill (2013), the hedonic regression method has been increasingly preferred due to the weaknesses of the alternative methods.

Most studies on house markets have utilized house price indexes based on hedonic regression method. Among them; Valadez (2012) which used the First American CoreLogic house price index which is published on a monthly, quarterly, semi-annual and annual basis to study the correlation between GDP and house prices. Simo-Kengne *et al.* (2013) used a house price index computed by Amalgamated Bank of South Africa, one of the major private banks in South Africa. The bank categorizes housing into three major price segments; luxury, middle (further classified into large-middle, medium-middle, small-middle) and affordable. Zhang *et al.*, (2012) also used a national house price index to explore determinants of housing prices in china. The Malaysian house price index developed in 1997 by the Valuation and Property Services Department also uses the hedonic regression method with attributes like terraced, semi-detached, detached, high-rise unit and other houses being used in the computation of the house price index (Pillaiyan, 2015).

Using hedonic pricing methodology, Charles (1970) disaggregated the location, structural as well as neighborhood elements of a house in addition to testing their effect on house prices individually or possibly in partial groups. Assuming that house attributes can only be priced implicitly and not explicitly, this method uses the hedonic regression method implicitly to discover the price of a house. Hedonic pricing involves regressing individual exogenous variables onto the dependent

variable. The house's exchange price as well as the revealed implicit prices indicate how each of the attributes is valued in the market. Summing up the implicit prices of different house attributes yields the house price. However, modelling of this nature fails to consider the real uncertain world, speculative aspects, purposeful traits and variations (Beltratti & Morana, 2010).

In the US, it is the Federal Housing Finance Agency that publishes the house price index, a quarterly broad measure of the single-family house prices. Herein, the house price index is a weighted, repeat-sale index which measures the average price changes in repeat sales or refinancing on the same property in 363 metropolises (Valadez, 2012). In the UK for example, different methods are used to compute governmental house price indices. For instance, the Department of Community and Local Government (DCLG) under the UK Ministry of Housing, Communities and Local Government employs the mix-adjusted method which has a basis on weighted averages. Herein, the DCLG utilizes mortgage completion data provided by a few large lenders to compute HPI (Mississippi Business Journal, 2013). On the other hand, in the computation of private sector house price indices, Nationwide HPI and Halifax HPI rely on hedonic regression using their own datasets compiled from their mortgage lending. Indices from the hedonic regression are applauded for having a longer time series than Governmental House Price Indices. This is an additional basis on which this paper was anchored while opting to make use of the hedonic regression house price index.

2.2.1 Hedonic Regression of House Prices

House price index measures the change in prices of residential houses as a percentage change from some specific start date which is assumed to have a house price index of

100. The seminal paper (Lancaster, 1966) was the first to attempt a theoretical foundation for hedonic modeling. The paper argued that it is not necessarily a good itself that creates utility, but instead the individual "characteristics" of a good creates utility. Specifically, an item's utility is simply the aggregated utility of the individual utility of each of its characteristics. Furthermore, the paper argued that items can be arranged into groups based on the characteristics they poses. Consumers make their purchasing decisions within a group based on the number of characteristics a good possesses per unit cost. (Singh, 2015). In this study a house is treated as good with several characteristics that have different attributes.

The hedonic pricing model theory was first proposed by (Rosen, 1974). He argued that an item can be valued as the sum of its utility generating characteristics; that is, an item's total price should be the sum of the individual prices of its characteristics. This implies that an item's price can be regressed on the characteristics to determine the way in which each characteristic uniquely contributes to the price(Hanlon, 2011). The application of the hedonic price model to the housing market rests on several key assumptions. First the model assumes homogeneity of the housing product. Secondly, it assumes that the housing market operates under perfect competition; and there are numerous buyers and sellers with free entry and exit. The model also assumes that buyers and sellers have perfect information concerning housing products and price. Finally, the hedonic pricing model only works on the assumption of market equilibrium where there are no interrelationships between the implicit prices of attributes (Rosen, 1974).

The main advantage of this model is that one only needs to have all or certain information on house sales in a sample period such as the property price, the composition of housing attributes and a proper specification of the functional

relationships. The method can also adjust for the effects of depreciation as well as renovations and repairs. The marginal attribute prices are obtained by estimating the parameters of the hedonic price function. It is a straightforward approach because only the coefficients of the estimated hedonic regression are needed to indicate the preference structure. No information whatsoever about individual characteristics or personal details of either the house buyers or the suppliers is required (Rosen, 1974; Chee Yin *et al.*, 2015).

The hedonic model is used as the appropriate empirical specification for the production of the House price Index (HPI) (Index, 2015).This approach is useful given its treatment of the marginal contribution of each house characteristic in constructing the price index. This facilitates accounting for the multiplicity of characteristics that contribute to the price of housing units. It is also good to reiterate that the approach is based on the premise that the price of a house is determined by its internal and external characteristics (Chee Yin *et al.*, 2015). In the context of the housing market, these characteristics refer to aspects of the physical structure as well as the location of the property. The employed econometric models therefore provide price indices that control for changes in the characteristics of the housing stock sold overtime (Singh, 2015).

2.2.2 Model Specification

To generate the house price index, it is assumed that the price p^t of property n in period t is a function of a fixed number of k characteristics measured by quantities, z^t. For **T+1** time periods, going from base period 0 to period T, price can be represented as a function:

$$p^t=(z^t_{n1},\dots,z^t_{nk},\varepsilon^t_n) \qquad \textbf{(1)}$$

Here $\varepsilon^t$is a random error term. While there are several possible functional forms for hedonic specifications, selecting an appropriate functional form for the hedonic model is important for minimizing any bias in the estimated coefficients and by extension, the house priceindex.Toestimatethemarginalcontributionofthecharacteristics, equation (1) is first specified as a logarithmic-linear (semi-log) parametric model. The time dummy method augments the regression equation by including a set of time dummy variables from which the price index is derived. A general shortcoming of the time dummy method is the revisions which occur once the index is updated to include current periods. Constant revisions to index valueswill ultimately prove undependable, especially in the context of policy decisions related to the housing market. In this model specification, a Time Dummy Method approach model is utilized to compute the indices in order to overcome this shortcoming. The equation for construction of the index is estimated using Ordinary Least Squares regression on a rolling sample of desired time period. The time dummies represent each time period over the sample window and the initial time period of each rolling sample is used as the reference dummy. The coefficients on these time dummies form the basis for estimating the price index using this approach. These coefficients estimate the proportionate change in price arising from the progress in time, having controlled for changes in the house characteristics (Langrin, 2016).

House price indices in Kenya are computed by Hass Consult Ltd and the Kenya Bankers Association using the hedonic regression method. The basic characteristics that are considered in the construction is the location which is further subdivided into house types and number of bedrooms. Other attributes that are used in the computation include but not limited to location, road development, number of beds, number of bedrooms, number of bathrooms, swimming pool, elevator, gym, Jacuzzi,

gated community, garage parking, balcony backyards, floors, age, social amenities and zoning among others (Hass, 2016). In the housing market, price appreciation rates vary across the different types of houses yet, the house price index should keep the houses characteristics fixed between the pricing periods over time (Singh, 2015).

The Hass Index series of products which was introduced as at the end of third quarter of 2010 replaced the indices that it had published earlier due to the fact that it was covering a long period of time going as back as 10 years from December 2000. This time coverage brings the index fully in line with the set international property data standards (Hass Consult, 2017). The index has been disintegrated into four categories for sale and let respectively, based on asking prices: all properties, detached houses, Semi-detached Houses and Apartments. There has also been grouping of number of bedrooms to give a clear breakdown of the disparities in stock of houses that is available in the market. The indices as at the third quarter of 2017 were computed on a rolling monthly annual averages from more than 199,700 Kenyan property observations in the public domain alongside the internal records of Hass Consult Ltd. Out of the 199,700 observations, 163,000 (81.6 percent) met the minimum threshold for validation procedure, 29,000 (14.5 percent) records were considered as duplicates and the remaining 7,700 (3.9 percent) as outliers. Thus the Hass results are based on only verified Kenyan nationwide property observations with the process, computation and statistical guidance validated by a data analyst (Hass Consult, 2017).

The Nairobi-18 Suburbs and Nairobi Satellite-14 Town Indices were introduced in the third quarter of2015. These indices compliment the Hass Land Index. Hass uses the same suburbs and towns to form the two composite indices. The indices are based on asking prices: all properties, houses only (both detached and semi-detached houses

grouped together) and apartments (Hass Consult, 2017). Hass utilizes best statistical practices to ensure that different mixture of properties traded in each quarter does not give misleading impression of the exact variation in house prices. The quarterly statistics serves as a measure of the mix adjusted average house price for both middle and upper sections of the Kenya housing market. This includes the three types of houses only, that is detached houses, Semi-detached houses and apartments. The aim of the mix adjustment is simply to segregate pure changes in prices (Hass Consult, 2017). The Hass Consult obtains majority of its house price information from sources in the public domain, from its own data base, from at least 30 other real estate agencies in Nairobi, various property portals available online, social media, newspapers and magazines. The numerous data sources have made it possible to develop a composite price series. The price series of Hass Consult relies singularly on residential property information. It should also be noted that Hass Consult subjects the data obtained from various sources through thorough scrutiny (Hass Consult, 2017). This study adopted the Hass price index constructed for three types of houses: town houses, apartments and villas with heterogeneous locations being Nairobi suburbs with 18 regions and Nairobi Satellite towns with 14 regions. The house price index is computed on a quarterly basis with the year 2000 being the base period.

2.3 Determinants of Residential House Prices

Similar to any other investment sector, a myriad of factors influence house prices. These factors include inflation rates, exchange rate volatility, rate of interest, supply of money in an economy as well output of a nation among others (Atterhog, 2005). The linkage between key variables and house prices has been established by a number of studies. Bonnie (1998) found that variability in employment leads to income variation which eventually triggers changes in house prices through its influence on

demand for houses. Variability in income especially, affordability of down payment among young members of households has an effect on the levels of house prices. In their study of housing market in Greece, Apergis and Rezitis (2003) found that there is a response of house prices to variables of interest, inflation, supply of money and employment. In particular, the variables noted to be central in driving housing market in Greece were rates of interest, inflation rates and employment rates. Similarly, money supply was found to be significant. Several studies including; Glaeser, Gyourko and Saks (2005) and Taltavull and Paz (2003) made a conclusion that a relationship exists between the house price increase and increase in income. It has been argued that the house price determination should be on the basis of key market variables suggesting that the determination of house value is through interaction of key variables which then has the influence on house prices (Alhashimi & Dwyer, 2004; Herring, 2006). However, according to Gerding (2007) fundamental values measured by the discounted values of expected future cash flows generated by the assets are not utilized in housing market studies due to the challenge of obtaining expected cash flow data for longer periods. Such data include expected cash inflows, the disposal value of the asset at the end of its useful life and rate at which cash flows should be discounted.

The link between determinants of house prices and house prices is important as it provides a feedback mechanism of the effects of house prices on the real economy. According to Beltratti and Morana (2010), the linkage between house prices and macroeconomic developments is bidirectional and that house price shocks produce larger effects on the macro economy. Most house price models including: Zhang *et al.* (2012) Beltratti and Morana, (2010) and Wadud *et al.* (2012) focus on the variables such as interest rate, inflation and income which are believed to influence the

movement of house prices. A study conducted by Shiller (2005) and a separate one by Gallin (2006) investigated the US house prices using data on price of houses, population, income, rates of interest, user cost as well cost of construction. They arrived at a conclusion that price variabilities are not purely associated to changes in fundamental macroeconomic variables but also on people's perceptions. A similar conclusion was arrived at by Herring (2006) who inferred that increase in house prices are not only caused by fundamental macroeconomics variables but also expectations by people that house prices will rise in future. This in turn has a positive influence on the demand of housing.

Glindro *et al.*, (2011) in their study examined house price developments in nine economies in the Asia Pacific area. Their main aim was to analyze the determinants of fundamental value of house prices as well as the long-run relationships and short-run dynamics of house prices. Their study variables included; real GDP, real mortgage rate, mortgage to GDP ratio, land supply index, real effective exchange rate and institutional indices. The study findings indicated a national house price dynamics that exhibit significant cross country differences. Panagiotidis and Printzis (2016) examined the role of the housing market in the Greek economy using GDP, loans, interest, employment, inflation, taxation and demographics as determinants of house prices. They found out that a long-run equilibrium relationship exist and that in the long-run, the retail sector and mortgage loans were the most important variables. They also concluded that the banking sector plays an important role in house prices since house price increases are preceded by an increase in mortgage rate.

The sub-prime crisis was caused by the historically low rate of interest which fueled expansion of credit and the ensuing boom of the property prices in the United

Kingdom and United States as suggested by Turner Review (2009). The housing boom in the UK was worsened by the escalating demand for housing units, its effect being augmented by the physical increase in house supply during the period 1997 to 2007 which resulted to a 30 percent rise in the aggregate mortgage debts. Lending decisions were driven by perceptions due to persistent appreciation in the price of houses which led to erosion of the borrowers' debt liability. The US experienced identical lending patterns which were however driven by the desire to direct credit to social classes that had faced exclusion in previous periods. Nevertheless, the study concentrated on the demand side of the housing market, where factors that shift demand were identified as: mortgage cost, expectations in price, foreign demand for houses within the domestic market and population changes.

Using a sample of seventeen industrialized nations, Goodhart and Hofmann (2008) conducted a study aimed at making an assessment of the association between money, credit, house prices and economic activity. The study covered more than three decade period using quarterly data for 1970 to 2006. This data was estimated using a fixed effect panel VAR. The findings suggested evidence of significant multidirectional linkage between prices of houses, monetary variables and other macroeconomic variables. Specifically, a stronger link between house prices and monetary variables was noted over the period 1985-2006 sub-sample and that the influences of monetary and credit shocks were noted to be stronger at the time when the house price was experiencing a boom. Furthermore, the findings indicated that all the house price shocks, credit shocks and money shocks had significant ramifications on economic activity and total price inflation. House prices, money and credit were also found to be significantly affected by shocks to gross domestic product, the consumer price index and the rate of interest.

In their study of factors determining the Chinese house prices, Zhang *et al., (*2012) concluded that the impact of various determinants on house prices has been difficult to establish as a result of the frequent interactions between the variables and the way in which they affect house prices. They found mortgage rate, producer price index, money supply and real exchange rate being the main determinants as opposed to disposable income in other housing markets. Wadud *et al. (*2012) found short term interest rate and inflation rate being the main determinants of house prices in Australia and that higher house prices significantly raise the quantity of new houses being constructed. In their study of Kenyan property prices, Miregi and Obere (2013) found that inflation and interest rate have no significant effect on property prices whereas stock price and building costs were found to have no relationship. According to DisPasquale and Wheaton (1996), an increase in construction costs leads to a decrease in construction and hence a decrease in new houses. It is this decrease in stock of houses which in turn increase the house prices. They concluded that the costs of new residential construction affect the supply side of the housing market since the supply is driven by the stock of houses.

Stadelmann (2010) investigated the robustness of thirty three community specific explanatory variables for house prices in the Swiss housing market. The study found that location, municipal taxes and expenditure for culture, health and social well-being capitalize house prices. Minor importance of demographic and other social-economic controls was noted by the study. Kim and Park (2005), asserted that the housing market could be influenced by several factors among them; macroeconomic variables, spatial differences, characteristics of community structure and environmental amenities. Argiolas *et al.*, (2014) analyzed the relationship between house values and a set of determinants of house values. The determinants related to

urban environment and structural characteristics of housing market in Italy. The study grouped the determinants into four groups; structural characteristics of the residential houses, neighborhood demographic characteristics, plan-related characteristics and land coverage by the residential houses.

Pillaiyan (2015) investigated macroeconomic drivers of house prices in the Malaysian housing market. The specific drivers examined included gross domestic product, money supply, stock market, average bank lending rate, inflation, consumer sentiment index, business confidence index and loan approvals. The study concluded that there was a long term relationship between inflation, stock market, money supply, number of residential loans approved and house prices. Leonhard(2013) in his study of Stockholm county identified income, population or dwelling ratio, user cost, back ward looking expectations and financial wealth as the key factors that affected house prices. The user cost specifically changes as a result of mortgage interest rates falling occasioning an increase in house prices. An increase in population on the other hand, is relative to house construction and leads to an increase in house prices. This study sought to establish how the independent variables of mortgage rate, exchange rate, interest rate, population, number of houses, inflation and gross domestic product affect residential house prices.

2.4 Theoretical Perspectives

Theories are put forth to offer explanation, prediction and understanding of phenomena and in a number of scenarios to challenge as well as extend on the existing body of knowledge, within the critical bounding axioms' limits (Torraco, 2004).Several frameworks have offered guidance to the perception and comprehension of the processes in which house prices plays a central role in the

development of an economy. This study was guided by a number of theories that are discussed in the subsequent parts of this sub-section of the paper.

2.4.1 The Economic Theory of Demand and Supply of Houses

The theory of demand and supply is of paramount importance in the analysis of the housing market. The theory suggests that in an uncontrolled economy, the interaction of market forces of demand and supply determines the price at which properties should be exchanged (Tsatsaronis & Zhu, 2004). The supply and demand is a cornerstone in pricing, it is therefore expected that supply will affect demand. House price movements are based on supply and demand curve and as more houses become available, prices will decrease (Shiller, 2007). The theory indicates that the quantity of houses supplied is a function of several factors among them the house prices. House prices is a function of demand factors among them; population growth, household income, interest rates and household formations (Brueggerman & Fisher, 2005). Availability of credit could increase mortgage lending and stimulate housing demand (Goodhart & Hofmann, 2008). On the other hand, unexpected rise in interest rates that raises house costs would lower house demand, slow growth of house prices and possibly lead to a house price decline. (Himmelberg *et al.,* 2005b). Generally, as the housing market increase, the demand for a fixed good tends to increase yielding higher prices (Flem, 2014).

Supply factors in the housing market include construction costs, cost of land, labour, materials, improvement of the existing housing stocks and changes in housing stock (Tsatsaronis & Zhu, 2004). It is therefore expected that as the returns from houses increase, the suppliers of houses will seek to supply more whereas consumers seek satisfaction at minimal costs. Price and demand correlation concludes that with larger

available quantities, prices tend to go down. An increase in the number of houses is regarded as an increase in quantity and is therefore regarded as having a negative effect on house prices (Schiller, 2007). The housing market is expected to have a continuous growth in supply due to a positive population growth. Constant price equilibrium is achieved when supply increases fulfil the demand increases. The Kenyan housing market is not regulated and players in the market among them real estate companies try to fulfil the demand for housing. Factors of demand in the housing market used in this study include; population, interest rate, inflation, exchange rate, gross domestic product and mortgage rate and supply factor being the number of houses. The interplay between these factors of demand and supply settle at an equilibrium price.

2.4.2 Competitive Theory of Housing Market

The competitive market theory was developed by Muth (1961). The theory views the housing market as a competitive market in which a homogeneous good is sold. The theory is premised on the following assumptions: both buyers and sellers of houses are numerous; the sales or purchases of each individual unit are small in relation to aggregate volume of transactions; there is no collusion between buyers and sellers; there is free entry and exit from the market by both producers and consumers; both producers and consumers have perfect knowledge about prevailing price and current bids and they take advantage of every opportunity to increase profits and utility respectively and that no artificial restrictions are placed on demand for, supply of and prices of houses and the resources used to produce houses.

Alonzo (1964) visually explored the housing market based on the interaction between demand and supply curves which offer explanations on how quantity of goods

supplied relate with corresponding quantity demanded. Normally, buyers' purchasing ability is summarized in a downward sloping demand curve implying that this group of economic agents buy more of a commodity when prices fall. On the other hand, the supply pattern of the sellers is captured by a supply curve that slopes upward suggesting a positive relationship between the quantities supplied and corresponding price levels. The intersection of the two curves establishes the price of the commodity. At such an intersection point, the market clears; which basically describes a point of equality between supply and demand.

Identical to the case of many goods, the housing market is basically assumed to take the form of a competitive market. The theory was used in the statistical estimation of demand function for housing and the speed of adjustment to long run equilibrium in the housing market. Adjustment in the supply of houses appear to exhibit the longest lags, changes in the number of houses determine house market prices and supply of houses form expectations concerning profits, construction or conversion of existing houses based on prices over a period of several years (Alonzo, 1964). Other studies that have used this theory include: Olsen (1969) and Watkins (1999) in their study of property valuation and the structure of urban housing market. This study used residential houses as a homogeneous good that is being sold with different desirable characteristics.

2.4.3 Price Expectations Theories

Coleman (2008) argued that appreciation of house prices in future as set by expectations of households is very critical since it tremendously impacts on the demand for housing. The general trend has been that as prices rise an increasing number of individuals become willing to take part in the booming market since they

have expectations for higher returns from their investments. Moreover, it was observed by Kraiser (1997) that during the boom, there is high demand to construct new houses since consumers with expectations of higher income are set to purchase new homes or better ones. According to DiPasquale and Wheaton (1996), stock-flow theory hypothesizes that demand for houses in the short-run period is driven by expected future prices of houses in addition to other key variables like income, rates of interest and levels of house prices.

According to the stock-flow hypothesis, in the short-run, demand for houses depends on the expectation of future prices of houses as well as other fundamental variables such as income, interest and house price levels (DiPasquale & Wheaton, 1996). In the explanation by Minford and Peel (2002), expectations were acknowledged tobe critical factors in making economic decisions and that variations in expectations of people about house prices in future can regulate the house price in the current period. Jing, Gyourko and Deng (2010) cautions about the seemingly risky nature of pricing. In support to this contention, they argued that generation of large declines in values of houses only require a modest fall in expected appreciation. More so, expectations becomes fundamental especially due to the overoptimistic nature of people relative to true market situations. The rational expectation hypothesis and adaptive expectation hypothesis are the two price expectation theories that can be used to explain how house prices responds to varying shocks on the determinants.

2.4.3.1 Rational Expectation Hypothesis

Formulation of the rational expectation hypothesis (REH) is attributed to the works of Muth (1961). The REH contends that behaviors in the market are based on rational expectations. The REH is founded on three fundamental axioms whose violation

wouldlead to a house bubble. First, this hypothesis assumes that people possess the capacity to rationally process the information and be more informed about the state of the economy; there is a believe that households have perfect information concerning the housing market and have the ability to make correct prediction of how prices in the housing market moves in respect to any uncertain shocks (DiPasquale & Wheaton, 1996). It is also assumed by the REH that people utilize all the information available while forecasting future house prices since they possess perfect information concerning the future at no extra cost (Malpezzi & Wachter, 2005). It has however been pointed out, that deviation of the house prices from the economic fundamentals will occur when all the Rational Expectation Hypothesis axioms do not hold. This will result to bubbles of either explosive nature or intrinsic nature (Eugene, 2006). Black *et al.* (2006) associates explosive bubbles to factors such as plants utilized for landscaping and varying weather patterns within the environs all of which were not essential to the values of houses. In their postulation, Froot and Obstfeld (1991) linked the intrinsic rational bubble to the varying nature of exogenous key variables which in the current scenario are macroeconomic in nature.

Apart from capturing expectations as proposed my Muth (1961), the theory was later modified by Lucas (1972) to cater for the transition period (a period during which expectations are adjusting to changes in fundamental variables) required for change of fundamental variables. According to Taylor (1979) the hypothesis is relatively attractive in the context of macroeconomic analysis since most macroeconomic policies are forward-looking. It is usual to take the rational expectation of a variable to equal its conditional mathematical explanation plus an additional random component reflecting noise in expectation behavior (McCallum, 1980). The current study aimed at evaluating the long-run relationship between fundamental

determinants of house prices and house prices for the period 2004Q1-2016Q4. This period is long enough and caters for the transition period for which the fundamental variables are expected to have changed. The 13 year period has witnessed a lot of changes in the fundamental determinants of house prices. For instance, there has been the interest rate policy changes over time including the recent capping of interest rates in the year 2016. Other studies that have used this hypothesis include: Beltratti and Morana (2010) in their study of international house prices and macroeconomic fluctuations; Nneji *et al. (*2013a) in their study of house price dynamics and their reaction to macroeconomic changes and Granziera and Kozicki (2012) to study the extent to which expectations affect how house prices evolve as well as the rent-price ratio in the US.

According to Shiller (1989), most buyers have little understanding of the market fundamentals and instead prefer to use recent house price trends to predict future house prices. Furthermore, on the basis of rational expectations, Eugene (2006) argued that it is in the belief of some market participants that there might be a difference between house prices and the fundamentals as a result of price uncertainty. The study period for this research is a period of 13 years, a period in which expectations are expected to adjust to macroeconomic variables as proposed by Sims (1980). The current study is designed to model house prices due to changes in fundamental determinants. With the changes in variables such as mortgage rates, exchange rate, interest rates, population, number of new houses, inflation and GDP, the REH was relevant in explaining the variation in housing price for a period of time.

2.4.3.2 Adaptive Expectation Hypothesis

The initial development and popularization of the adaptive expectation hypothesis (AEH) is credited to the work of Cagan (1956). In light of AEH, determination of future house prices is dependent on past information and house prices trends. This is what DiPasquale and Wheaton (1996) terms as backward-looking expectation whereas Case and Shiller (1988) refers to it as extrapolating behavior, a rampant phenomenon in housing market. The witnessed rise in house prices even with new stock of houses being put up has been linked to speculative behaviors (Malpezzi & Wachter, 2005). Riddel (1999) noted that some individuals make demand decisions based on the past housing prices as opposed to market fundamentals. This is as a result of reliance on information contained in houses previously traded while estimating the current prices in the market (Hwang & Quigley, 2002).

Kaiser (1997) maintained that it is expectations of positive growth of an economy that drive housing cycle to its highest causing optimism among investors when the housing market experiences price rise. Surprisingly, as observed by Davis and Zhu (2004), as house market experiences a decline in prices, home buyers continue to be optimistic and hence are willing to pay higher prices, a condition which exerts a further rise in prices. Malpezzi and Wachter (2005) made a conclusion that the housing market in the context of AEH does not follow a “random walk” since it based on past information where the growth rate path expectations for house price in each period has an association with previous trends in the movement of house price. The AEH could explain with a lot of ease the increase in prices observed in Kenya housing market overtime irrespective of the variations experienced in the prevailing economic circumstances.

2.5 Empirical Review

This section reviews empirical studies that are related to the effect of different exogenous variables on the endogenous variable, house price. The empirical literature is reviewed for every variable used in the study. A general overview of the studies showing relationship between a specific variable and house prices is given prior to a detailed review of such studies.

2.5.1 Mortgage Rate and House Prices

Mortgage rate is expected to be negatively related to house prices. A higher mortgage rate entails higher amortization which in turn impinges on cash flows of households. The effect of this would be reduced affordability of houses and hence dampen demand and consequently push down the house prices (Capozza *et. al.,* 2002). According to Mackmin (1994), the mortgage financing offered to borrowers depends on two factors; credit worthiness of the borrower and the collateral offered for the financing of the house. It is also a significant factor in generating housing demand (Warnock & Warnok, 2008).

Several other studies have aimed at establishing the relationship between mortgage rate and house prices (Tsatsaronis & Zhu 2004; Carbó & Rodríguez, 2010; Gimeno & Carrascal, 2010; Miles 2013; Albert, 2013). Gimeno and Carrascal (2010) made an assertion that there was interdependency between house purchase loans and prices of houses. In particular, the long-run analysis of parameters illustrate that there is a strong relationship between house prices and house loans. Accordingly, they find that from a policy perspective, the relationship between house prices and the structure of mortgage finance markets plays an important role in the economy.

Brissimis and Vlassopoulous (2009) examined the influence of mortgage rate on house prices in Greece. The study covered the period 1993:Q4 to 2005:Q2. A multivariate co-integration technique was used to achieve the study's objectives. Results revealed presence of co-integration between house prices and mortgage rates. Long run results revealed that the elasticity of house prices was 0.23. This means that an increase in mortgage rate by one per cent would increase house prices by 0.23 per cent. Short run dynamics however, showed evidence of bidirectional relationship. The limitation of this study is that it only used one variable being house loans. The current study sought to use more variables.

Using a Vector Autoregressive model, Mansor and Law (2014) examined the long run relationship between house prices and bank mortgage credits, and their dynamic interactions for Malaysian housing market using quarterly data from 1999 to 2015. The variables used were GDP and the 2008/09 financial crisis. Granger causality was used to test for the causality between bank credits and house prices while an autoregressive distributed lag model (ARDL) was used to measure the long run relationship. The study divided the housing market into four segments; terraced houses, semi-detached houses, detached houses and high rise houses. This provided both the aggregate and disaggregates perspectives on the behavior of house prices and its relations to bank credits and other variables. The results indicated that on the aggregate perspective, variations on house prices and bank credits exert significant impact on short-run output fluctuations. It also indicated that bank credits were positively related to house prices in the long run. The authors also found that in the short-run, changes in both house prices and bank credits exert a significant impact on aggregate output. The impulse response functions showed that real house prices increase in response to innovations in bank credits. The disaggregate analysis

indicated that the terraced houses prices formed a long run relationship with bank credits and a conclusion was made that the terraced segment of the housing market drives the house prices in Malaysia.

