HOUSING MARKET FUNDAMENTALS AND HOUSING PRICES IN NAIROBI CITY COUNTY, KENYA

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D86/CTY/31596/2015

A THESIS SUBMITTED TO THE SCHOOL OF BUSINESS IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF DEGREE OF DOCTOR OF PHILOSOPHY (FINANCE) OF KENYATTA UNIVERSITY.

DECEMBER, 2020

DECLARATION

I declare that this thesis is my original work and has not been presented for a degree at any other University.

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DEDICATION

This thesis is dedicated to my late brother Mr. Nelson Karani for his encouragement and guidance enabled me to commence my PhD study. I also dedicate this thesis to my wife and my daughters Laureen and Precious.

ACKNOWLEDGEMENT

Most of all, I give thanks to the almighty God for His fortitude, strength, and knowledge that inspired me to undertake a PhD study. I am incredibly thankful to my supervisors Dr. Job Omagwa and Dr. Lucy Wamugo, for their unconditional and continuous guidance and reassurance. Their invaluable suggestions and critical guidance was a source of motivation throughout my PhD work. My sincere gratitude goes to Dr. Ambrose Jagongo, the Chairman Department of Accounting and Finance, Kenyatta University, for his encouragement and support towards my studies. I wish to recognise and appreciate the encouragement of Dr. Eddie Simiyu, especially in the early stages of my studies. To all staff in the Department of Accounting and Finance, I recognise their invaluable contribution to this thesis. Moreover, I express my special gratitude to Dr. Peter Kamau, the Dean of the School of Architecture and Built Environment, Kenyatta University. His encouragement and support helped me identify the area of study. To my colleagues in the Department of Construction and Real Estate Management, Kenyatta Univesity, I acknowledge their encouragement and support throughout my study. I equally appreciate the effort and contribution of Mr. Cyrus Mutuku in the choice of the economic model. Finally, I express my most profound sense of appreciation to my daughters Laureen and Precious and the Nyachiro family. Thank you for your love, motivation, and moral support during my absence in pursuit of my PhD study.

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ABBREVIATIONS AND ACRONYMS

ADF	Augmented Dickey-Fuller
AfDB	African Development Bank
AIC	Akaike Information Criterion
ARCH	Autoregressive Conditionally Heteroskedastic
ARDL	Autoregressive Distributed Lags
BG	Breusch-Godfrey
B-P	Breusch–Pagan
CAHF	Centre of Affordable Housing in Africa
CBK	Central Bank of Kenya
CUSUM	Cumulative Sum of Residuals
DOLS	Dynamic Ordinary Least Square
DW	Durbin Watson
ECM	Error Correction Model
ECT	Error Correction Term
FAVAR	Factor Argument Vector Autoregression
FPE	Final Prediction Error
GDP	Gross Domestic Product
GLS	Generalised Least Square
GMM	Generalised Method of Moment
HPI	House Price Index
HQIC	Hanna Quin Information Criterion
JB	Jarque Bera
KBA	Kenya Bankers Association
KES	Kenyan Shillings
KIPPRA	Kenya Institute of Public Policy Research and Analysis
KNBS	Kenya National Bureau of Statistics
KPDA	Kenya Property Developers Association
KPSS	Kwiatkowski, Phillips, Schmidt, and Shin
LM	Lagrange Multiplier
NACOSTI	National Commission for Science, Technology, and Innovation

NSE	Nairobi Securities Exchange
OECD	Organisation of Economic Corporation Development
OLS	Ordinary Least Square
PIH	Permanent Income Hypothesis
PP	Phillip Peron
RESET	Ramsey Regression Equation Specification Test
SACCO	Savings and Credit Cooperative Society
SCIC	Schwarz Information Criterion
STAR	Smooth Transition Autoregressive
SVAR	Structural Vector Auto-Regressive
UK	United Kingdom
USA	United States of America
USD	United States Dollars
VAR	Vector Auto-Regressive
VECM	Vector Error Correction Model

OPERATIONAL DEFINITION OF TERMS

Bubble	A notable increase in the price of an asset that is not justified by fundamental factors or a condition whereby an increase in asset prices is way above the expected future value of an asset.
Construction Cost	The average cost of putting up a building, composed of the real cost of labour, building materials, and the cost of building plans approvals by the local governments.
Housing Prices	The sum of the long-run minimum average cost of producing a house and the necessary infrastructure and the value of land in alternative use.
Housing Prices Index	A measure that represents the levels and movement of typical prices for houses in a given housing market.
Housing Supply	The level of dwelling units produced at a given time, measured by the number of new residential buildings reported completed by the relevant authority.
Investor Sentiments	Beliefs of irrational market participants about future asset prices and investment risks that are not based on the current information set.
Housing Market Fundamentals	A set of factors that determine housing prices in a competitive market with rational economic agents anchored on an established theory on how the housing market works.
Residential Real Estate	Combination of land and improvement on land available to provide accommodation to households such as single-family houses, flats, and multifamily houses such as apartments.
Structural Break	An abrupt change in an economic time series, which occurs due to variations of either economic regime, policy directions, or external shocks.

ABSTRACT

In Kenya, housing prices persistently rose from the year 2005 to 2018. An increase in housing prices is beneficial to an economy, but a persistent increase raises concerns over housing affordability and the potential risk of an unstable housing market. Empirical evidence indicates that variations in housing prices have been associated with market fundamentals. However, the extant literature documents contradictory findings on the nature of relationships: this formed a good basis for this study. The general objective was to assess the effect of housing market fundamentals on housing prices in Nairobi City County, Kenya. The specific objectives were to determine the effect of per capita income, interest rates, construction cost, inflation, and credit supply on housing prices in Kenya; the mediating effect of housing supply, and the moderating effect of investor sentiments on the relationship between housing market fundamentals and housing prices respectively. The study was anchored on the efficient market theory, rational expectations theory, permanent income hypothesis, real estate market equilibrium theory, and stock-flow model. The study adopted the positivist philosophy and an explanatory research design. The target population was 163,000 residential buildings units put up for sale in Nairobi City County, Kenya, over the period 2005-2018. The study was a census that used secondary data sourced from five distinct sources. The study employed linear and nonlinear autoregressive distributed lag (ARDL) models. Additionally, the study evaluated the moderating and mediating role of investor sentiment and housing supply on the relationship between market fundamentals and housing prices. The linear ARDL outcome indicated that per capita income, interest rate, inflation, and construction cost significantly affect housing prices in the short run. The nonlinear ARDL model outcome indicated that interest rate, inflation, and credit supply have a significant asymmetric impact on house prices in the short and the long run. Equally, the outcome indicated that per capita income and construction cost had a significant asymmetric impact on housing prices only in the long run. Further, the study found that investors' sentiment significantly moderates the relationship between housing market fundamentals and housing prices in the long run. Finally, the study found that housing supply partially mediates the relationship between housing market fundamentals and housing prices in both horizons. The study concluded that housing prices have a strong downward price stickiness due to changes in the interest rate; have a relatively rigid reaction to inflationary pressure; credit supply and housing supply are key factors in the determination of dynamics of housing prices; and that investor sentiments have a persistent role in pushing prices away from equilibrium prices. This outcome implies that stable macro-economic and macro-prudential policies and reduction of building costs and supply restrictions would stabilise housing prices in Kenya. The findings also imply that investor sentiments can lead to mispricing relative to rational expectations. The study recommends that Central Bank of Kenya in collaboration with financial institutions to come up with innovative housing finance products that take into account incremental housing and mixed planning to cater for the lower and middle income households; the Central Bank of Kenya should also fast track creation of a mortgage liquidity facility to enhance long term financing to lenders; the Government of Kenya should consider harmonisation of the fee structures and procedures of planning, approvals and titling across the national and county governments to shorten the process of property registration; The Kenyan State Department of Housing and Urban Planning should enhance review of policies around planning and infrastructure provision to reduce supply restrictions and encourage incremental housing; and finally the Capital Markets Authority and Institute of Surveyors of Kenya should develop a nationwide real estate sentiment index to mitigate systematic risk associated with speculative housing development.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Housing forms a significant part of individual households' and national wealth portfolios (Oikarinen, 2012). Equally, housing investment is a significant constituent of the gross domestic product as it takes a lead role in formulating decisions related to consumption and investment (Iacoviello & Neri,2010). Housing as investment plays a crucial role in the economy by impacting financial stability, monetary policy transmission, and output growth (Galati, Teppa, & Alessie, 2011). The studies of Leamer (2007), Balcilar, Gupta, and Miller (2014), and Stock and Watson (2012) justify the importance of asset fluctuations, such as housing prices, in driving business and financial cycles.

Over time, changes in the real estate market have been associated with shocks to macroeconomic driving factors such as economic growth and interest rates (Nneji, Brooks & Ward, 2013). The preceding arguments underscore the association of housing markets to housing market fundamentals. In Kenya, the real estate and construction sectors contribute about 15 percent of the national gross domestic product (Central Bank of Kenya, 2018) and accounts for 70 percent of the middle-class household wealth (Centre for Affordable Housing Finance in Africa (CAHF), 2012). Hence, it is crucial to continuously measure housing price dynamics, especially at the regional (County) level.

Globally, the major financial and economic crises have been associated with housing bubbles. Therefore, it implies that a reversal of house price misalignment may severely affect the national economy (Rensburg & Burger, 2011). More often, housing markets tend to be cyclical, displaying episodes of boom and bursts whereby a consistent increase in house prices is followed by a downswing later (Lyons, 2018). A significant decrease in housing prices would negatively impact the financial sector through unanticipated losses (Wachter,2016). The impact may bring about lender institutions' failure, including banks, accompanied by adverse spillover effects on the entire economy (Mian & Sufi, 2011). Divergence of housing prices from market fundamentals may give rise to inappropriate investments, which lead to inefficiency in the economy (Carlson & Mishkin, 2006)

In the United Kingdom (UK), financial liberalisation in the 1980s, and the impact of reduced interest rates sparked a price boom in the housing market that ultimately crashed in the early 1990s. Similarly, during the US subprime mortgage crisis, properties rose by over 61 percent nationwide but decreased sharply in the following four years (Nneji *et al.*, 2013). The reversal of price appreciation led to the collapse of Lehman Brothers bank that had a significant number of mortgages in their books in the form of mortgage-backed products. Similarly, the financial liberation and a dramatic decrease in lending rates by the Central Bank of Japan in the 1980s ignited real estate prices to their highest levels (Allen & Gale, 2000). In the early nineties, the property bubble burst as the Central Bank of Japan aggressively moved in to reduce interest rates. Similar episodes have been witnessed in Ireland, Spain, and recently in

South Africa. These happenings have been linked to changes in the housing market's fundamental factors, such as economic growth and interest rate, among other variables. The possibility of similar occurrences in the Kenyan housing market motivated an extensive investigation of housing market fundamentals' effect on housing prices in Kenya.

Over the past 15 years, housing prices in Nairobi city county and its peripheral towns have risen astronomically (Miregi & Obere, 2014). On average, residential property prices rose from KES 7.1 million in 2000 to KES 32 million in 2018 (HassConsult Ltd, 2018). This trend has been consistent despite the political instability of 2007 and 2012 and the global economic shocks (World Bank, 2017). The upward trend in house prices in Kenya was witnessed in all zones, including the medium and high-income neighbourhoods. However, the leading housing indices by Hass Consult, Kenya Bankers Authority (KBA), and Knight Frank (Kenya) all indicate a slowed growth in housing prices between 2016 and 2018 (Financial Sector Regulators Forum, 2018). The possible reversal of the upward trend witnessed in Kenya raises concerns about the sustainability in the Kenyan real estate market and whether the housing prices movement corresponds to the changes in underlying market fundamentals. The preceding concerns further motivated the main objective of the study.

The Kenyan Government has initiated various policies to enable affordable housing, a critical development agenda for the Kenyan Government (Central Bank of Kenya, 2018). Kenya’s Vision 2030 development strategy intended to produce 200,00 housing units is not achievable with the actual production of about 50,000 units. Hence

the cumulative housing deficit stands at 2 million units over the years, with almost 61percent of urban households living in slums (World Bank, 2018). Nairobi City County alone had an annual public target of producing 150,000 residential properties, but planning applications have averaged about 15,000 units each year (Kenya Property Developers Association-KPDA), 2018). Since the government aims to reduce the housing market's affordability gap, factors affecting house prices needed to be highlighted.

Among the government of Kenya's policies is the formulation of the session paper on housing policy in 2004, mainly to address the housing deficit, among other objectives. Since the year 2005, Kenya's Government annually increased the budgetary allocation towards housing development, especially for low and middle-income households. Kenya's government has implemented the Kenyan Slum Upgrading Program (KSUP), revamped the National Housing Corporation (NHC), finalized the implementation of the rural and peri-urban housing loans, and created the civil servants' housing scheme fund(CSHSF). Besides, Kenya's central bank issued new regulations on interest rates, capping interest rates at 4% above the central bank benchmark rate in 2016 on top of severally increasing the interest rates since 2005, which directly affects mortgage rates.

Despite implementing these policies, among other measures to regularize the housing market, high housing prices still persevere against the theoretical expectations (CAHF, 2012). Once the housing shortage and affordability are overcome, the housing multiplier effect would improve economic growth, create jobs, and deepen the

financial sector. Therefore, there was a need to empirically assess whether housing price appreciation is congruent with market fundamentals. A more recent report by the (Kenya Bankers Association (KBA), 2015) indicated that house prices are overvalued and forecast a fall in prices towards equilibrium point over the next two years. Thus the upward movement in house prices in Kenya may partly be associated with factors unrelated to market fundamentals such as investor sentiments and speculative trading that needed empirical investigation.

The study's main objective was to evaluate the effects of housing market fundamentals on housing prices. The study partitioned the impact of housing market fundamentals on housing prices into their short-run and long-run components through the linear and nonlinear autoregressive methodologies. Equally, the study assessed whether these effects were symmetric or asymmetric. The study further investigated whether investor sentiment and housing supply have moderating and mediating effects on the relationship between housing market fundamentals and housing prices, respectively. The study's outcome would guide the policymakers in providing mitigating strategies to reduce localized housing market crash. Furthermore, understanding the behaviour of housing prices over time would be vital in assessing the effect of market shocks on housing prices and the spillover effect on the general economy.