Gimerno and Carmen (2010) investigated the relationship between house purchase prices and house purchase loans in Spain. The independent variables used were labor, income and nominal interest rates. The study used quarterly data for the period 1985Q1 to 2009Q1. The relationship between the two variables was estimated using vector error correction model (VECM). The study revealed the presence of co-integration, specifically a positive long run relationship between house purchase prices and house purchase loans. The study used labor, income and nominal interest rates assuming that income is only earned from employment which might not be true. The current study included gross domestic product as a variable so as to capture the element of wealth and income from all sources and not only from employment.

Nourzad and MCGibanny (2012) analyzed the short and long run relationship between mortgage and house prices in US using monthly data from 1963M1 to 1997M6. The variables used were the number of houses sold, household income and a month dummy. The study used co–integration, granger causality tests and vector error correction mechanism. The findings revealed presence of long run relationship between the independent variables and house prices. In addition, the study found that the response of house prices to mortgage rates was inelastic. However, contrary to other research, the granger causality results did not find any causation between mortgage rates and house prices.

Shi, Jou and Tripe (2013) examined the relationship between house prices and mortgage rates in New Zealand for six cities. The study covered the period 1999 to

2009. The variables used were house rent, interest rates, unemployment rates, household lending, official cash rate (OCR) and inflation. The research was based on the basic present value model which was estimated using pooled ordinary least squares (OLS). The results showed a positive correlation between house price growth and variations in real mortgage rates and retail rates of interest which can either be floating or fixed. More so, the impact on house prices was greater for real fixed interest rate than it was for real floating-interest rate. The authors concluded that when more and more money is pumped into the housing market, house prices will keep rising. It is however expected that higher levels of interest rate will lead to a decline in the demand for mortgage loans and therefore the influence of fixed and floating terms on house prices were in this case inconclusive. According to Tsatsaronis and Zhu (2004), a house purchase generally requires external financing and the cost of mortgage credit and the conditions under which it becomes available play a major role in shaping the pattern of house price dynamics.

Kim, Son and Yie, (2013) did a study on the dynamics of house prices with household debt in Korean housing market using quarterly data from 1991Q1-2011Q4. The main objective of the study was to establish factors determining house prices in the long run. The house price dynamics was analyzed using the Korean data while putting into consideration how house prices relate closely with house debt. In addition, the study made attempts to carry out forecasting on house pricesover five year that were to follow. The variables used in the study were population growth, real incomes, home ownership's user cost and stock of house supply. The co-integration regression results revealed a strong relationship between the increase in house prices in the 2000's and the sharp rise in debt held by households. The error correction process estimates showed that adjustments in the house prices had been gradual and that it took nearly

four years for the deviations between the true house prices and the fundamental ones to be lowered by half. Lastly, while considering the long term variations recorded in macro-financial environment, the study did not find any likelihood of house prices skyrocketing in the near future as it was witnessed in 2000s.

Using mortgage rates and federal funds rate as indicators of the long term interest rate, Miles (2014) investigated whether these variables determine the house prices in the United States of America (USA). The study used time series quarterly data covering the period 1972 to 2011 and four samples were used for estimation: 1972 to 2011, 1975 to 1992 and 1982 to 2011. Home price index was used as the dependent variable and its data was obtained from Federal Housing Finance Authority's (FHFA). The independent variables used were 30 years mortgage interest rate and federal funds rate (FFR) both lagged four times. The coefficient of first lag of mortgage rate was positive and significant in all the equations, while the second lag was negative and significant in two of the three samples. The coefficient of the fourth lag of federal funds rate was negative in all the equations but significant in two equations. The study did not consider other determinants of house prices apart from mortgage interest rates and federal funds rates.

Basten and Koch (2015) used a sample data for 106 areas of Switzerland for the period 2008 to 2013 to analyze the causal effect of house prices on mortgage demand and supply in Switzerland housing market. The variables used included; liquidity, income, house age and wealth among others. The study adopted a fixed effects model. The study found that one percent higher house prices imply 0.52 percent higher mortgages amounts. The study also found a full partial correlation of 0.78 percent and concluded that there was a positive feedback from mortgage volumes to house prices.

The study concluded that causality is not restricted to one direction but flows in both ways evidenced by the presence of reverse causality. They further found that higher house prices increase mortgage demand and banks respond by few offers with higher rates especially for highly leveraged households. The study also concluded that there is a positive relationship between immigration and house prices. In particular, a one per cent increase in immigration is associated with a 9.3 percent increase in house prices. The study however covered a period of six years and the current study sought to cover a longer period.

Panagiotidis and Panagiotis (2015) examined the macroeconomics determinants of the housing market in Greece using co-integration and a vector error correction model (VECM). The study used monthly data for the period 1997M1 to 2013M12 and used the following variables: industrial production index, consumer price index retail trade loan interest rate, unemployment and money supply growth. Co-integration analysis revealed the presence of one co-integration vector. From the long run relationship, mortgage loans were the most important determinant of house price index followed by retail trade. The coefficient of mortgage rate was 0.005 with a *p* value of 0.001 while the coefficient of retail volume was 0.784 with a p value of 0.055. Another key finding was that all the coefficients had positive signs and in line with the literature. The study further employed the impulse response functions to find out the effect of innovations in the independent variables on the house price index. The study found out that mortgage loan and retail volume shocks explained 29 per cent of all the variations in house price index after three years. This further confirmed the importance of mortgage loans and retail volume in explaining changes in house price index.

Muli (2011) employed secondary quarterly data for the period 2006 to 2010 to find out if the dramatic increase in mortgage credit was responsible for the booms experienced in the housing market in Kenya or whether it is the house prices that have driven the mortgage market. Data used was obtained from relevant government sources. In particular, data on disposable income, interest rate and household debts were extracted from the CBK whereas data on house prices, housing stock and housing turnover were obtained from Kenya's Ministry of Housing database. To achieve the objective, the study specified two multiple regression models, in the first one household debt (a measure of mortgage) was specified as the endogenous variables while in the second equation, the real house price was the dependent variable. The regression results revealed that mortgage credit were affected by house prices but the converse is not true. Based on the findings, Muli (2011) concluded that house price variations have a positive and significant relationship with evolution of mortgage credit in the long term. This findings suggested that evolution of house prices is independent of bank mortgage lending and that banks simply accommodate mortgage financing to house price evolution.

Addae-Dapaah and Anh (2014), employed the Johannsen co-integration test and the Vector Error Correction Model (VECM) to conduct an analysis of data on housing loan, house prices, interest rate and gross domestic product for the period 1991Q1 all through to 2010Q2. The analysis was particularly aimed at establishing the extent to which Singaporean house prices were affected by housing loan. The findings showed that there was existence of a long run co-integration among housing loans, house prices, interest rate and GDP. Moreover, housing loan was noted to have a positive correlation with house price and GDP but the correlation with interest rate in the long run was negative. In addition, there was no evidence for existence of any correlation

between housing loan and house prices during the short run period. It was also noted that even though there is a long run relationship among housing loan, house prices, interest rate and GDP, the direction of causality between house prices and housing loan was somewhat not clear. The implication of this was that a move to target housing loan as an approach to curb Singaporean property price inflation was likely to flop in achieving instantaneously desired outcome.

2.5.2 Exchange Rate and House Prices

Exchange rate is the price of a currency of a nation in terms of a currency of another nation. Exchange rate serves as acritical link through which domestic and international goods markets and financial markets are connected (Yang & Zhiqiang, 2012). According to Yang and Zhiqiang (2012), property investors have three dimensional expectations from real estate which are rental yield, appreciation expected from a property and expectation on appreciation of exchange rate. Furthermore, prices are driven up by foreign direct investments through encouragement of direct investment in the housing market causing demand to rise. Together, the domestic real estate firms' piles an upward pressure on the real estate prices as building cost rises. Consequently, this maintains the house price on an increasing trend which in turn lures foreign investors to inject in more foreign capital into the housing market.

In their analysis of how real effective exchange rate and the Chinese real estate price relate, Yang and Zhiqiang (2012) relied on the VAR model using monthly data for the period January 2007 to December 2010. The study used a Granger Causality model and a variance auto-regression (VAR) model. The Granger causality test revealed a unidirectional causality from real estate prices to real effective exchange rate. The

estimates from the VAR model suggested that the increase in house prices during the short run period caused the real exchange rate to depreciate, with the first and second lags of real estate prices being negative and statistically significant. However, the impact of real estate prices on the real exchange rate in the long run was noted to be positive. In their conclusion, the authors reiterated the importance of controlling real estate prices so as to sustain a steady appreciation of real effective exchange rate. Nonetheless, the study did not include other variables apart from the real effective exchange rates and real estate prices.

Zhang, Hua and Zhao (2012) explored the determinants of house prices in China using monthly data for the period 1999:1 to 2010:6. House price index was used as the dependent variable and nine explanatory variables were used. These included: personal disposable income, real GDP, inflation (as measured by consumer and producer price index), national rent index, real exchange rate, among others. Prior to estimation, variables were tested for stationarity using Augmented Dicker Fuller and Phillips Perron test. The study adopted a nonlinear autoregressive moving average estimation technique combined with a vector error correction method (VECM). Results revealed that exchange rate, broad money supply, mortgage rates and producer price index were important in determining house prices. The coefficient of exchange rate was positive and significant.

Qiao and Guo (2014) adopted a Vector Autoregressive model to examine the effect of exchange rate of Ren Min Bi (RMB) as well as relative factors on house prices. The study relied on quarterly data for the period 2000 to 2012. The authors conducted empirical tests using cointegration analysis, granger causality test, impulse response and variance decomposition analysis to carry out an analysis of the impact of relative

variables. Their study findings showed that movements of exchange rate of RMB and house prices were in the same direction. This was a contradiction to the theoretically hypothesized relationship where a negative relationship is expected between house prices and exchange rate. The authors associated this unexpected relationship to China's exchange rate regime. Ideally, in a nation with mature a market economy and sound exchange rate system, appreciation of domestic currency increases import, domestic currency increases in supply which put upwards pressure on general prices whereas interest rate is expected to fall down; all these have the general effect of rising house prices. On the contrary, China embraces the policy of capital account unopened for a long period which may be the major factor behind the deviation.

Ya-chen and Shuai (2013), motivated by the rise in real estate prices of china hitting extremely high levels except for a short time interval which experienced a price fall, they empirically examined the relationship between exchange rate and real estate prices. The study relied on monthly secondary data for both variables; real estate prices and exchange rate, for the period July 2005 to December 2012. The study used a combination of correlation analysis and econometric models where the VAR model was estimated. Their findings revealed a positive relationship between the two variables. Ya-chen and Shuai (2013) argued further that if foreign capital entrance into China is controlled as a result of the appreciation of RMB, then a positive impact will be experienced on maintaining the stability of real estate prices in the Chinese housing market. It should however be noted that in their study, Ya-chen and Shuai (2013) only narrowed their analytical model to one exogenous variable being exchange rate. The current study extends this into a multivariate framework where other independent variables such as interest rate, population, gross domestic product among others are also included.

In their study, Xiuzhi and Xiaoguang (2006) focusing Taiwan and Japan conducted an analysis of how the reforms within the exchange rate institutions affect the housing market. Their findings suggested that when a currency of a country appreciates, it pushes the price of real estate up or in some extreme cases it results to an economic bubble. Analyzing quantitatively the international flow of capital and the volatility of prices experienced in the real estate market in China revealed that the expectation that RMB will appreciate is one of the factors that inspire speculation in regard to foreign investment in real estate market of China. Thus, Xiuzhi and Xiaoguang (2006) suggested that the government employs a number of macroeconomic control mechanisms which will ensure that appreciation of RMB is done step by step so that speculators are cracked down and the yield level is maintained at normal levels. This will hinder the speculative capital from international sources from gaining speculative profits and therefore halt speculative activities.

2.5.3 Interest Rate and House Prices

In the view of Gardner (1999), changes in prices experienced in the real world are expected and this expectation forms part of the interest rate determining procedure. Movements in the interest rate have an effect on affordability of housing and consequently on the demand for new homes as well as those being resold. The cost of borrowing can be raised by a rise in interest rate which eventually discourages potential buyers resulting to a fall in demand for houses (Apergis & Rezitis, 2003). The end results of this being high repayment of mortgage which lowers property affordability as well as demand (Keynes, 1936).On the other hand, when interest rate is low, many people qualify for mortgages thus increasing the demand for houses (Thomsett & Kahr, 2007). Rangel and Pilay (2007) also concur and argue that a decrease in interest rate leads to a reduction in mortgage payments, resultingin an

increase in house prices caused by higher demand for houses. There is particularly, a significant link between property and lending by banks as has also been highlighted by a number of studies (Herring & Wachter, 1999; Chen, 2001; Hilbers *et al.*, 2001; Gerlach & Peng, 2005). This finding is in line with the expectations given that housing market heavily dependents on mortgage financing. This is not surprising given the heavy reliance on mortgage financing in the housing market.

Harris (1989) investigated the effects of real interest rates on house prices in USA using quarterly data from 1970 to 1985. The explanatory variables used were household permanent income, total occupied housing stock, total vacant housing stock, quarterly dummy variables (Q2, Q3 and Q4), mortgage loans cost relative to interest rates and the expected house sales price appreciation. Four variables were used in separate regressions to capture the expected house price appreciation: past inflation, past house price appreciation, lag of past appreciation and weighted past appreciation. The analysis was done using OLS based on Cochran – Orcutt procedure to reduce autocorrelation. The model with the past lag of inflation was selected as the best as it had the best fit and the most precise estimates. In the best model, the coefficient of interest rate was negative and significant where a 10 percentrise in interest rate was found to decrease house prices by 2.1 percent. The coefficient of interest rate in other modelswas also found to be negative and significant. In addition, the coefficient of vacant houses and the fourth quarter were negative and significant in all the models. However, the coefficients of Q2 and Q3 were positive and significant. The seasonal dummies indicated that houss prices tended to be strongest in the second and third quarters but lowest in the fourth quarter.

Sutton (2002) used a VAR model to investigate how shocks in interest rates, gross domestic product (GDP), stock prices and interest rates affect house prices in Canada, Netherlands, Australia, United States and United Kingdom. The study found that a 100 basis point reduction in the short term interest rate increase house prices by between 0.5 to 1.5 percentage points over four quarters. For all the countries, a weaker relationship was found between long term interest rates and house prices. This can be attributed to the market imperfection. Another key finding was that a one per cent increase in GDP led to between one and four per cent increase in house prices after three years. There was a positive relationship between stock prices and house prices for all the countries, but the magnitude varied. The study showed that a 10 per cent increase in stock prices led to a one per cent increase in house prices in United States, Canada and United Kingdom. However, in Australia and Netherlands, a ten per cent increase in stock prices led to a two per cent increase in house prices.

McQuinn and O'Reilly (2006) used quarterly data from 1980:Q1 to 2005:Q4 to investigate how interest rates and income determine house prices in Ireland. This study deviated from the earlier ones in that the amount borrowed was used to proxy disposable income levels and interest rates. Other variables that were used in this study include the supply of houses, mortgage interest rate, mortgage duration, and mortgage payments as a proportion of household income. Estimations were done using dynamic OLS, fully modified OLS, error correction mechanism and co-integration. The coefficient of the error correction term was negative and significant. It had a value of -0.045, indicating that 4.5 per cent error to equilibrium is corrected in each quarter. The long run results revealed a positive and statistically significant result of the amount borrowed, which is influenced by the rate of interest. The

limitation of this study is that interest rate and income cannot be represented adequately by the amount borrowed.

Li and Chand (2013) used data for 29 Chinese provinces for the period spanning 1998 to 2009 to determine the impact of selected market fundamentals on house prices, specifically interest rates, land prices, user cost, land prices, age and household income. A fixed effects model was specified and estimated. Though interest rate had the expected sign, contrary to the other studies, the coefficient was insignificant. Surprisingly, all the coefficients of other variables were significant in explaining house prices. Another finding was that house prices in developed provinces tended to be determined by the supply factors (like land prices and construction costs) while both demand and supply factors influenced land prices in the less developed provinces. Similarly, Yang and Turner (2004) used the Vector Autoregressive model to analyze the impulse response function of private housing market with the aim of understanding how fundamentals factors influence house prices. They found interest rate to be important in explaining the fluctuations of house prices in the long-run and short-run. The study used a common trend model which decomposes permanent and transitory shocks into the co-intergration model.

Using a data sample for the period 1982 to 2012, Costello, MacDonald and Fraser (2015) explored how the monetary policy (via the interest rates) affects the Australian housing market. The study adopted a two part structural VAR. The explanatory variables used were real GDP, household consumption and real effective exchange rate. A one standard deviation shock on interest rate, the main variable of interest, had a positive and statistically significant effect on house prices which lasted for five and a half quarters. A one per cent shock on interest rates resulted to 0.57 per cent

increase in house prices. This indicated that the house prices had responded little to changes in interest rates. A one per cent shock in interest rate had insignificant effect on GDP for the first seven quarters but thereafter fell steadily until the twelfth quarter where it leveled at 0.26 per cent. A shock on household consumption to house prices showed a similar pattern, while a one per cent shock on exchange rate and on house prices leveled after eleven quarters with a 1.126 per cent increase. The authors concluded that shocks in monetary policy (interest rates) have almost a neutral effect on house prices. However, all the other variables used in the study were significantly influenced by interest rate shocks.

Using correlation and trend analysis, Olowofeso and Oyetunji (2013) investigated how interest rates affect house prices in Nigeria using time series data for the period 1989 to 2008. No other variables were considered in the study. Three categories of houses were considered: block of houses, detached houses and duplex houses. The correlation coefficient between interest rates and block of flats was -0.54 (significant at five per cent), -0.55654 (significant at five per cent) between interest rate and detached houses and -0.6154 (significant at one per cent). The study therefore revealed that there existed a negative relationship between house prices and interest rate, and the relationship is strongest between interest rate and detached houses. The limitation of this study is that it used an oversimplified methodology (correlational analysis) and also did not consider other variables apart from interest rates. There is therefore a need to undertake a similar study that addresses these limitations.

Ouma (2015) conducted a study which was aimed at determining the effects of various macroeconomic variables on real estate prices in Kenya. The specific exogenous variables used were interest rates, GDP, money supply and inflation rate.

The study relied on secondary data which was obtained from various secondary sources. These sources were: Housing Finance corporation database, CBK, KNBS, Hass Consult Ltd and property reports among others. The regression results showed a positive effect of interest rate on real estate prices. This direction of influence was associated to the fact that an increase in interest rate drives up the cost of borrowing. The results also revealed a strong positive effect of both inflation and money supply on real estate prices. On the contrary, GDP was noted to have a negative influence on real estate price. Based on this, the study recommended that the government of Kenya through the CBK, should use various monetary policies to regulate the rate of inflation as well as interest rates. This study however suffers from some pitfalls; first, it failed to subject data to pre-estimation tests for the classical linear assumptions before conducting ordinary least square estimation. Secondly, the use of OLS in time series estimation without conducting stationarity test might have led to spurious estimation. More so, the study did not include exchange rate among the exogenous variables. The current study addressed all these drawbacks.

Nkoyo (2017) examined the effect of interest rate on the prices of residential real estate in Kenya. The author used quarterly secondary data for a period of 10 years (2007-2016). Apart from interest rate, other exogenous variables that were fitted in the simple regression model estimated were economic growth, rate of inflation and the supply of money. Data on residential price index were obtained from Hass Consult Ltd whereas data on interest rates, supply of money and gross domestic product growth were obtained from the Central Bank of Kenya. The findings showed a negative effect of both interest rate and economic growth on residential real estate prices. The effect of interest rate is insignificant unlike that of economic growth which is significant. On the other hand, the effect of inflation on residential property

index was positive and significant whereas the effect of money supply was positive but insignificant. Just like the case of Ouma (2015), Nkoyo (2017) also left out exchange rate in the analysis. It should also be noted these two studies found contradicting results in regards to how interest rate affect residential property index, negative and insignificant in the latter but positive and significant in the former. This is just one of the dilemma in the direct effect of the variables which called for further investigation on the mixed results.

Nneji, Brooks and Ward (2013b) applied a three regime Markov switching model to carry out an investigation of how macro economy impacts on the dynamics of the market for residential real estate in United States. With the focus on the 1960 to 2011 period, the methodological approach that Nneji *et al*. (2013b) implemented allows for a better comprehension of the real estate market drivers during the time of a boom, during steady-state period and when there is crash. Their results revealed how sensitive real estate market is to economic variations depending on the regime. In their paper, Nneji *et al.* (2013b) went ahead to examine if policymakers have the capability of influencing a regime switch away from that of the crash. They found out that a likelihood of a decline in interest rate spreads can be a catalyst effective enough to cause such a change of state.

Sutton, Mihaljek and Subelyte (2017) estimated how house prices respond to variations in both short term and long term rates of interest among 47 developed as well as emerging economies. The authors relied on data selected by statistical authorities as their finest series for house prices. The quarterly observed data for US covered nearly half of a century whereas more than 1000 annual observations were made for remaining sample. One of the results which their analysis yielded was the

remarkable role played by short term rate of interest in driving house prices particularly outside the US. Sutton *et al*. (2017) interpreted this as a reflection of the significance of the bank lending channel of monetary policy in house price fluctuations particularly in economies where home mortgage securitization is not dominant. Furthermore, they showed significant house prices inertia and argued based on empirical evidence that variations in interest rates and other house price determinants have a gradual rather than instantaneous effect on house prices. More interestingly, Suton *et al.* (2017) also found out that interest rates of the US appear to have an effect on house prices for other economies outside the US itself. Kenya however was not affected by the financial crisis of 2007/2008 and it was worthwhile to confirm the same.

The study conducted by Xu (2013), focused on the contribution of three factors on the sharp rise in the house prices and mortgage debt observed in the US between 1994 and 2005. The three predictor variables considered here were population aging, innovation of mortgage and historically low rates of interest. Xu (2013) constructed an overlapping general equilibrium housing model which revealed that all the three exogenous variables jointly account for more than half of the increase in house prices as well as to most of the rise in mortgage debt during the period 1994 to 2005. Furthermore, it was shown that though population ageing contributed towards the increasing house and mortgage debt, this variable only accounted for a substantially small portion of the changes witnessed. In the meantime, innovation of mortgage was noted to significantly increase the mortgage borrowing of different age cohorts but its effect on house prices is minimal due to the fact that the rise in the rate of interest occurs due to higher demand for mortgage loans. This has the effect of increasing the savings of households in financial assets and renders their housing assets generally

unaltered. The results also showed that falling rate of interests compel households at main saving ages to shift their wealth to housing assets from financial assets which pushes the house price up intensely.

A number of studies have been able to draw a link between rates of interest and house prices (Hendershott, 1992; Lacoviello & Minetti, 2003; Himmelberg *et al*., 2005; Nneji *et al*., 2013a). A greater proportion of these studies have revealed a direct and negative effect of interest rate on house price. Whenever interest rate rise, it leads to a decline in house prices because loan repayment will become more costly resulting into a decline in demand for credit facilities by potential investors. On the other hand, a decline in rate of interest has an increasing effect on credit demand and thus lowers the cost at which investments are financed. Whereas rates of interest are determined by the market in the case of the 91-day Treasury bill rate as the benchmark rate, the Central Bank has an influence on the direction of the benchmark rate through liquidity availability in the economy. The Kenyan housing market has several players including investors and this study sought to use variance decomposition and impulse response functions as well as VECM to determine the relationship between interest rate and house prices.

2.5.4 Population and House Prices

Population is the total or aggregate of all the objects, subjects or members that conform to a set of specifications. In this context, population was taken to be the total number of humans currently living. According to Mulder (2006), population growth is either caused by natural population growth of higher births and low mortality or non-natural causes which consists of immigration. Louise (1982), portends that population growth drives house price appreciation. With natural growth of population, home

construction reacts to market demands by providing more supply so as to offset the anticipated demand which in turn drives up house prices.

Mankiw and Weil (1989) found that an increase in number of newborns increases the demand for new houses twenty years later. IMF (2010) attributed this to the fact that the supply side of the market is rigid because of shortage of land for housing and the time taken for new construction to be complete. Cvijanovic *et al.* (2010) attributed the UK population growth to rising life expectancy, a relatively high birth rate and high net immigration which contribute to shortages of houses and increase in house prices. According to Bourne (1981), this can be attributed to the difference between the market for housing and the market for other commodities and that production of housing is slow and subject to many laws and regulations.

Using an autoregressive distributed lag model, Mankiw and Weil (1989) examined the effect of major demographic variables changes in United States of America using time series data from 1940 to 1980. Specifically, the study focused on the effect of baby boom on house demand (the baby boom happened in early 1980's in USA). The author regressed the age structure of the population of house demand and various years were used as dummies. The findings showed that the increase of house demand from 1940 to 1980, over a ten year consecutive period, was 1.84, 1.16, 1.31 and 1.66 percent, respectively. These indicated that the baby boom had increased the demand for houses, and hence rise in their prices. The study further forecasted the growth in house demand between 1980 and 1990, between 1990 and 2000 and between 2000 and 2010 to be 1.33, 0.68 and 0.57 respectively. In addition, the correlation between growth in house demand and growth in population of those aged 21 years and over

was 0.86. Notably, the largest increase in house demand was from those aged between age 20 and 30.

Turner (1995) investigated the determinants of house prices in Sweden using a sample data for the period 1989 to 1993. Specifically, the study considered the following explanatory variables: population, individual income, and share of households with tertiary education, building costs, average sales price of secondary homes, among others. Estimation was done using regression analysis. The coefficients of population, individual income, share of households with tertiary education, building cost and sales price of secondary homes were positive and statistically significant. Nevertheless, new home as percentage of change in population and the density of houses had no significant effect on the price of houses. The limitation of this study is that inclusion of prices of secondary homes led to the correlation of residuals with the dependent variable (house prices) and thus there is need to use a better estimation technique instead of ordinary least squares, like seemingly unrelated method (SUR) or instrumental variable (IV).

O'Donovan and Rae (1997) investigated the house price determinants for 14 cities in New Zealand using monthly data from 1974 to 1996. The independent variables used in the study included youthfulness of the population (as measured by those aged between age 20 to 35), number of occupied houses per person, consumption per household and real user cost of capital. The model was estimated using panel regression techniques. The coefficient of consumption, which measures the coefficient of relative risk aversion was negative one (one in absolute terms). From the aggregate results, the coefficient of real user cost (interest rate) was negative and statistically significant as expected, with a coefficient of -2.4. This meant that a one

per cent increase in interest rate would lower the price of houses by 2.4 per cent. The coefficient of population was positive and significant, meaning increase in the population of youth (those aged between ages 20 and 35) increased house demand and hence house prices. Estimation of each regions house prices model further revealed that population, region's economic performance and prices of agricultural commodities significantly determined the house prices.

Using panel data for 62 metro areas and data covering the period 1979 to 1995, Cappoza, Hendershott, Mack and Mayer (2002) explored the determinants of house prices in USA. The study sought to estimate the serial correlation and mean reversion coefficients. The model was estimated using Ordinary Least Square and using a fixed effects estimator. The variables used in the study were personal income, real construction costs, population growth, mortgage rates, income tax rates and consumer price index. Both indicators were found to vary with the population growth, construction cost, the size of the city and real household incomes. On one hand, the study found that mean reversion was greatest with areas of high income, construction costs and population growth. On the other hand, mean reversion was found to be greater in large cities, with high population growth and low population growth rates. The study further found that areas with high construction costs, low mean reversion and high serial correlation were more likely to experience house price overshooting. These include Los Angeles, New York and Boston.

Cvijanovic, Favilukis and Polk (2010) analyzed the relationship between expected and realized house price appreciation and demographic changes for 23 cities in 17 states in USA for the period 1975 and 2009. The data used were house prices, house rents, and GDP. Using a pooled regression, the coefficient of population growth was

positive and statistically significant, with a value of 1.1073. The authors further identified two components of expected population growth: natural component due to fertility and mortality rate changes and a non-natural component as a result of immigration. The findings indicated that only the natural component of expected population growth forecast house price appreciation.

Lin, Ma, Zhao, Hu and Wei (2018) focused on 32 major cities in China and relied on panel data model to conduct an empirical investigation of the impact of population migration on prices of urban housing. The panel data used covered the period 2007 to 2016. The study was in two perspectives that is, national level and regional level (Eastern, Central and Western regions). The estimation results showed that on the national level, inflow of population had a positive and significant correlation with urban house prices where a one percent increase in population inflow rate had the effect of increasing urban house price by 0.31 percent. Regionally, a one percent increase in population inflow rate pushed up the urban house price by 1.34 percent in the Eastern region. However, the effect of population inflow on urban house price in the Central region as well as Western region was not obvious. Based on the findings, Lin *et al*. (2018) recommended that housing supply imbalance should be addressed through diversification of housing product and improvement of affordable housing systems. Among other policies, the study also suggested that more nationally central cities should be build given the trend of urbanization. Generally, the work of Lin *et al*. (2018) implies and sends signals for China and other developing economies to ensure proper coordination of population and development of urban areas especially in the wake of rapid urbanization.

Chen, Gibb, Leishman and Wright (2011) studied how house prices is impacted by population ageing this was after these authors had acknowledged the unceasing debate on whether population ageing exerts an upward or downward pressure on house prices. Unlike most of the studies that preceded their work which were majorly relying on macro time series data regression estimation, Chen *et al.* (2012) adopted a micro-simulation technique which combines a macro-level house price model with a micro-level household formation model. Focusing on the case of Scotland, a nation with population which is expected to age so fast in the future, the authors used panel data estimation. These data was obtained from the British Household Panel Survey which stretched through the period 1999 to 2008. The estimates were then used to conduct a set of simulations. The key result from the simulation indicated that population ageing (variations in age structure) is not probably a key determinant of house prices especially in Scotland. It was worth finding out if urban population affects house prices.

Motivated by both the fact that housing is the greatest component of wealth of people and the then persistent debate on the general effect of migrants, Chanpiwat (2013) examined how the housing markets of New Zealand respond to immigration shocks. The study relied on housing, migration and census data covering the period between 1996 and 2011. It was revealed by the regression results that external migration shocks were positively correlated with house prices. It was also estimated that an increase in migration shock by one percent raised the house prices by about 7.5 percent on a national scale. Moreover, it was shown that bigger cities which often have the tendency of migrants clustering are more able to cope with housing pressure exerted by such migrants relative to smaller housing markets.

A study conducted by Sa (2014) aimed at establishing the effect of immigration on house prices in the UK. Surprisingly, the findings showed that immigration negatively impacted on the house price. Sa (2014) argued that the negative effect was as a result of mobility response of the native population. Ideally, natives' response to immigration involves relocating to different areas and those who leave are basically at the peak of wage distribution. Such movement sparks a negative income effect on the demand of housing and drives house prices down. According to Sa (2014), this negative effect of immigration on house prices is propelled by local regions where immigrants are lowly educated.

Kalantaryan (2013) conducted an empirical examination of how immigration impacts on the housing price dynamics across Italian provinces from 1996 to 2007. The study used the number of valid residence permits as a measure of immigration stock and the self-reported housing values from the survey of households' income wealth in Italy. With the help of different methodological techniques, the study findings suggested that a rise in immigrant population had the effect of driving up the average house prices in Italy. The Study further demonstrated that an increase in concentration of immigrants in provinces of Italy drives average house prices up but at a declining rate. The Difference and system Generalized Method of Moments estimation that were performed confirmed both positive effect of the rise in immigrant population on house prices as well as the non-linear response to the concentration of immigrants.

Accetturo, Manaresi, Mocetti, and Olivieri (2014) studied the impact of immigration on residential markets within Italian urban areas. The authors developed a spatial equilibrium model which shows the effect of immigration inflow in a district on local house prices through variations in the natives' perceptions on the quality of their local

amenities and the influence of this on their mobility. Using a novel dataset on house prices and population variables at the district level for a sample of 20 large Italian cities, the model predictions were tested. The author further adopted an instrumental variable approach to address the problems of endogeneity. The study results revealed that immigration piles an upward pressure on average house prices at the city level. However, immigration lowers growth in house prices in districts that experience a population inflow. These trend is associated with the flight of natives from immigrant dense districts to other city areas.

Myrmo (2012) investigated the relationship between growth of population and house prices. The paper conducted an analysis of whether the housing bubble was present in the cities of America at the time of the recent financial crunch. The author did this by making a comparison between the development of housing market among cities and similar trends in growth of population. The study used two empirical approaches to identify housing bubbles. The price-to-rent and the price-to-income ratios help in determining if house prices reflect critical market values during the entire period. In addition, qualitative analysis was used to examine the effect of both monetary conditions and variations in regulations governing housing on the housing market of America during the 2000s period. The study arrived at a conclusion that positive growth in population had the effect of exerting an upward pressure on demand which then escalated house prices and consequently enhancing the risk of forming a bubble. Myrmo (2012) argued that there was existence of bubbles in the cities that experienced rapid population growth rate before the crunch. Nevertheless, the disparity between house price and essential values were greater before, during and after the financial crunch in cities with large steady size of population. Therefore, a sharp surge in population which signifies a sudden increase in demand is essential to

make house prices to expansively surpass critical values and therefore craft housing bubbles.

Gonzalez and Ortega (2013) conducted an empirical estimation of how immigration influences the Spaniard house prices and the residential construction activities for the period 1998 to 2008. The decade under consideration was marked by remarkable boom in the housing market as well as a striking immigration wave. Gonzalez and Ortega (2013) exploited the dissimilarity in immigration across provinces of Spain and constructed an instrument based on the historic location trend of immigrants by countries from which they originated. The results provided evidence for a significant causal influence of immigration on house prices and house quantities. From the start until the end of the study period (1998 to 2008), the average province of Spain received an inflow of immigrants estimated at around 17 percent of the initial population of the working age. It was estimated that this inflow drove the house prices up by approximately 52 percent and was responsible for about 37 percent of the entire creation of new house units during the period. These statistics send a signal that roughly one third of the boom observed in the housing market (both as measured by the price as well as erection of new structures) can be explained by immigration (Gonzalez & Ortega, 2013).

Liew and Haron (2013) observed a radical rise in house prices in the Malaysian Klang Valley. Due to the then scanty empirical work to explain this trend, Liew and Haron (2013) were inspired to conduct a study to address this. They achieved their objective through rigorous literature review and also based on data obtained from representatives of sampled National House Buyer Association. In particular, primary data was obtained with the help of questionnaires from a sample of 10 municipal districts in Klang Valley region including Kuala Lumpur, is the capital city. The

results from the analysis showed that housing market fluctuations, rising cost of construction, expansion of population and rising demand were the major factors behind the witnessed rise in housing prices in the study area. Nairobi City County has witnessed rural urban migration and the current study sought to evaluate the effect of population on house prices.

Kamal, Hassan and Osmadi (2016) carried out a study which investigated various factors that drive the housing price from the perspective of the developers. The researcher targeted housing developers operating in Penang, a Malaysian state who were interrogated both through online means as well as by face-to-face surveys. The findings showed that location; macroeconomic factors; demographic factors; land/zoning; and industry factors are the fundamental factors that influence the house prices. According to the results, it is in the perception of the developers that location is the most important factor that influences the house prices. In particular, the results revealed that if the location of the house is characterized by proper infrastructure, high quality and good design specification, location can drive the housing price. In view of the developers, the second factor that had influence on the housing price in the study area (Penang) is the macroeconomic factor. For example, the rate of inflation was noted to have influence on the house price. In addition, to inflation rate, low interest rates encourages people to buy houses which then puts demand for houses on an upward trend. With increased demand, decision of the developers is also influenced. Other than location and macroeconomic factors, demographic factors were also noted by developers to have an effect on house prices. Specifically, growth in population, current lifestyle as well as living standards have an influence on the developers while making decisions concerning house prices. Moreover, land and zoning issues were noted to play a role too. The results showed that ownership of land, whether freehold

or leasehold had an influence on developer's decisions about house price. That is, developers have the tendency of setting higher prices on freehold as compared to leasehold land. Finally, industry factor was also noted to drive the house price decisions in Penang. In this regard, the study revealed that professional and highly skilled labor force hired for the projects had caused an increase in the construction cost which eventually pushes the housing prices up. Another industrial factor that was identified was the regulatory barriers which also raises the cost of development and hence housing cost.

Kagochi and Kiambigi (2012) analyzed the influence of remittances, population and other macroeconomic variables on house prices using time series data from 1970 to 2008 in Kenya. The study used the ARDL model to estimate the short and long run elasticities. The specific variables used were government expenditure, lending interest rate, trade intensity index, inflation (CPI) and per capita income. The coefficient of population growth, as proxied by urban population growth rate was positive and highly significant, with a value of 2.02. This meant that a one per cent increase in urban growth rate increased the price of houses by 2.02 per cent, holding all other factors constant. Other coefficients that were positive and statistically significant were GDP per capita, remittances, trade and government expenditure. The coefficient of interest rates, as expected, was negative and statistically significant. The relationship can be two sided whereby population influences house prices via house demand and it also follows that housing could influence the number of people and households since the demand for housing is not only determined by the number of people but also the number of households. Kenya has witnessed population growth over time and it was worthwhile finding the relationship between population growth and house prices.

2.5.5 Number of Houses and House Price

According to Leonhard (2013), quality and features of housing stock available for purchase may have effects on house price changes overtime. Generally, construction firms should want to build more when house prices rise but housing stock is slow moving and this may affect prices. In a housing market which is efficient, an increase in house prices is likely to cause an increase in the number of new houses under construction as private contractors recognize the potential of making higher returns and increase production (Marsden, 2015). An analysis of the housing market in the United States within a framework of a stock-flow model was conducted by Dipasquale and Wheaton (1994). The results provided a strong evidence suggesting that for housing market to clear, it will take a number of years. In the study, an extension of the traditional stock-flow model was used by allowing convergence of prices to equilibrium over a number of periods. The model gave a proposal of an equation for the price that clears the market whose determination is by interaction of demand variables and housing supply as measured by actual number of houses. In the study, an estimation of the equation for residential investment was conducted. Herein, construction was treated as a dependent variable with exogenous ones being house prices, the current stock level and a number of cost shifters. It was concluded that investment in residential sector responds to variations in house prices but there is a clearly higher supply elasticity in the long run than there is in the short run. White (2016) used a Vector Autoregressive and error correction model to test the asset inflation channel in UK and Spanish housing market from 1991 to 2013. Results indicated that both countries showed rapid convergence to equilibrium with a larger elasticity of supply in Spain than in UK but with a short-run effect of new supply of houses on house prices in UK.

Zahirovich-Herbert and Gibler (2014) analyzed the effect of new residential house construction on house prices in Baton Rounge Housing market in the US for the period October 1984 to April 2005. The variables of interest considered were a set of house characteristics being; number of bedrooms, living room area, number of bathrooms among others and new house construction variables like; overall size of the house and distance from existing houses. The study adopted a pooled cross sectional hedonic regression. A hedonic regression is a revealed preference method of demand or value estimation. It breaks down and estimates the contributory value of each characteristic. The study found that if new houses are constructed within a well-established neighborhood, then the effect of these new houses would be positive but insignificant. However, the prices of the existing houses are negatively affected if similar sized houses are built. Larger new houses were also found to positively influence the price of existing houses. The spillover effect of new houses were found to vary with distance from the existing houses, with both positive and negative price effect reducing with distance greater than half a mile.

A study carried out by Teklay (2013) aimed at focusing on the supply and demand relationship in influencing house prices within the Stockholm County. The study used both time series and cross sectional regression by fitting in the models data on the number of houses that had been constructed for every one thousand inhabitants per municipality, the house price development in each municipality and the average annual development of wages. Out of a total of 26 municipalities in Stockholm County, the study sampled out 5 municipalities with the highest and lowest rates of construction per thousand inhabitants. The time series regression results suggested that most of the municipalities' house prices predominantly rely on the housing construction rate; when construction increases the prices are pushed down and vice

versa. Nevertheless, the Vallentuna municipality had unexpected coefficient signs which suggested that factors other than variables used in the model were responsible for driving the house price up. In the cross sectional regression which involved regressing together both the 5 highest and lowest municipalities with rates of construction, similar signs as for the case of Vallentuna municipality were observed.

Shimizu and Nakagawa (2018) based their analysis on housing market to focus on external diseconomies of aging condos. There is a likelihood of the quality of stock of condos to deteriorate more rapidly with time than ordinary houses do. This quality deterioration results to a fall in quality of housing services that residents receive. As residential environment worsen, it may culminate into external diseconomies. The study used hedonic models of house pricing to detect the external diseconomies of aging condos on the residential market. Their estimation results indicated that such external diseconomies for detached housing were felt in regions where there was coexistence of detached house and condos and these pushes the prices downwards. The results specifically revealed that detached house prices are reduced by 3.2 percent in response to a one percent rise in the proportion of the total building floor area in neighborhoods in which condos were constructed before 1990. Generally, Shimizu and Nakagawa (2018) argued that aging condos start to generate diseconomies in their environs approximately 20 years after their construction.

Ebru and Eban (2011) used quantile regression methods which involved estimation of a hedonic equation for every quantile of the conditional distribution of house price. The study used the data set which included some housing features of the dwellings to examine the relationship between house prices and housing features in Istanbul. The housing features considered included number of rooms, bathroom, heating systems

and location of houses among others. Their estimation results showed that age, cable television set, security, heating system, garage, area of the kitchen, the rising number of rooms and bathroom have the effect of pushing house prices upwards. Though Ebru and Eban (2011) included the number of rooms; which can be a measure of house supply in its estimation, it narrowed its scope to the features of the houses with no inclusion of other key economic variables such as inflation rate, mortgage rate, gross domestic product among others. More so, exclusion of Istanbul's population implied that the effect of supply of houses on their prices was analyzed with no consideration of the demand. This is likely to have deprived their study of an important economic element where supply and demand interact to determine price. The current study sought to use several variables to capture the effect of demand and supply in pricing of houses.

Sivitanides (2018) conducted a study aimed at validation and quantification of the effect of key macroeconomic factors that drive house prices in London. The study achieved this objective using annual data for the period stretching from 1983 to 2016. Sivitanides (2018) estimated alternative error-correction and partial adjustment models to model the sluggish adjustments of house prices to supply and demand shocks. The findings from estimation confirmed the presence of a long-term link between house prices in London and fundamental macroeconomic variables such as the population of London, the United Kingdom's gross domestic product and completion of houses. One of the key findings of Sivitanides (2018) relevant to the currently heated debate on factors behind the affordability crisis affecting the housing crisis is that the findings failed to provide significant evidence to the proposition that user demand, measured by Greater London population, may have experienced a weakened influence on house price inflation experienced in London. Two major

implication were made. First, increased activities in London involving homebuilding would definitely aid in restraining house price escalations. Second, any potentiality in the reduction of immigration as well as economic growth would have an effect similar to that of homebuilding activities.

Using panel dynamic regression model to calculate the relationship between trend in real house prices and trend in supply in dwellings among several other factors, Leonhard (2013), found that in most countries, stock of houses has a negative impact on house price trend with a stronger impact in municipalities with major cities and weaker in the outlying municipalities whereas at the same time, some countries showed no effect. Marsden (2015) observes that although in-elastic supply of houses in the short run contributes to house price volatility, it does not necessarily follow that increases in the housing stock will dampen the pace of house price appreciation. Given the stock of housing in Nairobi City County, being the capital of Kenya, it would be important to find out the type of relationship that exist between the number of houses and the house prices.

2.5.6 Inflation and House Prices

Inflation has also been cited as one of the key factors in determining house prices. For instance, Kearl (1979) conducted a study which was aimed at examining the impact of inflation on investment in the housing sector. The results showed that inflation negatively affects house prices. Taltavull and McGreal (2009) explored the effect of house price expectations on house price on residential properties and found that about 8 percent of the house price changes within the Spanish housing market is accounted by price expectations. Tsatsaronis and Zhu (2004) focused on industrialized economies to carry out a study which noted inflation as one of the key factors driving

house prices. This was linked to the fact that houses may be perceived as an investment and a good to hedge against inflation by the general public. Kim (2004) adopted a granger causality test to examine the house prices of the Korean housing market and found that inflation and house prices tend to move together. The study concluded that the two-way relationship indicated that inflation had a significant explanatory power as a house price determinant in Korea.

There has been mixed results among other studies which considered inflation in their empirical inquiry. Nneji *et al.* (2013) employed a Markov switching model to show that house price respond to GDP as well as to short term rates of interest, only excluding inflation which makes it an incomplete view of the market. Similarly, Tze (2013) found an insignificant relationship between inflation and house prices in the Malaysian housing market.Past behavior of inflation data has been used by several studies to proxy for future expectations (Kearl, 1979; Muth, 1986). This study used past behavior data of inflation as a proxy to measure people's expectation of future increase in house prices. The increase in house prices signals an inflationary pressure in the economy, which results in a decrease in housing demand and consequently lower house prices (Barot & Takal, 1998). Theory predicts that in an ideal housing market, movements in inflation rate and house prices are in opposite directions.

Anari and Kolari (2002) examined the long run impact of inflation on house prices in United States using monthly data from January 1968 to June 2000 based on an ARDL model and recursive regressions. The study only considered three variables: prices of new houses, prices of existing houses and non- house inflation. The study found presence of long run co-integration between house prices and non -housing inflation. The Fisher coefficient estimates from ARDL for new homes ranged between 1.08 and

1.26. The Recursive estimates that time – varying Fisher estimates ranged between 1.19 and 1.42 for the period 1974 to 2000. The study therefore concluded that the Fisher elasticity house prices with respect to non-house inflation were stable in the study period and exceeded one. The study however, failed to take into account other variables that affect house prices.

Tsatsaronis and Zhou (2004) explored the determinants of house prices in 17 industrialized countries over a period of 33 years from 1970 to 2003. The study divided the countries into three groups depending on their business practices and mortgage finance regulatory framework. The variables of interest considered in this study were the growth rates of GDP, bank credit, consumer price indices (CPI), short term interest rates and the term spread interest rates. The study adopted a structural VAR which was used to derive the variance decomposition and impulse response functions. Shocks in inflation composed the greatest variation in house prices in all the three samples: 62.5, 42.3 and 50.3 per cent in groups 1, 2 and 3 respectively. In all the countries, innovations in inflation accounted for 53 per cent in the variations in house prices. Bank credit and short term interest rate were the second and third most significant in explaining the variations in house prices respectively, explaining 11.4 per cent and 10.8 per cent variation in all house prices.

Abelson *et al.*, (2005) carried out a study to find the determinants of Australian housing market from 1970 to 2003 using the error correction model to determine short run relationship and the long run model estimated using dynamic Ordinary Least Squares. The variables included in the model were household disposable income per capita, real exchange rate, consumer price index, housing stock per capita, unemployment rate, real mortgage interest rate and real All Ordinary index. The

study found out that inflation and real disposable income positively influenced the house prices. Mortgage rates, unemployment rate, housing stock and equity prices negatively influenced the house prices.

Using a panel data of China's 35 major cities, Kuang and Liu (2015) analyzed the relationship between inflation and house prices for the period 1996 to 2010. The study developed a four sector general equilibrium model composed of consumers, firms, central banks and developers. A system Generalized Method of Moments (system GMM) and co – integration analysis was used to investigate the relationship. The explanatory variables included in the model were rental price, money supply, interest rate, household savings and GDP index. The study specified two regressions where house price index was the dependent variable in one equation and inflation (CPI) was the dependent variable in the other. Co-integration analysis revealed the presence of long term relationship between dependent variables and the explanatory variables. The findings indicated an asymmetric relationship between inflation and house prices with inflation having a stronger causality effect on house prices than vice versa. Interest rates were found to be negatively related with house prices but household incomes were positively related with house prices. Economic growth was also found to have more effect on house prices more than on inflation.

Zou and Chau (2015) explored the determinants and sustainability of house prices in Shanghai, China. The study used monthly data from 2005 to 2010. The variables used in the study were inflation rate, house sales, house completion rates and house prices. The study used both PP and ADF methods to test for unit roots after which Johansen Co-integration, error correction mechanism and Granger causality were applied. Johansen multivariate test statistics indicated presence of co-integration, suggesting

that long run relationship exist between variables. ECM results indicated a coefficient of error correction term of 0.41, which, contrary to expectations, was positive and significant. Generally, the error correction term is expected to be negative and significant. Results further indicated a negative relationship between stock of houses being completed and house sales with house prices in the short run. However, CPI, an indicator of inflation and house prices were found to be positively related in the short run. Granger causality test revealed CPI, sales and completion Granger cause house prices. At the same time, CPI and house price both Granger cause completion. The other Granger causation relationships between the variables were insignificant.

Mallick and Mahalick (2015) investigated the determinants of house prices in 15 India's major cities using quarterly data from 2010Q1 to 2013Q4. The variables used were household income, interest rate, foreign direct investment, real effective exchange rate, gold prices, share prices and credit availability. The equation relating house prices and its determinants was estimated using a fixed effects regression and Pedroni's co-integration technique. The study found that non-bank credit, foreign direct investment, and share price index positively influence the price of house while inflation and capital market capitalization negatively influence the same. Exchange rate, net portfolio investment and real exchange rate were found not to have any significant effect on house prices. Co-integration analysis revealed the presence of long run co-integration between house prices and the variables. The error correction mechanism showed that a departure of house prices from its long run equilibrium takes five quarters to go back to the long run equilibrium.

Meidani Zabihi and Ashena (2011) investigated the existence of causality among house prices, economic growth and inflation in Iran using quarterly data for the period

1990Q1 to 2008Q1 measured at constant 1997 prices and obtained from Iranian Central Bank balances. The time series data set used comprised of real gross domestic product, the consumer price index and exchange rate. The study employed the Toda and Yamamoto technique. The findings provided evidence that there was a significant multidirectional relationship between house prices and macroeconomic variables. It was confirmed by causality test that both GDP and Consumer Price Index granger cause house prices and feedback effects are detected for house price and GDP. Nevertheless, the study did not reveal any evidence for granger causality of variations in real house price to inflation as measured by the CPI. The current study sought to find out if the variables granger cause each other.

The empirical work of Frappa and Mésonnier (2010) was motivated by the recent boom experienced in housing market of majority of advanced economies which had ignited criticism following the financial crisis of 2007/2008. As such, the study by Frappa and Mésonnier (2010) was aimed at testing such claims using a formal empirical test. Any bias likely to have arisen from self-selection into inflation targeting was corrected by the standard program evaluation methodology which the study employed. Focusing on the period 1980 to 2006, the study considered 17 industrial economies among which 9 nations have had inflation targeting at least at some point. The analytical results revealed strong evidence of a positive and significant effect of inflation targeting on the growth of real house prices as well as on the house price to rent ratio.

2.5.7 Gross Domestic Product and House Prices

Among other indicators used by empiricists to reflect economic conditions, Maclennan and Pryce (1996) argued that GDP is perhaps one of the most popular

ones. According to Wheeler and Chowdhury (1993), the consideration of GDP as a popular indicator arises from the link between the macroeconomic activity and the house prices. Egert and Mihaljek (2007) analyzed factors that determine house prices in Central and Eastern Europe and 19 organizations of economic development and co-operation (OECD) countries. The specific variables of focus were stock prices, unemployment, share of working age population to total population, labor force as a percentage of population, interest rates, credit as a percentage of GDP and GDP per capita. The coefficients of the variables were estimated using a panel dynamic ordinary least squares. Co-integration mechanism and error correction model were used to model the long term relationship. The coefficient of GDP per capita, as expected, was positive and highly significant in all the regressions. The elasticities of income and interest rate to house prices were higher in transition countries compared with OECD countries. The coefficient of real interest rate was negative and statistically significant, while the coefficient of credit was positive and statistically significant. The demographic indicators of population, labor force and unemployment for the OECD countries were all significant and had the expected a priori signs. From the error correction model estimation, the error correction term for the OECD countries ranged between -0.05 and -0.11, while the ones for Central and Eastern Europe ranged between -0.15 and -0.33.

Valadez (2012) investigated the relationship between house prices and GDP in USA before, during and after the 2008 global economic recession using quarterly data from 2005Q1 to 2009Q3. Using regression analysis, the study used change of GDP as the dependent variable and change in house price index (HPI) as the independent variable. In the study, the regression of HPI and GDP showed that the two variables were linearly related. The coefficient of change of HPI was 0.9320 and was

statistically significant. The correlation between HPI change and change in GDP was 0.6904. The limitation of this study is that it did not consider other variables that affect GDP growth. It may also be misleading to assume a linear relationship between GDP and HPI since it may not be the case that they are linear over time.

Tze (2013) examined the determinants of house prices in Malaysia using data for the fourth quarter of every year from 2001 to 2010. The study empirically examined whether the changes in GDP, inflation, labor force, construction costs, population, interest rates and property gains tax were related to the increasing Malaysian prices. A regression analysis was used to estimate the coefficients. The study found that the coefficients of GDP, population and property gains tax were tht key determinants of house prices since all their coefficients were positive and statistically significant. The coefficients of the other variables were insignificant. This study had three limitations. First, the study used a sample of ten years specifically, fourth quarter only for every year which is not sufficient. Secondly, the study did not test for the presence of unit root in the data series before estimation. Finally, the study ought to have investigated the effect of changes in the included variables on changes in house prices. This is because changes in these variables may not necessarily influence the changes in house prices.

Droes and Minne (2016) investigated whether the determinants of house prices change over time using data spanning 1825 to 2012 in Amsterdam housing market, Netherlands. The variables used in the study were population, unemployment, labor force, housing supply, opportunity cost of capital, supply of houses and construction costs. The study used the error correction method (ECM) to capture the short and long run dynamics. The ECM was estimated using ordinary least squares. Between 1825

and 1900, the supply of houses, construction costs, population and unemployment were found to be key determinants of house prices. Between 1900 and 1945 GDP per capita and labor force were found to be the key factors. Between 1945 and 1970, GDP per capita, population, house supply and opportunity cost of capita emerged significant. Finally, between 1970 and 2012, GDP per capita and the opportunity cost of capita emerged as the key determinants of house prices. Notably, of the four periods, GDP per capita was the only variable that significantly explained changes in house prices in these periods.

Hoxha and Salaj (2014) sought to provide strategic insights for both real estate appraisers and managers so that they could comprehend the economic determinants of the dynamic house prices witnessed in Kosovo. The study used quantitative factor analysis to examine if the conventional key drivers of house price namely: GDP per capita, real interest rates, demographic factors and cost of construction have been responsible for house priceswitnessed in Kosovo. Generally, the study findings indicated that the conventional critical factors were significantly behind the house prices observed in Kosovo. Among other findings, the study also revealed that GDP had a positive contribution towards housing price in Kosovo. In addition, the bivariate correlation coefficient of 0.52 between GDP and house prices in Kosovo was an indication of the positive association of GDP with house prices in Kosovo (Hoxha & Salaj, 2014).

In another study, Tem and Yilmaz (2018) analyzed the determining factors of residential real estate in Turkey using monthly, quarterly and annual secondary data covering a period of 7 years from 2010 to 2016. These data was extracted from government and financial institution publications. Descriptive statistics complemented

multiple regression and backward elimination. The findings revealed existence of a significant negative relationship between interest rates and house prices whereas the relationship between house prices and rate of inflation was noted to be negative and weak. The relationship between house prices and both population and GDP were found to be positive and strong. Tracing the trends of the variables indicated that house prices could increase over time even when there was no significant variations in the study variables. This was a signifier of a significantly stable Turkish market for real estate.

Pashardes and Savva (2009) investigated how different macroeconomic factors impact on house prices in Cyprus an island in the Eastern basin of the Mediterranean Sea for the time period 1988 to 2008. More so, the study examined the effect of specific house features on its own price. The results revealed that house prices are particularly sensitive to changes in the population of Cyprus. Furthermore, house prices were also noted to be sensitive to the cost of building materials used, labor, economic growth and the exchange rate of sterling pound versus euro. The study also provided evidence which revealed that the rise in cost of material and labor, GDP per capita and population were the major contributors to the massive rise in house prices in the Island of Cyprus during the study period.

2.6 Conceptual Framework

Young (2009) considers a conceptual framework to be a diagrammatical representation showing how an endogenous variables relates to exogenous variables. The key feature of the conceptual framework is that it is basically a concept or model of what a study is all about. The conceptual framework plays the role of assessing and refining goals, developing realistic and relevant research questions, selection of

appropriate methodology and identification of potential validity threats to the inferences. In addition, a conceptual framework aids in providing a justification of the research (Young, 2009).