1.1.1 Housing Market Fundamentals

Housing market fundamentals are a set of factors that determine housing prices in a competitive market with rational economic agents in connection with an established theory on how the market works (Lind, 2018). In the current world, the generally

established theory to consider is the microeconomic theory. The 4-Q standard equilibrium framework by DiPasquale and Wheaton (1992) represents an established theory that contextualizes the microeconomic theory in the real estate market. Taking this model into consideration, it can be said that housing price formation dependent on the residential housing market's supply and demand. Examining this model in detail, housing price becomes a function of income, construction cost, housing supply, the user cost of housing prices, and a vector of demand and supply shifters.

Case and Shiller (2003) identified per capita income, housing starts, mortgage interest rates, among other factors, to constitute fundamental factors. Other studies consider construction costs or gross domestic product (GDP) growth as fundamentals (Anop-engerstam, 2015). In most empirical studies, income growth, credit availability, interest rates, and inflation have emerged as the most influential factors on the demand side (Muellbauer & Murphy, 2008), while construction cost and employment affect the supply side (Anop-Engerstam 2017). However, the outcomes of these studies vary depending on the geographical context and the study period. The theoretical considerations of these housing market fundamentals signal some tentative indications but may not be generalized in Nairobi, Kenya. Hence, the study sought to empirically assess the potential impact of housing market fundamentals on housing prices in Kenya.

The demand side market fundamentals include per capita income (Fraser, Hoesli, & Mcalevey, 2012), interest rates (Adam & Fuss, 2010), inflation (Parker & Wong, 2014), and the demographic characteristics of households (Harter, 2010). Supply-side

market fundamentals include the cost of construction (Mayer, 2011) and existing homes' prices (Lerbs, 2014). These sets of variables have significantly influenced housing price dynamics, as suggested in the extant literature. The study considered these variables to analyse the housing market in Kenya supported by the unpredictable effect of these variables on housing prices in Kenya (Kibunyi, Ndiritu, Carcel, & Gil-Alana, (2017); Njaramba, Gachanja, & Mugendi, 2018))

The growth rates in housing market fundamentals and housing prices in Kenya are presented in Figure 1.1

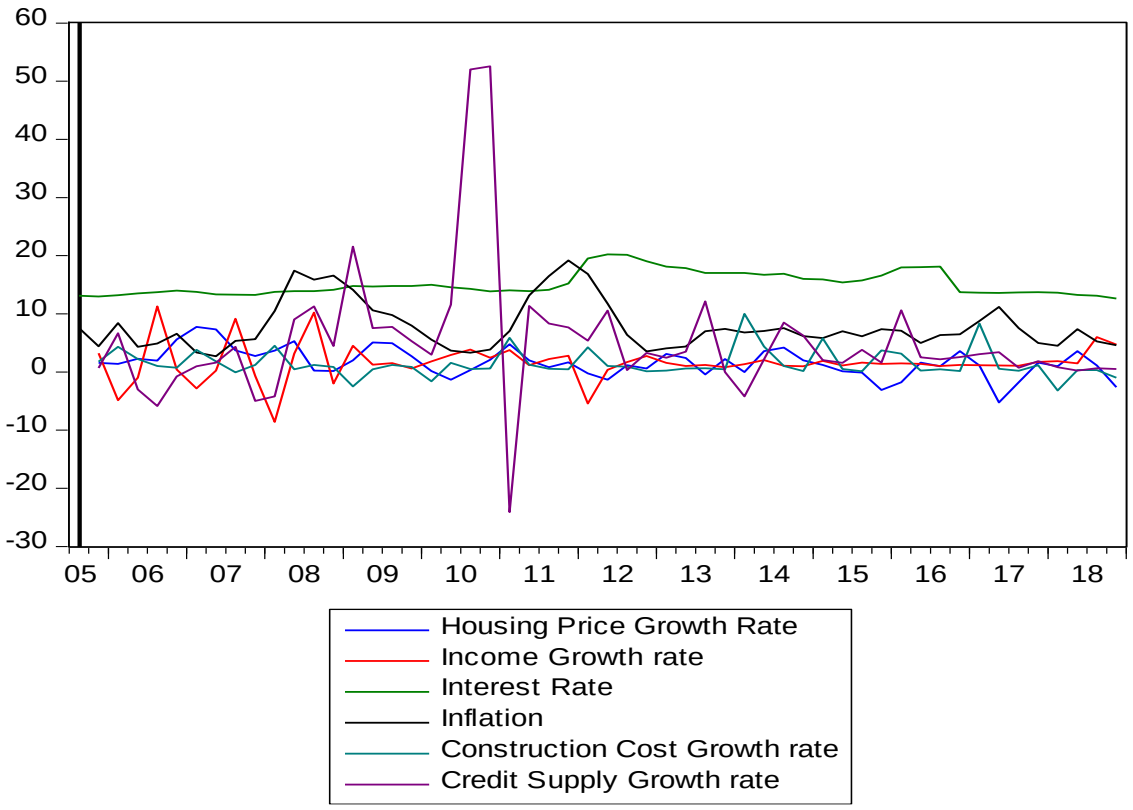

Figure 1.1: Housing Market Fundamentals in Kenya (2005-2018)

Source: Research Data (2020)

As shown in Figure 1.1, per capita income growth ranged between -5.0 percent and 11.3 percent over the study period, but it remained below 0.05 from 2009 to 2018. The nature of movement in housing prices compared to changes in income partly indicates that housing prices are not moving in line with income growth, necessitating the empirical investigation. Per capita income represents the households' wealth that influences housing stock affordability to the rest of the population (Xu & Tang, 2014). The gap between income and housing prices would indicate over or undervaluation if they have a long-run relationship, acting as a useful indicator of future housing prices (Gallin, 2006). The study empirically tested this view in the Kenyan housing market.

Traditionally, income growth is included in the equilibrium housing price models as a critical determining factor alongside other fundamental determinants such as the cost of capital, inflation, employment, and construction cost (Mack, Capozza & Hendershott, 2004). The effect of changes in the level of income on housing prices is twofold. Firstly, if more households prefer purchasing completed housing units to constructing their residential units, the effect would be positive, thereby straining the housing market demand (Hilbers, Banerji, Shi, & Hoffmaister, 2008). Secondly, the outcome could be negative if households preferred constructing their units compared to purchasing completed units (Fraser, Hoesli, & McAlevey, 2008). Over the longer term, the impact of income on housing prices would depend on the nature of income shocks in the economy (Fraser *et al.*, 2012). In contrast, the relationship may deviate temporarily, in the short-run, but would revert to the long-run equilibrium (Gallin, 2006).

As shown in Figure 1.1, interest rates in Kenya fluctuated between 12.6 and 20.2 percent during the study period, whereas housing prices consistently increased with few instances of decline during this period. Despite the higher and varying interest rates, housing prices have been on an upward trend. Generally, Kenya enjoyed a dynamic regulatory regime over the last three decades, achieving full liberation in the 1990s, which paved the way for market-driven interest rates. However, in 2016, interest capping laws came into effect, which imposed restrictions on bank loans' interest rates. As a result, private sector credit growth declined to a historically low average of one percent in 2017 compared to a previous five-year average of 14.4 percent (Kenya Institute for Public Research and Analysis (KIPPRA), 2018). The effect may give rise to adverse spillover effects on the construction and real estate sectors. Therefore, the impact of changing financial and monetary regulatory environments on housing prices needed to be investigated empirically in Kenya.

Theoretically, interest rates should be negatively correlated to housing prices. Furthermore, the study expected higher interest rates to drive up mortgage service costs, which exert pressure on housing demand and subsequently lead to a decline in housing prices (Beltratti & Morana, 2010). The responsiveness of housing prices to long term interest rates would be more significant when the recent past interest rates were relatively low (Himmelberg, Mayer, & Sinai, 2005). Hence there are several channels through which changes in interest rates can impact housing prices, including the impact on housing supply, the user cost of capital, and the effect on the expectation of future changes in housing prices (Igan & Loungani, 2012). Besides, changes in

interest rate would impact housing markets through the wealth effects emanating from house prices and credit channels effects that affect housing demand and the consumers' propensity to spend. The study investigated these assertions in the Kenyan housing market context.

Theoretically and practically, inflation policies aim at economic growth rather than asset price stabilisation (Kuang & Liu, 2015). In response to inflationary shocks, households may hedge their wealth from inflation risk through investment in real estate (Demary, 2010). As a result, housing prices would increase due to increased demand for residential housing units. Holding housing supply elasticity in the short run, any increase in inflation would increase housing prices as long as the real interest rate is constant as the nominal interest rate increases proportionally (Barot, 2006). Retrospectively, the housing demand may diminish if the central bank restricts the monetary policy in response to inflationary pressure. Eventually, house prices would decline as housing financing goes up (Iacoviello & Neri, 2010). The study tested these theoretical assertions in the Kenyan housing market context.

Figure 1.1 indicates that the rate of inflation in Kenya varied between 2 percent - 19.2 percentage averaging 7.8 percent during the study period. A consistent increase in prices signals inflationary pressure in the economy. Equally, high inflation would signify higher construction costs and housing prices, which tend to decrease housing demand and housing prices (Mallick & Mahalik, 2012). Therefore, inflation can be an indicator of housing price instability, a source of uncertainty in an economy. Consequently, inflation can represent future expectations (Karagedikli & McDermott,

2016). Due to the varying nature of the trend in housing prices and inflation, the study empirically examined the effect of inflation on house prices in Kenya.

The cost of constructing a new house is composed of real cost building materials, labour, land, and building plan approvals by the local government (Quigley, Raphael, Ulsen, Mayer, & Schill, 2005). As such, the construction cost can significantly affect the housing supply, which largely influences the housing-derived demand. From the developers' perspective, the increase in housing stock indicates higher demand, which would result in an increased supply of houses to the market despite the delays in the completion of houses (Adams & Füss, 2010). This can be attributed to the slow responsiveness of new house construction to transitory market equilibrium (DiPasquale & Wheaton, 1996). While the theoretical explanation may be justified, empirical investigations on the interaction between construction cost and housing prices have elicited mixed outcomes over time. Therefore, the study contextualised the analysis into the Kenyan housing market.

In view of Figure 1.1, change in construction cost was volatile over the study period ranging between -.2 to 10.2 percent and averaging 2 percent during the study period. Overall construction cost had accelerated growth between 2012 and 2014 but a slowed growth rate for 2015 and 2018. The uneven growth and inconsistent empirical findings over time warranted examining the effect of construction cost on housing prices in Nairobi City County, Kenya. In general, construction cost tends to be a flexible variable that positively impacts the volume of space available in the housing market and, therefore, higher rents and house prices (Adams & Füss, 2010). Construction lags

and the marginal cost of construction play a vital and complementary role in driving up costs that distort the housing supply elasticity, ultimately increasing house price volatility (Paciorek, 2013). As such, construction cost is expected to commove with housing prices but inversely relate to housing supply. Thus construction costs might largely be expected to explain house prices (Mayer, 2011).

As shown in Figure 1.1, the growth rate in credit supply fluctuated between -12.6 and 32 percent. It averaged between 5-10 percent during the study period, while changes in house prices ranged between – 3 percent and 7.8 percent. The varying nature of empirical conclusions and the time-varying nature of credit supply motivated the housing model's inclusion of credit supply. Credit supply should theoretically affect housing prices. The two variables are linked through collateral and housing wealth on demand for credit and the impact of credit supply changes on housing prices (Goodhart & Hofmann, 2008).

The expansion of credit through affordable and more accessible financing may reduce the borrower's financial constraints, consequently boosting housing demand. Higher demand for houses would increase housing prices, holding the assumption of low housing supply elasticity (Mayer, 2011). Equally, credit supply may react to investors' expectations of more robust housing demand, translating to higher prices. Despite the apparent importance of credit supply on the housing market, the role of credit supply in the house price model is not standard (Wachter, 2016). The study included credit supply in the housing price model to support these theoretical considerations and understand the effect on housing prices in Kenya.

Furthermore, it is noteworthy that the housing market and credit markets are interlinked since most residential houses are purchased on credit (Anenberg, Hizmo, Kung, & Molloy, 2017). Just before the historical 2008 global financial crisis, borrowers' ability to borrow to purchase new houses and refinance mortgages at low-interest rates and favourable terms triggered a rapid expansion of mortgage credit that led to the crisis. Given the consequences brought about by the financial crisis, the attention of housing market stakeholders has shifted to the impact of credit supply and availability on housing prices. However, as noted by Adelino, Schoar, and Severino (2012), most empirical studies have documented dual causality between house prices and credit supply. The evidence of bidirectional causality indicates that the role of credit on housing prices can be noted by examining the effect of fundamental factors affecting both markets.

1.1.2 Housing Supply

Housing supply is the production level or provision of dwelling units at a given time (Glaeser & Gyourko, 2018). The number of new residential buildings approved by the Nairobi City County government was used as a proxy for housing supply. Besides, housing supply was used as a mediating variable as permitted by the reviewed extant literature. Generally, the way housing supply reacts to the demand pressures indispensably contributes to the modern economy because of the resultant impact on the general economic activity (Paz & Gabrielli, 2015) and understanding housing market equilibrium in productive places such as Nairobi City County. In view of the foregoing, there was the need to examine the changing nature of housing supply and

its possible role as a mediator variable in the association between mediating effect on the relationship between market fundamentals and housing prices

Urban spatial theory indicates that the housing market's supply-side can mediate urban growth and decline (Glaeser & Gyourko, 2018). Two opposing theories predict the nature of the relationship between housing supply and housing prices. Firstly, the competition hypothesis predicts an indirect relation between changes in housing stock and the changes in house prices. Secondly, the contagion hypothesis envisions a positive relationship (Ooi & Le, 2011). However, most empirical studies document a strong negative correlation across countries whereby housing permit issuance is more on the low-priced markets than in high-priced markets, underpinning the importance of the supply side of the market. As such, changes in the conditions of the housing markets' supply-side would determine whether demand shocks manifest in housing prices and housing stock (Glaeser, Gyourko & Saks, 2006). This is justifiable because, in the case of elastic supply, housing demand's response manifests in a growing population amidst the construction of high housing units. As such, higher housing demand would be emulated in higher housing prices.

Therefore, house prices changes would depend on how quickly supply responds to exogenous demand (Ooi & Le, 2011). If supply responsiveness is weak, housing demand shocks would lead to variations in housing price (Iacoviello & Neri, 2010). The builders' inadequate response to housing market prices and production processes typically leads to housing price changes. Intuitively when the response is not quick and cheap more of these shocks would manifest in housing prices. The impact of the

demand-side market fundamentals, such as inflation and interest rates, on house prices and investment, would vary depending on the supply environment (Füss & Zietz, 2016). More often, increasing prices are experienced in areas where there is strong demand and constrained housing supply compared to new construction (Paciorek, 2013). Despite the theoretical justification of housing supply influence in the housing market dynamics, no comprehensive studies are recorded in the Kenyan housing market. This gap necessitated the modeling of housing supply as a mediating variable in the relationship between housing market fundamentals and housing prices.