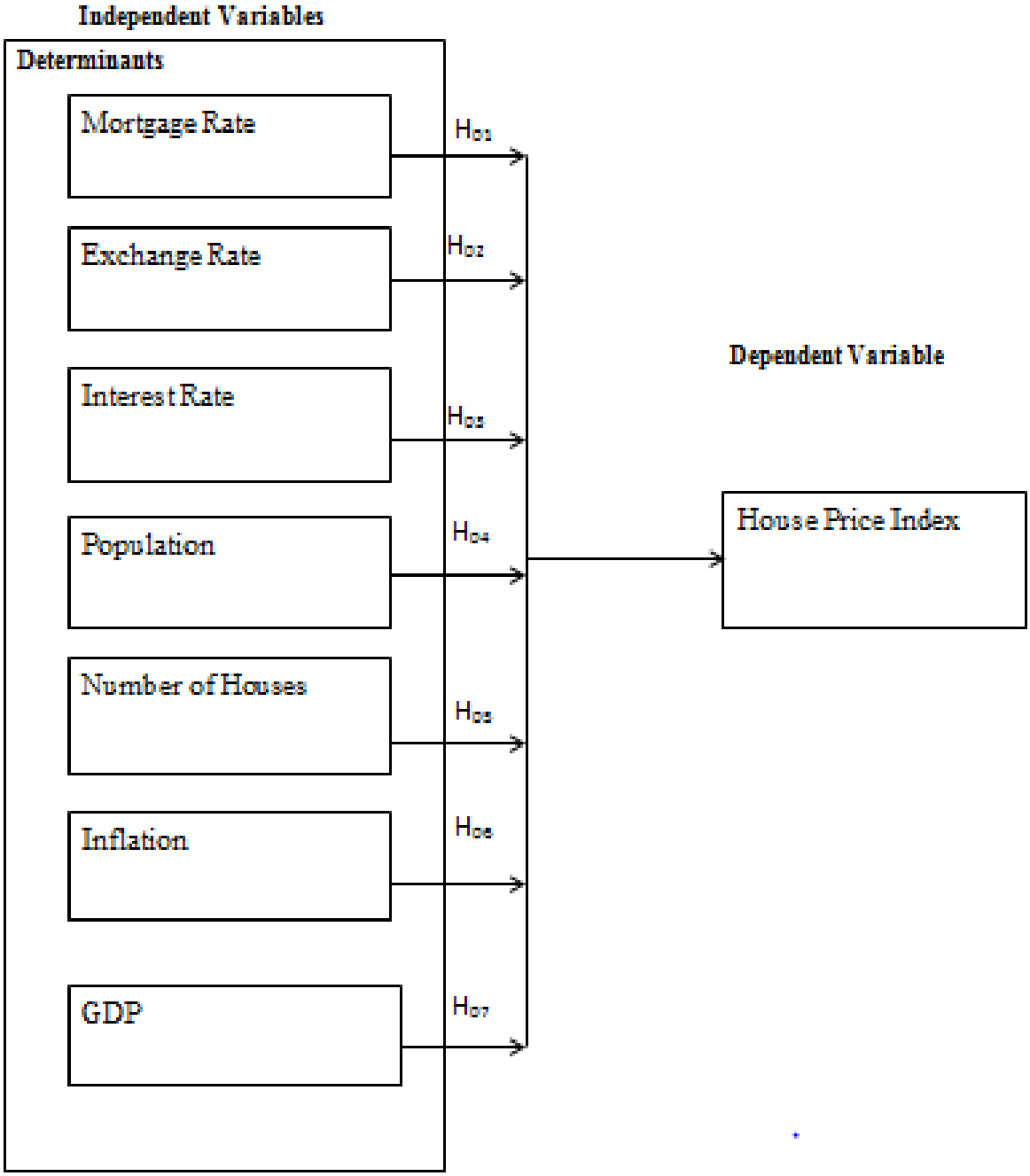


Figure 2.1: Conceptual Framework

Source: Researcher, 2017

The conceptual framework in particular, shows the relationship between the independent variables and the dependent variable, house prices. It was expected that population, inflation and gross domestic product would have a positive relationship with houses prices whereas mortgage rate, exchange rate, interest rate and number of houses would have a negative relationship.

Summary of Gaps from Literature

In their study of Greece housing market. Brissimis and Vlassopoulous (2009) used house loans as the only variable and could have suffered from missing variables. There are other variables that influence house prices Gimerno and Carmen (2010) while investigating the relationship between house purchase prices and house purchase loans in Spanish housing market used labor income and nominal interest rates. The study used labor income assuming that income is only earned from employment which might not necessarily be true. There are other ways and means of earning income including business and income from rent. Using mortgage rates and federal funds rate as indicators of the long term interest rate in the United States of America housing market, Miles (2014) did not consider other determinants of house prices apart from the two.

Yang and Zhiqiang (2012) analyzed the relationship between real effective exchange rate and real estate prices in China. The study only used real effective exchange rates assuming that it's only this variable that influence real estate prices. There could be several variables that influence house prices and their interactions can be determined over time. While investigating the effects of real interest rates on housing prices in USA, Harris (1989) used Ordinary Least Squares based on Cochran – Orcutt procedure to reduce autocorrelation and therefore failed to determine if there was any

long run relationship between the variable and house prices. McQuinn and O'Reilly (2006) investigated how interest rates and income determined house prices in Ireland. A limitation of this study is that interest rate and income cannot be represented adequately by the amount borrowed. Olowofeso and Oyetunji (2013) investigated how interest rates affect house prices in Nigerian housing market using correlation and trend analysis. The study however, used an oversimplified methodology and failed to find the short and long run dynamics. The study also failed to consider other variables other than interest rates. While investigating the effects of various macroeconomic variables on real estate prices in Kenya, Ouma (2015) used OLS in time series estimation without conducting stationarity test a situation that could have led to spurious estimation.

While investigating the determinants of house prices in Sweden, Turner (1995) used population, individual income, and share of households with tertiary education, building costs, average sales price of secondary homes as explanatory variables. The limitation of this study is that inclusion of prices of secondary homes led to the correlation of residuals with the dependent variable; house prices. Ebru and Eban (2011) examined the relationship between housing prices and housing features in Istanbul. The study excluded population which implies that the effect of supply of houses on their prices was analyzed with no consideration of the demand. This is likely to have deprived the study an important economic element where supply and demand interact to determine price.

Valadez (2012) investigated the relationship between house prices and gross domestic product in USA. The study however, failed to consider other variables that affect GDP growth. It can also not be assumed that the relationship between the two

variables is linear since it may not be linear over time. In the study of Malaysian housing market, Tze (2013) did not test for the presence of unit root in the data series before estimation. The study also ought to have investigated the effect of changes in the included variables on changes in prices. This is because changes in these variables may not necessarily influence the changes in house prices. Generally most studies had focused on one or two explanations by regressing a few variables and hence could have suffered from 'missing variables' or 'variable selection biases'. Most also failed to test for the short-run or long-run dynamics. This study used the Vector Error Correction Model (VECM) to find the short-run and long-run dynamics.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Overview

This chapter presents the methodology relied upon to achieve the study objectives specified in chapter one. The chapter covers the following sections: research philosophy, research design, target population, sample design, data collection procedure, the measurement of variables, data analysis and presentation, diagnostic tests, limitation of the study and concludes with ethical considerations.

3.2 Research Philosophy

Given the research problem as stated in chapter one, this study adopted a positivism paradigm since events of interest were objective, external and independent of the researcher (Bryman *et al.*, (2003). In addition positive paradigm was appropriate since the study was based on observable social reality. According to Cohen and Crabtree (2006) and Saunders *et al,* (2009), positivism philosophy is adopted when working with observable social reality and that the end product of the research can be generalized in the form of law. The study was based on hypotheses that were derived from existing finance theory and later tested to support or reject the hypotheses.

3.3 Research Design

This study adopted an explanatory research design. This is in accordance with Saunders *et al.*, (2009) and Robson (2002) who stipulated that an explanatory research seeks to establish causal relationship between variables. The aim of this study was to evaluate the relationship between the independent variables and the dependent variable. Specifically, the interaction between the house prices and its determinants was analyzed. The study used secondary data which is appropriate for an explanatory

research design (Saunders *et al.,* 2009). In particular, the design brought out the relationship between the endogenous variable and exogenous variables as well as between the exogenous variable. The data was subjected to rigorous tests using the various statistical tests so as to ensure it was useful in the study. A similar research design was used by (Beltratti & Morana, 2010; Gerlach & Peng, 2005; Ghent & Owyang, 2010; Zhang *et al.,* 2012; Sing *et al.,* 2006 and Nneji *et al.,* 2013).

3.4 The Study Area

The study area was Nairobi City County, the capital city of Kenya. The City was founded in 1899 as one of the many railway stops from Mombasa. Nairobi has become a regional hub both for local and international business, it is also hosting many international organization's among them United Nations Environmental Programme (UNEP). Nairobi City has a population of over 4,941,708 million people (KNBS, 2018). These numbers have stretched the demand for houses. The Nairobi City County is divided into seventeen sub counties having residential houses categorized as either apartments, bungalows, flats, villas or stand-alone houses. Due to population pressure and expansion of infrastructure, there has been expansion to Nairobi satellite towns of Athi River, Juja, Kiambu, Kiserian, Kitengela, Limuru, Mlolongo, Ngong, Ongata Rongai, Ruaka, Ruiru, Syokimau, Thika and Tigoni. It was chosen as a study area because the Hass House price index is computed on the basis of residential houses that are in Nairobi and its suburbs and can be taken to be a representative of house prices in Kenya (Hass Consult, 2016). Hass Consult limited is the only organization that has computed house price index consistently in Kenya since the year 2000.

3.5 Target Population

A researcher should choose a target population or whole group of individuals or objects one is interested in generalizing conclusions. That is to say, a researcher can either conduct a census or do sampling upon which inference is generalized (Sekara, 2003). The study focused on the period 2004Q1-2016Q4. The study population comprised of all residential houses in Nairobi. In total the number of residential houses was 1,874,181 (KNBS Report, 2017). These included town houses, villas and apartments.

3.6 Sample Design

The study focused on Nairobi City County by adopting a census study of all the residential houses in the Hass property index. These included town houses, villas and apartments. The data used was time series in nature and all the data gathered was used. Time series analysis was used so as to identify trends and seasonal variances to aid in forecasting future house prices. The unit of analysis for this study was the residential house prices which was provided by the house price index.

3.7 Data Collection

Secondary data was collected for the period January 2004 to December 2016 from World Bank reports, Central Bank of Kenya, Kenya National Bureau of Statistics and Hass Consult Limited. The choice of the period was guided by the availability of the data on the dependent variable (data on house price index) obtained from Hass Consult Limited data base. It is the only index that is publicly available with 2000 being the base period. The data comprised of the house price index (HPI) and determinants of house prices. Other studies that have used similar time spans include: Zhang *et al., (*2012) which studied the Chinese house prices for the year 1999-2010;

Miregi and Obere, (2014) which studied property prices in Kenya for the period 2001-2013 and Xu and Chen (2011) which studied the Chinese market for the period 1998-2009 and Pillaiyan, (2015) which studied the Malaysian house prices for the year 2000-2010.

3.8 Data Analysis and Presentation

The data collected was analyzed using simple regression and multiple regression analysis.Regression analysis has five basic assumptions; there must be a linear relationship between the dependent and the independent variables, the model is correctly specified, the model has additive error term with zero population mean, the error term is normally distributed and all explanatory variables are uncorrelated with the error term. Data was subjected to diagnostic tests to affirm the basic assumptions of regression. In particular, the data was subjected to stationarity tests to ensure that they have constant mean and variance. It was also tested for cointegration to establish if there was any long run equilibrium relationship between the independent variables. Coefficient of determination and p-values were relied upon to interpret the regression results and level of significance. The hypotheses were also to be tested to confirm the significance of parameters based on the respective p-values.

Some of the data are published on a monthly basis whereas others are published on a quarterly basis. To standardize the data into similar frequencies, data on determinants that are published on a monthly basis were converted into quarterly frequencies using E-Views 9.1. This conversion of monthly data was necessary because the main housing market data, house price index is published on a quarterly basis. This was consistent with other studies which used quarterly data to study the housing market

some of them being; Beltratti and Morana (2010); Gerlach and Peng (2005); Ghent and Owyang, (2010) and Nneji *et al.* (2013).

3.8.1 Vector Autoregressive (VAR) Model

In view of Sims (1980), the study adopted the vector autoregressive (VAR) model where all the variables are assumed to be endogenous with each in the system regressed on its lagged values with specific number of lags and the same number of lags for all other variables in the system. The model is crucial in studying the joint behavior of variables by providing empirical evidence on the response of house price determinants to various exogenous shocks of one variable of interest to the others. It is the best in scrutinizing the role of each variable in determining house prices. Vector Autoregressive Model is advantageous in that it treats all the variables as endogenous and allows both contemporaneous and dynamic relationships between all the variables to be included in the set and can be estimated through a simple OLS regression model (Sims, 1980). The same methodology was used by: Sims (1980); Kim and Lee (2000) and by Ochieng and Obere (2014).

The model was specified as follows:

$$HPI_t = \beta_0 + HPI_{t-1} + \beta_1 MGR_{t-1} + \beta_2 EXCR_{t-1} + \beta_3 INTR_{t-1} + \beta_4 UPOPG_{t-1} + \beta_5 NEWHSE_{t-1} + \beta_6 INFLR_{t-1} + \beta_7 QGDP_{t-1} + \varepsilon_t \quad \ldots\ldots\ldots\ldots (2)$$

Where HPI_t is the house price index at time t while HPI_{t-1}, MGR_{t-1}, $EXCR_{t-1}$, $INTR_{t-1}$, $UPOPG_{t-1}$, $NEWHSE_{t-1}$, $INFLR_{t-1}$, $QGDP_{t-1}$ represents the respective lagged house prices, mortgage rate, exchange rate, interest rate, population, number of houses, inflation and gross domestic product; with i representing the number of lags, assumed to be free to take on any value. The β_0, β_1, β_2, β_3, β_4, β_5, β_6, β_7 in the equation represents the coefficients of the independent variables to be estimated by the VAR

model while the ε_t is a random error term at a given time. The error term is introduced because of number of reasons such as: the model may not have captured all the variables; there could measurement error arising among other factors. The possibility of lags in the housing market adjustment process is examined by including into the equation the lagged values of independent variables; but most importantly to suit the condition in the VAR model, requiring each variable in the system to be regressed on a given number of lags of itself and the same number of lags of all other variables in the system. The lags represent the adjustment process in the housing market.

3.8.2 Vector Error Correction Model (VECM)

The VECM (Vector Error Correction Model) was used to determine both the long-run and short-run relationship of house prices with its determinants. One of the advantages of VECM is that it can provide short and long-term explanations of the behavior of house prices (Wang *et al.,* 2008). It also treats each variable in the system as endogenous and associates each variable with its own past values and the past values of other variables (Tuluca *et al.,* 2000). Vector Error Correction Model (VECM) was estimated to find the short-run and long-run dynamics and to establish the speed of adjustment from short-run equilibrium to long-run equilibrium. The Vector Error Correction Model has been employed in a number of previous studies such as: Malpezzi (1999); Sing *et al.* (2006); Gallin (2006) and Oikarinen (2009).

The VECM model took the form:

$$\Delta HPI_t = \beta_o + \varphi ECT_{t-1} + \sum_{i=1}^{p} \beta_1 \Delta HPI_{t-1} + \sum_{i=1}^{p} \beta_2 \Delta \mathrm{MGR}_{t-1} + \sum_{i=1}^{p} \beta_3 \Delta \mathrm{EXCR}_{t-1} + \sum_{i=1}^{p} \beta_4 \Delta INTR_{t-1} + \sum_{i=1}^{p} \beta_5 \Delta UPOPG_{t-1} + \sum_{i=1}^{p} \beta_6 \Delta NEHSE_{t-1} + \sum_{i=1}^{p} \beta_7 \Delta INFLR_{t-1} \quad \text{..... (3)}$$

Where;$ECT_{t-1}$is the Error Correction Term that reflects the deviation from the long-run equilibrium path, φ is the correction coefficient that captures the short-run dynamic or adjustment of the variables towards their equilibrium values.

3.9 Diagnostic Tests

3.9.1 Stationarity Test

A stationary time series is one whose statistical properties such as mean, variance and autocorrelation remain constant over time (Jani, 2014). Unit root is a fundamental test performed to ensure that time series data has a constant mean and variance to enhance meaningful results. Unit roots test was carried out to avoid the problem of the non-stationarity variable that leads to spurious results due to trend in the data series. The study employed Augmented Dickey-Fuller test as specified by Dickey and Fuller (1979). The null hypothesis of this test was that the data has no unit roots. Rejection of null hypothesis lead to the conclusion that the study data had unit roots. A major problem with time series data is that they often exhibit non-stationary variables which may lead to false regression results and therefore make statistical inference invalid (Banda, 2010). For those variables found to be stationary, they we rechecked for cointegration.

3.9.2 Cointegration Test

Cointegration is a statistical property of time series variables. Cointegration test was carried out for those variables that were found to be non- stationary. Specifically, the trace statistic which according to Enders (2010) is likely to give more reliable results in the event that the two tests of cointergration rank are in conflict was applied to establish the long run equilibrium relationship between independent variables (Johansen, 2000). The existence of long-run equilibrium relationship implies that in

the short-run variables may wander away from each other but move together in the long-run, showing a long-run relationship. Cointegration analysis was done to capture the equilibrium relationship between non-stationary series within a stationary model after stationarity test. Cointegration was done to permit combination of the long-run and short-run information in the same model to overcome the problem of losing information that could have occurred in the effort of addressing non-stationary series through differencing. In addition, it helps to avoid inconsistent and spurious results. It makes it possible to capture the information of non-stationary series while retaining statistical validity of the estimated equation (Elder & Kennedy, 2001).

3.9.3 Granger Causality Test

For those variables that were found to be cointregrated, Granger Causality test was used to find the direction of the cointergration. According to Giles (2011) X is said to Granger-cause Y if Y can be better predicted using the histories of both X and Y than it can by using the history of Y alone. Granger causality was employed in situations where there was some relationship between two variables, but it was not known with clarity which variable caused the other to move. Granger causality test was done using Block Exogeneity Wald Tests. The four possible expectations were; presence of unidirectional causality, presence of unidirectional causality, variables Granger cause each other, i.e., bilateral causality and variables were independent of each other.

3.9.4 Autocorrelation

Autocorrelation reflects the degree of similarity between a given time series and a lagged version of itself over successive time intervals. Autocorrelation was tested using Portmanteau Autocorrelation test to test for the presence of serial correlation. Portmanteau Autocorrelation test computes the multivariate Box-Pierce/ LjungBox Q

statistics for serial correlation up to a specified order. The null hypothesis of this test was that the data has no autocorrelation.

3.9.5 Heteroscedasticity

The Classical Linear Regression model assumes that the variance of the errors is constant and this is known as the assumption of homoscedasticity. If the errors do not have a constant variance, they are said to be heteroscedastic and there is heteroscedasticity in the data. According to Wooldridge (2002) running a regression model in the presence of heteroscedasticity has the consequence of obtaining an Ordinary Least Square estimation that provide unbiased coefficient estimates but not Best Linear Unbiased Estimator. This implies that if heteroscedasticity is ignored the standard error could be inappropriate and hence any inference made would be misleading. In this study, the presence of heteroscedasticity was tested using the White's test as specified by (White, 1980). The null hypothesis of this test was that there was no heteroscedasticity which simply implies the null hypothesis specified that the error term which could be called white noise process had a constant variance.

3.9.6 Residual Normality Tests

The study adopted the multivariate extension for the Jarque Bera test. This is a general test for two main types of misspecifications; inclusion of irrelevant variables as well as exclusion of relevant variables in the regression model. The null hypothesis was that; the model has no specification errors.

3.10 Measurement of Variables

3.10.1 House Prices

According to Kim Lum (2004), a house price index is used to measure changes in price, which is not caused by changes in the quality or quantity of the goods in the

index. House price index represents the level of the house price at a certain time period compared to the base line time point. House price indices in Kenya have been prepared by the Kenya Bankers association, Knight and Frank Property Company and Hass Consult Limited. This study used quarterly data on house prices proxied by HPI. The study used HPI to capture house prices since this index is the universally relied upon index by researchers, investors in the housing sector and policy makers among other stakeholders. In particular, the HPI is relied upon by World Bank and Centre for Affordable Housing Finance in Africa (CAHF). Economist and financial analysts also rely on HPI to monitor long-term trends and make judgement on developments in the housing market. Moreover, the HPI has the ability of showing areas where values for houses are rising or declining. The HPI, especially when measured on a quarterly basis serves as a snapshot of house prices across a country, in a specific area or even as close to an individual's city. The quarterly data for 13 years from 2004Q1 to 2016Q4 was obtained from Hass Consult Limited. The study relied on the data obtained from Hass Consult Ltd for a number of reasons. First, Hass Consult Ltd was the first company to develop house price index with the year 2000 being the base year and have always had a consistency in the publishing of the indices. Secondly is that the HPI is constructed using the hedonic regression model which is recommended for housing market studies. Third is that the Hass Consult Ltd HPI data covers a long period which is consistent with the set international property data standards (Hass Consult, 2017). Fourth, the Hass results are based on only verified Kenyan nationwide property observations with the process of computation and statistical guidance validated by an expert in data analysis (Hass Consult, 2017). It is important to note however that the availability of house price indices data restricted the period of study to 13 years (2004-2016).

3.10.2 Mortgage Rate

Mortgage rate is the rate of interest charged on a mortgage. According to Case and Shiller (2003), a rise in short term interest rates, could lead to a rise in long term interest rates driven by the future expectations of rise in short term interest rates which in turn drives up the mortgage rate. The inclusion of mortgage rate was justified on two major grounds. First, mortgage rate can serve as a measure of how costly it can be to acquire a house. Second, a number of researchers such as Tsatsaronis and Zhu (2004); Carbó and Rodríguez (2010); Gimeno and Carrascal (2010); Miles (2013) and Albert (2013) among others established a link between mortgage rate and house price. This study obtained data on mortgage rate from Central Bank of Kenya which is published on monthly basis. Following the insights from previous studies such as that of Zhang *et al.* (2012), this study used quarterly averages of mortgage rates. Use of quarterly data on mortgage rate was also necessary to ensure homogenous frequency of variables which paves way for better analytical procedures. Conversation of monthly data to quarterly data was made possible by the use of Eviews version 9.1. The expectation was that mortgage rate and house prices would have a negative relationship.

3.10.3 Exchange Rate

Exchange rate is the price of a nation's currency in terms of another currency. Theoretically, exchange rate fluctuations may influence house price changes through capital inflows especially if the capital inflows is for speculative reasons. Speculative capital inflow is believed to fuel inflation and drive up house prices (Zhang *et al.,* 2012). Following Pavlova and Rigobon (2007) and Zhang *et al.,* (2012), the study used real effective exchange rate. It was expected that the relationship between exchange rates and house prices would be negative with causation running from

exchange rates to house prices. Exchange rate data was extracted from CBK which publishes such data on a daily basis. In particular the study used the US dollar (USD) rate to Kenya shillings. The USD is one of the reserve currencies and most studies have used the USD to measure the exchange rate. From the daily statistics, quarterly averages were computed using Eviews version 9.1 so as to ensure data obtained was of time interval identical to other variables in the study.

3.10.4 Interest rates

Interest rate refers to the rate of return required by financiers (Liow, 2004). Interest rates have been used in a number of studies as proxy for expectations about future economic conditions and capture the state of investment opportunities (Tsatsaronis & Zhu, 2004). Lending interest rates in particular, affects an individual's ability to purchase residential property as well as cost of financing (Liow, 2004). At least for this reason, this study used data on the lending interest rate as a proxy for the interest rate, an approach that had been followed by previous studies such as Ochieng and Obere (2014); Nneji *et al*. (2013) and Simo-Kengne *et al*. (2013). According to Nneji *et al.,* (2013), an increase in the rate of interest is expected to drive borrowing rates up, thus increasing the cost of servicing mortgages which could also lead to an increase in number of defaults on mortgages and eventual fall in house prices. The study extracted secondary data on lending interest rate (a proxy for interest rate) which is also published on a monthly basis from CBK database. In a manner similar to the conversation involving mortgage rate, quarterly averages of lending interest rates were computed from monthly data using Eviews version 9.1. It was expected that the relationship between interest rates and house prices would be negative.

3.10.5 Population

Population is the total or aggregate of all the objects, subjects or members that conform to a set of specifications. In this study, population was taken to be the total number of humans currently living. According to Mulder (2006), population growth is either caused by natural population growth of higher births and low mortality or non-natural causes which consists of immigration. The study included population primarily for two reasons, which is theoretical basis and empirical view point. First is for theoretical reason which is based on the interaction of the forces of demand and supply for housing, market prices for houses should be determined. Ideally, houses are demanded by people and for people which implies that there exist a link between demand of houses (which population can partly be an indicator) and house prices. Secondly, previous literature has also shown extensive inclusion of the population variable while examining determinants of house prices (Mankiw & Weil, 1989; Turner, 1995; O'Donovan & Rae, 1997; Cappoza et al., 2002; Cvijanovic et al., 2010; Kagochi & Kiambigi, 2012; Lin et al., 2018; Chen et al., 2011); Accetturo *et al.*, 2014). This study used population data from population census reports published on annual basis by KNBS. With the help of Eviews version 9.1, annual data was converted into the required quarterly data. In particular, the study used urban population to proxy for population. The use of urban population was justified on the basis that the geographical scope of the study; Nairobi City County, Kenya, was and still is an urban center hence the urban population was believed to be a better reflection of the reality. It was expected that the relationship between population and house prices would be positive.

3.10.6 Number of new houses

The number of houses refers to the residential capital stock in any period. It is determined by the existing stock in the previous period and the flow of new residential construction investment (DiPasquale & Wheaton, 1996). Federal Reserve Bank of San Francisco (2009) noted that new house construction can serve as an important measure of activities in the housing market. Other studies such as Zahirovich-Herbert and Gibler (2014) have also fitted in their models the number of new residential house construction when examining how various factors affect house prices. Number of new houses constructed is a major driver of housing supply which from the theoretical postulation is expected to have an effect on house prices. For these reasons, the study saw the need to model the determinants of house prices with inclusion of number of new houses. Data on this variable was extracted from the KNBS database which publishes it on an annual basis before being converted into quarterly data in a conversion approach similar to the case of data on urban population using Eviews version 9.1. It was expected that the relationship between number of houses and house prices would be negative.

3.10.7 Inflation

Inflation refers to a sustained rise in general level of prices thus eroding the purchasing power of money over time (Tsatsaronis & Zhu, 2004). It is defined as the declining purchasing power in the home country. A higher inflation which declines household purchasing power is expected to discourage the purchase of houses. Inflation can be measured by a number of indices which include consumer price index, producer price index and GDP deflator among others. However, the widespread use of consumer price index as a measure of inflation is advantageous and thus was used by this study as proxy for inflation for a number of reasons. First, CPI

can be understood with relative ease and is also the best measure available for the cost of living confronted by consumers. For example unlike simple deflator, CPI attaches weight to particular items, implying that if house prices increases, then more citizens are affected than if an increase in price is experienced in cigarettes for example. Second, CPI is an index familiar to the largest proportion of the population which is also regularly reported in the media. Lastly, CPI availability is at a relatively high frequency with little subjection to numerous revisions which enhances its transparency (Moreno, 2009). In addition to the just outlined advantages of CPI as a proxy for inflation, this study also based such a decision on other empirical studies such as those of Zhang *et al.* (2012); Betratti and Morana (2009); Kagochi and Chen (2013); Ochieng and Obere, (2014) that preceded it. Data on CPI (a proxy of inflation) which is often published on monthly basis was obtained from KNBS. Analogous to the transformation of data on interest rate, data on inflation rate was also converted to quarterly averages with the aid of Eviews 9.1. Generally, the trend of house prices was expected to be directly proportional to inflation.

3.10.8 Gross Domestic product

The gross domestic product (GDP) is the total market value overall for all final goods and services produced in a country in a particular year. It is the proportion of income available to individuals for spending after deducting personal current taxes (Valadez, 2012). Following (Green, 1997; Case & Shiller, 2003; Valadez, 2012; Zhang *et al*., 2012), this study used quarterly percentage changes in GDP as a proxy of income. According to Rangel and Pillay (2007), GDP should move positively with the housing market since increases in income cause the demand for housing to increase through higher prices. It was therefore expected that GDP would be positively related to house

prices. Data on GDP was obtained from KNBS and are normally published on a quarterly basis.

3.11 Limitations of the Study

The study relied on information from KNBS, CBK and Hass Consult Limited. Specifically, the study relied on Hass Consult Limited house price index. This is because it is the only institution that has computed house price indices in Kenya with consistency with the year 2000 as the base year. The company also collects data from other institutions and compiles a composite index making it reliable. The World Bank and Centre for Affordable Housing Finance in Africa also relies on the Hass property Price index. Kenya Bankers Association also computes house price indices but only started the computation from the year 2014. The study restricted itself to the period within which data was available.

3.12 Ethical Considerations

Any research should be guided by ethical standards. According to Hoyle *et al.* (2002), ethical standards are ethical practices embraced in research undertaking. The study ensured that it did not interfere with any rights of individuals or organization and also corporation in gathering the data i.e. CBK, NHC, Hass Consult and KNBS. The researcher followed all the code of ethics so as to come up with the views that reflect the reality rather than own judgment and of importance did not subject data to any bias including obtaining an authorization from the university to collect data.

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1 Overview

This chapter highlights the research findings, their interpretation and discussions of the study results. The sections include: descriptive statistics results, correlation analysis, Unit root tests results, determination of lag length, estimation of the VAR model, Impulse response functions, variance decomposition, Granger causality results, cointegration test results, Vector Error Correction Model (VECM) estimates, Post-Estimation Diagnostic Tests and concludes with empirical findings which have been presented as per the study objectives.

4.2 Descriptive statistics

Descriptive statistics gives summaries about the sample and they form a fundamental basis for every quantitative data analysis. Analysis of the descriptive statistics enable us to determine whether the data is normally distributed. For data to be normally distributed, the mean and the median should be equal. The most common measures include: the mean, median, standard deviation, skewness, kurtosis and the Jacque-Bera statistics. The mean and standard deviation in particular were used because they are the most robust and stable respectively (Gall *et al*., 2005). The summary of the statistical characteristics of all the variables are shown in Table 4.1

Table 4.1: Descriptive Statistics results for the variables

	HPI	EXCR	INFLR	INTR	MGR	NEWHS	QGDP	UPOPG
Mean	268.5872	82.07542	10.40818	15.10038	15.04825	4401.615	575675.6	9632291.
Median	271.0754	80.65367	7.466667	14.44167	14.67334	4696.875	370817.5	9505177.
Maximum	439.3879	102.9673	29.13333	20.21333	20.14041	10825.53	1079341.	12511119
Minimum	139.9944	62.64600	3.333333	12.20333	9.089416	1597.469	272474.0	7220223.
Std. Dev.	92.30754	10.45918	6.317467	2.153000	2.492063	2398.545	315476.7	1571646.
Skewness	0.076222	0.386904	1.369709	0.755194	0.023712	0.746476	0.518501	0.192463
Kurtosis	1.771411	2.491350	4.458412	2.597064	2.829427	2.861341	1.389925	1.834914
Jarque-Bera	3.320784	1.857923	20.86798	5.294535	0.067912	4.870949	7.946716	3.262121
Probability	0.190064	0.394964	0.000029	0.070845	0.966614	0.087556	0.018810	0.195722
Sum	13966.53	4267.922	541.2252	785.2200	782.5087	228884.0	29935129	5.01E+08
Sum Sq. Dev.	434554.8	5579.121	2035.430	236.4058	316.7292	2.93E+08	5.08E+12	1.26E+14
Observations	52	52	52	52	52	52	52	52

Source: Researcher 2017

A normality test was done to determine whether the sample data was obtained from a normally distributed population. All the variables in this study had a mean and median that are almost equal which means that the data was normally distributed. Skewedness provides information about the symmetry of the distribution (Tabachnick & Fidell, 2007). It is the tilt in the distribution and should be between $-2 \leq +2$ for a normally distributed series. In a positively skewed distribution, the, mean typically is higher than the median and the reverse is true for whereas in a negatively skewed distribution, the mean is lower than the median. For a normal distribution, the skewedness is zero. Using skewedness, all variables in this study were normally distributed. House prices, exchange rate, mortgage rate and population have their skewedness close to zero, whereas Inflation, interest rate, and gross domestic product have their mean being higher than median and new houses has a mean that is lower than the median.

The Jarque-Bera test was used to test for normality of the series. The test utilizes the mean based coefficients of skewedness and kurtosis to check normality of variables used in the study. It does this by measuring the difference of the skewedness and kurtosis of a series from those of normal distribution. The null hypothesis (H_O) for this test was that residuals are normally distributed. We reject H_O if $p< 0.05$. For this study p was less than 0.05 and a conclusion was made that the series were normal. These results therefore suggested that the data was suitable for further analysis.

4.3 Correlation Analysis

Pairwise correlation analysis helps to establish whether there is a relationship between variables of the study. The relationship between variables is shown by Correlation coefficient (r). The analysis does not necessarily explain causal effect between the variables. This study carried out correlation analysis in order to establish if there was any significant relationship between exchange rate, inflation rate, interest rate, mortgage rate, new houses, gross domestic product, urban population and residential house prices. Correlation analysis is done as preliminary test whose purpose is to measure the relationship between variables and text the strength of the relationship (Pallant, 2001). It is often used to investigate the nature of the relationships between different variables. However, it should be noted with emphasis that correlation does not imply causation but the reverse is true

A correlation coefficient of 1.0 indicates a perfect positive correlation coefficient between variables whereas a (-1.0) indicates a negative perfect correlation coefficient. A correlation coefficient of (0) means that there is no linear relationship between the variables. Adjusted R-square is the coefficient of determination that gives the degree to which the variation in dependent variable is explained by the independent variables

in their entirety. A high correlation between the independent variables can lead to a high value of adjusted R- square. According to Cooper and Schindler (2008) and Gujarati (2003), variables with correlation coefficient that are greater than 0.8 are an indication of near multicollinearity. The study used the Karl Pearson correlation matrix to explain the strength of the relationship between the independent variables and the dependent variable. The results are presented in Table 4.2

Table 4.2: Pearson Correlation Matrix Results

	HPI	EXCR	INFLR	INTR	MGR	NEWHS	QGDP	UPOPG
HPI	1.000000							
EXCR	0.795288	1.000000						
INFLR	-0.459065	-0.402901	1.000000					
INTR	0.773642	0.600793	-0.329602	1.000000				
MGR	0.776037	0.476824	-0.243291	0.921714	1.000000			
NEWHS	0.985423	0.835361	-0.512938	0.715914	0.710226	1.000000		
QGDP	0.875157	0.773707	-0.445300	0.809456	0.735398	0.874665	1.000000	
UPOPG	-0.134269	-0.268257	0.096306	0.164353	0.098997	-0.229696	-0.206838	1.000000

Source: Researcher 2017

From the findings displayed in Table 4.2, exchange rate, interest rate, mortgage rate, new houses and GDP have a positive correlation with house prices, whereas inflation rate and urban population had a weak negative correlation. In particular, new houses and GDP had a correlation coefficient of 0.98 and 0.87 respectively which was an indication of high association of these two variables with House Price Index. Notice however, that what is of interest at this stage is the association between predictor variables. Based on this suspicion of multicollinearity is likely to be between interest and mortgage rate (0.92), new house and GDP (0.87), new house and exchange rate (0.84) and between GDP and interest rate. Solutions to near multicollinearity according to Brooks (2008), include ignoring it if the model is adequate in terms of significant coefficient and having an appropriate sign. This is because multicollinearity itself is a problem of the data and not the variables and therefore does not affect the properties of the estimator neither does it violate the classical

linear regression model assumptions. Another option could be dropping one of the collinear variables. However, the researcher ignored solving multicollinearity by dropping any of the variables because doing so could have most likely reduced the explanatory power of the model.

In general, multicollinearity was ignored because this violation of the classical linear assumption is only to cause serious concern if correlation occurs between predictor variables that are expected to be uncorrelated, standard errors are considerably high, estimated coefficients have magnitude and signs that are in contradiction to the expectation and such coefficients are insignificant when R-squared is high. Fortunately, the estimation results in this paper did not conform to any of these anomalies. For instance as aforementioned, high correlation existed between interest rate and mortgage rate which is expected since mortgage rates are often set based on the prevailing interest rates. In another example new house being correlated with GDP is not a surprising result since increase in income (measured by GDP) will most likely push up construction of new houses and/or new houses is captured while measuring GDP. Notice also that the estimation results that comes at later parts of this paper shows low standard errors (see for example Tables 4.5, 4.7, 4.10, and 4.11). All these are evidence against any cause of panic for multicollinearity unless it is exact, which was not the case.

4.4 Unit root tests

A stationarity test was conducted by the study to determine the statistical properties of the time series data used in the study. The main objective was to ensure that data is stationary. A stationary time series is one that exhibits near constant mean, variance and autocorrelation. Stationarity was examined by performing a unit root test. A unit

root is a feature of processes that evolves through time that can cause problems in statistical inference involving time series models.

The study employed the Augmented Dickey- Fuller (ADF) as the standard test for unit root. This test is performed so as to avoid spurious results. The Augmented Dickey- Fuller (ADF) statistic used in the test is usually a negative number. The more negative it is, the stronger the rejection of the hypothesis that there is unit roots at some level of confidence. The null hypotheses tested in the study were that H_0: $p = 0$ and H_1: $p < 0$. If the p-value was less than 0.05, then the null hypothesis that the series contained unit root was rejected and the series was concluded to be stationary. The unit root properties of the eight variables was analyzed at level and first difference using the ADF unit root test at both the intercept only and for intercept and trend and the results are as shown on Table 4.3 and Table 4.4.

Table 4.3: ADF Unit Root Test Results (At levels)

Variable	Level		Remarks
	Intercept Only	**Intercept and trend**	
LnHPI	-1.090 (0.7127)	-1.0445 (0.9278)	Non-stationary
LnEXCR	-0.3941 (0.9023)	-2.7171 (0.2345)	Non-stationary
LnINFLR	-2.102 (0.2447)	-3.0144 (0.0701)	Non-stationary
LnINTR	-2.827 (0.0617)	-2.7183 (0.2340)	Non-stationary
LnMGR	-3.594 (0.0093)	-3.2703 (0.0831)	Non-stationary
LnNEWHS	0.502 (0.9852)	-2.6778 (0.2499)	Non-stationary
LnQGDP	-0.376 (0.9052)	-2.0728 (0.5481)	Non-stationary
LnUPOPG	-0.3763 (0.9052)	-2.0728 (0.5481)	Non-Stationary

Source: Researcher 2017

Table 4.4: ADF Unit Root Test Result (at first difference)

Variable	First Difference		Remarks
	Intercept Only	**Intercept and trend**	
LnHPI	-5.1163 (0.0001)***	-5.1102 (0.0007)***	Stationary
LnEXCR	-5.8471 (0.000)***	-5.944 (0.0000)***	Stationary
LnINFLR	-5.9816 (0.000)***	-5.9066 (0.0001)***	Stationary
LnINTR	-3.2062 (0.0256)**	-3.1567 (0.0140)**	Stationary
LnMGR	-5.180 (0.0001)***	-5.5359 (0.0002)***	Stationary
LnNEWHS	-3.6750 (0.0075)***	-3.7741 (0.0263)**	Stationary
LnQGDP	-7.1289 (0.0000)***	-7.0702 (0.0000)***	Stationary
LnUPOPG	-7.6414 (0.0000)***	-8.1494 (0.0000)***	Stationary

Source: Researcher 2017

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

The results indicates that all the variables in this study were stationary at first difference I (I) at a 5 percent significance level (at 95 per cent confidence level). This therefore means that the variables in this model all had a time varying mean or a time-varying variance at levels. When the variables are non-stationary then the errors will also not be stationary, meaning they will either have a varying mean or a varying variance, and when this happens then we end up violating the assumptions of the Ordinary Least Square regression. It therefore follows that an OLS regression results with non-stationary time series variables would lead to spurious or nonsensical results (Gujarati, 2011). According to Granger and Newbold (1974) the rule of thumb for detecting spurious regressions is that: if R^2>DW statistic or if R^2 is very large approximately equal to 1 then the estimated regression 'must' be spurious. As a result, this study went ahead to test by running the OLS regression with the variables at levels so as to check if the regression was spurious. The results are presented in Table 4.5.

Table 4.5: OLS Spurious Regression

Dependent Variable: LNHPI
Method: Least Squares
Sample: 2004Q1 2016Q4
Included observations: 52

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNEXCR	-0.144887	0.101493	-1.427549	0.1605
LNINFRT	0.002562	0.014679	0.174564	0.8622
LNINTR	0.650080	0.150452	4.320851	0.0001
LNMGR	-0.202740	0.119852	-1.691580	0.0978
LNEWHS	0.268260	0.094746	2.831342	0.0070
LNQGDP	-0.206138	0.046591	-4.424452	0.0001
LNUPOP	1.770277	0.395355	4.477688	0.0001
C	-23.00002	5.235605	-4.393002	0.0001

R-squared	0.990511	Mean dependent var	5.529954
Adjusted R-squared	0.989001	S.D. dependent var	0.367658
S.E. of regression	0.038558	Akaike info criterion	-3.532651
Sum squared resid	0.065417	Schwarz criterion	-3.232460
Log likelihood	99.84892	Hannan-Quinn criter.	-3.417565
F-statistic	656.1206	Durbin-Watson stat	0.696676
Prob(F-statistic)	0.000000		

Source: Researcher, 2017

As can be seen in Table 4.5, the results of the OLS regression model for the variables shows that the coefficient of determination is very high (R^2=0.99), in fact it's approximately 1, and the DW statistic shows a high degree of autocorrelation (0.6966). Using the rule of thumb by Granger and Newbold (1974) this regression model is definitely spurious or meaningless since the R^2>DW statistic and as such the coefficient of this model cannot be relied upon. As a consequence of this, this study went ahead to make use of the VAR and VECM models for non-stationary data which analyzed the data at first differences making them stationary and thus giving results that are meaningful.

4.5 Determination of Lag Length

The application of the VAR model involves the selection of appropriate lag intervals for the endogenous variables. This is necessary so as to avoid the problem of either over or under parameterization occasioned by inappropriate lag selection (Mahalik &

Mallick, 2010; Shahbaz, 2015). The lag length can be determined using Akaike Information Criterion (AIC), Schwarts Information Criterion (SIC), Likelihood Ratio Test (LRT), Final Prediction Error (FPE) and Hannan-Quinn Information Criterion (HQ). The lag length was selected based on the minimum of their values. The results of the lag length selection criteria are presented in Table 4.6.

Table 4.6: Lag Length Selection Criteria for VAR

Lag	LogL	LR	FPE	AIC	SIC	HQ
0	237.1943	NA	1.61e-13	-9.591428	-9.318544	-9.488305
1	793.6539	66.19356	1.84e-19*	-24.61058*	-16.69696	-21.62001*
2	576.9222	566.2132	9.03e-19	-21.70509	-19.52202*	-20.88011
3	710.0409	56.17196	3.43e-19	-23.16837	-17.16494	-20.89967
4	658.1899	111.7431*	2.68e-19	-23.04958	-18.95633	-21.50273

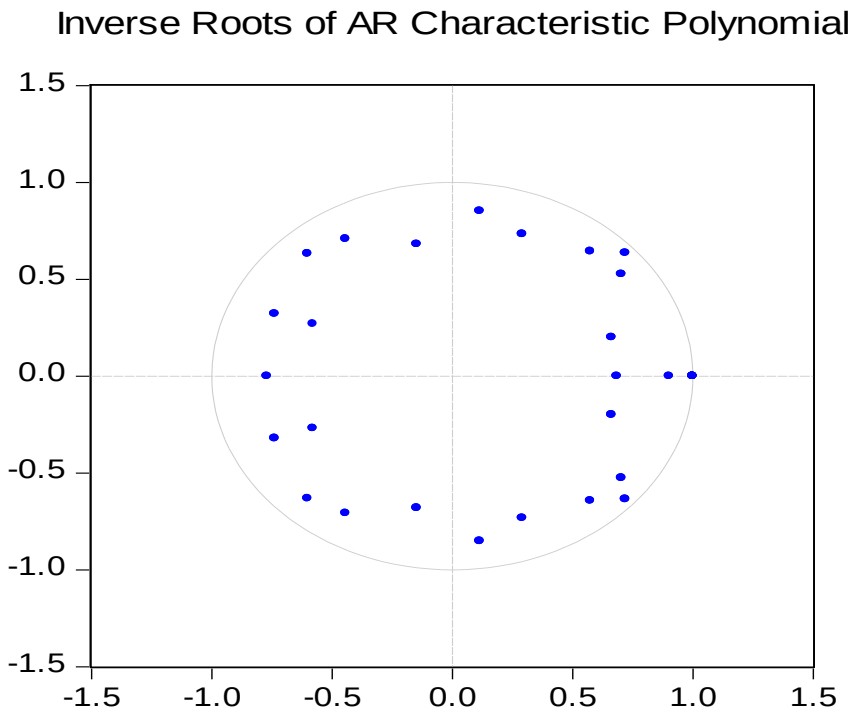
* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Source: Researcher 2017

From the findings as shown in Table 4.6, LR selection criterion selects lag 4, FPE and AIC selects lag as well as HQ selected lag 1 whereas SC selected lag 2. The optimal lag length selected for this study was 1 based on the consensus between the FPE, AIC and HQ lag length criterion. Besides, one lag were appropriate because they reduced the loss of degrees of freedom and minimized information criterion.

To confirm the stability of the VAR model with one lag a stability test using the AR roots table was carried out. The results are displayed in Figure 4.1:

Figure 4.1: Inverse Roots of AR Characteristic Polynomial



Source: Researcher 2017

From the results in Figure 4.1, the VAR is stable as none of the roots lie outside the unit circle: all the moduli of the roots of the characteristic polynomial are less than one in magnitude. A conclusion was made that VAR satisfies the stability condition and therefore the coefficients are unbiased.

4.6 Estimating VAR

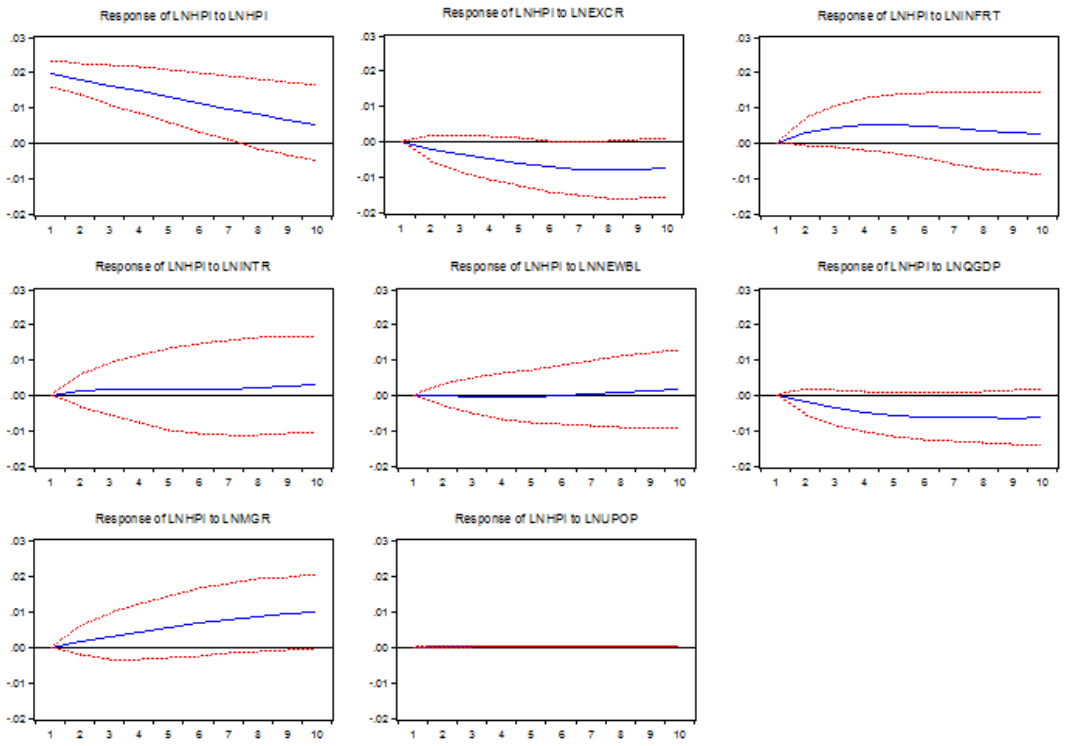
The estimated coefficients of VAR are presented in Appendix XI. The lag length selected was lag one based on the consensus between the FPE, AIC and HQ lag length criterion.

4.6.1 Impulse Response

Impulse response functions is a practical tool which aid in visualizing the behaviour of the variables under study. In this study, impulse response analyses were carried out to indicate the VAR systems' dynamic behaviour including transmission of shocks,

direction and magnitude of the shocks. In particular, it showed how a variable responds to one standard deviation shock in another variable of interest and trace out the response of current and future values of each of the variables to one- unit increase in the current value of one of the VAR errors, assuming that the error returns to zero and that all other errors equal zero. Impulse response therefore allows for tracing the time profile of various shocks on the variable in the VAR system. The results for impulse response are shown on Figure 4.2.

Figure 4.2: Impulse Response



Source: Researcher 2017

From Figure 4.2, Impulse response results indicated that a positive one-standard deviation shock to exchange rate had a negative effect on house prices index in the short-run and in the long-run. A shock on inflation had a positive effects on house price index in the first four quarters, thereafter, had negative effects in the long-run. A

shock on interest rate had a positive effect on house price index in the short-run, then steadily increases in the long-run. A shock on mortgage rate had a positive impact on house price index, and thereafter a stable long-run positive relationship. A shock on new houses had a slight positive impact on house price index in the short-run and in the long-run. A shock on GDP had a significant negative and steady impact on house price index both in the short-run and long-run. Lastly, a shock on population had no significant impact on the household prices.

4.6.2 Variance Decomposition

Variance decomposition enables us to study the variation in the dependent variable that is due to its own shocks versus the component of the variation that is due to shocks in other variables (Enders, 2010). Variance decomposition helped determine the relative importance of each innovation in explaining the variables in the system. Table 4.7 shows the results of variance decomposition. The first column lists the time period. The second column reports the standard errors of the sample test. The remaining columns report variance proportion of the shocks to each variable in each time period.

Table 4.7: Variance Decomposition

Period	S.E.	Lnhpi	lnexcr	Lninflr	Lnintr	lnmgr	lnnewhs	Lnqgdp	Lnupopg
1	0.018014	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.030866	98.96479	0.099740	0.217612	0.429463	0.214246	0.036557	0.010840	0.026753
3	0.040780	95.08485	1.226414	0.952523	2.007282	0.582584	0.025957	0.031446	0.088941
4	0.048243	89.00134	3.551804	1.767784	4.526269	0.904126	0.036267	0.050590	0.161816
5	0.053875	82.87902	6.618440	2.280602	6.737099	1.076465	0.110292	0.074286	0.223793
6	0.058199	77.79962	10.13957	2.500182	7.788327	1.159021	0.239153	0.107516	0.266606
7	0.061722	73.60946	14.01117	2.534062	7.843318	1.218869	0.344125	0.150858	0.288137
8	0.064860	69.83851	18.07309	2.458361	7.493220	1.279182	0.376299	0.198673	0.282658
9	0.067831	66.29668	22.03294	2.320544	7.158851	1.326854	0.358741	0.246798	0.258598
10	0.070731	62.96273	25.52706	2.156230	7.117517	1.334487	0.330761	0.299494	0.271719

Cholesky Ordering: lnhpilnexcrlninflrlnintrlnmgrlnnewhSlnqgdplnupop

Source: Researcher 2017

The results in Table 4.7 indicated that during period 1 of the study, the variance decomposition of HPI implied that all the randomness in the variable is produced by itself. In period 2 however, through the VAR representation, the other variables also play a role in the randomness of house prices. For instance, in period 2, 98.96% of the randomness in the house prices was produced by house prices itself whereas as exchange rate, inflation, interest rate, mortgage rate, new houses, GDP and urban population produced 0.09 percent, 0,22 percent, 0.43 percent, 0.21 percent, 0.04 percent, 0.01 percent and 0.03 percent of the randomness respectively. In the long run, exchange rate shock was the most important source of house price variability. The role played by exchange rate shock increased over time and accounted for about 25.53 percent in the tenth period.

4.7 Granger Causality

The existence of cointegration proofed that there existed a Granger Causality in at least one direction. To establish the direction of the causal link, Granger Causality test (1987) was carried out to establish the direction of casual link between determinants of house prices and house prices in Nairobi City County, Kenya. The null hypothesis was that the determinants do not granger cause house prices in Nairobi City County, Kenya. The granger causality estimation results are presented in Table 4.8.

Table 4.8: Granger Causality

Null Hypothesis:	Obs	F-Statistic	Prob.
LNINFRT does not Granger Cause LNHPI	50	1.12465	0.3337
LNHPI does not Granger Cause LNINFRT		2.74806	0.0748
LNINTR does not Granger Cause LNHPI	50	0.64177	0.5311
LNHPI does not Granger Cause LNINTR		1.86555	0.1666
LNMGR does not Granger Cause LNHPI	50	1.65567	0.2024
LNHPI does not Granger Cause LNMGR		1.84811	0.1693
LNNEWBL does not Granger Cause LNHPI	50	7.37429	0.0017
LNHPI does not Granger Cause LNNEWBL		1.06769	0.3524
LNUPOP does not Granger Cause LNHPI	50	3.82794	0.0292
LNHPI does not Granger Cause LNUPOP		2.55848	0.0886
LNQGDP does not Granger Cause LNHPI	50	4.90682	0.0118
LNHPI does not Granger Cause LNQGDP		0.33063	0.7202
LNEXCR does not Granger Cause LNHPI	50	6.52643	0.0032
LNHPI does not Granger Cause LNEXCR		1.13640	0.3300

Source: Researcher 2017

The granger causality results as displayed in Table 4.8 show the Granger causality between house prices and the independent variables for this study. From the results in Table 4.8, inflation rates, interest rates and mortgage rates did not show evidence of having any granger causality relationship with house prices at 5 percent significance level. This was inferred based on the p values that were greater than 0.05 in the

assessment of the directional granger causality between the variables. However, at 10 percent level of significance, house prices granger caused inflation rate since the null hypothesis of "House prices does not Granger cause inflation" was rejected.

The results further showed that there was a unidirectional relationship between the variables: number of houses, population, gross domestic product, exchange rate, and House prices at 5 percent level of significance. Specifically, the results indicated that the null hypothesis of "Number of houses does not granger cause house prices", "Population does not granger cause house prices", "GDP does not granger cause house prices" and "Exchange rate does not granger cause house prices" were all rejected at 5 percent level of significance. Therefore, it was justified for this study to argue that there was a unidirectional granger causality running from; population to house prices, GDP to house prices, Exchange rate to house prices and number of houses to house prices. This findings further affirms the choice of study pertaining the independent variables and dependent variable.

4.8 Cointegration Test Results

Cointegration is a statistical property of time series variables. Two or more time series variables are cointegrated if they share a change of the average value. According to Nelson and Plosser (1982), time series data evolve over time such that their mean and variance are not constant. To address this problem in the data series, a cointegration test is normally performed. From the unit root test results, the study concluded that the data series is multivariate. The study therefore adopted Johansen's cointegration test as opposed to Engel- Granger's test to test whether the variables were cointegrated. The preference of Johansen's test over Engel-Granger's test was informed by the two major advantages the former has over the latter. One of the advantages is the ability of

Johansen's cointegration test to test for a number of co-integrating vectors when N>2 and the joint procedure of testing the maximum likelihood estimation of the vector error correction model and long run equilibrium relationship. Johansen's method reports two statistics: Trace test and Maximum Eigenvalue Test. To test for trace statistics, null hypothesis states that the rank r=0 (No co-integration). The alternative hypothesis is that r>0 (there is one or more co-integrating vectors). The maximum Eigen value test statistic on the other hand tests the null hypothesis that the number of co-integrating vectors is r against the specific alternative of r + 1 co-integrating vectors.

This study adopted the trace statistic which according to Enders (2010) is likely to give more reliable results in the event that the two tests of co-intergration rank are in conflict. According to Cheung and Lai (1993), trace statistic is more robust to skewness and excess kurtosis in residuals than the maximum Eigen value statistic and hence the best for choosing cointergration rank. We fail to reject the null hypothesis if p<0.05. The results of trace test are indicated in Table 4.9.

Table 4.9: Cointegration Results using trace test

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.705991	217.9614	159.5297	0.0000
At most 1 *	0.620156	156.7541	125.6154	0.0002
At most 2 *	0.544922	108.3543	95.75366	0.0051
At most 3	0.429236	68.99003	69.81889	0.0581
At most 4	0.281392	40.95103	47.85613	0.1902
At most 5	0.219739	24.42905	29.79707	0.1829
At most 6	0.156438	12.02271	15.49471	0.1558
At most 7	0.067916	3.516639	3.841466	0.0608

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Source: Researcher 2017

From the findings summarized in Table 4.9, three variables had their p values being less than 0.05 and therefore the null hypothesis of no cointegration was rejected. The results indicated that we have three cointegrating equations. Therefore, the study made a conclusion that there was existence of a stable long-run cointegration relationship between independent variables and residential house prices in Nairobi City County, Kenya.

4.9 Vector Error Correction Model (VECM)

The presence of co-integration among the variables provided the support for the use of an error correction model mechanism (ECM) representation in order to investigate the short run dynamics. The pre-condition for the VECM is that the variables be integrated of order one or simply should be I (1) and be cointegrated or rather have a long run relationship. Since the variables in this study met this condition then the coefficients were estimated using vector error correction model approach. One important advantage of the VECM model is that all the terms are stationary and the standard Ordinary Least Square estimation is valid. This is because if Y_t and X_t are I(1),then ΔY_t and ΔX_t are I(0), and by definition if Y_t and X_t are cointegrated then their linear combination is definitely I(0) (Asteriou, 2007).The three cointergrating variables were used to fit a cointergrating vector error correction model (VECM) developed by Johansen (1998), so as to determine the number of co-integrating relationship among the three variables. The estimation results of the long run coefficients and the VECM model, based on the Schwartz Bayesian information criteria, are presented in table 4.10 and table 4.11 respectively.

Table 4.10: Long Run Coefficients

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNINFRT	0.039004***	0.01169	3.33628	0.0015
LNINTR	-0.443711***	0.13982	-3.17343	0.0025
LNMGR	0.658211***	0.09470	6.95018	0.0000
LNNEWHS	0.367718***	0.08158	4.50733	0.0000
LNGDP	-0.011223	0.04834	0.23219	0.8174
LNPOP	0.829389**	0.36835	2.25166	0.0286
LNEXCHR	0.173646**	0.08362	2.07669	0.0428
C	12.10506***	4.497102	2.69174	0.0096

Source: Researcher 2017
*Note: ***,**,* represent significance at 1 %, 5% and 10 % significance level*

The results in the long run model in Table 4.9 can be expressed in a summarized equation as:

$$LNHPI = -12.01 + 0.03LNINFRT - 0.44LNINTR + 0.65LNMGR + 0.36LNNEWHS - 0.001LNGDP + 0.82LNPOP + 0.17LNEXCHR$$

These results showed that in the long-run inflation rate, mortgage rates, new houses, population growth rate and exchange rates had a positive and significant effect on the house prices in Kenya. This is because their respective p-values were all lower than 0.05 ($p<0.05$) which implied significance at 5 percent level. However, the results showed that interest rates had a negative and significant effect on house prices in the long run at 5 percent significance level with a p-value of 0.0059. Further the results showed that the gross domestic product of Kenya was insignificant at 5 percent level in its effect on house prices in the long run with a p value of 0.8174.