1.1.3 Investors Sentiment

Investors' sentiment is the propensity of investors to trade based upon emotions and noise instead of facts (Baker & Wurgler, 2006). This is described as an irrational component of investors' expectations (Ling, Naranjo, & Scheick, 2010). The significance of investor sentiments in asset pricing is theoretically based on the premise that economic agents in the market shape their perceptions of available information and expectations that are not justified by economic fundamentals (Marcato & Nanda, 2016). In view of the Nanda and Heinig (2018) approach, the study employed a macroeconomic composite sentiment index to represent the investors' expectations about future cash flows and investment risks. This indicator reflects the agent's expectation about future fundamentals and economic conditions, which are not reflected in other macroeconomic fundamentals.

Behavioural finance theories contend that investors can form incorrect assumptive expectations, filled with extreme pessimism or optimism (Chung, Hung, & Yeh,

2012). Extreme pessimism or optimism result in incorrect asset prices, causing assets to deviate from their intrinsic values (Clayton, MacKinnon, & Peng, 2008). Mispricing is corrected when the housing market fundamentals are affirmed while investor sentiments diminish (Dergiades, 2012). Theoretically, this behaviour can be explained by the overreaction concept, whereby homebuyers respond disproportionately to new information (Jin, Soydemir, & Tidwell, 2014). Therefore, the housing sector may respond to investors sentiment changes possibly transmitted through the underlying market fundamentals.

Housing markets exhibit several classic inefficiencies associated with significant illiquidity, information asymmetries, and the inability to short sell (Wang & Hui, 2017). These inefficiencies more often lead to irrational behaviour. Therefore, a better understanding of the role of investor sentiment in housing price modeling is an area of interest for financial institutions, pension funds, and other market participants (Heinig, Nanda, & Tsolacos, 2016). With limited market data on real estate transactions, investors in the real estate market may not have the relevant and quality information required to make judgments. Therefore, they rely on indirect signals in the form of investor sentiment in decision making. Consequently, sentiment induced trading behaviour is relevant in real estate investment decisions.

In real estate markets, the sentiments of investors contain crucial information that enables the prediction of changes in real estate returns (Marcato & Nanda, 2016). As the housing market goes through cycles, the changes in market fundamentals can not completely justify the changes in house prices (Jin *et al*., 2014). Hence the housing

market represented an ideal situation to analyse investor sentiments as speculation and expectations carry a special function in the housing sector. Despite the documented impact investor sentiment is likely to have on the real estate sector, limited literature exists in the Kenyan housing market. As such, the study examined investor sentiments as a moderating factor in the relationship between housing market fundamentals and housing prices. Equally, the study demonstrated how capturing market sentiment could significantly improve the housing market model's ability to explain how the market sentiment is extracted.

1.1.4 Housing Prices

Housing price is the average selling price of residential houses, including single-family residential units, mansions, bungalows, condominiums, and apartments. In this study, housing price was represented by a Housing Price Index (HPI). The index is designed to measure the changes in asking prices of residential houses, which epitomise trends in house prices in Nairobi City County. The reliability of the HPI is strengthened as it has been relied upon by several regulators, including the World Bank, Centre for Affordable Housing Finance-Africa, and the Central Bank of Kenya(CBK) in forecasting housing prices. Equally, it is the only existing housing price index that has lasted over ten years in sub-Saharan Africa except in South Africa (World Bank, 2011).

Housing prices in Kenya's city county and the peripheral towns have consistently increased since 2005 (Ministry of Land and Urban Development, 2015). The average residential property price stood at KES 32.7 million in 2018 compared to KES 7.1

million in December 2000 (Hass Consult, 2018). The increase in price levels was in all spheres, including the medium income band and higher-income segments. According to the African Development Bank (AfDB) (2013) estimates, housing prices in Nairobi city increase by about 41% between the beginning and the end of the construction process, which lasts an average of 18 months. The persistent movement of house prices upwards is conceived to make headway in the near future amidst a relatively flourishing economic growth and a burgeoning middle-income population. Nairobi city is rated as the most expensive in Africa, according to Knight Frank's (2015) reports. For instance, the lowest-priced house built by a formal developer cost about KES 1.342 (USD 15,200) in December 2012. However, there was hardly a house of less than 4 million in Nairobi (USD 43,956).

The scarcity and limited access to land in Nairobi city county have led to inflated prices in the available land, especially for the past ten years (KIPPRA, 2018). This has also led to urban sprawl as developers seek affordable land in satellite towns in Nairobi's environs. An increase in housing prices in Kenya has equally been associated with a shortfall in supply to counter the housing demand associated with the growing urban population (World Bank, 2016). This has made a well-located land in Kenya unaffordable to most households, especially the low to middle-income households (Bah, Faye, & Geh, 2018). The observed inflexible behaviour of housing supply has been associated with housing price volatility but not empirically tested.

The trunk infrastructure development in Kenya has also been associated with soaring prices (World Bank, 2018). According to the 2005 national housing agency in Kenya

survey, the price of an acre of land in Nairobi jumped from KES 2.8 million to KES 10 million during the construction of Nairobi- Mombasa Highway. Equally, during the construction of Ruiru- Juja Road, an eight-acre land plot jumped from KES 1.5 million to KES 2 million after construction (HassConsult, 2016). These trends are symptomatic of long-term constraints on building affordable houses and a continued price appreciation (Ministry of Land and Urban Development,2015). This is exaggerated by the cost, process, and duration of obtaining a mandated county government development approval. In aggregate, these lead to the increased cost of development borne by investors leading to soaring house prices.

The trend in housing prices and growth rates are shown in Figure 1. 2

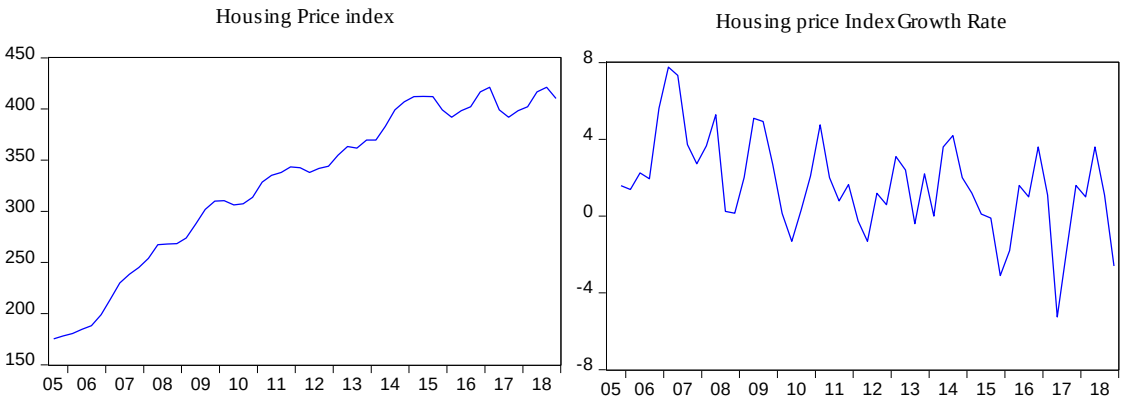

Figure 1. 2: Housing Prices in Kenya (2005-2018)

Source: Research Data (2020)

As captured in Figure 1.2, the housing price index has risen threefold from 175 points in 2005 to 410 points in 2018. However, the housing price growth has not been consistent as it oscillated between -5.3 percent and 7.8 percent during the study period. Two notable observations emerge: Firstly, the growth rate between 2005 and 2016 was

impressive and consistent. Secondly, the growth rate in residential housing prices between 2016 and 2018 was either declining or stagnant with traces of modest up and down movement. The former observation was unexpected given the political instability witnessed in Kenya in 2008 and 2013, the global economic downturn, and exogenous shocks such as droughts and macroeconomic policy shocks depicted by a high inflation rate (Kenya National Bureau of Statistics (KNBS), 2018). Surprisingly, these factors did not significantly impact house prices against the theoretical expectations. Notwithstanding, the latter observation portrays early signs of a reversal of the previous upward trend in housing prices, which deserves investigation.

These episodes have ignited a debate as to whether the property market is correcting itself towards equilibrium, or it is a reflection of an imminent crash associated with real estate cycles, or it is just early signs of a bubble building up in the Kenyan market. For instance, a more recent report by the KBA (2015) indicates that house prices are overvalued and forecast a fall in prices towards equilibrium point over the next two years. Empirical evidence by Cytonn (2017) equally reports substantial decline in occupancy rates, especially in high-end markets amidst tremendous demand pressure. Thus the upward movement in house prices in Kenya may partly be associated with factors unrelated to market fundamentals such as speculation and wrong investor sentiments that needed empirical investigation. Consequently, the study aimed to establish the relationship and the alignment between underlying housing market fundamentals aforementioned and house prices.

1.1.5 Nairobi City County Housing Market

Nairobi City County has an estimated total population of 3.5 million, with approximately 985,016 households, which translates to a density of 4800 per square (CAHF, 2012). On average, one million people in this county live in slums, and a meager 3 percent live in houses with water, electricity, and permanent walls (World Bank, 2017). The City County's residential land, which accounts for 25 percent of the total land, is occupied disproportionately, whereby over three quarters are occupied by only 20 percent of the city population (United Nations- Habitat, 2016). This indicates a limited supply of land for the poor majority. Among the largest urban areas in Kenya, ten are in the Nairobi Metropolitan area, consisting of about 5.777 million people and nearly 40 % of the Kenyan urban population (Habitat for Humanity International, 2013).

Nairobi City County is an unparalleled area of study as it contributes about 21.7 percent of the national GDP (Ombongi, 2014). Additionally, the city-county is a significant labour market that drive up the demand for more housing units to rectify the shifts of the labour markets from other countries (Beguy, Bocquier & Zulu, 2010). The county's housing market is generally experiencing progressive growth supported by a growing middle-income population, especially in the business and service industries. The Kenyan middle class encompasses about 44.9 % of the population in 2010 (African Development Bank, 2013). The housing sector's growth is equally supported by road networks that have opened new areas for housing development. Moreover, the national government's revised housing policy of 2004, emphasises on

addressing the shortfall in supply of residential real estate and upgrading the slums in Nairobi City County. Despite all these efforts, housing shortages and affordability gaps have continued to be a challenge.

The county's housing market is characterised by an ever-growing affordability gap whereby the real estate developers and consumers of houses have limited access to financing (World Bank, 2017). The Central Bank of Kenya's (2018) estimates indicate that the average mortgage loan portfolio is approximately KES 8.3 million (USD 80,000) up from 4.1 million in 2010, which requires a down payment of KES 90,000 (USD 1,000) per month. However, the Central Bank of Kenya (2016) estimates that only 10% of the urban dwellers can access formal housing finance, translating to 2-3 percent of the total population. The World Bank's (2011) affordability simulation points out that only 11 percent of the population could afford a 3.2 million (USD 37800) mortgage over a term of 15 years. In contrast, a 1-3-bedroom house, on average, costs 4.6 million (USD 46,000). This reflects an expensive housing market dominated by high-income borrowers and way above the greater proportion of the population's income.

In the Kenyan housing market, only a small number of private investors can be able to develop 200 housing units and above for the low and middle-income housing sector (African Development Bank, 2013). Developers have shifted to high-density developments, more often inclined to apartments, driven by the increasing cost of land and building materials (HassConsult, 2016). For instance, out of 2013 planning approvals, 628 were for detached houses, 798 for semidetached while 13,914 were for

apartments. The trend is exacerbated, where the upcoming and new housing development target the increasing middle-income class at 48 percent and upper-income category at 35 percent with only 2 percent for the lower-income population segment (Cytonn, 2017)

In general, Kenya's annual housing deficit is vast and persistently burgeoning, particularly in urbanised areas like Nairobi city county (World Bank, 2011). The government of Kenya estimates the yearly housing deficit to be around 120,000 houses in addition to 2 million housing units carried over from the previous years, with over 60 percent of the population residing in informal settlements (World Bank, 2018; CAHF, 2012). Nairobi City County alone has a public target of producing 150,000 to 200,000 properties a year. In 2017, only 12,000 private residential buildings were completed in the Nairobi city council, and 90 percent of these completions were for apartments (KNBS, 2018). Despite the increasing need for more housing units for the lower-income sector, more than three-quarters of the developments are for the upper and middle-income sectors and an estimated 2 percent for the lower-income sector. According to the (2017), the situation can only worsen over the next ten years, with an additional 500,000 new city dwellers and high urbanisation rates. The focus needs to be shifted to financing needs of the average Kenyan.The vast deficit calls for increased and targeted housing development to narrow the gap between housing supply and demand.

The government has made strides to narrow the housing deficit, in view of the constitutional right of the need for decent housing for every citizen, evidenced by a

consistent increase in the annual national budget allocation to housing that stood at KES 6.5 (USD 63.3 million) in the 2018/19 financial year. Besides, the government launched several initiatives for affordable housing in 2017 as one of the pillars of the government's big four plans. For instance, the government partnered with the private sector in the ongoing 1500 units in the new Ngara project and the 1500 units in the Jevanjee Project, which is at the initiation stage. Equally, through the national housing corporation (NHC), Kenya's government had previously made an effort to provide and facilitate access to affordable housing. These efforts saw NHC produce 243 residential houses in Nairobi in 2014. During the same period, NHC partnered with the housing finance company of Kenya (HFCK) to produce additional 161 units. Several other initiatives have been set aside to improve homes in Kenya, including the Slum upgrading scheme (2003), civil servants' schemes (2004) by the government of Kenya, and the Kenya informal settlement improvement project spearheaded by the world bank.

1.2 Statement of the Problem

Residential housing prices in Kenya rose on average from KES 7.1 million in 2000 to KES 31.9 million in 2018, with slight fluctuations over the study period (Hass Consult, 2018). This trend raises concerns about housing prices sustainability and the extent to which they reflect the underlying housing market fundamentals. Appreciation of housing prices can benefit the economy through increased expected lifetime wealth of homeowners, reduced capital outflow, and increased investment inflow (Simo-Kengne, Balcilar, Gupta, Reid & Aye, 2013). However, the overall effect of higher

house prices on the national economy is not apparent. This is because a significant decline in housing prices can lead to the property value falling below the outstanding balance on the mortgage that secured it. This will lead to a bigger risk of defaults that would spill over to the financial system, consequently triggering systematic risk (Glindro, Subhanji, Szeto & Zhu, 2010). The implication of the unprecedented rise in housing prices and the possible reversal is an important issue for policymakers that motivated the study.

International studies on housing price dynamics are immense (Adams & Füss, 2010; Bahmani-Oskooee & Ghodsi, 2017; Demary, 2010; Case & Shiller, 2003; Fraser *et al*., 2012; Gupta, Jurgilas, Kabundi & Miller, 2012; and Kishor & Marfatia,2017). However, these studies record diverse outcomes on the relationship between market fundamentals and house prices over time and across many nations. The varying outcomes are partly attributed to the housing markets' local orientation and different methodologies employed, either in linear or nonlinear frameworks.For instance, Case and Shiller (2003) found an exclusive influence of income on housing prices in the long run and short run, while Kishor and Marfatia (2017) and Fraser *et al.* (2012) found that changes in housing prices were independent of interest rates and income in the short run. Adams and Füss (2010) found a unidirectional positive effect of short term interest rates on housing prices, while Gupta, Jurgilas, and Kabundi (2010) and Demary (2010) found dual causality between interest rates and housing prices. The outcomes rule out a global consensus on the effect of market fundamentals on house prices. Therefore, the outcomes cannot be generalised in the Kenyan market that is

characterised by thin information on housing transactions. This contextual gap motivated the study.

In the Kenyan context, Kibunyi *et al*. (2017) found a positive relationship between housing prices, construction cost, and interest rates but a negative relationship with inflation. Miregi and Obere (2014) found an insignificant effect of interest rates and inflation on housing price movements, while Kosgei and Rono (2018) found a negative relationship between mortgage rates and housing prices. However, these studies are contradictory and assumed a stable and consistent relationship between housing prices and housing market fundamentals and did not incorporate the possible effects of structural breaks and asymmetries in the data series. The linear models employed in these studies may not capture the parameters' instability across the cyclical housing phases. Equally, none of these studies had considered the impact of investor sentiments and housing supply in their modeling. This study addressed these gaps by adopting a linear and nonlinear autoregressive representation to uncover whether the effect of market fundamentals is symmetrical or asymmetrical. The study further explored the moderating and mediating effect of investor sentiments and housing supply on housing price, respectively.

1.3 Objectives of the Study

The study sought to achieve the following objectives:

1.3.1 General Objective

To assess the effect of housing market fundamentals on housing prices in Nairobi City County, Kenya.

1.3.2 Specific Objectives

The specific objectives of the study were:

i) To determine the effect of per capita income on housing prices in Nairobi City County, Kenya.

ii) To establish the effect of interest rates on housing prices in Nairobi City County, Kenya.

iii) To establish the effect of inflation on housing prices in Nairobi City County, Kenya.

iv) To establish the effect of construction cost on housing prices in Nairobi City County, Kenya.

v) To determine the effect of credit supply on housing prices in Nairobi City County, Kenya.

vi) To determine the moderating effect of investor sentiments on the relationship between housing market fundamentals and housing prices in Nairobi City County, Kenya.

vii) To establish the mediating effect of housing supply on the relationship between housing market fundamentals and housing prices in Nairobi City County, Kenya.

1.4 Research Hypotheses

The study sought to test the following null hypotheses:

H_{01}: Per Capita income does not have a significant effect on housing prices in Nairobi City County, Kenya.

H_{02}: Interest rates do not have a significant effect on housing prices in Nairobi City County, Kenya.

H_{03}: Inflation does not have a significant effect on housing prices in Nairobi City County, Kenya.

H_{04}: Construction cost does not have a significant effect on housing prices in Nairobi City County, Kenya

H_{05}: Credit supply does not have a significant effect on housing prices in Nairobi City County, Kenya

H_{06}: Investor sentiments do not have a significant moderating effect on the relationship between housing market fundamentals and housing prices in Nairobi City County, Kenya.

H_{07}: Housing supply does not have a significant mediating effect on the relationship between housing market fundamentals and housing prices in Nairobi City County, Kenya.

1.5 Significance of the Study

The study outcome bolsters the theory of housing finance, policy, and practice in several fashions. Firstly, the study's findings would form the basis for formulating and implementing policies in the housing sector in Kenya. Based on the study outcomes, a precise model would be constructed to forecast and understand the future trends in property prices that would allow the investors to maximise their investment profits in real estate. Secondly, the study outcomes would help the central government and other policymakers to take advantage of positive externalities linked to the real estate market

developments and devise strategies to minimise unforeseen shocks. Implementing such policies would benefit private and public companies and individuals seeking real estate exposure as an investment at lower transaction costs.

Thirdly, financial institutions would find information on housing prices' trends useful in devising real estate financing products. At the same time, property developers stand to gain from the study by ascertaining periods of over or undervaluation in the housing sector and appreciate the role of investor sentiments in the formulation of the real estate development strategies. The study's outcome would guide them on when to buy, sell, or develop to maximise their real estate investment returns. Fourthly, the study outcome would enable domestic and foreign investors seeking to invest in real estate or expand their investments, make robust investment decisions, beware of their risk exposure and detect early signals of investment opportunities.

Lastly, the study adds to the existing knowledge in real estate finance theory by introducing behavioural aspects into the pricing of real estate through unravelling a technique of extracting market sentiment and applying it to the housing prices model. Housing finance knowledge would also be enhanced by documenting the asymmetric effect of housing market fundamentals' shocks in the housing market and demonstrating the extent to which housing supply influences the relationship between housing market fundamentals and housing prices. In that regard, academicians and students alike would use the outcome as a base for enhanced real estate finance research.

1.6 Scope of the Study

The focus of the study was the Nairobi City County housing sector from the year 2005 to 2018. Nairobi City county provided an ideal situation for modeling housing prices dynamics as it has witnessed a continuous upward movement in house prices over the last 15 years (KPDA, 2018). The city-county equally formed a unique area of study as it contributes about 25 percent to Kenya's national Gross domestic product (KNBS, 2018) and produces about 60 percent of the national housing supply. Equally, a representative housing price index is available for Nairobi city county, permitting the analysis of market fundamentals' effect on housing prices.

The study limited the time scope to the period 2005 to 2018, comprising of 54 quarterly observations. The time scope was chosen and justified due to the availability of reliable data on the dependent variable (housing price). Although the information on market fundamentals was available before 2005, the study analysis's starting point was bound by the housing price index's availability. The sample period equally gave an adequate sample size for examining the effects of market fundamentals on housing prices. Further justification of the sample period emanated from the fact that significant events occurred in the Kenya economy that may have influenced the housing sector. These events include three general elections (in 2007, 2013, and 2017), revision of land laws (in 2012), rebasing of national accounts (in 2014), and introduction of interest rate capping laws (in 2016).

The study content was restricted to the following housing market fundamentals; per capita income, interest rate, inflation, construction cost, and credit supply, as supported

by the reviewed literature. The selection of study variables was inspired by the exitant empirical and theoretical studies, especially the guiding framework established by DiPasquale and Wheaton (1996). Additionally, the housing supply was considered a mediating variable due to inelastic adjustment to demand pressure cited in most empirical studies. Finally, investor sentiments were considered as a moderating factor because the irrational component of investor expectation is now a standard feature in contemporary behavioural finance studies.

1.7 Organisation of the Study

The thesis comprises five chapters as highlighted hereunder: Chapter one provides the background to the study and the statement of the problem. The chapter equally sets out the study's objectives, significance, scope, and limitations. The second chapter entails reviewing theoretical and empirical literature related to housing price dynamics, including the conceptual framework and the literature review gaps. Chapter three describes the research methodology capturing various subsections, including the research philosophy and design, the target population, empirical model specification, data analysis techniques, and operationalisation of study variables. The fourth chapter highlights the findings of the study and the subsequent discussions. Lastly, chapter five summarises the study finding and provides conclusions thereof. The chapter also points out the study's policy and practice implications and the subsequent recommendations and highlights future research fields.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter looks into the theoretical and empirical literature on housing market fundamentals and housing prices. The chapter explicitly presents a review of relevant theories that anchored the study and the relevant empirical studies that affect the dependent and independent variables over time and across nations. Then the study presents a conceptual framework that figuratively highlights the linkage between the independent and the dependent variables. Finally, the research gaps are documented based on the reviewed literature that contextualise the study.

2.2 Theoretical Review

The study was based on the efficient market theory, rational expectations theory, permanent income hypothesis, real estate market equilibrium theory, and the stock-flow model. These theories ensured that the constructs were grounded on a strong theoretical background.

2.2.1 Efficient Markets Theory

This theory was developed by Eugene Fama in the early sixties and subsequently modified by Fama (1970). The theory postulates that efficient markets fully reflect all available information in asset prices, and all pertinent information is freely available to all investors. In essence, no one investor can make abnormal returns in the market because securities' prices adjust quickly to the available new information set (Malkiel, 2003). The efficient market theory is linked to the random walk theory proposed by

Kendall & Hall (1953), which postulates that market prices cannot be reliably be predicted based on the previous movement in prices (Herath & Maier, 2015). This points out that variations in asset prices follow a stochastic process such that past data and other public information cannot be used to forecast future prices.

Jagric, Podobnik, and Kolanovic (2005) assert a quick adjustment of asset prices to a set of new information in the market in an efficient market. As such, the securities capable of being selected would engross all the relevant information concerning the associated securities. Hence investors are assumed to make investment choices based on well-defined predispositions. However, in reality, rational choices cannot be empirically proven, or if choices are based on debatable assumptions, then rationalisation concept is anomalous (Lowies, Hall, & Cloete, 2015).

In housing markets, information efficiency denotes that market prices' distribution reflects the assets' risk and other characteristics accurately (Larsen & Weum, 2008). Real estate markets can be regarded as inefficient due to dispersed markets, heterogeneity, infrequency in trading, and information cost (Wang & Hui, 2017). The housing markets are locally oriented, so specialised knowledge of the factors that influence risk and return is required. Furthermore, residential houses tend to trade infrequently, limiting market participants from determining correct prices (Beechey, Gruen, & Vickery, 2000). Moreover, most property sale transactions are privately negotiated, and owner-occupiers dominate the housing markets' large segments. Therefore, the difficulty in holding short positions limits the professionals in eliminating inefficiencies in the housing market (Bayer, Murphy, & Timmins, 2007)

In the context of the current study, the theory was logically assumed to apply to the housing market as investors who want to buy property may not have full information from the sellers or property agents. Mortgage lenders alike may not disclose the hidden transaction cost inherent in real estate transactions at the point of sale. As such non-fundamental factors such as investor sentiment may push housing prices away from their fundamental values. If market fundamentals do not drive housing prices, then this is a matter of operational efficiency. Therefore, this theory was relevant to the dependent variable as it shows the predictability of housing prices by incorporating a set of available facts relating to prices in the past. The study laid emphasis upon the house price patterns over time and whether housing market fundamentals could capture future changes in house prices.

2.2.2 Rational Expectation Theory

Rational Expectation Theory, due to Muth (1961), is a forward-looking theory model of expectations focused on whether market participants use all the available information in predicting the future. The theory is also linked to the author's suggestion that expectations are just like predicting a relevant theory. By Muth's definition, rational expectations are fact-based mathematical prospects of a particular variable bound up with the information on the known connected variables (Hansen & Sargent, 2010). Therefore, how the theory predicts future events does not correspond to the eventual outcome, with errors independent of the variables that generate the prediction. The theory can be rephrased that, given the same information set about theory prediction, market participants' expectations would tend to be distributed

(Ayala & Palacio-vera, 2014). Based on this definition, subjective expectations should be modelled to vary endogenously with the system structure change. Therefore, the rational expectation theory's main idea is the interaction of reality and expectations by broadening the individual rationality tenet from the resource allocation problem to the generation of expectations.

In the housing market, the rational expectation theory assumes that market participants follow rational procedures and utilise all pertinent information in investment decision making (Diappi, 2013). Market participants are considered to use all the relevant and available information on exogenous factors to predict endogenous factors' future value (Barot, 2006). Therefore, people's expectations about fundamental variables such as future housing prices are significant in determining housing prices, which are equal to the expected future value of housing prices on average(Wang & Hui, 2017). The hypothesis assumes that the market participants possess all the housing market available information and can correctly predict the changes in house prices based on unforeseen shocks (DiPasquale & Wheaton, 1996). As such, changes in housing prices should be random since the release of new information to the market is random, thus eliminating any chances of consistently predicting or making abnormal returns (Gertchev, 2007)

In the present study, the theory was logically assumed to apply to the housing market as market participants' subjective expectations of future prices impact house prices. If the expectations are backward-looking and rely on extrapolation of the past house prices changes, then housing prices would not form a random walk and may lead to

speculative bubbles. The expectations of prices based on extrapolation and speculation may equally lead to real estate cycles even when the movement in underlying market fundamentals are cyclical. This theory's relevance was further justified by developing a housing market fundamentals model from the rational expectation point of view to test whether housing prices could reflect these fundamentals. Therefore, there was a need to ascertain the alignment of the witnessed house prices to market fundamentals changes and whether unrealistic expectations and non-fundamental investor sentiments fueled the upsurge in house prices.

2.2.3 Permanent Income Hypothesis

Permanent Income Hypothesis was developed by Friedman (1957). According to this theory, household consumption decisions depend on their lifetime permanent income rather than the current income. Specifically, the permanent income hypothesis stems from the perception that people would desire to smooth their consumption and not let it vary with short-run fluctuations (DeJuan & Seater, 2007). Therefore, consumption can be determined by two factors, wealth and the interest rate on the assets (Beznoska & Ochmann, 2012).

Hall and Mishkin (1982) critiqued the permanent Income hypothesis, who presented a theory of Rational Expectation- Permanent Income Hypothesis. This hypothesis claims the adequacy of current consumption predicting future consumption based on the premise that future prices are incorporated in the current consumption. However, as Attanasio and Pavoni (2011) suggested, households smooth their consumption with permanent income changes. They are sensitive to transitory income changes that reject

the PIH and explain liquidity (Johnson, Parker, & Souleles, 2006). More importance is laid on current income in intertemporal consumption than permanent income (Jappelli & Pistaferri, 2010). Therefore, the theory anticipates small or possibly negative price induced effects of the housing wealth effect on summative consumption where the credit effects are not existing. Thus countries with trivial mortgage markets and void of home equity loans would exhibit adverse wealth effects (Geiger, Muellbauer, & Rupprecht, 2016).