Table 4.11: Vector Error Correction Estimates

Dependent Variable: D(LNHPI)

	Coefficient	Std. Error	t-Statistic	Prob.
ECT	-0.397084**	0.144777	-2.742728	0.0122
D(LNHPI(-1))	1.008109***	0.180530	5.584153	0.0000
D(LNEXCR(-1))	-0.363777***	0.118643	-3.066144	0.0059
D(LNPOP(-1))	-0.262181**	0.106367	-2.464868	0.0224
D(LNINFR(-1))	-0.023526**	0.008683	-2.709358	0.0131
D(LNINTR(-1))	-0.304816**	0.134804	-2.261174	0.0345
D(LNMGR(-1))	0.274368*	0.148015	1.853650	0.0779
DLNNEWHS(-1)	-0.148306	0.089387	-1.659148	0.1119
D(LNGDP(-1))	-0.083299*	0.042513	-1.959383	0.0635
C	0.020487**	0.008821	2.322586	0.0303

R-squared	0.765194	Mean dependent var	0.023630
Adjusted R-squared	0.725663	S.D. dependent var	0.020361
S.E. of regression	0.014602	Akaike info criterion	-5.314522
Sum squared resid	0.004478	Schwarz criterion	-4.291037
Log likelihood	150.8913	Hannan-Quinn criter.	-4.929378
F-statistic	2.737419	Durbin-Watson stat	2.195642
Prob(F-statistic)	0.011041		

Source: Researcher 2017

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

On the other hand the short run coefficients and the error correction term were estimated by VECM model represented in table 4.10 and can be summarized in the following equation:

$$(\Delta\, LNHPI_t) = 0.0204 + 1.01\ (\Delta \mathrm{LN}HPI_{t-1}) - 0.3638(\Delta \mathrm{LN}EXCR_{t-1}) - 0.2621(\Delta LNPOP_{t-1}) - 0.0235(\Delta \mathrm{LN}INFR_{t-1}) - 0.3048(\Delta LNINTR_{t-1}) + 0.2744(\Delta LNMGR_{t-1}) - 0.1483(\Delta LNNEWHSE_{t-1}) - 0.0832(\Delta LNGDP_{t-1}) - 0.397ECM_{t-1}$$

The findings in Table 4.10 indicated that the R^2 is 0.77 suggesting that the error correction model specified explains around 77 percent of the variations in the differenced log values of house price index. A p-value of 0.011041 corresponding to F-statistics suggested that a null hypothesis all the model parameters are statistically equal to zero was rejected at 5 percent and 10 percent levels of significance leading

the conclusion that the model was jointly statistically significant in explaining variation in house price index. The error correction coefficient (ECT) had the expected negative sign (-0.397) and was highly significant. This suggested that the model converged back towards the long run equilibrium at a speed of 39.7 percent in one quarter after an economic shock in the short run and that it took more than approximately 3 quarters (100/39.7) to eliminate disequilibrium. From the findings, the negative parameter of the error correction term helped strengthen the finding of a long run equilibrium relationship among the variables in the model. The size of the coefficient of the error correction term (-0.397) suggests a relatively high speed of adjustment from the short run deviation to the long run equilibrium. This implies 39.7 percent of the deviation from long run growth in one quarter.

The short run coefficients in the Vector Error Correction model showed the effects of the previous quarter values on the current quarter house prices. The results showed that exchange rates, population rates, inflation rates and interest rates had a negative and significant effect on house prices at 5 percent significant level since their p values were all below 0.05 ($p<0.05$). The results however showed that in the short run no significant relationship existed between mortgage rate, new buildings and GDP with house prices and 5 percent significance level since all their p values were above 0.05. The results further showed that house prices in the previous quarter had a positive and significant effect (p value=0.000) on house prices in the current quarter in Kenya in the short run. This study further discusses the findings in section 4.11.

4.10 Post-Estimation Diagnostic Tests

Once the VEC is fitted, it is important to check its appropriateness. This was done by performing a number of post estimation diagnostic tests.

4.10.1 Autocorrelation Test Results

Autocorrelation reflects the degree of similarity between a given time series and a lagged version of itself over successive time intervals. Serial correlation is present if residuals of one period are related to the residuals of the previous period. The study used Portmanteau Autocorrelation test to test for the presence of serial correlation. The null hypothesis for serial correlation test was stated that there is no serial correlation. If the probability value (p-value) is greater than 5%, the null hypothesis is not rejected. Breusch Godfrey serial correlation test used for this study. Results for both tests under the null hypothesis of no serial correlation are shown on table 4.12.

Table 4.12: Breusch Godfrey Serial Correlation LM test results

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.652103	Prob. F(4,17)	0.6333
Obs*R-squared	6.252180	Prob. Chi-Square(4)	0.1811

Source: Researcher 2017

From the results in table 4.12 we do not reject the null hypothesis of no serial correlation since the p value (0.6333) is greater than 0.05.

4.10.2 Heteroscedasticity

The Classical Linear Regression model assumes that the variance of the errors is constant and this is known as the assumption of heteroscedasticity. If the errors do not have a constant variance, they are said to be heteroscedastic and there is heteroscedasticity in the data. According to Wooldridge (2002) running a regression model in the presence of heteroscedasticity has the consequence of obtaining an OLS estimation that will provide unbiased coefficient estimates but not Best Linear Unbiased Estimator. This implies that if heteroscedasticity is ignored the standard error could be inappropriate and hence any inference made will be misleading. This

study used the White's test as specified by (White, 1980). This is because compared to other tests, it is not sensitive to any violation of assumption of normality and it is based on regression of the error term on all the explanatory variables, their squares and their cross products. The null hypothesis is rejected if the joint probability test is less than 0.05.The null hypothesis of this test was that the variance of the error term is homoskedastic against the alternative hypothesis that its heteroskedastic. The results are presented in table 4.13

Table 4.13: Heteroskedasticity Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.605255	Prob. F(30,16)	0.8854
Obs*R-squared	24.98443	Prob. Chi-Square(30)	0.7258
Scaled explained SS	6.071921	Prob. Chi-Square(30)	1.0000

Source: Researcher 2017

From the findings on table 4.13, the null hypothesis of homoscedasticity is not rejected since the probability value (0.7258) is greater than 0.05. Therefore a conclusion was made that there is no heteroscedasticity.

4.10.3 Vector Error Correction Residual Normality Tests

The study adopted the multivariate extension for the Jarque- Bera test. This test requires that the researcher chooses a factorisation of residuals that are orthogonal to each other, in this case, Cholesky. Jarque-Bera test utilizes the skewness and kurtosis to check for normality of variables. Skewness is the tilt of the distribution and should be within -2 and +2 for data to be normally distributed. Kurtosis measures the degree of peakedness and should be between -3 and +3 and the Jarque-Bera statistic should be greater than the level of significance. The null hypothesis was that the data was normally distributed. The normality test results are presented in figure 4.3

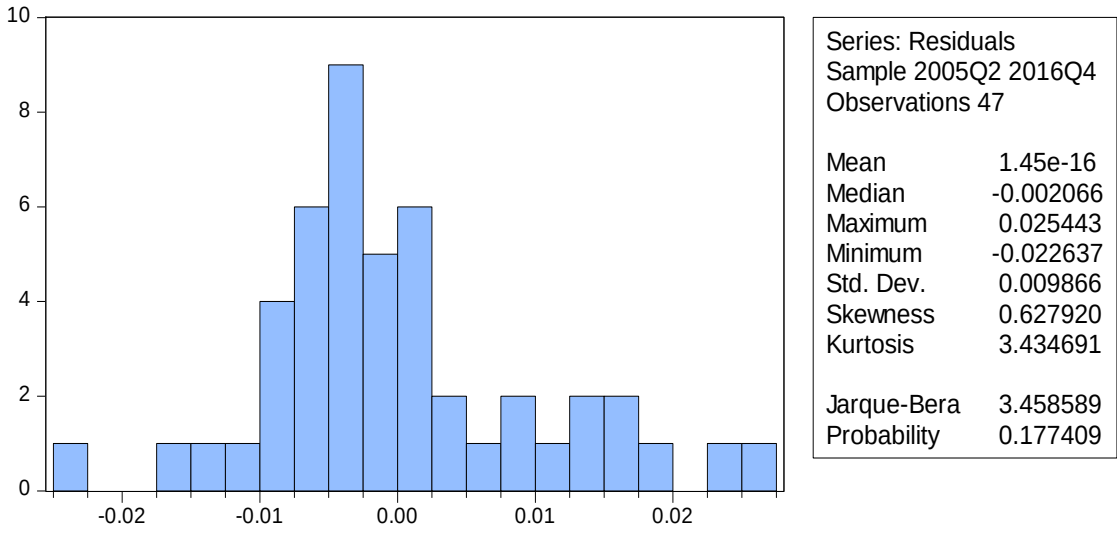


Figure 4.3: VEC Residual Normality Tests
Source: Researcher, 2017

From the results on figure 4.3, the Jarque-Bera statistic was 0.1774 which is greater than 0.05 and therefore the error term was normally distributed. In addition, both the p-values of skewness and kurtosis were significant and therefore the data is normally distributed. Although normality is not a necessary condition for the validity of many of the statistical procedures related to VAR models, deviation from normality assumption may nevertheless indicate that improvement to the model are possible. However, since the model is normally distributed then the results were reliable.

4.11 Discussion of the Findings

4.11.1 Effect of Past Values of House Prices on Current House prices

Variance decomposition results indicated that 98.96 percent of variations in house prices was contributed by house prices themselves in period 2 (Quarter 2) and 62.96 percent in period 10 (Year 3). This implies that a current shock on house prices will contribute to 62.96 percent of house prices in year three. Variance decomposition results further indicated that the upward trend in house prices is caused by house prices followed by exchange rate, interest rate, inflation, mortgage rate, new houses,

GDP, and urban population respectively. The study findings are consistent to those of (Gimeno & Carrascal, 2010; Tsatsaronis & Zhu, 2004; Shi & Jou, 2013; Alm & Follain, 1984) who find a positive relationship between previous house prices and current house prices. The Vector Error Correction Model short run coefficient for house prices is one with a p-value of 0.0000 and is highly significant. This implies that in the short run a 1 percent increase in house prices in the previous quarter would lead to a one percent increase in current quarter house prices. The interpretation of these results is traceable to the rational expectation hypothesis which portends that in the short run, demand for houses depends on the expectations of future prices of houses as well as other fundamental variables (Muth, 1961).

4.11.2 Effect of Mortgage Rate on House Prices

Variance decomposition results indicated that 0.21 percent of variation in house prices was contributed by mortgage rate in period two and 1.33 percent in period ten, this implies that a shock on mortgage rate now will contribute to 1.13 percent of house prices in year three. Impulse response function on the other hand, indicated that a shock on mortgage rate had a positive impact on house prices both in the short-run and in the long-run. This is inconsistent with the expectation of a negative relationship between mortgage rate and house prices.

The long-run and short-run relationship of the variables were estimated by Vector Error Correction Model (VECM). The long run coefficient for mortgage rate was 0.658 with a p value of 0.000 which indicated that a positive and highly significant relationship existed between mortgage rate and house prices. This implies that in the long run a 1 percent increase in mortgage rate would lead to an increase in house prices by approximately 0.658 percent. This led to the rejection of the null hypothesis

and the study concluded that there was a long-run relationship between mortgage rate and house prices. The short run dynamics indicates a coefficient value of 0.274 with a p value of 0.07 which was statistically insignificant at 5 percent as the p value was greater than 0.05. This therefore implied that there was no significant relationship between mortgage rate and house prices in the short run. The study findings are consistent with those of (Brissimis and Vlassopoulous, 2009; Gimeno & Carrascal, 2010; Tsatsaronis & Zhu, 2004; Shi &Jou, 2013) who found a positive relationship between mortgage rate house prices in the long run. Brissimis and Vlassopoulous (2009) found a long-run relationship with a coefficient of 0.23 which was statistically significant for Greece. Gimeno & Carrascal (2010) found a coefficient of 0.78 for the Spanish housing market which was also statistically significant. They concluded that there was a strong linkage between mortgage rate and house prices and that borrowing for house purchase depended positively on house prices. Zhang *et al.,* (2012) found mortgage rate to have a coefficient of 0.3 and concluded that mortgage rate has a significant nonlinear effect on house prices and that it had the most explanatory power on house price movements in China. Tsatsaronis & Zhu (2004) found a coefficient of 0.083 and concluded that changes in house prices could be explained by mortgage rate among industrialized countries.

Low mortgage rate stimulate new house sales which has an immediate effect of reducing supply, hence raise house prices in the short run. In the long run however, based on expectation hypothesis, new houses will be constructed hence increasing supply and the effect will be reduced house prices (Zhang *et al.,* 2012; Nneji *et al.,* 2010). In Kenya however, the demand for houses far outstrips the supply (National Housing Survey, 2013). This can be explained by the results of the study which

concluded that there is a long-run positive relationship between mortgage rate and house prices.

Mortgage market in Kenya is not fully developed, hence mortgage rates are rather high. When the mortgage rate is high, fewer people have access to mortgage financing. According to World Bank Report (2011), 2.4 percent of total population in Kenya can afford a mortgage for a basic house (World Bank, 2011a). This can be attributed to the positive relationship between mortgage rate and house prices and a desire to have lower mortgage rate should be encouraged so as to expand affordability.

4.11.3 Effect of Exchange Rate on House prices

Variance decomposition indicated that 0.09 percent of the variations in the house prices was contributed by exchange rate in period two (quarter 2). Other than its own shock, exchange rate was the highest contributor of variations accounting for 25.53 percent of house price variation in period ten (year 3) from variance decomposition. This implies that a shock on exchange rate now will contribute to 25.53 percent of house prices in year three. This can be attributed to investor's expectations from houses in the form of expected exchange rate fluctuations (Yang & Zhiqiang, 2012). Impulse function response indicates that a positive one-standard deviation shock to exchange rate has a negative effect on house prices in the short-run and in the long-run.

The long run and short-run relationships of the variables was estimated by VECM. The long run coefficient for exchange rate was 0.174 with a p value of 0.0428 which was statistically significant affirming the existence of a long-run relationship between exchange rate and house prices. This therefore meant that in the long run a 1%

increase in exchange rate, ceteris paribus, would lead to a 0.17 percent increase in house prices. Short run dynamics indicate a coefficient of -0.3637 with a p value of 0.0059, which indicated a statistical significant effect at 5 percent level. This implied that in the short run a 1 percent increase in exchange rate in the previous quarter would lead to a 0.36 percent decrease in the current quarter's house prices. This therefore implied that in the short run exchange rate had a statistically negative relationship with house prices. These results are consistent with past studies (Yang & Zhiqiang, 2012; Zhang *et al.,* 2012) who found a positive relationship between exchange rate and house prices in the long run. Zhang *et al.,* (2012) found a coefficient of 0.072 which was statistically significant. Ideally, exchange rate appreciation is expected to exert a positive influence on house prices, particularly in markets where there is substantial demand from non-residents for investment purposes (Capozza *et al.,* 2002). This study results indicated a long-run positive relationship between exchange rate and house prices in Nairobi County which was consistent with exchange rate depreciation witnessed in Kenya.

4.11.4 Effect of Interest Rate on House Prices

Variance decomposition results indicated that 0.43 percent of the variation in house prices was contributed by interest rates in period two (Quarter 2) and increases to 7.11 percent in period ten (year 3). This implies that a shock on interest rate now will contribute to 7.11 percent of house prices in year three. This makes interest rate second to exchange rate as a contributor to variations on house prices. Impulse response function results indicated that a shock on interest rate had a positive effect on house prices in the short-run, then keeps a steady increase in the long-run. The impulse response results are consistent with rational expectations hypothesis. According to the rational expectations hypothesis, demand may actually increase

during the impact period if people perceive this increase in interest rate as a signal for further increase in interest rate in the future (Muth 1961).

The long run VECM coefficient for interest rate was -0.444 with a p value of 0.0025, which was statistically significant at 5 percent level. This implied that in the long run a 1 per cent increase in interest rates would lead to a 0.444 per cent reduction in house price. This therefore implied that there was a long run relationship between interest rate and house prices. The short run dynamics indicated a coefficient of -0.305 with a p value 0.03 which was equally statistically significant. This implied that in the short run a 1 percent increase in the interest rate in the previous quarter would result in a 0.3 percent decrease in the house prices in the current quarter. The study therefore concluded that in the short-run and long-run, there is a negative relationship between interest rates and house prices in Nairobi County. This results are consistent with past studies (Miregi & Obere 2014; Pillaiyan, 2015; Tsatsaronis and Zhu, 2004; Zhang*et al.*, 2012). Miregi & Obere (2014) found a coefficient of -0.004 which was statistically significant and concluded that property prices are inversely related to interest rates. This they attributed to the fact that interest rate impacts on house prices via its effect on the supply of new houses. Pillaiyan (2015) found a coefficient of -3.9 which was statistically significant and concluded that there was a long term inverse relationship between average lending rate and house prices. This was attributed to a drastic drop in average interest rates resulting in a rise in house prices. Tsatsaronis and Zhu (2004) found a coefficient of - 0.26 which was statistically significant indicating a strong inverse relationship between interest and house prices and concluded that a declining interest rate environment typically boosts the demand for residential houses. Zhang *et al.* (2012) found a coefficient of -0.8 which was statistically significant and concluded that lower interest rates tend to accelerate the

subsequent home price growth and vice versa collaborating the fact that low levels of interest rate results into cheap loans which has an effect of increasing demand for houses, hence pushing the prices up. Despite the government's effort of capping interest rate, there seems to be no significant change in house prices. The capping of interest rate only became operational in the last quarter of the year 2016.

4.11.5 Effect of Population on House Prices

Variance decomposition results indicated that 0.027 percent of the variations in house prices was contributed by population in period two and 0.27 percent in period ten (Table 4.7). This implies that a current shock on population will contribute to 0.27 percent of house prices in year three. The impulse response function result indicate that the response of house price to shocks in population growth has no significant effect.

The VECM results indicated that in the long run, population had a coefficient of 0.829 with a p value of 0.028 which was statistically significant. This implies that a 1 per cent increase in population will lead to a 0.82 per cent increase in house prices. A conclusion was therefore made that there was a positive long run relationship between population and house prices. This led to the rejection of null hypothesis and conclude that population had a positive and significant effect on house prices in the long run. The short run dynamics indicated that population had a coefficient of -0.262 with a p value of 0.022 which was statistically significant. This implied that in the short run a 1 percent increase in population in the previous quarter leads to a 0.26 percent decrease in the house prices in the current quarter. This therefore meant that in the short run there existed a negative relationship between population and house prices. These results are consistent with those of Case & Shiller (2003) and Li (2014) who

found a positive relationship between population and house prices in the long run. Li (2014) found a coefficient of 0.027 which was positive and significant and concluded that an increase in working age population has a significant effect on appreciation of house prices. This is attributed to the fact that the working age population tend to be the main demanders of houses hence the main influencers in shifts in house prices. The increase in population of the working age group influence demand for housing albeit low supply, hence the growth in house prices. Case and Shiller (2003) found a coefficient of 0.3 and concluded that population growth is positively related to house price appreciation as more and more seek accommodation in the form of formal housing. On the contrary, most of the urban population in Kenya are low income groups and are concentrated in the informal settlements located in various parts within Nairobi County.

Mankiw and Weil (1989) found a coefficient of -0.57 which and was statistically significant in the short run and concluded that population changes only affect the short-run housing prices. This is consistent with the findings of the study that found a negative relationship between population and house prices in the short run. Following Bourne (1981), the assertion that best suits the Kenya scenario is that it is the population that influence house prices via house demand and not housing influencing the number of people. This clearly shows that population as a fundamental determinant of house prices behave differently in different housing markets.

4.11.6 Effect of Number of New Houses on House Prices

Variance decomposition results showed that 0.03 percent of the variations in house prices was contributed by new houses in period two (quarter two) and 0.33 percent in period ten(year three). This implies that a current shock on the number of new houses will contribute to 0.33 percent of house prices in year three. Impulse response

function indicate that a shock on new houses has a negative impact on house prices in the short-run, but has a positive impact in the long-run.

The VECM coefficient of new houses in the long run model was 0.367 with a p value of 0.000 which was statistically significant at 5 percent level. This implied that in the long run a 1 percent increase in new houses would lead to a 0.367 percent increase in house price. This led to the rejection of the null hypothesis and the study concluded that there is a positive and significant relationship between new houses and house prices. In the short run however, new houses was insignificant in explaining house prices with a p value of 0.1119. These results however, are inconsistent with those of (Marsden, 2015; Leonhard, 2013; Halket *et al.*, 2015) who found a negative relationship between number of houses and house prices. Marsden (2015) found a negative coefficient which was statistically significant and concluded that in the short-run, the inelastic supply of housing contributes to house price volatility. In this particular study, he attributed the relationship to the constraints of the planning system in London. Leonhard (2013) found a negative coefficient and concluded that the effect of new stock of houses is strongest in municipalities with major cities and weaker in those with small cities. Nairobi is the major city of Kenya and faces inelastic supply of houses. Even though there has been an increase in the number of houses, this does not necessarily mean that it has been sufficient to reduce the growth in house prices since demand has continued to increase (Marsden, 2015).

4.11.7 Effect of Inflation on House Prices

Variance decomposition results indicated that 0.21 percent of variations in house prices was contributed by inflation in period two (quarter two) and 2.15 percent in period ten (year three). This implies that a current shock on inflation will contribute to 2.15 percent of house prices in year three. The impulse response function indicate that

a shock on inflation has a positive effect on house price in the in the short run (first four quarters) and thereafter a negative effect in the long-run.

The long run results for inflation indicated a coefficient of 0.039 with a p value of 0.0015 which was statistically significant. This implies that in the long run a 1 per cent increase in inflation will lead to a 0.039 per cent increase in house prices. This study therefore concluded that there was a positive significant relationship between inflation and house prices. This led to the rejection of null hypothesis and a conclusion made that inflation has a positive and significant effect on house prices. In the short run, inflation had a coefficient of -0.023 with a p value of 0.013 which was statistically significant. This implied that in the short run a 1 percent increase in inflation rate in the previous quarter led to a 0.02 percent decrease in house prices in the current quarter. This findings therefore indicated that there was a significant negative relationship between inflation and house prices in the short run. The findings are consistent with those of (Kearl, 1979; Tsatsaronis & Zhu, 2004 and Ochieng & Obere, 2014) who found that inflation had a positive and significant effect on house prices in the long run. Ochieng and Obere (2014) found a coefficient of 0.00672 and concluded that during periods of high inflation, demand for houses would increase as investors try to secure their investments from inflationary pressures.

The findings of this study are also consistent to those of Zainnadun (2010) who found a coefficient of -2.28 and was statistically significant in the short run. He concluded that house prices are sensitive to inflation and inflationary signal of a future increase in prices influences the buyer's decision. It also shows that demand for houses in Kenya could be based on expectations about future prices of houses.

4.11.8 Effect of Gross Domestic Product on House Prices

Variance decomposition results showed that 0.01 percent of the variations in house prices was contributed by GDP in period two (quarter two) and 0.30 percent in period ten (year three). This implies that a current shock on GDP will contribute to 2.15 percent of house prices in year three. It also follows that impulse response indicate that a shock on GDP has an initial sharp negative impact on the house prices. This negative impact also holds in the long-run.

The VECM estimates results revealed the long run and short run coefficient of GDP was -0.011 (p value=0.8174) and -0.0832 (p value=0.0635) respectively and therefore was statistically insignificant in both cases at 5 percent level of significance. Since the coefficients were statistically insignificant the study did not make any inference on the long run and short run relationships between GDP and house prices. The study therefore failed to reject the null hypothesis that there was no significant relationship between GDP and house prices. These results in Kenya are consistent with those of Pillayan (2005) who found a coefficient of 0.000031 and failed to identify GDP as a long term driver of house prices in Malaysia. This results are however inconsistent with past studies which found GDP to be a long term driver of house prices among them (Valadez, 2012; Zhang *et al.,* 2012; Nneji *et al.,* 2013). Valadez (2012) found a coefficient of 0.0011 which was statistically significant and concluded that GDP affected house prices in the US housing market. Nneji *et al.* (2013) found a coefficient of 0.1645 which was statistically significant and concluded that GDP plays a key role in the US housing market.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Overview

This chapter provides a summary of the research findings, conclusion and recommendations by highlighting policy implications from the study findings and point out the areas for further research. The chapter is composed of four sections; summary of findings, conclusions, recommendations and concludes with recommendations for further research.

5.2 Summary of Findings

The first objective was to determine how mortgage rate affect house prices in Nairobi City County, Kenya. Study findings indicated a positive long-run relationship between mortgage rate and house prices contrary to expectations.

The second objective was to evaluate the effect of exchange rate on house prices in Nairobi County, Kenya. Contrary to expectations, the findings indicated a positive relationship between exchange rate and house prices. The variations of house prices can be attributed to exchange rate which can be explained by expectations on rental yields, expected exchange rate appreciation and foreign direct investments and remittances in the housing market which has an effect of increasing demand for houses.

The third objective was to determine the effect of interest rate on house prices in Nairobi County, Kenya. Study findings conformed to expectation and indicated a long-run negative relationship between interest rates and house prices. In the short-run however, a positive shock on interest rate had a positive effect on house prices. This

can be attributed to the fact that demand may increase during the impact period if it is perceived to be a sign of further increase in interest rates.

The fourth objective was to evaluate the effect of population on house prices in Nairobi County. Population is one of the key drivers of house price increase. A larger population leads to a higher demand of housing and eventual increase in house prices. It was therefore expected that the relationship would be positive. Study findings indicated that there was a positive relationship between population and house prices.

The fifth objective was to establish how the number of new houses affect house prices in Nairobi County. The study findings indicated a positive relationship between number of new houses and house prices. It also confirmed a long run relationship between new houses and house prices. This can be attribute to inelastic supply of houses with possible causes being shortage of land for constructing new houses and the time lag between construction and purchase of the new houses. It could also mean that increase in number of houses is not sufficient enough to reduce growth in house prices'.

The sixth objective was to determine the effect of inflation on house prices in Nairobi City County. Inflation measures the general price increase and it is expected that house prices will be in line with this general price increase. In line with the expectation, the study findings indicated a positive relationship between inflation and house prices. This could be attributed to future expectations on inflation. To hedge against inflation and rising user costs, buying of houses is seen as the best option in Kenya. This is because the financial sector offers limited investment options with real estate investments trusts (REITs) having been introduced recently. It also follows that

the growing demand for houses could be due to both construction companies and investors fear of inflation.

The seventh objective was to establish how Gross Domestic Product affect house prices in Nairobi City County. Generally, it is expected that when income increases, demand for houses increase and so are the house prices. Study findings conformed to this expectation and indicated a positive relationship between GDP and house prices though not significant. The study could not therefore make any inference on the relationship. Generally, four variables did not yield results as per expectations. These are mortgage rate, exchange rate, number of new houses and GDP.

5.3 Conclusion

The study empirically examined determinants of house prices in Nairobi City County, Kenya. The empirical investigation was conducted within Vector Autoregressive (VAR) and Vector Error Correction Model (VECM) frameworks over the period 2004Q1-2016Q4. This approach was chosen because of its ability to simultaneously study the effects of a number of variables on house prices with special attention to exchange rate, mortgage rate, interest rates, inflation, Gross Domestic Product (GDP), number of new houses, and urban population.

The exchange rate turned out to be one of the most important predictor of house prices in Nairobi City County apart from house prices themselves. Specifically, exchange rate shock accounted for 25% of house price variation. Interest rate and inflation also played a significant role in explaining house price variation but to a lesser degree, with contribution of 7% and 2% respectively. Small but significant effect on house prices was also exerted by the mortgage rate, new houses, GDP, and urban population. In accordance with other studies, GDP explanation was

insignificant. All the variables had a long run relationship with house prices except for Gross Domestic Product. In particular, mortgage rate, exchange rate, urban population and number of new houses and inflation had a positive and statistically significant long run relationship with house prices. Interest rate had a negative and statistically significant long run relationship. The Vector Error Correction Model (VECM), indicate the speed of adjustment from short-run to long-run equilibrium as approximately 39.7 percent. This suggested that the model converged back towards the long run equilibrium at a speed of 39.7 per cent in one quarter after an economic shock in the short run and that it took more than approximately 3 quarters (100/39.7) to eliminate disequilibrium.

In a nutshell, the study findings suggested that mortgage rate, exchange rate, urban population and number of new houses, inflation and interest rate play a key role in determining house prices in Nairobi City County. However, the robustness of the study findings as well as a better understanding of the interactions of these variables with house prices could be further enhanced if more work is devoted in developing better and more accurate indicators. For instance, mortgage rate as an indicator that captures mortgage securitization more adequately would most probably have rendered it a higher explanatory power, but the study found the contrary. This could be attributed to the underdevelopment of the mortgage market in Kenya. The findings of this study are consistent with rational expectations hypothesis which explains that short-run demand for houses depends on expected future prices of houses and other relevant variables (Dipasquale & Wheaton, 1996).