In the current study context, it can be argued that housing consumption at any particular period is associated with the current household income cycle as much as housing stock is both a consumer good and an investment asset (Katrakilidis & Trachanas, 2012). Income is linked to housing prices through collateral and wealth effects. The wealth effect indicates that households' expected lifetime wealth may vary due to unexpected changes in housing prices. Since homeowners willingly smooth their lifetime consumption, expansion of lifetime wealth would enhance their housing consumption (Geiger *et al*., 2016). Additionally, due to collateral effects, when households are constrained financially, an increase in house prices would relax this financial constraint, which transforms into credit expansion. The consequences of housing collateralisation and higher housing prices boost the homeowner's credit accessibility, thereby easing housing investment financing. Therefore, this theory was relevant to the study variables, per capita income, credit supply, and housing prices.

2.2.4 Real Estate Market Equilibrium Theory

This theory is grounded on the theoretical framework accredited to DiPasquale and Wheaton (1996), which exhibits the long-run equilibrium in the housing market. This model's four quadrants illustrate the interconnection between the macroeconomy, financial markets, and their effect on real estate markets. As shown by (Fabozzi & Xiao, 2017), rents are determined in the first quadrant, whereas supply is assumed to be given. In the second quadrant, property values are determined based on this rent via the addition of investors' opportunity cost. New construction is determined in the third quadrant by the values in quadrant two and production cost. The new construction will continue on account that the values exceed the cost of construction (Lind, 2018). This new construction continues to increase supply and pushes rents in quadrant one, and the process continues.

In this study's context, the framework predicate that adjustment of housing prices resulting from changes in housing demand is not immediate. The adjustment will be gradual because housing markets are geographically diverse, with varying characteristics over time (Wang & Hui, 2017). Additionally, the framework distinguishes different fundamental determinants of property prices anchored on the fact that housing can be produced at a known cost and the possibility of increasing supply in the long run. Under this framework, it is readily observed that housing prices, the user cost of housing, income, and a vector of demand shifters determine housing demand. The housing supply is influenced by housing prices, construction costs, and a vector of supply shifters (Deng, Ma, & Chiang, 2009). When this framework is

unpacked, housing price becomes a function of income, construction cost, housing supply, the user cost of housing prices, and a vector of demand and supply shifters. Hence, this model was relevant to all the study variables and fulfilled the study's main objective by extension.

2.2.5 Stock Flow Model

This model is deeply entrenched in the seminal work by Poterba (1984) and broadened by Topel and Rosen (1988). The model places emphasis on the long-run correlation between changes in fundamental variables and the observed house prices. Additionally, the model captures the interrelationship between housing prices, housing supply, and demand over time through a demand and supply framework (DiPasquale & Wheaton, 1996). Under this model presumes a negative relationship between the housing user cost and housing prices, while rental value and housing prices move together in the same direction (Steiner,2010). Other fundamental factors, such as household permanent income, demographics, and credit conditions, are connected to this model.

The study formulated an equation, based on this model, that relates the housing market fundamentals and housing prices from 2005 to 2018. The derived housing model is consistent with the error correction process to expound the dynamics of housing prices. The model was then used to quantify the effect of housing market fundamentals on housing price adjustments. The flexibility of the model provides a framework to include other potential housing market fundamentals. In view of the preceding

narrative, the model was assumed to be relevant in analysing all the study variables, the dependent and independent variables.

2.3 Empirical Review

The section puts on view a review of the empirical studies related to housing market fundamentals and housing price dynamics. The review was crucial to understand the interconnection between the dependent and predictor variables and establish the gaps that the study would be premised.

2.3.1 Per Capita Income and Housing Prices

Xu and Tang (2014) evaluated the determinants of housing prices in the United Kingdom (UK) between 1971 to 2012. Using an error correction model (ECM), the study found a negative relationship between disposable income on housing prices in the long run and a positive impact of the interest rate and construction cost on housing prices. Similarly, in the short run, house prices were found to affect income and interest rates. For all that, the study relied on Engle and Granger's approach to cointegration. The approach is based on a restrictive assumption of a single cointegration relationship, which renders the detection of more than one relationship difficult. The present study employed a bound testing approach that brings to light more than one equilibrium relationship in the long run.

Fraser, Hoesli, and Mcalevey (2012) assessed the dynamic link between income and housing prices in the UK, Newzealand, and the US housing markets between 1973 and 1998. The study used a structural vector autoregressive (SVAR) model. The study found that housing prices' responsiveness to temporary income shocks in the short run

varied significantly across the three housing markets. However, the study employed a bivariate model with disposable income as the only explanatory variable. Therefore, this model could not account for the effects of other innovations not related to the income process. The present study filled this gap by including more housing market fundamentals drawn from both the supply and demand side using linear and nonlinear ARDL models.

Omboi and Kigige (2011) analysed various factors that influence the prices of houses in Meru County in Kenya. The study used a survey methodology and found that approximately over half of housing price changes are attributed to income changes. In contrast, 20 percent of the changes were linked to housing demand. However, the study used a qualitative (survey) methodology, which is not suitable for understanding the historical context of price changes over time. The method used cannot capture the dynamic and complex features of housing prices. The survey methodology is equally subject to recall bias, especially on the occurrence of non-fundamental events with a long time frame or the circumstances surrounding the occurrence of a particular event in the housing market. These biases can significantly affect the outcomes' reliability and validity. The present study adopted an autoregressive regression analysis that captures the effect of housing market fundamentals on house prices over time and nonlinearities in the data series.

2.3.2 Interest Rates and Housing Prices

Kishor and Marfatia (2017) assessed the dynamic relationship between income, interest rates, and housing prices in 15 Organisation of Economic Corporation

Development (OECD) countries between 1975 and 2013. The study employed a vector error correction model (VECM). The study found a positive association between income and house prices but a negative link with the rate of interest in most countries under consideration. In the short run, additional findings pinpoint that interest rate, and income were independent of housing prices in 10 out of 15 countries as long-run disequilibrium is corrected. The results are consistent with Fraser *et al*. (2012) but contradict (Case and Shiller, 2003). The latte established a consistent and robust relationship between income and house prices in both horizons. Nevertheless, the conclusion only holds for OECD countries, which cannot be generalised in Kenya, considering the heterogeneity of real estate markets in different geographical contexts. The present study shifted the focus to the Kenyan housing market to counter the gaps. The study also employed a nonlinear autoregressive model to account for any asymmetric reaction of housing prices to shocks in housing market fundamentals.

Bahmani-Oskooee and Ghodsi (2016) evaluated the impact of mortgage rates and income on housing prices in the USA between 1975 and 2014 using linear and nonlinear autoregressive distributed lags models. It was found that, in the short run, both increase and decrease in mortgage rates significantly impact house prices in all the states considered. Notwithstanding, the mortgage rate did not significantly affect housing prices in 15 states in the long run. The other result indicated that negative shocks to interest rates dominate the positive shocks in the long run. However, the study was notably carried out in the USA housing market that is well established compared to Kenya. Hence the conclusions cannot be generalised in the Kenyan

housing market. The study only used income and mortgage rates as explanatory variables leaving out other crucial market fundamentals, mostly relying on bivariate models. This means that the model cannot account for the effects of innovations not related to the income and mortgage interest process. The present study used the same methodology to fill these gaps but considered more market fundamentals alongside income and mortgage interest rate in the Kenyan context. Furthermore, the study assessed the investor sentiment's moderating effect on the relationship between housing market fundamentals and housing prices.

Adams and Füss (2010) studied the impact of economic activity, construction cost, and the interest rate on international housing prices of fifteen OECD countries. Panel cointegration analysis was employed over 30 years created by a principal component approach. The outcome revealed that short-term interest rates positively affected housing prices, while long-run interest rates had a significant negative impact. However, the study assumed a linear relationship between market fundamentals and housing prices and did not consider explanatory variables' effects in the short run. Moreover, the findings were specific to OECD countries with different housing market structures from those in Kenya. The present study filled these gaps by the use of linear and nonlinear ARDL models. Since real estate markets are heterogeneous and regionally-specific, the study was equally localised to the Kenyan housing market.

Kim and Bhattacharya (2009) assessed nonlinearities in housing prices. The study used a smooth transition autoregressive (STAR) model in the USA between 1969 to 2004. The asymmetric granger non-causality test indicated that mortgage rates

significantly affected housing prices in upswing periods, unlike in the downswing phase. The study also found that the presumed dynamic nonlinear characteristic justified the archetypical formation that exemplifies the USA's housing markets. However, the study used only two explanatory variables (mortgage interest rate and employment) to generalise market fundamentals' asymmetric effect on housing prices in all USA markets. The present study filled this gap by including more market fundamentals in the Kenyan housing market context using linear and nonlinear ARDL models.

Égert and Mihaljek (2007) evaluated the impact of market fundamentals on house prices in eight transition countries and nineteen OECD countries between 1990 and 2005 using a mean grouped panel dynamic ordinary least square(OLS) method. It was found that interest rates, per capita income, and private sector credit were the main factors affecting house prices in these countries. However, the study did not capture house prices' short-term responsiveness to variations in the market fundamentals. Furthermore, the study neither delved into examining the equilibrium nor the excessive house price growth, which indicates the degree of misalignment in housing prices. The outcome may not be generalised in Kenya as housing prices' responsiveness to changes in underlying factors differs under different time horizons. The present study countered the gaps by employing a more flexible ARDL model in the Kenyan context. Additionally, housing market fundamentals were decomposed into their increase and decrease to capture the possibility of asymmetries in the housing market.

2.3.3 Inflation and Housing Prices

Kuang and Liu (2015) assessed inflation's influence on house prices in major cities of China. The study used a generalised method of moments (GMM) model for the period 1996 - 2010. The outcome revealed an endogenously determined positive relationship. The study equally found asymmetric dual causality between inflation and house prices. However, the study was conducted at a highly aggregated level of Chinese cities. Although the GMM framework is well suited for dynamic micro panel data and has consistent estimators, the time series data estimators may be biased. The present study carried the analysis at a disaggregated regional level (Nairobi City County) and used the autoregressive distributed lag structure to fill the gaps.

Gupta, Jurgilas, Kabundi, and Miller (2012) assessed the effect of monetary policy change on house price development in South Africa from 1980 to 2006. The study used a factor augmented vector autoregressive (FAVAR) approach. The study found negative responsiveness of house price growth to positive monetary shocks. It was also found that the degree of variations in house prices was different across the five housing market segments in South Africa. This indicates a contextually varying behaviour of housing prices concerning inflationary pressures. However, the linear augmented VAR model methodology employed is conditional on the stationarity of variables. It cannot capture nonlinearities eminent in the interest rate and housing prices time-series under different economic conditions. The present study filled these gaps by using linear and nonlinear ARDL models that do not require stationarity of variables and can be used with variables integrated of different orders.

Demary (2010) modeled the linkage between housing prices, interest rate, inflation, and economic output between 1970 and 2005 in 10 OECD countries. The study employed Vector Autoregression (VAR) and found that interest rates and inflation significantly contributed to house price changes. The study also indicated a dual causality between housing markets and fundamental variables. This finding supports Goodhart and Hofmann (2008) but contradicts Iacoviello and Neri (2010) results, who found a one-way causality from market fundamentals onto housing prices. The contradicting empirical conclusion indicates that the linkage between house prices and the macroeconomic variable has no global generalisation. The present study localised the analysis in the Kenyan housing market. Equally, the study filled these gaps by using linear and nonlinear ARDL models. The approach examines the short and long-run effects of market fundamentals on housing prices. It equally assesses inflation's asymmetric impact by decomposing market fundamentals into their positive and negative partial sums.

Brunnermeier and Julliard (2008) analysed the effect of interest rates and inflation on housing prices in the USA between 1970 and 2004. The study applied a vector autoregressive model and the Campbell and Shiller (1988) decomposition model that considers housing specific risks. The study found that a large component of house prices mispricing is attributed to nominal interest rates and inflation, and the tilt effect could not rationalise the findings. However, the study's outcome can only hold for USA and UK housing markets compared to the Kenyan market characterized by unpredictable inflation rates. The present research contextualised the investigation to

Kenya, a developing country, and considered other housing market fundamentals. The study equally assessed the implied asymmetric impact of inflation on housing prices.

2.3.4 Construction Cost and Housing Prices

Kibunyi, Ndiritu, Carcel, and Gil-Alana (2017) examined the presence of housing bubbles in Kenya by evaluating house prices' main drivers between 2004 and 2014 using fractional integration methodology. The study found evidence that housing prices are strongly and positively correlated to interest rates, gross domestic product, and construction costs. However, the study assumed a stable linear relationship between the study variables. Moreover, the study did the study account for structural breaks, nor did it give a clear conclusion on the existence of a housing bubble. The present research decomposed the movements in housing market fundamentals into their positive and negative partial components in a nonlinear ARDL framework to capture the implied asymmetries in the time series. Additionally, investor sentiment was introduced as a moderating variable and housing supply as a mediator variable in the relationship between housing market fundamentals and housing prices.

Miregi and Obere (2014) evaluated the effect of market fundamentals on housing prices in Nairobi City County during the period 2002 to 2014 using a VAR approach. It was found that construction cost and equity do not explain the changes in prices. The study also found insignificant lagged positive and negative effects of inflation and interest rates on housing prices, respectively. However, this study was premised on a linear relationship assumption and did not account for implied structural breaks over time. Moreover, the study did not consider any mediating or moderating effect. In that

context, the present research decomposed movements in housing market fundamentals into their positive and negative partial components in nonlinear ARDL systems to capture the possibility of the asymmetries in the housing market. Additionally, investors' sentiments were considered a moderating variable in the relationship between the housing market and housing prices.

Tsai (2012) assessed the long run and short-run correlation between construction cost, rental price, and housing price in Taiwan from 1998 to 2010. The study employed both linear and nonlinear cointegration approaches. The study found a significant nonlinear relationship between the three variables. However, the study relied on Engle and Granger's approach to cointegration. The approach is based on a restrictive assumption of a single cointegration relationship, which renders the detection of more than one relationship difficult. The present study employed a bound testing approach that brings to light more than one equilibrium relationship in the long run. A nonlinear ARDL model was also introduced by decomposing movements in housing market fundamentals into their positive and negative partial components to capture the possibility of asymmetries in the Kenyan housing market.