5.4 Recommendations

The findings of the study add new understanding to the literature on the housing market with reference to the Kenyan housing market. This study identified measurable relationships between the determinants of house prices in Nairobi County, Kenya. Based on the findings of the study, the following recommendations have been made:

The financial sector directly influences the housing market through mortgage financing. Growth of mortgage financing generally captures information such as government regulation and how it impacts the uptake of mortgage loans. The Kenyan government through its selective credit control policy by the Central Bank of Kenya can stimulate the growth of the housing market by channeling funds to the market. Based on expectation hypothesis, this growth in funds towards the housing market will increase mortgage uptake, increase supply of houses and in the end check the growth of house prices. Apart from capping of interest rates, a policy geared towards capping of mortgage rate should be introduced to allow more people to have access to mortgage facilities and not only the public servants. This can be achieved by increasing housing investment using innovative and targeted development to boost supply. The government can also provide appropriate housing finance products. It therefore follows that the mortgage finance markets should be restructured to capture the desire and expectations of house buyers of having affordable houses.

Kenya has had a steady currency depreciation making imported goods expensive which in turn is pushed forward to the final consumer in form of house prices via the building materials. In effect, higher housing material costs leads to reduced housing supply. Findings of this study indicate the role played by exchange rate through

remittances from abroad in enhancing supply of houses. This can be attributed to the adaptive expectation hypothesis where future house prices are determined using past information and trends in house prices. To this end, the Kenya government should enact a remittance policy that targets appropriate groups and give them the incentives to use the remittances to grow the housing market. This can be achieved by orienting the policy towards increasing the flow of remittances and channeling them into national financial institutions that are geared towards promoting the housing market.

Kenya is a developing economy and like other developing economies has a less mature financial market which is borrowing constrained. The CBK manipulates the base lending rate to influence the interest rate on loans from commercial banks. The Kenya government can therefore attempt to match the credit cycles, using its selective credit control policy, with the housing pricing cycles so as to stabilize the house prices. This can be achieved by intervening in the supply of new houses. Government can help ensure that there is sufficient supply of low cost housing by allocating funds in the budget. This is because private developers are focused on high end housing development leading to shortage of low cost and affordable houses.

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

since most people will seek employment opportunities at the county level. The government should therefore create polices that enables the county governments provide affordable housing to the urban population.

Stock flow hypothesis, makes a distinction between the stock of housing which is rigid in the short run and the flow of residential investment which can react quickly to expected changes on house price determinants. In particular, the government should intervene by ensuring sufficient supply of low cost housing by allocating government land for use. Private developers are focused on high end housing developments which are profitable to them. If left to the market forces there will be a shortage of low cost and affordable houses and this will result in an increase in the prices of low cost houses. Kenya government should develop policies that endeavor to increase supply of houses. Such an intervention would be in line with the governments 'Big Four' Agenda on provision of affordable housing to its citizens.

Among other policies, the findings of this study argue in favor of speedy move by the government to reduce cost of construction materials which will compliment other policies like lowering mortgage rate. Land disputes should be resolved as well as title deeds be issued where there are none to give developers a leeway to construct more houses. All these moves should be skewed towards increasing the number of housing units which will make housing in Kenya affordable. Achievement of increased housing can be enhanced through partnering with key organizations like Shelter Afrique under the framework of public private partnership so as to ensure provision of houses in a bid to increase supply.

The government has adopted the provider- based approach through the National Housing Corporation often acting as a social welfare agency to build houses for those

sections of urban population who need or deserve special treatment like the civil servants and low income groups as well the slum upgrading projects. This makes supply responses to be based on the premise that people need housing and not on the ability of investment in housing to improve the economy. The government should also focus on housing as an investment and partner with international organization like World Bank and International Monetary Fund to provide housing as an investment channel. This can be coupled with tax incentives for those who construct the highest number of house units so as to increase supply. The government should also strive to have a stable macroeconomic environment with stable inflation which in turn translate to positive GDP.

5.5 Recommendations for Further Research

Given that investors are now warming up to the market as an investment vehicle, it would be worthwhile to undertake a study that will include more variables, both demand side and supply side variables so as to assess the effect on the house prices. Variables like net government spending on housing, Housing permits, Construction costs and Stock market index could be included.

This study used quantitative data. A combination of qualitative and quantitative data could be used to analyze house prices. The qualitative data should include behavioral and psychological aspects of home buyers focusing more on the future price expectations.

REFERENCES

Abelson, P., Joyeux, R., Milunovich, G., & Chung, D. (2005). ‘‘Explaining house prices in Australia’’. *The Economic Record, 81(255),* 96-103.

Accetturo, A., Manaresi, F., Mocetti, S., & Olivieri, E. (2014). Don't stand so close to me: the urban impact of immigration. *Regional Science and Urban Economics*, *45*, 45-56.

Addae-Dapaah, K., Anh, N. M. (2014). Housing Loan and the Price of Housing in Singapore. *Journal of Business and Economics*, *5*(9), 1513-1524.

Ahearne, A. G., Ammer, J., Doyle, B. M., Kole, L. S., & Martin, R. F. (2005). House prices and monetary policy: A cross-country study. *International finance discussion papers*, *841*.

Algieri, B. (2013). House price determinants: Fundamentals and underlying factors. *Comparative Economic Studies*, *55*(2), 315-341.

Alhashimi, H., & Dwyer, W. (2004, January). Is there such an entity as a housing market? In *10th Annual Pacific Rim Real Estate Conference (press), Bangkok*.

Anari, A., & Kolari, J. (2002). House prices and inflation. *Real Estate Economics*, *30*(1), 67-84.

Apergis, N., & Rezitis, A. (2003). Housing prices and macroeconomic factors in Greece: prospects within the EMU. *Applied economics letters*, *10*(9), 561-565.

Asal, (2017). Long-run drivers and short-term dynamics of Swedish real house prices International Journal of Housing Markets and Analysis. Available at: https://doi.org/10.1108/IJHMA-08-2017-0070

Basten, C., & Koch, C. (2015). The causal effect of house prices on mortgage demand and mortgage supply: Evidence from Switzerland. *Journal of Housing Economics*, 30(2015), 1-22.

Beltratti, A., & Morana, C. (2010). International house prices and macroeconomic fluctuations. *Journal of Banking & Finance*, *34*(3), 533-545.

Benjamin, J., Chinloy, P., & Jud, D. (2004). Why do households concentrate their wealth in housing? *Journal of Real Estate Research*, *26*(4), 329-344.

Bhuyan, R., Kuhle, J. L., Al-Deehani, T. M., & Mahmood, M. (2015). Portfolio Diversification Benefits Using Real Estate Investment Trusts–An Experiment with US Common Stocks, Equity Real Estate Investment Trusts, and Mortgage Real Estate Investment Trusts. *International Journal of Economics and Financial Issues*, *5*(4), 922-928.

Black, A., Fraser, P., & Hoesli, M. (2006). House prices, fundamentals and bubbles. *Journal of Business Finance & Accounting*, *33*(9-10), 1535-1555.

Blanchard, O., & Watson, M. (1982). Bubbles, Rational Expectations and Financial Markets. NBER Working Paper No 945.

Brissimis, S. N., & Vlassopoulos, T. (2009). The interaction between mortgage financing and housing prices in Greece. *The Journal of Real Estate Finance and Economics*, *39*(2), 146-164.

Bryman, A. and E. Bell (2003). Business Research Methods. Oxford: Oxford University Press.

Cagan, P. (1956). "*The Monetary Dynamics of Hyperinflation."* In Studies in the Quantity Theory of Money, edited by M. Friedman. Chicago: Univ. Chicago Press.

Capozza, D. R., Hendershott, P. H., Mack, C., & Mayer, C. J. (2002). *Determinants of real house price dynamics* (No. w9262). National Bureau of Economic Research.

Case, K. E., & Shiller, R. J. (1989). The Efficiency of the Market for Single-family homes. *American Economic Review,* 79 (1), 152-137.

Case, K. E., & Shiller, R. J. (2003). Is there a bubble in the housing market?. *Brookings papers on economic activity*, *2003*(2), 299-342.

Case, K. E., Quigley, J. M., & Shiller, R. J. (2001). Comparing Wealth Effects: The Stock Market vs the Housing Market. *NBER Working Paper 8606*, 117.

Central Bank of Kenya (2013), Monthly economic review.

Chanpiwat, N. (2013). *Estimating the impact of immigration on housing prices and housing affordability in New Zealand.* Retrieved from https://aut.researchgateway.ac.nz/bitstream/handle/10292/5573/ChanpiwatN.pdf?sequence=4&isAllowed=y

Chee Yin, Y. *et al.* (2015) 'Macroeconomic Drivers of House Prices in Malaysia', *Canadian Social Science*, 11(9), pp. 119–130. doi: 10.3968/7482.

Chen, H. C., Ho, K. Y., Lu, C., & Wu, C. H. (2005). Real estate investment trusts. *The Journal of Portfolio Management*, *31*(5), 46-54.

Chen, Y., Gibb, K., Leishman, C., & Wright, R. (2012). The Impact of Population Ageing on House Prices: A Micro-simulation Approach. *Scottish Journal of Political Economy*, *59*(5), 523-542.

Coleman, A. (2008). Inflation and the measurement of saving and housing affordability. Motu Working Paper 08-09

Cooper, R. D., & Schindler, S. P. (2008). Business Research Methods. India: Tata McGraw Hill.

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

Cytonn. (2018, November 7). Current Real Estate Trends in Kenya & How They Affect Investors. Retrieved from https://www.cytonn.com/blog/article/current-real-estate-trends-in-kenya-and-how-they-affect-investors

Damen, S., Vastmans, F., & Buyst, E. (2016). The effect of mortgage interest deduction and mortgage characteristics on house prices. *Journal of Housing Economics*, 34(2016), 15-29.

Das, S., Gupta, R., & Kabundi, A. (2011). Forecasting regional house price inflation: a comparison between dynamic factor models and vector autoregressive models. *Journal of Forecasting*, *30*(2), 288-302.

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

Dickey, D. A., & Fuller, W. A. (1981). Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica: Journal of the Econometric Society*, 49(4), 1057-1072.

DiPasquale, D., & Wheaton, W. C. (1996). *Urban economics and real estate markets* (Vol. 23, No. 7). Englewood Cliffs, NJ: Prentice Hall.

Droes, M., & van de Minne, A. (2016). *Do the Determinants of House Prices Change over Time? Evidence from 200 Years of Transactions Data* (No. eres2016_227). European Real Estate Society (ERES).

Ebru, Ç., & Eban, A. (2011). Determinants of house prices in Istanbul: a quantile regression approach. *Quality & Quantity*, *45*(2), 305-317.

Égert, B., & Mihaljek, D. (2007). Determinants of house prices in central and eastern Europe. *Comparative economic studies*, *49*(3), 367-388.

Engle, R. F., & Granger, C. W. (1987). Co-integration and error correction: representation, estimation, and testing. *Econometrica: journal of the Econometric Society*, 55 (2), 251-276.

Eugene, W. N. (2006). Bubbles and Busts: The 1990s in the Mirror of the 1920s. *NBER Working Paper*, (12138).

Eurostat. (2017). A quarter of household expenditure allocated to housing. Retrieved from https://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20171121-1

Federal Reserve Bank of San Francisco. (2009). what are some of the commonly used statistics on housing prices and housing market conditions and where can I find them? Retrieved from https://www.frbsf.org/education/publications/doctor-econ/2009/september/housing-prices-market-conditions/

Frappa, S., & Mésonnier, J. S. (2010). The housing price boom of the late 1990s: Did inflation targeting matter? *Journal of Financial Stability*, *6*(4), 243-254.

Froot, K.A., & Obstfeld, M. (1991). Intrinsic Bubbles: The Case of Stock Prices. *American Economic Review*, 81, 1189-2114.

Gallin, J. (2006). The long-run relationship between house prices and income: evidence from local housing markets. *Real Estate Economics*, *34*(3), 417-438.

Gerding, E. F. (2007). Laws against bubbles: An experimental-asset-market approach to analyzing financial regulation. *Wisconsin Law Review*. 977-1039

Gerlach, S., & Peng, W. (2005). Bank lending and property prices in Hong Kong. *Journal of Banking & Finance*, *29*(2), 461-481.

Ghent, A. C., & Owyang, M. T. (2010). Is housing the business cycle? Evidence from US cities. *Journal of Urban Economics*, *67*(3), 336-351.

Gimeno, R., & Martinez-Carrascal, C. (2010). The relationship between house prices and house purchase loans: The Spanish case. *Journal of Banking & Finance*, *34*(8), 1849-1855.

Glindro, E. T., Subhanij, T., Szeto, J., & Zhu, H. (2011). Determinants of house prices in nine Asia-Pacific economies. *International Journal of Central Banking*, *7*(3), 163-204.

Gonzalez, L., & Ortega, F. (2013). Immigration and housing booms: Evidence from Spain. *Journal of Regional Science*, *53*(1), 37-59.

Goodhart, C., & Hofmann, B. (2008). House prices, money, credit, and the macroeconomy. *Oxford Review of Economic Policy*, *24*(1), 180-205.

Granziera, E., & Kozicki, S. (2015). House price dynamics: Fundamentals and expectations. *Journal of Economic Dynamics and control*, *60*, 152-165.

Green, R. K. (1997). Follow the leader: how changes in residential and non-residential investment predict changes in GDP. *Real Estate Economics*, *25*(2), 253-270.

Grissom, T. V., Kuhle, J. L., & Walther, C. H. (1987). Diversification works in real estate, too. *The Journal of Portfolio Management*, *13*(2), 66-71.

Guo, F., Chen, C. R., & Huang, Y. S. (2011). Markets contagion during financial crisis: A regime-switching approach. *International Review of Economics & Finance*, *20*(1), 95-109.

Gupta, R., & Das, S. (2010). Predicting downturns in the US housing market: a Bayesian approach. *The Journal of Real Estate Finance and Economics*, *41*(3), 294-319.

Gupta, R., & Hartley, F. (2013). The role of asset prices in forecasting inflation and output in South Africa. *Journal of Emerging Market Finance*, *12*(3), 239-291.

Gupta, R., & Kabundi, A. (2010). Forecasting real US house price: principal components versus Bayesian regressions. *International Business and Economics Research Journal*, *9*(7), 141-152.

Hanlon, N. O. (2011) 'Constructing a National House Price Index for Ireland', XL, pp. 167–196.

Harris, J. C. (1989). The effect of real rates of interest on housing prices. *The Journal of Real Estate Finance and Economics*, *2*(1), 47-60.

Harris, J. M. (2014). The Financial Crisis and the Great Recession. 337-356. Retrieved from https://www.researchgate.net/publication/277326625_The_Financial_Crisis_and_the_Great_Recession

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

Hass Consult. (2017). Kenya's First and Most Expansive Price Index: About the Hass Index. Retrieved from http://hassconsult.co.ke/real-estate/hass-index/12-about-the-hass-index.

Herring, R.J., & Wachter, S (1999). Real Estate Booms and Banking Busts: An International Perspective. *The Wharton Financial Institutions Centre Working Paper* 99, 1-27.

Hilbers, P. Q., Lei, Q., & Zacho, L. (2001). Real Estate Market Developments and Financial Sector Soundness. *IMF Working paper No 01/129.*

Himmelberg, C., Mayer, C., & Sinai, T. (2005). Assessing high house prices: Bubbles, fundamentals and misperceptions. *Journal of Economic Perspectives*, *19*(4), 67-92.

Hoxha, V., & Salaj, A. T. (2014). Fundamental Economic Factors That Affect Housing Prices: Comparative Analysis between Kosovo and Slovenia. *Management (18544223)*, *9*(4) 323–348.

Hwang, M., & Quigley, J. (2002).Price discovery in time and space: The cost of condominium Prices in Singapore. *Working Paper University of California Berkeley*.

Iacoviello, M. (2005). House prices, borrowing constraints, and monetary policy in the business cycle. *American economic review*, *95*(3), 739-764.

Ibrahim, M. H., & Law, S. H. (2014). House prices and bank credits in Malaysia: An aggregate and disaggregate analysis. *Habitat International*, *42*(2014), 111-120.

Index, H. P. (2015) 'Housing Price Index Conceptual Framework © The Centre for Research on', (February).

Johansen, S. (1988). The mathematical structure of error correction models. *Contemporary Mathematics*, *80*(4), 359-87.

Johansen, S. (2000). Modelling of cointegration in the vector autoregressive model. *Economic modelling*, *17*(3), 359-373.

Kagochi, J. M., & Kiambigi, M. (2012). Remittances' Influence on Housing Construction Demand in Sub-Saharan Africa: The Case of Kenya. *African Development Review*, *24*(3), 255-265.

Kaiser, R. (1997). The long cycle in real estate. *Journal of Real Estate Research*, *14*(3), 233-257.

Kalantaryan, S. (2013). Housing market responses to immigration; evidence from Italy. Retrieved from https://www.eui.eu/Documents/RSCAS/Research/MWG/201314/4Jun-Kalantaryan.pdf

Kamal, E. M., Hassan, H., & Osmadi, A. (2016). Factors influencing the housing price: Developers' perspective. *Int. J. Soc. Behav. Educ. Econ. Bus. Ind. Eng*, *10(5)*, 1667-1673.

Kearl, J. R. (1979). Inflation, mortgage, and housing. *Journal of political economy*, *87*(5, Part 1), 1115-1138.

Kenya National Bureau of Statistics (2009) 'Housing Wall Material by County and District', *Kenya Census 2009*.

Keynes, J. M. (1936). The General Theory of Employment, Interest, and Money, New York: H arcourt, Brace & World.

Kim Lum, S. (2004). Property price indices in the commonwealth: Construction methodologies and problems. *Journal of Property Investment & Finance*, *22*(1), 25-54.

Kim, H. J., Son, J. C., & Yie, M. S. (2013). House price dynamics with household debt: the Korean case. *Asian Economic Journal*, *31*(1), 39-59.

Kim, K. H. (2004). Housing and the Korean economy. *Journal of Housing Economics*, *13*(4), 321-341.

Kim, K. H., & Lee, H. S. (2000, July). Real estate price bubble and price forecasts in Korea. In *Asia Real Estate Society Fifth Annual Conference, Beijing* (pp. 26-30).

Kim, K., & Park, J. (2005). Segmentation of the housing market and its determinants: Seoul and its neighboring new towns in Korea. *Australian Geographer*, *36*(2), 221-232.

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

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

Kuang, W., & Liu, P. (2015). Inflation and House Prices: Theory and evidence from 35 major cities in China. *International Real Estate Review*, *18*(2), 217-240.

Kuhle, J. (1987). Portfolio diversification and return benefits—common stock vs. real estate investment trusts (REITs). *Journal of Real Estate Research*, *2*(2), 1-9.

Lai, F., Chan, S. N., Shum, W. Y., & Zhou, N. (2017). Household Debt and Housing Price: An Empirical Study across 36 Countries. *International Journal of Business and Management*, *12*(11), 227-241

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

Liew, C., & Haron, N. A. (2013). Factors influencing the rise of house price in Klang Valley. *International Journal of Research in Engineering and Technology*, 2(10), 261-272

Lin, Y., Ma, Z., Zhao, K., Hu, W., & Wei, J. (2018). The Impact of Population Migration on Urban Housing Prices: Evidence from China's Major Cities. *Sustainability*, *10*(9), 3169.

Liow, K.H., Ibrahim, M.F. & Huang, Q. (2006). Macroeconomic risk influences in the property Stock market. *Journal of property investment and finance,* 24(4), 295-323.

Lucas Jr, R. E. (1972). Expectations and the Neutrality of Money. *Journal of economic theory*, *4*(2), 103-124.

Mackmin, D. (1994). *The valuation and sale of residential property* (2 Ed.). London: Routledge.

Mallick, H., & Mahalik, M. K. (2015). Factors determining regional housing prices: evidence from major cities in India. *Journal of Property Research*, *32*(2), 123-146.

Malpezzi, S., & Wachter, S. (2005). The role of speculation in real estate cycles. *Journal of Real Estate Literature*, *13*(2), 141-164.

Mankiw, N. G., & Weil, D. N. (1989). The baby boom, the baby bust, and the housing market. *Regional science and urban economics*, *19*(2), 235-258.

McQuinn, K., & O'Reilly, G. (2008). Assessing the role of income and interest rates in determining house prices. *Economic modelling*, *25*(3), 377-390.

McQuinn, K., & O'Reilly, G. (2008). Assessing the role of income and interest rates in determining house prices. *Economic modelling*, *25*(3), 377-390.

Meidani, A. A. N., Zabihi, M., & Ashena, M. (2011). House prices, economic output, and inflation interactions in Iran. *Research in Applied Economics*, *3*(1), 1-13.

Miles, W. (2014). The housing bubble: How much blame does the fed really deserve? *Journal of Real Estate Research*, *36*(1), 41-58.

Miregi, M. O., & Obere, A. (2014). Effects of Market Fundamental Variables on Property Prices in Kenya–A Case of Nairobi Residential Property Market. *Journal of Economics and Finance, 5*(5), 101-113.

Mississippi Business Journal. (2013, November 19). FNC: Home prices show 'strong growth' during third quarter. Retrieved from http://msbusiness.com/2013/11/fnc-strong-growth-home-prices-third-quarter/

Moko, S. K., & Olima, W. H. (2014). Determinants of house construction cost in Kenya: a case of Nairobi County. *International Journal of Business and Commerce,* 4(1), 19-36.

Moreno, R. (2009). Some issues in measuring and tracking prices in emerging market economies. *Bank for International Settlements*, BIS Papers (No 49), 13-51.

Muli, J. N. (2011). *The Relationship between House Prices and Mortgage Credit in Kenya* Retrieved from http://erepository.uonbi.ac.ke/bitstream/handle/11295/95679/Muli_%20The%20re lationship%20between%20house%20prices%20and%20mortgage%20credit%20in%20kenya.pdf?sequence=3

Muth, R. F. (1986). The supply of mortgage lending. *Journal of Urban Economics*, *19*(1), 88-106.

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

Mwaniki, C. (2017, August 8). Number of mortgage accounts declines for first time in decade. Retrieved from https://www.nation.co.ke/business/Uptake-of-home-loans-drops-after-rate-caps/996-4074768-f6k69b/index.html.

Mwanza, K. (2017). Home prices hit three-year low on credit squeeze, poll period. Business Daily. Retrieved from https://www.businessdailyafrica.com/news/Housing-prices-rate-three-year-low-KBA-index/539546-4172174-q12714z/index.html

Myrmo, M. (2012). Does population growth affect housing bubbles? A study on population growth's influence on the US housing market during the 2000's.

Nkoyo, E. P. (2017). The Effect of Interest Rates on Residential Real Estate Pricing in Kenya. Retrieved from http://erepository.uonbi.ac.ke/bitstream/handle/11295/102438/Enjolis%20Full%20Project.pdf?sequence=1&isAllowed=y.

Nneji, O., Brooks, C., & Ward, C. (2013a). Intrinsic and rational speculative bubbles in the US housing market: 1960-2011. *Journal of Real Estate Research*, *35*(2), 121-151.

Nneji, O., Brooks, C., & Ward, C. W. (2013b). House price dynamics and their reaction to macroeconomic changes. *Economic Modelling*, *32*, 172-178.

Nourzad, F. & MCGibanny, M. (2012). Do lower mortgage rates mean higher housing prices? *Applied Economics, 2004, 36* (5), 305–313

Ocran, M. K., & Anyikwa, I. (2013). Trends and volatility in residential property prices in South Africa. *Studies in Economics and Econometrics*, *37*(1), 55-74.

O'Donovan, B., & Rae, D. (1997). The determinants of house prices in New Zealand: An aggregate and regional analysis. *New Zealand Economic Papers*, *31*(2), 175-198.

Oikarinen, E. (2009). Interaction between housing prices and household borrowing: The Finnish case. *Journal of Banking & Finance*, *33*(4), 747-756.

Okonkwo, O. (1998). Housing finance and housing delivery systems in Kenya: Bottlenecks, recent developments and the way forward. *Housing Finance International*, *12*(4), 14-26.

Olowofeso, E., & Oyetunji, A. K. (2013). Interest Rate as a Determinant of Housing Prices in Lagos State, Nigeria. *International Journal of Economic Development Research and Investment*, *4*(3), 1-10.

Olsen, E. O. (1969). A competitive theory of the housing market. *The American Economic Review*, *59*(4), 612-622.

Ouma, A. O. (2015). *Effect of Macroeconomic Variables on Real Estate Prices in Kenya* Retrieved from http://erepository.uonbi.ac.ke/bitstream/handle/11295/93547/Ouma_Effect%20of%20macroeconomic%20Variales%20on%20real%20estate%20prices%20in%20Kenya.pdf?sequence=1

Pallant, J. (2001). SPSS *survival manual: A step by step guide to data using SPSS for Windows* (Version 10 and 11). Philadelphia: Open University Press.

Panagiotidis, T., & Printzis, P. (2016). On the macroeconomic determinants of the housing market in Greece: A VECM approach. *International Economics and Economic Policy*, *13*(3), 387-409.

Pashardes, P., & Savva, C. S. (2009). Factors affecting house prices in Cyprus: 1988-2008. *Cyprus Economic Policy Review*, *3*(1), 3-25.

Phillips, P. C., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, *75*(2), 335-346.

Pillaiyan, S. (2015). Macroeconomic drivers of house prices in Malaysia. *Canadian Social Science*, *11*(9), 119-130.

Plakandaras, V., Gupta, R., Gogas, P., & Papadimitriou, T. (2015). Forecasting the US real house price index. *Economic Modelling*, *45*, 259-267.

Qiao, X., & Guo, H. (2014). Research on the Effect of the Exchange Rate of RMB on Housing Prices Based on the VAR Model. In *ICCREM 2014: Smart Construction and Management in the Context of New Technology*, 1251-1259.

Rangel, G.J., & Pillay, S.S. (2007). Evidence of bubbles in the Malaysian stock market: Interpretation and Challenges. *International Finance Review*, 175-202.

Riddel, M. (1999). Fundamentals, feedback trading, and housing market speculation: evidence from California. *Journal of Housing Economics*, *8*(4), 272-284.

Robson, C. (2002). Real world research: A resource for social scientists and practitioner researchers, Vol. 2, Blackwell Oxford.

Sá, F. (2014). Immigration and House Prices in the UK. *The Economic Journal*, *125*(587), 1393-1424

Saunders M, Lewis P. and Thornhill, A. (2009) Research methods for business studies Fifth Ed Pearson educational Centre Edinburgh Gate, Harlow, and Essex CM 202 J. England.

Sekara, U. (2013). *Research Methods for Business* (4thed.). Hoboken: John Wiley & Sons.

Selim, H. (2009). Determinants of house prices in Turkey: Hedonic regression versus artificial neural network. *Expert Systems with Applications*, *36*(2), 2843-2852.

Shao, A. W., Hanewald, K., & Sherris, M. (2015). Reverse mortgage pricing and risk analysis allowing for idiosyncratic house price risk and longevity risk. *Insurance: Mathematics and Economics*, 63(2015), 76-90.

Shao, A. W., Sherris, M., & Hanewald, K. (2013). Disaggregated house price indices. UNSW Australian School of Business Research Paper No. 2013ACTL09.

Shi, S., Jou, J. B., & Tripe, D. (2013). Policy Rate, Mortgage Rate and Housing Prices: Evidence from New Zealand. Retrieved from http://www.nzae.org.nz/wp-content/uploads/2014/05/Tripe.pdf

Shiller, R. J. (2005). Irrational exuberance, Princeton, NJ Stiglitz, Joseph E., 1990. In *Symposium on bubbles, in: The Journal of Economic Perspectives*, 4(2), 13-18.

Shiller, R. J. (2007). *Understanding recent trends in house prices and home ownership* (No. w13553). National Bureau of Economic Research.

Shimizu, C., & Nakagawa, M. (2018). Aging and House Prices: The Impact of Aging Housing Stock to Housing Market in the Tokyo Metropolitan Area. Retrieved from https://hermes-ir.lib.hit-u.ac.jp/rs/bitstream/10086/29062/1/070econDP18-01.pdf

Sila, T. M., & Olweny, T. (2014). Financial determinants affecting the cost of houses in Kenya: a case study of National Housing Corporation. *International Journal of Business & Law Research*, *2*(4), 1-16.

Simo-Kengne, B. D., Balcilar, M., Gupta, R., Reid, M., & Aye, G. C. (2013). Is the relationship between monetary policy and house prices asymmetric across bull and bear markets in South Africa? Evidence from a Markov-Switching Vector Autoregressive model. *Economic Modelling*, *32*, 161-171.

Sims, C. A. (1980a). Macroeconomics and reality. *Econometrica,* 48(1), 1-48.

Sing, T. F., Tsai, I. C., & Chen, M. C. (2006). Price dynamics in public and private housing markets in Singapore. *Journal of Housing Economics*, *15*(4), 305-320.

Singh, C. (2015). 'Working Paper No : 477 Housing Price Indices In India', (January), pp. 1–48.

Sivitanides, P. (2015). Macroeconomic Influences on Cyprus House Prices: 2006Q1-2014Q2. *Cyprus Economic Policy Review*, *9*(1), 3-22.