2.3.5 Credit Supply and Housing Prices

Anenberg, Hizmo, Kung, and Molloy (2017) assessed the impact of credit availability on house prices and housing construction in the USA for the period 2001 to 2014. The study employed a loan Frontier Estimation approach to examining the changes in credit availability for different types of borrowers, housing markets, and periods. The study found an increase in credit availability explained over fifty percent of the rise in

house prices and housing stock during the study period. Equally, the subsequent decrease in credit accounted for three-quarters of house prices and new construction reduction. The study outcome contradicted the findings of Glaeser, Gottlieb, and Gyourko (2013) that the effect of easy credit in the form of interest rate and permissive mortgage approvals has a minimal influence on the housing boom formation. The study did not separate the short-run and long-run effects of credit availability, which created a research gap. The present study considered the more flexible linear and nonlinear ARDL models to overcome this shortcoming in the Kenyan housing market context.

Turk (2016) examined the interaction between household debt and housing prices in Sweden between 1980 to 2015 in a three equation model. The study employed the Dynamic Ordinary Least Square (DOLS) framework. The study found that, in the short run, household dret has a significant effect on house prices. The study also found that market fundamentals explained the trends in housing prices and household debt. While the study established significant effects of credit supply and other market fundamentals on housing prices in both horizons, the study assumed a linear impact on housing prices. The symmetric assumption is inconsistent with what is happening in the world of the housing market. The housing market may react differently to expansion and contraction in credit supply. Consequently, the present study employed a nonlinear ARDL model to assess the Kenyan housing market's asymmetries.

Adelino, Schoar, and Severino (2012) examined the impact of mortgage loan supply on housing prices in the USA between 1998 to 2008. The study employed hedonic

regression using annual exogenous changes in conforming loans limit to measure credit cost and availability. The study found credit accessibility had a significant positive effect on housing prices. The study findings did not find evidence to show credit supply exogenously responds to housing demand but instead reported the directional impact of credit supply on housing prices only. However, the study's outcome can only hold for the USA housing market compared to the Kenyan market characterised by unpredictable credit supply trends. The study carried a similar analysis in Kenya, a developing economy, and tested for implied asymmetric impact of credit supply on housing prices. Consequently, the present research decomposed credit supply into its positive and negative components to ascertain asymmetric in a nonlinear ARDL specification.

Anundsen and Jansen (2013) studied the dynamic relationship between household credit and housing prices in Norway from 1986 – 2008. The study used a structural vector equilibrium correction model. The study established a bidirectional causality between credit supply and house prices whereby higher housing prices influenced credit expansion that, in turn, impacted house prices. Conversely, the study found an indirect effect of interest rates on housing prices through their credit channel influence. While the study supports Fitzpatrick and McQuinn (2007) findings of bidirectional causality in Ireland, the study contradicts Oikarinen's (2012) findings of unidirectional causation from credit supply to housing prices in Finland. The contradicting results in different geographical contexts indicate that the effect of credit supply on housing prices is not universal. The present study filled the gaps by assessing whether the

impact of credit supply was symmetric or asymmetric through a nonlinear ARDL model estimation in the Kenyan housing market.

2.3.6 Investor Sentiments and Housing Prices

Ling, Ooi, and Le (2015) examined the role of non-fundamental based sentiment on housing prices in the USA between 1990 and 2010. The study used a three equation vector autoregression (VAR) model. The study employed survey-based indicators of the sentiment for three housing market participants, including mortgage lenders, home builders, and home buyers. The study found that the orthogonalised indicators significantly influence the changes in prices in the subsequent quarters, way above the effect of market fundamentals and market liquidity. The study also revealed that investor sentiment and housing prices' dynamism generates a feedback mechanism that influences the observed persistent house price changes. However, the study only used direct sentiment measures based on surveys and interviews of market participants. Due to the lack of a direct sentiment index in Kenya, the present study established a composite sentiment index based on five orthogonalised indirect indicators of sentiment in the Kenyan housing market.

Jin, Soydemir, and Tidwell (2014) investigated the influence of excess return risk and irrational sentiment in the real estate pricing patterns. The study was for 10 Metropolitan areas in the USA from 1998 - 2008 using error correction models. The study further looked into housing market volatility pricing through supply and demand market fundamentals and consumer sentiment as a non-fundamental variable. The study found that the part of the sentiment that is not explained by market fundamentals

exogenously contributes to real estate price formation in the USA. However, in the analysis, the study only used consumer sentiment to generalise the impact of sentiments, which may be biased. The present study used an indirect composite sentiment index based on the orthogonality of direct measures of sentiment. This indicator reflects the agent's expectation about future fundamentals and economic conditions, which are not reflected in other macroeconomic fundamentals. Moreover, the study extended the study by examining investor sentiments as a moderating variable in the Kenyan housing market.

Ling, Naranjo, and Scheick (2010) evaluated the influence of investor sentiments on commercial real estate market returns in the USA using vector autoregressive (VAR) models. The study found that, in the short run, sentiment induced returns tend to drive housing prices away from the fundamental value in both public and private markets. The study equally found that sentiment induced mispricing is quickly corrected in the public real estate markets in the long run, while it is prolonged in private real estate markets. Nevertheless, the study was localised in the US real estate market, where data on commercial property trading is readily available. Contrary, the Kenyan real estate records on commercial property trading are neither properly kept nor accessible to the public. The present study localised sentiment analysis to the Kenyan residential housing market using a dynamic autoregressive distributed lag model. The study equally employed a composite investor sentiments index as a moderating variable.

Clayton, Ling, and Naranjo (2009) assessed how investor sentiments and market fundamentals commingle in determining the US's commercial real estate capitalisation

rate for the sample period 1996 to 2007.The study employed ECM potential lags in the adjustment with fundamental control variables. The study found that investor sentiments directly affects real estate pricing even after controlling for equity risk premium and lagged adjustment from equilibrium in the long run. The study, however, was based on commercial real estate that does not trade more frequently. Because most of the housing market transactions in Kenya are privately negotiated, they are susceptible to non-fundamental sentiments worth investigating. Therefore, the present study used a market-wide indirect composite sentiment index based on orthogonalised direct sentiment indicators. This indicator reflects the agent's expectation about future fundamentals and economic conditions, which are not reflected in other macroeconomic fundamentals. Moreover, the study extended the study by examining investor sentiments as a moderating variable in the Kenyan housing market.

2.3.7 Housing Supply and Housing Prices

Conefrey and Whelan (2013) evaluated the dynamic relationship between housing supply, demand, and prices in the US from 1990 – 2012. The study found evidence that the supply of new homes strongly impacts house prices downwards. The study also found a small impact of the other market fundamentals such as GDP growth and interest rate after controlling the supply of new homes. The study concluded that housing market fundamentals affect housing prices via their effect on the supply of new homes. However, the result cannot be generalised in the Kenyan housing market since housing markets are heterogeneous. Nairobi County is an emerging market with different housing market characteristics from the US Markets. The present study

localised the investigation in Kenya to overcome these gaps. Equally, the housing supply was employed as a mediating variable in a more flexible ARDL model to unravel the mediating role of housing supply on the association between market fundamentals and housing prices.

Lerbs (2014) evaluated the relationship between housing prices, development costs, and the housing supply for German cities from 2004 to 2009. Using regression analysis, the study found that housing supply had a positive relationship with house prices and construction costs. However, the study did not incorporate any demand-side fundamentals in the investigation and assumed linear relationships. The present research filled the gap by incorporating demand-side factors and considered the supply of new houses rather than the supply of existing homes as a mediating variable owing to the ever-increasing housing supply deficit in Kenya.

Ooi and Le (2011) examined house prices' response to changes in Singapore's housing supply between 1996 and 2009 using Vector Autoregressive (VAR) models. The study found that the marginal supply of houses positively granger causes existing houses' prices. The causal effect continued even after controlling the demand side market fundamentals. The study further found that the marginal supply of new homes and House prices had an insignificant inverse relationship. Nonetheless, the study only focused on the market for apartment buildings market in Singapore. As such, the finding cannot be generalised to the whole housing sector. The present study filled the gaps by incorporating all dwelling units, including apartments, detached and semidetached houses in Nairobi city county, Kenya. This was justified because the

housing supply sluggishly responds to price signals in the Kenyan Housing market (Vuluku & Gachanja, 2014).

Karantonis (2010) assessed the link between housing prices and new construction in housing markets in all cities in Australia between 1980 and 2008. This study also investigated the common factors affecting new residential stock and residential prices. Empirical results found little negligible correlation between housing prices and new housing supply except for two cities that showed a weak positive relationship. This study, however, only utilised correlational analysis in the study. Correlational research only brings to light the direction of a relationship but does not indicate the significance of the cause-effect. The present study adopted a dynamic autoregressive framework to assess the mediating effect of new houses' supply.

2.4 Summary of Literature and Research Gaps

Several noteworthy research gaps were identified after the review of empirical and academic literature. Firstly, several studies reviewed either analysed the supply side, excluding the housing market's demand-side, or concentrated on the housing market's demand side, excluding supply factors. The study filled this gap by considering a combination of housing market fundamentals drawn from both sides of the housing market. Consequently, interest rate, inflation, and per capita income were considered demand-side market fundamentals while construction cost and credit supply represented the supply-side fundamentals.

Secondly, some studies considered econometric methodologies that cannot account for complex housing market dynamics. For instance, the studies reviewed in Kenya have used models that assume a linear relationship between housing market fundamentals and housing prices. None of the studies have accounted for structural breaks and the possibility of asymmetries in the housing price series. The study filled this research gap by employing a more flexible nonlinear ARDL model alongside other methods to uncover asymmetries in the housing time series data by decomposing housing market fundamentals into positive and negative partial sums.

Thirdly the studies reviewed have employed different methodologies in either linear or nonlinear frameworks, using different panel data set and time series that yield conflicting results. This attests that there is no global consensus on the long-run relationships between market fundamentals and housing prices. Although some studies found enough evidence to reject the null hypothesis of no cointegration among market fundamentals and housing prices, other studies fail to reject the null hypothesis. The present study employed two related methodologies: the linear ARDL and a nonlinear ARDL. The two methodologies unravel the short run and long run relationships among the study variables simultaneously. Moreover, the nonlinear ARDL model would capture the implied asymmetries in the housing market.

Lastly, it is noteworthy that a large portion of the studies that were reviewed were carried out in international housing markets where data on housing transactions are readily available, unlike the Kenyan housing market with thin information. Therefore, the result could not be assumed true to the Kenyan housing market. The study filled

the gap by contextualising the housing price dynamics analysis to the Nairobi City County housing market. This would uncover the inherent idiosyncrasies because housing markets are heterogeneous, localised, and geographically specific.A summary of the reviewed literature and research gaps are presented in Table 2.1.

Table 2.1: Summary of literature Review and Gaps

Author and Context	**Purpose of the study**	**Key Findings**	**Research Gaps**	**How the Study Filled the Gaps**
Kibunyi, Nderitu, Carcel and Alana (2017) Kenya	Fundamental factors affecting housing prices in Kenya	a positive relationship between interest rates GDP, construction cost, and housing prices. Inflation has a negative relationship.	Assumed market fundamentals to have a consistent linear relationship with house prices. No clear conclusion on a housing bubble	Employed nonlinear ARDL model. Introduced investor sentiments as a moderating factor
Miregi and Obere (2014) Kenya	Effect of Market fundamental variables on property prices	construction cost inflation and interest rates had no significant effect on negative relationship	Assumed market fundamentals to have a consistent linear relationship with house prices	Employed nonlinear ARDL to account for nonlinear effects in the short run and long run.
Sunde Muzindutsi (2017 Namibia	Factors affecting Construction activity and housing prices	construction activity and housing prices cause each other	Used a restricted VAR that may be misspecified due to the omission of crucial variables.	Used a more flexible ARDL to take into account additional

				variables and their lags
Omboi and Kigige (2011) Kenya	Determinants of housing prices	Income growth accounts for more than 80 percent of price changes	The study used a survey research methodology which is subject to recall bias and inability to capture complex features in housing markets over time.	Used dynamic regression analysis that can capture Short-run and long-run effects of explanatory variables
Mehel Asal (2017) Sweden	Long run drivers of real house prices	Mortgage rates and disposable income are the main drivers in the short run.	The effect of lagged housing prices was not considered in the modelling.	Considered the effect of lagged house prices
Bahman-Oskooee and Ghodsi (2017) USA	The symmetric and asymmetric effect of fundamentals on house prices in the USA.	Interest rates and income have an Asymmetric effect on house prices in the long and short-run.	Restriction to bivariate models in the analysis.	Considered multivariate models in a NARDL specification Introduced Investor sentiments as a moderating factor.
Kishor and Marfatia (2017) OECD countries	Dynamic Relationship Between Housing Prices and the Macroeconomy.	Changes in housing prices are transitory compared to movement in interest rates and income.	Use of only two demand-side variables, personal income, and interest rates Excluded supply-side fundamentals .	Introduced investor sentiments as a moderating factor. Considered supply-side variables in the model.

Anenberg, Hizmo, Kung and Molly (2017) USA	Relationship between mortgage affordability and housing market.	An increase in credit availability explains the rise in house prices, while a a decrease in credit accounts for the three-quarter reduction in house prices.	The study did not delve into separating the short-run and long-run effect of credit availability and did not consider the housing demand factors	Introduced investor sentiments as a moderating factor. Considered supply-side variables in the model.
Fraser, Hoesli, and Mcalevey (2012) USA	Relationship between housing prices and disposable income	Significant long-run relationship and transitory short-run responsiveness	Only considered income as the independent variable. Employed Bivariate model to income which may lead to the limited information problem	Employed a multivariate model to avoid the problem of limited information. Introduced investor sentiments as a moderating factor.
Xu and Tang (2014) UK	Factors affecting housing prices	Income, interest rate and constructions costs had positive effects on house prices Money supply and disposable income have a negative effect	Did not consider supply-side factors. Used Engle and Granger cointegration approach that is based on a single cointegration relationship.	Used bounds test cointegration to account for multiple cointegrating relationships in the system
Lerbs (2014) Germany	Relationship of Housing prices, development	Housing supply had a positive effect on the prices of	The study considered the supply side factors only	Incorporated the housing demand fundamentals

	cost and Supply of housing	existing homes and the cost of construction.	The study assumed a linear relationship between housing supply and housing prices.	in a nonlinear model specification.
Adam and Fuss (2010) OECD Countries	Effect of macroeconomic variables on international housing prices	Economic activity, short term interest rates positively affect house prices long term interest rates negatively affect house prices	Assumed a linear relationship between market fundamentals and housing prices Did not consider short run effects of explanatory variables on housing prices	Introduced investor sentiments as a moderating factor. Considered supply-side variables in the model.
Gupta, Jurglas and Kabundi (2010) South Africa	Impact of monetary policy shocks on housing prices	Found negative response of house prices to positive monetary shocks	The FAVAR approach used does not capture the short run and long run effects as well as the asymmetric impacts of various policy measures.	The study used a nonlinear ARDL model to capture the short run and long effects of housing market fundamentals

Source: Review of Empirical Literature, 2020

2.5 Conceptual Framework

A conceptual framework is an analytical tool illustrating how the research variables connect. This framework highlights the interaction between independent variables and dependent variable while incorporating the mediating and moderating paths as shown in Figure 2.1

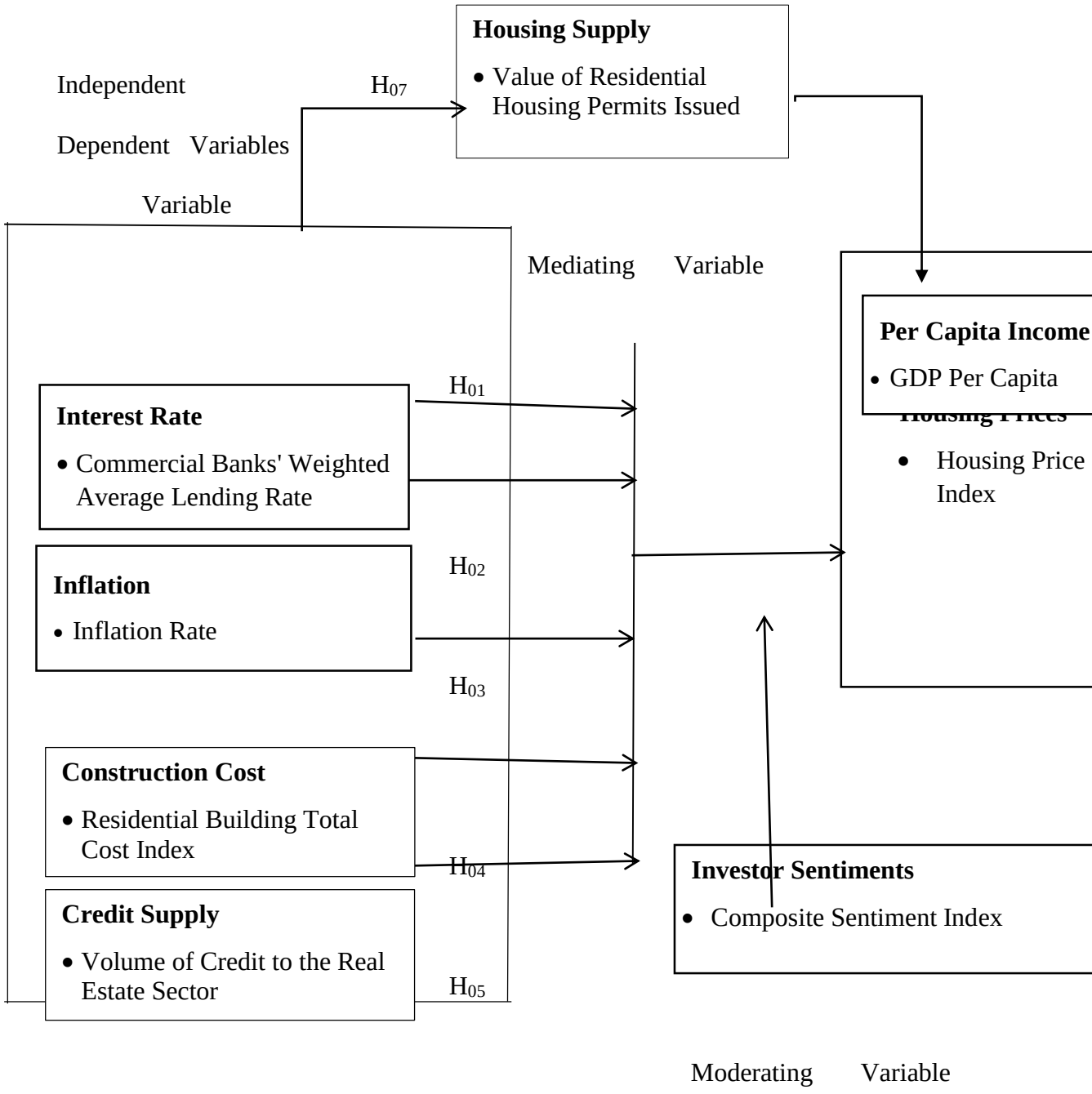

Figure 2.1: Conceptual Framework

Source: Researcher (2020)

Figure 2.1 indicates housing prices proxied by the housing price index permeates the dependent variable. The interest rate was measured by the weighted commercial banks' lending rate. Per capita income was represented by seasonally adjusted GDP per capita, while the average quarterly inflation rate measured inflation. Construction cost was proxied by the residential building total cost index as loans to the real estate sector represented credit supply. Investor sentiments (the moderator variable) was measured by a composite sentiment index based on five indirect sentiment indicators. Housing supply (the mediating variable) was measured by the value of residential building permits issued by the Nairobi City County Government.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter highlights the study methodology employed and the process through which the study's objectives were achieved. Notably, it covers the research philosophy anchoring the study, the research design adopted, the target population and sampling methods used, the procedure of collecting data, operationalisation of study variables that informed the study, and techniques used for data analysis.

3.2 Research Philosophy

Research philosophy is a belief in the way data about a phenomenon should be gathered, analysed, and used (Saunders, Lewis, & Thornhill, 2009). There are two commonly used epistemological positions in academic researches, that is, positivism and interpretivism. This study adopted a positivist philosophy. Positivism is an epistemological position that focuses on facts and causality amongst the variables under study through tests of hypotheses. Additionally, the positivist epistemological stance entails working with observable social reality (Gill & Johnson, 2010). Therefore, the positivist approach enables a researcher to replicate a study's findings in a different context.

The positivist's position was deemed appropriate for the study as testing the causal effect of housing market fundamentals on housing prices was involved. As asserted by Bryman (2012), positivism is grounded on the principle of deduction whereby hypotheses are first derived from theory, followed by data collection and empirically

testing the data to accept or reject the hypotheses. In view of Saunders *et al*. (2009) assertions, the study conducted a thorough review of the literature, stating the study objectives, and formed hypotheses that were statistically tested. The study assumed that the data collected on housing prices portrays the market agents' actions and decisions. Consequently, the housing market fundamentals constituted the mode through which housing prices phenomena would be observed.

Another notable feature of positivism is that the environment and events under investigation are objective, external, and extraneous of the researcher (Saunders *et al*., 2009). Gill and Johnson (2010) advocated for a highly structured methodology and emphasised the quantifiable observation that calls for statistical analysis to facilitate replication. The study investigated the causal effect of housing market fundamentals on housing prices by employing quantitative techniques within this context. Quantitative methods were most preferred for analysing housing price dynamics because objectivity is a crucial characteristic in housing market research.

3.3 Research Design

Research design is a conceptual structure of how the research will be conducted. Research design encompasses a plan on measuring the collection of data and how to analyse the data collected (Kothari, 2010). In this study, an explanatory research design was adopted. The design emphasises studying a problem or a situation to unveil the causal connection between the study variables (Saunders *et al*., 2009). It is grounded on theory such that the researcher develops a particular theory that seeks to explain why and how a phenomenon occurs or why specific outcomes were obtained

(Cooper & Schindler, 2014). As such, the investigator uses theories or at least a hypothesis to account for the forces behind a particular phenomenon's occurrence. Thus, the fundamental implication under this design is that changes occurring in one variable would change other study variables.

An explanatory research design is more suitable where the researcher intends to clarify a particular phenomenon's operation by ascertaining the sources of change without manipulating the explanatory factors (Kerlinger & Lee, 2000). Therefore the investigator would be bound to keep the relevant variables unchanged through the experiment by carefully choosing subjects according to a rigorous sampling process and statistical control of the findings (Cooper & Schindler, 2014). Based on these assumptions, the study formulated seven hypotheses concerning the effects of market fundamentals on house prices, tested the hypotheses, and made appropriate recommendations. Therefore, the explanatory research design fulfilled the central objective of establishing market fundamentals' effect on housing prices.

This study considered two possible relationships between market fundamental and housing prices: linear and asymmetrical, by analysing 13-year quarterly time-series data. The relationships were conditioned to consider the moderating variable (investor sentiments) and a mediating variable (housing supply). The data collected was subject to several statistical tests such as correlation and significance testing to demystify the relationship and how changes in market fundamentals cause housing prices changes. What emerged was that housing market fundamentals had a little linear effect on

housing prices. Nonetheless, the asymmetric impact was significant and mediated by changes in housing supply.

3.4 Empirical Model

The study employed two empirical models: A linear autoregressive distributed lag (ARDL) model associated with Pesaran and Shin (1995) and a nonlinear ARDL (NARDL) model due to Shin, Yu, and Greenwood-Nimmo (2014). These models have many advantages compared to traditional cointegration approaches. The most notable is the possibility to test cointegration for variables integrated of different orders (integrated order zero, one, or fractionally integrated) as long as they are not integrated of order two and above.

The methodological limitation has been a significant weakness in the housing literature (Katrakilidis & Trachanas, 2012). Most studies on housing prices have been restricted to linear models, which cannot encapsulate the parameter instability across the cyclical housing phases (Plakandaras, Gupta, Katrakilidis, & Wohar, 2018). Hence, the study first estimated the linear ARDL model and then extended the analysis to a nonlinear framework to reduce the deficiencies and biases associated with linear models. Comparing and contrasting the two models' findings and perspectives on the same phenomenon was an effective way to find inconsistencies in the previous studies and posed an opportunity for further investigation.

Therefore, the critical justification of methodological triangulation was to overcome the shortfalls in any one method of analysis and effect, arriving at a more valid conclusion on the inquiry (Downward & Mearman, 2007). Equally, as asserted by

Creswell and Plano Clark (2007), multiple methods complementarity helps the researcher get a clearer picture of the research problem, confirm a particular outcome, and cross-validate the research outcomes. Therefore, the use of different methodologies helped in giving a wider view by generating multiple and different perceptions of the research problem.

3.4.1 Linear Autoregressive Distributed Lag Model

The general empirical model, ARDL (n,m) representation, is expressed in Equation 3.1.

$$\Delta Y_t = \alpha_0 + \beta_1 Y_{t-1} + \beta_{2i} X'_{t-1} + \sum_{i=1}^{n} \beta_{3i} \Delta y_{t-i} + \sum_{i=1}^{m} \beta_4 i \, \Delta X'_{t-i} + \varepsilon_t \quad \ldots\ldots (3.1)$$

Where Y_t is housing prices at time t proxied by a Housing Price Index t is the period running 2005Q3 – 2018Q4. X' represents a vector of independent variables (housing market fundamentals). β_s represent the coefficient of explanatory variables, Δ is a first difference operator, n and m are the optimal lag length to be used, α_0 is a constant term and ε_t is a composite error term during time t.

Equation (3.1) was parameterised and expanded to obtain equation (3.2), which was used for linear analysis.

$$\begin{aligned}\Delta lnHPI_t = \beta_0 + \sum_{i=1}^{p1} \beta_{1i} \, \Delta lnHPI_{t-i} + \sum_{i=0}^{p2} \beta_{2i} \, \Delta lnINC_{t-i} + \sum_{i=0}^{p3} \beta_{3i} \, \Delta lnINT_{t-i} \; + \\ \sum_{i=0}^{p4} \beta_{4i} \, \Delta lnINF_{t-i} + \sum_{i=0}^{p5} \beta_{5i} \, \Delta lnCCI_{t-i} + \sum_{i=0}^{p6} \beta_{6i} \, \Delta lnCRED_{t-i} + \\ \beta_7 lnHP_{t-1} + \quad \beta_8 lnINC_t + \beta_9 \, INT_t + \beta_{10} \, lnINF_t + \beta_{11} \; lnCCI_{It} + \\ \beta_{12} \; \ln CRED + \varepsilon_t \quad \ldots\ldots (3.2)\end{aligned}$$

Where

HPI_t - Housing Price at Time *T*;

HPI_{t-i} - Lagged Housing Prices;
INC_t - Per Capita Income at Time *T*;
INC_{t-i} - Per Capita Income at Time *T*;
INT_t - Interest Rate at Time *T*;
INT_{t-i} - Lagged Interest Rate;
INF_t - Inflation Rate at Time *T*;
INF_{t-i} - Lagged Inflation Rate;
CC_t - Construction Cost at Time t;
CC_{t-i} - Lagged Construction Cost;
$CRED_t$ - Credit Supply at Time t;
$CRED_{t-i}$ - Lagged Credit Supply;
ln - Natural Logarithm;
Δ - First Difference Operator;
β_0 - Constant term;
β_s - Coefficients of Explanatory Variables;
ε_t - Composite Error Term

3.4.2 Error Correction Model

The short-run effects were examined by the error correction model equation (3.3) based on the ARDL model (3.2).

$$\Delta lnHPI_t = \beta_0 + \sum_{i=1}^{p1} \beta_{1i}\, \Delta lnHPI_{t-i} + \sum_{i=0}^{p2} \beta_{2i}\, \Delta lnINC_{t-i} + \sum_{i=0}^{p3} \beta_{3i}\, \Delta lnINT_{t-i} + \sum_{i=0}^{p4} \beta_{4i}\, \Delta lnINF_{t-i} + \sum_{i=0}^{p5} \beta_{5i}\, \Delta lnCCI_{t-i} + \sum_{i=0}^{p6} \beta_{6i}\, \Delta lnCRED_{t-i} + \lambda ECT_{t-1} + \varepsilon_t \quad \ldots \quad (3.3)$$

Where

HPI_t - Housing Prices at time *t*;
HPI_{t-i} - Lagged Housing Prices;
INC_{t-i} - Lagged per Capita Income;

INT_{t-i} - Lagged Interest Rate;

INF_{t-i} - lagged Inflation Rate;

CC_{t-i} - Lagged Construction Cost;

$CRED_{t-i}$ - lagged Credit Supply;

ECT - Error Correction term

β_0 - Constant term;

β_{is} - Coefficients of Explanatory Variables;

λ - Speed of Adjustment

ε_t - Composite Error Term

3.4.3 Nonlinear Autoregressive Distributed Lag Model

The linear ARDL model illustrated in Equation (3.3) assumes a linear relationship between explanatory variables and the criterion variable and cannot capture potential nonlinear effects. The study estimated a nonlinear ARDL (NARDL) model due to Shin *et al*. (2014) to account for non-linear relationships. Changes in housing market fundamentals were decomposed into positive and negative partial sums, as shown in equation (3.4) in Appendix III. Then the decomposed partial sum components were estimated in a nonlinear ARDL model Equation (3.5).