Sivitanides, P. S. (2018). Macroeconomic drivers of London house prices. *Journal of Property Investment & Finance*.DOI 10.1108/JPIF-02-2018-0012

South African Reserve Bank (2011), Note on Recent Developments in Household Balance Sheet. Quarterly Bulletin, December 2011: retrieved from https://www.resbank.co.za/Lists/News%20and%20Publications/Attachments/4899/01Full%20Quarterly%20Bulletin.pdf

Stadelmann, D. (2010). Which factors capitalize into house prices? A Bayesian averaging approach. *Journal of Housing Economics*, *19*(3), 180-204.

Stadelmann, D. (2010). *Effects of Fiscal Policies on House Prices*. Nomos Verlagsgesellschaft mbH & Co. KG.

Sutton, G. D, Mihaljek, D., & Subelyte, A. (2017). Interest rates and house prices in the United States and around the world. BIS Working Paper No. 665. Available at SSRN: https://ssrn.com/abstract=3052374.

Sutton, G. D. (2002). Explaining changes in house prices. *BIS quarterly review*, *32*, 46-55.

Tabachnick, B. G. & Fidell, L.S. (2007). *Using Multivariate Statistics*, 5thed. Boston: Parson Education.

Taylor, J.B (2007). Housing and Monetary Policy. Proceedings of the Jackson Hole Symposium, Federal Reserve Bank of Kansas City, August.

Teklay, F. (2012). Housing supply and the level of house prices: An outlook on the greater Stockholm region real estate market. Retrieved from https://www.kth.se/polopoly_fs/1.330945!/Menu/general/column-content/attachment/Nr%20130.pdf

Tem, N. S. D., & Yilmaz, N. K. (2018). Determinants of Residential Real Estate Prices in Turkey. *European Journal of Business and Social Sciences*, *6*(10), 41-54.

Terrones, M., &Otrok, C. (2004). *The global house price boom*. International Monetary fund, Pp.71-89.

Tsatsaronis, K., & Zhu, H. (2004). What Drives Housing Price Dynamics: Cross-Country Evidence. *Bank of International Settlement Quarterly Review,* (March, 65-78).

Tuluca, S. Myer, F., & Webb, F. (2000). Dynamics of Private and Public Real Estate Markets, *Journal of Real Estate Finance and Economics*, 21(3), 279-96.

Turner, B. (1995). What determines regional house prices in Sweden?—a cross sectionanalysis, *Scandinavian Housing and Planning Research, 12*(3), 155-163, DOI: 10.1080/02815739508730384

Tze, S. O. (2013). Factors affecting the price of housing in Malaysia. Journal of Emerging Issues in Economics, Finance and Banking (JEIEFB). *An Online International Monthly Journal* (ISSN: 2306 367X), *1*(5), 414-429.

United States Department of Labor, Bureau of Labor Statistics. (2018). Economic News Release: Consumer Expenditures—2017. Retrieved from https://www.bls.gov/news.release/cesan.nr0.htm.

Valadez, R. M. (2011). The housing bubble and the GDP: a correlation perspective. *Journal of Case Research in Business and Economics*, *3* (1), 1-18

Wadud, I. M., Bashar, O. H., & Ahmed, H. J. A. (2012). Monetary policy and the housing market in Australia. *Journal of Policy Modeling*, *34*(6), 849-863.

Wang, S. T., Yang, Z., & Liu, H. Y. (2008). Empirical study on urban housing price interactions among regional markets in China. *Research on Financial and Economic Issues*, *6*, 122-129.

Warnock, V. C., & Warnock, F. E. (2008). Markets and housing finance. *Journal of Housing economics*, *17*(3), 239-251.

Watkins, C. (1999). Property valuation and the structure of urban housing markets. *Journal of Property Investment & Finance*, *17*(2), 157-175.

West, X. (2018). Mortgage Debt is the Largest Liability for Most U.S. Households: retrieved from https://dsnews.com/news/08-03-2015/mortgage-debt-is-the-largest-liability-for-most-u-s-households.

White, H. (1980). A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. *Econometrica: Journal of the Econometric Society* 48, 817-838.

White, P.T (2016). The sources of house price change: identifying liquidity shocks to the housing market. *Journal of European Real Estate Research*, *9*(1), 98-120.

Williams, M. (April 12, 2010). Uncontrolled Risk. McGraw-Hill Education. ISBN 978-0-07- 163829-6

World Bank (2011a). Turning the Tide in Turbulent Times: Making the Most of Kenya's Demographic Change and Rapid Urbanization. © Washington, DC.

World Bank. (2011b). Developing Kenya's Mortgage Market: World Bank Report No. 63391-KE. Retrieved from https://housingfinanceafrica.org/app/uploads/Kenya_Expanding_Mortgage_FinanceSM.pdf

Wu, J., Gyourko, J., & Deng, Y. (2012). Evaluating conditions in major Chinese housing markets. *Regional Science and Urban Economics*, *42*(3), 531-543.

Xiuzhi, Z., & Xiaoguang, W. (2006). The Analysis: the Influence of RMB Exchange Rate Fluctuation on Real Estate Price in China. Retrieved from https://www.fig.net/resources/proceedings/fig_proceedings/fig2006/papers/ts66/ts66_06_zhang_wu_0440.pdf

Xu, S. (2013). *An equilibrium analysis of the rise in house prices and mortgage debt* (No. 2013-9). Bank of Canada Working Paper.

Xu, X. E., & Chen, T. (2012). The effect of monetary policy on real estate price growth in China. *Pacific-Basin Finance Journal*, *20*(1), 62-77.

Ya-chen, L., & Shuai, Z. (2013, July). Econometric Analysis on the Relationship between RMB Exchange Rate and Real Estate Price by V AR Model. In *2nd International Conference on Science and Social Research*, 428-430.

Yang, L., & Zhiqiang, H. (2012). On correlation between RMB exchange rate and real estate price based on financial engineering. *Systems Engineering Procedia*, 3(2012), 146-152.

Zahirovich-Herbert, V., & Gibler, K. M. (2014). The effect of new residential construction on housing prices. *Journal of Housing Economics*, 26(2014), 1-18.

Zhang, Y., Hua, X., & Zhao, L. (2012). Exploring determinants of housing prices: A case study of Chinese experience in 1999–2010. *Economic Modelling*, *29*(6), 2349 2361.

Zoppi, C., Argiolas, M., & Lai, S. (2015). Factors influencing the value of houses: Estimates for the city of Cagliari, Italy. *Land Use Policy*, 42(2015), 367-380.

Zou, G. L., & Chau, K. W. (2015). Determinants and sustainability of house prices: The case of Shanghai, China. *Sustainability*, *7*(4), 4524-4548.

APPENDICES

Appendix I: Introduction Letter For Data Collection

Margaret Kosgei,

P.O. Box, 29329 00625,

Nairobi.

Date

Name of Respondent----------

Company Name and address----------

Dear Sir/ Madam,

RE: FACILITATION OF RESEARCH

I am a Doctor of Philosophy student at Moi University, undertaking a Research Project: "**Determinants of house prices in Nairobi County, Kenya''**

The research is being carried out as part of the requirements of obtaining the degree. You have been selected to form part of this study and are kindly requested to provide appropriate data from your organization.

The information provided will exclusively be used for academic purposes only and will be treated with utmost confidence. As a participant, you are free to request for a soft copy which can be sent to you via email. Your cooperation and assistance will be highly appreciated.

Yours faithfully,

_____ _____

Margaret Kosgei Dr. Joel Tenai

SBE/DPHIL/117/12

_____

Dr. Lucy Rono

(Supervisors)

Appendix II: Hass Consult Market Categorization By Location

Nairobi Suburbs
Donholm
Eastleigh
Gigiri
Karen
Kileleshwa
Kilimani
Kitisuru
Langata
Lavington
Loresho
Muthaiga
Nyari
Parklands
Ridgeways
Runda
Spring Valley
Upperhill
Westlands
Nairobi Satellite Towns
Athi River
Juja
Kiambu
Kiserian
Kitengela
Limuru
Mlolongo
Ngong
OngataRongai
Ruaka
Ruiru
Syokimau
Thika
Tigoni

Source: Hass Consult Ltd (2017)

Appendix III: Data Collection Tool (House Price Index)

Year	Quarter	HPI	Year	Quarter	HPI
2004	Q1	142.0247		Q3	273.7769
	Q2	144.0892		Q4	287.6825
	Q3	142.7754	2011	Q1	301.8601
	Q4	139.9944		Q2	309.9525
2005	Q1	144.0781		Q3	310.4008
	Q2	148.9866		Q4	306.2797
	Q3	150.8158	2012	Q1	307.2757
	Q4	151.2563		Q2	313.6621
2006	Q1	153.0944		Q3	328.6008
	Q2	156.2556		Q4	335.1862
	Q3	164.8936	2013	Q1	337.838
	Q4	171.3559		Q2	343.3704
2007	Q1	175.2836		Q3	342.5169
	Q2	178.0796		Q4	337.9537
	Q3	180.5343	2014	Q1	341.9523
	Q4	184.5749		Q2	345.6109
2008	Q1	188.1679		Q3	352.5041
	Q2	198.753		Q4	362.6107
	Q3	214.2017	2015	Q1	363.1787
	Q4	229.9038		Q2	367.8486
2009	Q1	238.4699		Q3	380.8292
	Q2	244.9479		Q4	396.951
	Q3	253.9392	2016	Q1	412.7976
	Q4	267.3133		Q2	428.9344
2010	Q1	267.9673		Q3	439.3879
	Q2	268.3738		Q4	437.4422

Source: Hass Consult Ltd (2017)

Appendix IV: Data Collection Tool (Mortgage Rate)

Year	Quarter	MGR	Year	Quarter	MGR
2004	Q1	10.4108		Q3	14.3767
	Q2	9.08942		Q4	14.0171
	Q3	10.1131	2011	Q1	14.0568
	Q4	11.0794		Q2	13.967
2005	Q1	12.0382		Q3	14.1252
	Q2	13.3891		Q4	17.972
	Q3	13.0999	2012	Q1	20.1075
	Q4	12.5497		Q2	20.0208
2006	Q1	14.124		Q3	20.1404
	Q2	13.894		Q4	18.5165
	Q3	13.1307	2013	Q1	18.0469
	Q4	13.3642		Q2	17.3667
2007	Q1	13.1363		Q3	17.1525
	Q2	13.2457		Q4	17.1844
	Q3	13.0105	2014	Q1	17.2296
	Q4	13.2236		Q2	16.7064
2008	Q1	14.5504		Q3	16.4136
	Q2	14.7188		Q4	16.0792
	Q3	13.0154	2015	Q1	15.5226
	Q4	14.6279		Q2	15.2811
2009	Q1	15.4783		Q3	15.5665
	Q2	15.6794		Q4	17.3877
	Q3	15.6352	2016	Q1	18.4857
	Q4	15.4893		Q2	18.4483
2010	Q1	15.5585		Q3	16.4449
	Q2	14.5738		Q4	13.667

Source: CBK (2017)

Appendix V: Data Collection Tool (Exchange Rate)

Year	Quarter	EXCR	Year	Quarter	EXCR
2004	Q1	76.65		Q3	80.93
	Q2	78.81		Q4	80.58
	Q3	80.51	2011	Q1	82.24
	Q4	80.73		Q2	86.12
2005	Q1	76.56		Q3	93.01
	Q2	76.41		Q4	93.87
	Q3	75.38	2012	Q1	84.14
	Q4	73.85		Q2	84.12
2006	Q1	72.10		Q3	84.28
	Q2	72.16		Q4	85.58
	Q3	73.13	2013	Q1	86.72
	Q4	71.01		Q2	84.61
2007	Q1	69.60		Q3	87.26
	Q2	67.45		Q4	85.91
	Q3	67.01	2014	Q1	86.33
	Q4	65.21		Q2	87.25
2008	Q1	67.88		Q3	88.24
	Q2	62.65		Q4	89.88
	Q3	68.60	2015	Q1	91.52
	Q4	77.62		Q2	95.84
2009	Q1	79.58		Q3	102.97
	Q2	78.45		Q4	102.38
	Q3	76.24	2016	Q1	101.91
	Q4	75.14		Q2	101.04
2010	Q1	76.49		Q3	101.34
	Q2	78.94		Q4	101.73

Source: CBK (2017)

Appendix VI: Data Collection Tool (Interest Rate)

YEAR	MON	RATE	YEAR	MON	RATE	YEAR	MON	RATE	YEAR	MON	RATE	YEAR	MON	RATE	YEAR	MON	RATE
2004	Jan	13.48	2006	Mar	13.33	2008	May	13.53	2010	Jul	14.29	2012	Sep	19.73	2014	Nov	15.94
2004	Feb	13.01	2006	Apr	13.51	2008	Jun	13.30	2010	Aug	14.18	2012	Oct	19.04	2014	Dec	15.99
2004	Mar	13.12	2006	May	13.95	2008	Jul	13.46	2010	Sep	13.98	2012	Nov	18.70	2015	Jan	15.93
2004	Apr	12.67	2006	Jun	13.79	2008	Aug	13.11	2010	Oct	13.85	2012	Dec	18.15	2015	Feb	15.47
2004	May	12.55	2006	Jul	13.72	2008	Sep	13.43	2010	Nov	13.95	2013	Jan	18.13	2015	Mar	15.46
2004	Jun	12.17	2006	Aug	13.64	2008	Oct	13.91	2010	Dec	13.87	2013	Feb	17.84	2015	Apr	15.40
2004	Jul	12.31	2006	Sep	13.54	2008	Nov	13.85	2011	Jan	14.03	2013	Mar	17.73	2015	May	15.26
2004	Aug	12.19	2006	Oct	14.01	2008	Dec	14.40	2011	Feb	13.20	2013	Apr	17.87	2015	Jun	16.06
2004	Sep	12.27	2006	Nov	13.93	2009	Jan	14.78	2011	Mar	13.69	2013	May	17.44	2015	Jul	15.75
2004	Oct	12.39	2006	Dec	13.74	2009	Feb	14.67	2011	Apr	13.92	2013	Jun	16.97	2015	Aug	15.68
2004	Nov	11.97	2007	Jan	13.78	2009	Mar	14.87	2011	May	13.88	2013	Jul	17.02	2015	Sep	16.82
2004	Dec	12.25	2007	Feb	13.64	2009	Apr	14.71	2011	Jun	13.91	2013	Aug	16.96	2015	Oct	16.58
2005	Jan	12.12	2007	Mar	13.56	2009	May	14.85	2011	Jul	14.13	2013	Sep	16.85	2015	Nov	17.16
2005	Feb	12.35	2007	Apr	13.44	2009	Jun	15.09	2011	Aug	14.32	2013	Oct	17.00	2015	Dec	18.30
2005	Mar	12.84	2007	May	13.38	2009	Jul	14.79	2011	Sep	14.79	2013	Nov	16.89	2016	Jan	17.96
2005	Apr	13.12	2007	Jun	13.14	2009	Aug	14.76	2011	Oct	15.21	2013	Dec	16.99	2016	Feb	17.86
2005	May	13.11	2007	Jul	13.29	2009	Sep	14.74	2011	Nov	18.48	2014	Jan	17.03	2016	Mar	17.79
2005	Jun	13.09	2007	Aug	13.04	2009	Oct	14.78	2011	Dec	20.04	2014	Feb	17.06	2016	Apr	17.94
2005	Jul	13.09	2007	Sep	12.87	2009	Nov	14.85	2012	Jan	19.54	2014	Mar	16.91	2016	May	18.08
2005	Aug	13.03	2007	Oct	13.24	2009	Dec	14.76	2012	Feb	20.28	2014	Apr	16.70	2016	Jun	18.15
2005	Sep	12.83	2007	Nov	13.39	2010	Jan	14.98	2012	Mar	20.34	2014	May	16.97	2016	Jul	18.10
2005	Oct	12.97	2007	Dec	13.32	2010	Feb	14.98	2012	Apr	20.22	2014	Jun	16.36	2016	Aug	17.71
2005	Nov	12.93	2008	Jan	13.41	2010	Mar	14.96	2012	May	20.12	2014	Jul	16.91	2016	Sep	13.84
2005	Dec	13.16	2008	Feb	13.26	2010	Apr	14.58	2012	Jun	20.30	2014	Aug	16.24	2016	Oct	13.65
2006	Jan	13.20	2008	Mar	13.48	2010	May	14.44	2012	Jul	20.15	2014	Sep	16.04	2016	Nov	13.46
2006	Feb	13.27	2008	Apr	13.46	2010	Jun	14.39	2012	Aug	20.13	2014	Oct	16.00	2016	Dec	13.67

Source: CBK (2017)

Appendix VII: Data Collection Tool (Urbanpopulation)

YEAR	NUMBERS
2000	6,179,613
2001	6,448,809
2002	6,731,606
2003	7,028,280
2004	7,338,623
2005	7,661,904
2006	7,999,252
2007	8,351,571
2008	8,719,733
2009	9,103,961
2010	9,505,787
2011	9,927,120
2012	10,367,724
2013	10,827,096
2014	11,304,277
2015	11,799,008
2016	12,313,727

Source: KNBS (2017)

Appendix VIII: Data Collection Tool (Number of Houses)

YEAR	NEWHS
2000	1,017
2001	941
2002	1,040
2003	1,142
2004	1,740
2005	1,815
2006	1,903
2007	2,350
2008	2,401
2009	3,557
2010	4,715
2011	4,812
2012	4,824
2013	5,447
2014	6,538
2015	7,434
2016	9,685

Source: KNBS (2017)

Appendix IX: Data Collection Tool (Inflation)

Year	Quarter	INFLR	Year	Quarter	INFLR
2004	Q1	9.11		Q3	3.33
	Q2	6.06		Q4	3.84
	Q3	14.44	2011	Q1	7.05
	Q4	17.59		Q2	13.16
2005	Q1	14.32		Q3	16.50
	Q2	14.24		Q4	19.19
	Q3	7.63	2012	Q1	16.87
	Q4	5.77		Q2	11.78
2006	Q1	17.80		Q3	6.38
	Q2	12.97		Q4	3.53
	Q3	11.80	2013	Q1	4.08
	Q4	15.30		Q2	4.37
2007	Q1	7.47		Q3	6.99
	Q2	7.70		Q4	7.42
	Q3	12.57	2014	Q1	6.78
	Q4	11.47		Q2	7.03
2008	Q1	19.70		Q3	7.54
	Q2	29.13		Q4	6.18
	Q3	27.43	2015	Q1	5.82
	Q4	28.50		Q2	6.99
2009	Q1	14.17		Q3	6.14
	Q2	10.20		Q4	7.35
	Q3	7.47	2016	Q1	7.02
	Q4	5.63		Q2	5.36
2010	Q1	5.56		Q3	6.33
	Q2	3.68		Q4	6.50

Source: KNBS (2017)

Appendix X: Data Collection Tool (GDP)

YEAR	QUARTER	KHS.M	YEAR	QUARTER	KHS.M
2004	Quarter 1	277,843	2010	Quarter 3	372,972
2004	Quarter 2	272,474	2010	Quarter 4	374,262
2004	Quarter 3	274,250	2011	Quarter 1	376,982
2004	Quarter 4	283,922	2011	Quarter 2	381,629
2005	Quarter 1	284,909	2011	Quarter 3	387,494
2005	Quarter 2	292,281	2011	Quarter 4	393,028
2005	Quarter 3	295,448	2012	Quarter 1	840,105
2005	Quarter 4	301,341	2012	Quarter 2	848,105
2006	Quarter 1	303,285	2012	Quarter 3	865,628
2006	Quarter 2	309,246	2012	Quarter 4	887,025
2006	Quarter 3	317,895	2013	Quarter 1	900,023
2006	Quarter 4	317,918	2013	Quarter 2	908,883
2007	Quarter 1	326,997	2013	Quarter 3	919,729
2007	Quarter 2	335,444	2013	Quarter 4	928,553
2007	Quarter 3	337,180	2014	Quarter 1	941,306
2007	Quarter 4	338,043	2014	Quarter 2	960,133
2008	Quarter 1	327,473	2014	Quarter 3	968,765
2008	Quarter 2	346,655	2014	Quarter 4	980,579
2008	Quarter 3	347,608	2015	Quarter 1	997,936
2008	Quarter 4	338,944	2015	Quarter 2	1,010,039
2009	Quarter 1	352,367	2015	Quarter 3	1,023,792
2009	Quarter 2	347,477	2015	Quarter 4	1,040,914
2009	Quarter 3	348,390	2016	Quarter 1	1,057,489
2009	Quarter 4	345,943	2016	Quarter 2	1,067,755
2010	Quarter 1	358,101	2016	Quarter 3	1,072,565
2010	Quarter 2	368,663	2016	Quarter 4	1,079,341

Source: KNBS (2017)

Appendix XI: VAR Estimates

Table 4.6 Vector Auto regression Estimates

	LNHPI	LNEXCR	LNINFRT	LNINTR	LNMGR	LNNEWBL	LNQGDP	LNUPOP
LNHPI(-1)	0.932738	0.429414	-0.041107	0.106304	0.036421	0.295426	-1.034680	0.000553
	(0.07668)	(0.11580)	(1.22850)	(0.17520)	(0.26263)	(0.16396)	(0.29445)	(0.00014)
	[12.1645]	[3.70831]	[-0.03346]	[0.60675]	[0.13867]	[1.80186]	[-3.51397]	[4.07206]
LNEXCR(-1)	-0.060171	0.743088	-0.426948	0.320784	0.328465	0.077565	0.410600	-0.000131
	(0.05256)	(0.07937)	(0.84203)	(0.12009)	(0.18001)	(0.11238)	(0.20182)	(9.3E-05)
	[-1.14491]	[9.36238]	[-0.50705]	[2.67126]	[1.82467]	[0.69022]	[2.03450]	[-1.40611]
LNINFRT(-1)	0.005677	0.020578	0.577897	0.017585	0.012630	-0.000861	-0.000143	-4.02E-06
	(0.00763)	(0.01153)	(0.12227)	(0.01744)	(0.02614)	(0.01632)	(0.02931)	(1.4E-05)
	[0.74382]	[1.78546]	[4.72627]	[1.00840]	[0.48315]	[-0.05273]	[-0.00489]	[-0.29743]
LNINTR(-1)	-0.034186	-0.230063	1.148693	0.997222	0.307626	-0.097692	1.755193	0.000230
	(0.09636)	(0.14553)	(1.54389)	(0.22018)	(0.33006)	(0.20605)	(0.37004)	(0.00017)
	[-0.35476]	[-1.58090]	[0.74403]	[4.52904]	[0.93203]	[-0.47412]	[4.74323]	[1.34757]
LNMGR(-1)	0.050139	-0.140375	-2.483577	-0.011503	0.668920	-0.007574	-0.530217	-2.82E-05
	(0.06312)	(0.09532)	(1.01126)	(0.14422)	(0.21619)	(0.13496)	(0.24238)	(0.00011)
	[0.79435]	[-1.47264]	[-2.45591]	[-0.07976]	[3.09409]	[-0.05612]	[-2.18753]	[-0.25226]
LNNEWBL(-1)	-0.017531	0.004173	-1.772520	-0.282525	-0.297859	0.788400	-0.230239	-5.45E-05
	(0.05363)	(0.08099)	(0.85921)	(0.12254)	(0.18369)	(0.11467)	(0.20594)	(9.5E-05)
	[-0.32689]	[0.05153]	[-2.06296]	[-2.30562]	[-1.62156]	[6.87530]	[-1.11800]	[-0.57340]
LNQGDP(-1)	-0.024008	0.132738	-0.808533	-0.152976	-0.186612	0.006092	0.303313	-1.18E-05
	(0.03006)	(0.04539)	(0.48155)	(0.06868)	(0.10295)	(0.06427)	(0.11542)	(5.3E-05)
	[-0.79877]	[2.92434]	[-1.67902]	[-2.22748]	[-1.81269]	[0.09479]	[2.62795]	[-0.22158]
LNUPOP(-1)	0.301866	-0.866542	9.370285	0.967181	1.275998	0.098778	4.208167	0.998804
	(0.25065)	(0.37853)	(4.01576)	(0.57271)	(0.85851)	(0.53595)	(0.96250)	(0.00044)
	[1.20435]	[-2.28925]	[2.33337]	[1.68877]	[1.48629]	[0.18431]	[4.37210]	[2248.28]
C	-3.787383	11.86612	-118.7270	-13.20429	-17.20796	-1.574303	-55.95805	0.027573
	(3.29615)	(4.97784)	(52.8097)	(7.53153)	(11.2899)	(7.04803)	(12.6575)	(0.00584)
	[-1.14903]	[2.38379]	[-2.24820]	[-1.75320]	[-1.52419]	[-0.22337]	[-4.42094]	[4.71955]
R-squared	0.997563	0.954959	0.737212	0.911889	0.862627	0.995230	0.983374	1.000000
Adj. R-squared	0.997098	0.946379	0.687158	0.895105	0.836461	0.994321	0.980207	1.000000
Sum sq. resids	0.015984	0.036456	4.103091	0.083455	0.187528	0.073083	0.235711	5.02E-08
S.E. equation	0.019509	0.029462	0.312558	0.044576	0.066820	0.041714	0.074914	3.46E-05
F-statistic	2148.662	111.3098	14.72812	54.33364	32.96713	1095.350	310.5218	1.35E+08
Log likelihood	133.3672	112.3429	-8.103699	91.22372	70.57830	94.60760	64.74700	456.4728
Akaike AIC	-4.877146	-4.052665	0.670733	-3.224460	-2.414835	-3.357161	-2.186157	-17.54795
Schwarz SC	-4.536236	-3.711754	1.011644	-2.883549	-2.073925	-3.016250	-1.845246	-17.20704
Mean dependent	5.541208	4.400971	2.185965	2.707685	2.704232	8.256984	13.13084	16.07294
S.D. dependent	0.362158	0.127231	0.558815	0.137633	0.165233	0.553554	0.532490	0.160490

Determinant resid covariance (c	1.16E-28
Determinant resid covariance	2.46E-29
Log likelihood	1100.867
Akaike information criterion	-40.34772
Schwarz criterion	-37.62043

Source: Researcher 2017

Appendix XIII: White Heteroscedasticity Tests Results

Table 4.13: White Heteroscedasticity Tests (no cross terms)
VEC Residual Heteroscedasticity Tests (Levels and Squares)
Date: 07/12/17 Time: 15:50
Sample: 2004Q1 2016Q4
Included observations: 49

Joint test:

Chi-sq	Df	Prob.
1225.834	1224	0.4799

Individual components:

Dependent	R-squared	F(34,14)	Prob.	Chi-sq(34)	Prob.
res1*res1	0.667648	0.827178	0.6864	32.71476	0.5306
res2*res2	0.494312	0.402501	0.9849	24.22128	0.8926
res3*res3	0.776127	1.427516	0.2418	38.03024	0.2909
res4*res4	0.662514	0.808330	0.7047	32.46319	0.5430
res5*res5	0.630068	0.701319	0.8056	30.87335	0.6217
res6*res6	0.643768	0.744123	0.7661	31.54461	0.5885
res7*res7	0.933691	5.798044	0.0005	45.75087	0.0859
res8*res8	0.465520	0.358637	0.9927	22.81046	0.9278
res2*res1	0.813703	1.798494	0.1205	39.87145	0.2253
res3*res1	0.757474	1.286051	0.3152	37.11622	0.3273
res3*res2	0.787531	1.526237	0.2007	38.58903	0.2698
res4*res1	0.668667	0.830988	0.6828	32.76470	0.5281
res4*res2	0.682448	0.884918	0.6309	33.43993	0.4949
res4*res3	0.549365	0.501980	0.9497	26.91891	0.8008
res5*res1	0.673912	0.850977	0.6635	33.02170	0.5154
res5*res2	0.601183	0.620700	0.8737	29.45796	0.6899
res5*res3	0.478628	0.378006	0.9897	23.45275	0.9129
res5*res4	0.610200	0.644583	0.8546	29.89978	0.6689
res6*res1	0.467817	0.361962	0.9922	22.92301	0.9253
res6*res2	0.668814	0.831539	0.6822	32.77188	0.5277
res6*res3	0.602015	0.622860	0.8720	29.49875	0.6880
res6*res4	0.756905	1.282081	0.3176	37.08837	0.3285
res6*res5	0.492040	0.398860	0.9857	24.10998	0.8957
res7*res1	0.691484	0.922896	0.5950	33.88270	0.4734
res7*res2	0.738710	1.164124	0.3943	36.19677	0.3664
res7*res3	0.579637	0.567781	0.9118	28.40222	0.7383
res7*res4	0.731936	1.124302	0.4235	35.86484	0.3810
res7*res5	0.723803	1.079074	0.4586	35.46636	0.3990
res7*res6	0.352366	0.224033	0.9998	17.26592	0.9924

res8*res1	0.575966	0.559302	0.9173	28.22236	0.7462
res8*res2	0.587618	0.586737	0.8989	28.79326	0.7207
res8*res3	0.554014	0.511503	0.9449	27.14668	0.7917
res8*res4	0.793372	1.581016	0.1810	38.87522	0.2594
res8*res5	0.760060	1.304351	0.3047	37.24294	0.3221
res8*res6	0.370618	0.242471	0.9996	18.16026	0.9880
res8*res7	0.571288	0.548704	0.9239	27.99309	0.7562

Source: Researcher 2017