A general form of the NARDL (n,m) model is expressed as,

$$\Delta Y_t = \beta_0 + \sum_{i=1}^{p} \alpha_i \Delta y_{t-i} + \sum_{j=0}^{q} (\alpha_j^{+} \Delta X'^{+}_{t-j} + (\alpha_j^{-} \Delta X'^{-}_{t-j}) + \beta_1 Y_{t-1} +$$

$$\beta'^{+} X'^{+}_{t-1} + \beta'^{-} X'^{-}_{t-1} + +\varepsilon_t \quad \text{..... (3.4)}$$

Where

Y_t – Dependent Variable,

Y_t – Lagged Dependent Variable,

X'^{+}_t –Positive Partial Sum of Explanatory Variables at time t;

X'^{+}_{t-j} – Lagged Positive Partial Sum of Explanatory Variables;

$\beta^{+}s$ – Long Run Coefficients of Positive Partial Sum of Explanatory Variables;

$\beta^{-}s$ – Long Run Coefficients of Negative Partial Sum of Explanatory Variables.

α_j^{+} – Short Run Coefficients of Negative Partial Sum Variables

α_j^{-} – Short Run Coefficients of Negative Partial Sum Variables

p, q – Lag Length

Equation (3.4) was expanded to form Equation (3.5), which was used for nonlinear analysis

$$\Delta lnHPI_t = \beta_0 + \sum_{i=1}^{p1} \beta_{1i}\, \Delta lnHPI_{t-i} + \sum_{i=0}^{p2} \beta_{2i}\, \Delta LnINC^{+}_{t-i} + \sum_{i=0}^{p3} \beta_{3i}\, \Delta LnINC^{-}_{t-i} + \sum_{i=0}^{p4} \beta_{4i}\, \Delta INT^{+}_{t-i} + \sum_{i=0}^{p5} \beta_{5i}\, \Delta INT^{-}_{t-i} + \sum_{i=0}^{p6} \beta_{6i}\, \Delta INF^{+}_{t-i} + \sum_{i=0}^{p7} \beta_{7i}\, \Delta INF^{-}_{t-i} + \sum_{i=0}^{p8} \beta_{8i}\, \Delta LnCCI^{+}_{t-i} + \sum_{i=0}^{p9} \beta_{9i}\, \Delta LnCCI^{-}_{t-i} + \sum_{i=0}^{p10} \beta_{10i}\, \Delta LnCRED^{+}_{t-i} + \sum_{i=0}^{p11} \beta_{11i}\, \Delta LnCRED^{-}_{t-i} + \alpha_1 lnHP_{t-1} + \alpha_2 LnINC^{+}_{t-1} + \alpha_3 LnINC^{-}_{t-1} + \alpha_4 INT^{+}_{t-1} + \alpha_5 INT^{-}_{t-1} + \alpha_6 INF^{+}_{t-1} + \alpha_7 INF^{-}_{t-1} + \alpha_8 LnCCI^{+}_{t-1} + \alpha_9 LnCCI^{-}_{t-1} + \alpha_{10} LnCRED^{+}_{t-1} + \alpha_{11} CRED^{-}_{t-1} + \varepsilon_t \quad \ldots\ldots\ldots (3.5)$$

Where

HPI_t – Housing Prices at time *t*;

HPI_{t-i} – Lagged Housing Prices;

$INC^{+}{}_{t-i}$ – Lagged Positive Partial Sum of Income per Capita;

$INC^{-}{}_{t-i}$ – Lagged Negative Partial Sum of Income per Capita;

$INT^{+}{}_{t-i}$ – Lagged Positive Partial Sum of Interest Rate;

$INT^{-}{}_{t-i}$ – Lagged Negative Partial Sum of Interest Rate;

$INF^{+}{}_{t-i}$ – Lagged Positive Partial Sum of Inflation Rate;

$INF^{-}{}_{t-i}$ – Lagged Negative Partial Sum of Inflation Rate;

$CCI^{+}{}_{t-i}$ – Lagged Positive Partial Sum of Construction Cost;

$CCI^{-}{}_{t-i}$ – Lagged Negative Partial Sum of Construction Cost;

$CRED^{+}{}_{t-i}$ – Lagged Positive Partial Sum of Credit Supply at time t;

$CRED^{-}{}_{t-i}$ $-$ Lagged Negative Partial Sum of Credit Supply;

β_0 $-$ Constant term;

β_{is} $-$ Short Run Coefficients of Explanatory Variables;

α_{is} $-$ Long Run Coefficients of Explanatory Variables.

3.4.4 Moderating Effect Model

The study adopted Whisman and McClelland's (2005) approach to moderation to examine how investor sentiments (moderator variable) moderates the relationship between housing market fundamentals (explanatory variables) and housing prices (the dependent variable). This approach estimates two hierarchical regressions equations as shown in Equation (3.6) and (3.7)

In the first step, investor's sentiment (moderator) is introduced as a variable in Equation (3.6)

$$HP_t = \beta_0 + \beta_1 HP_{t-i} + \beta_2 INC_t + \beta_3 INT_t + \beta_4 INF_t + \beta_5 CCI_t + \beta_6 CRED_t + \beta_7 INVS_t + \varepsilon_t \quad (3.6)$$

In the second step, investor sentiments was introduced as a moderator in Equation (3.7)

$$HP_t = \beta_0 + \beta_1 HP_{t-i} + \beta_2 INC_t + \beta_3 INT_t + +\beta_4 INF_t + \beta_5 CCI_t + \beta_6 CRED_t + \beta_7 INVS_t + \beta_8 INVS_t * INC_t + \beta_9 INVS_t * INT + +\beta_{10} INVS_t * INF_t + \beta_{11} INVS_t * CCI_t + \beta_{12} INVS_t * CRED_t + \varepsilon_t \quad (3.7)$$

Where

HPI_t - Housing Prices at time *t*;

HPI_{t-i} - lagged Housing Prices;

INC_t - Per capita Income at time *t*;

INT_t - Interest rate at Time *t*;

INF_t - Inflation Rate at time t;

CCI_t - Construction Cost at time t;

$CRED_t$ -Credit Supply at time t;

$INVS_t$ - Investor sentiments at time t;

β_0 - Constant term;

β_s - Coefficients of Explanatory Variables; and

ε_t - Composite Error Term

Table 3.1 summarises the criteria used to decide if investor sentiments moderate the relationship between housing market fundamentals and housing prices.

Table 3.1: Moderation Decision-Making Criteria

	Result	**Decision**
Decision One	If the moderator coefficient is significant in model 3.6	Investors sentiments is an explanatory variable or a mediating variable
	If the coefficient of interaction terms between explanatory variables and moderator are insignificant in model 3.7	
Decision Two	If the moderator coefficient is insignificant in model 3.6	Investors sentiments have a moderating effect
	If the coefficients of interaction terms between explanatory variables and the moderator are significant in model 3.7	
	If the coefficients of explanatory variables significant in model 3.2 but more than in model 3.7 and moderator coefficient is significant in model 3.7	

Source: Researcher (2020)

3.4.5 Mediating Effect Model

Baron and Kenny(1986) outlined a four causal step approach for testing mediation with regression analysis that tests the coefficients' significance at each step. This approach was adopted in a hypothesised causal chain in which market fundamentals

affect housing supply (the mediating variable) that, in turn, cause changes in housing prices (the dependent variable) as shown in Figure 3.1

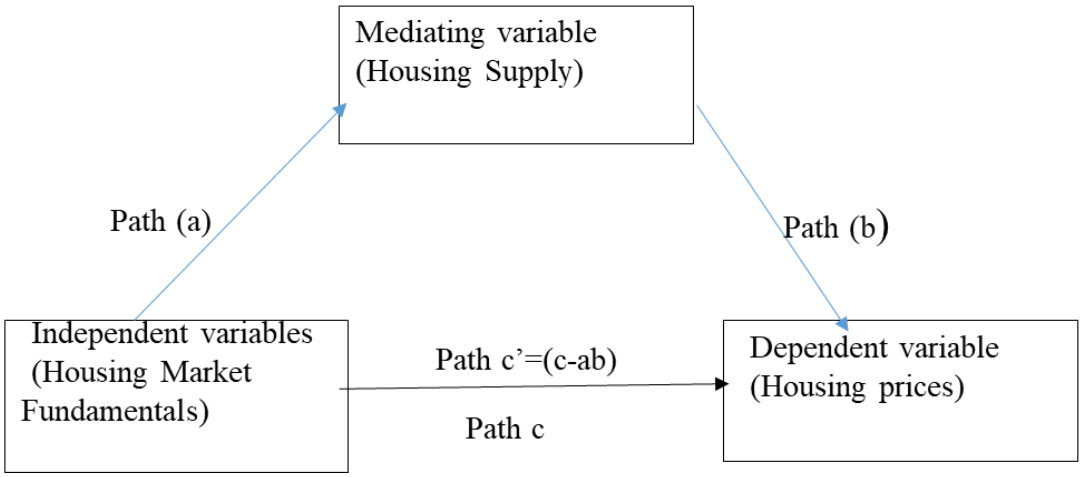

Figure 3.1: Mediation Path

Source: Baron and Kenny (1986)

As shown in Figure 3.1, the direct path from housing market fundamentals to housing prices (path c) is said to be mediated by direct path (a) to housing supply and (path b) from housing supply to housing prices, whereby the mediation effect is (ab). Path (c') represents the effect of market fundamentals on housing supply after controlling the mediator variable. If the housing supply (mediator variable) effect remains significant after controlling for housing market fundamentals, some mediation is supported. However, if market fundamentals are no longer significant when the moderator is controlled, the findings would support full mediation. If both the moderator and market fundamentals significantly predict housing prices, then the results support partial mediation.

The study followed the four steps suggested by Baron and Kenny (1986) as follows: In the first step (Path c), Equation (3.2) was estimated as the base model to show the

direct effect of housing market fundamentals on housing prices. This step establishes whether there is an effect that may be mediated.

In the second step (Path a), Equation 3.8 was estimated to determine whether the causal and mediator variables are correlated. In this step, the housing supply (mediator variable) was employed as a dependent variable and housing market fundamentals as explanatory variables. This step is to test whether the explanatory variables statistically predicts the mediator variable.

$$M = \beta_0 + \beta_1 INC_t + \beta_2 INT_t + \beta_3 CC_t + \beta_4 INF_t + \beta_5 CRED_t + \varepsilon_t \ldots\ldots\ldots\ldots \quad (3.8)$$

Where

M - Mediating Variable (New Housing Supply)

INC_t - Per Capita Income at time *t*;

INT_t - Interest rate at Time *t*;

INF_t - Inflation Rate at time *t*;

CCI_t - Construction Cost at time t;

$CRED_t$ - Credit Supply at time t;

β_0 - Constant term;

β_s - Coefficients of Explanatory Variables;

ε_t - Composite Error Term

In the third step (Path b), Equation 3.9 was estimated to assess whether the mediating variable affects the outcome variable controlling for the independent variable and whether the independent variables affect the dependent variable controlling for the mediator variable (Path (c'). At this stage, housing price is regressed against the housing market fundamentals and housing supply simultaneously. The causal

variables were controlled in establishing the effect of the mediator on the outcome variable.

$$HP_t = \beta_0 + \beta_1 INC_t + \beta_2 INT_t + \beta_3 CC_t + \beta_4 INF_t + \beta_5 CRED_t + \beta_6 M + \varepsilon_t \ldots (3.9)$$

In the step four: A decision on the nature of mediation is made based on Table 3.2.

Table 3.2: Mediation Decision Making Criterion

	Result	**Decision**
Decision One	If the coefficients of explanatory variables are significant in model 3.2	Complete Mediation
	If the coefficients of explanatory variables are significant in model 3.8	
	If the coefficients of explanatory variables are not significant in Model 3.9 but the mediator variable coefficient is significant	
Decision Two	If the coefficients of explanatory variables are significant in model 3.2	Partial mediation
	If the coefficients of explanatory variables are significant in model 3.8	
	If the coefficients of explanatory variables are significant in model 3.2 but more than in model 3.9 while the coefficient of the mediator variable is significant in model 3.9	
Decision Three	If the coefficients of explanatory variables are not significant in model 3.2	No mediation
	If the coefficients of explanatory variables are not significant in model 3.9	
	If the coefficients of explanatory variables in model 3.2 are significant and equal to the coefficients of explanatory variables in model 3.9 while the mediator variable not significant in model 3.9	

Source: Baron and Kenny (1986)

3.5 Target Population

A target population comprises the entire group of people, objects, or events from which the researcher intends to generalise their study (Bryman, 2012). The target population was 163,000 residential housing units put up for sale in Nairobi City County over the period 2005-2018 (Hass Consult, 2018). The unit analysis for the study was the entire Nairobi city county housing sector. The statistical observation unit was the observed asking prices of residential housing units aggregated in the housing price index.

3.6 Sampling Design

Sampling is the process of selecting some of the elements in a population to enable concluding the entire population errors (Cooper & Schindler, 2014). A sample design prescribes the researcher's selection of the sample frame to derive inference about the target population (Kothari, 2010). A census is a count of all the elements of a population. The study conducted a census of all 163,000 residential buildings units put up for sale in Nairobi City County over 2005 – 2008.

3.7 Data Sources and Collection Instrument

The study obtained a dataset for analysis from five different secondary sources: The Central Bank of Kenya, the Kenya National Bureau of Statistics, the World Bank, Nairobi Securities Exchange (NSE), and Hass Consult Ltd databases for the period 2005 to 2018. The data on the housing price index was obtained from Hass consult Ltd's quarterly reports. The information on the interest rate and inflation were obtained from Kenya's central bank monthly and quarterly statistical reports. Data on credit

supply and per capita income was gathered from the Central Bank Of Kenya and the World Bank statistical abstracts and bulletins. The data on construction cost and housing supply were retrieved from KNBS databases supplemented by minutes of Nairobi City County department of housing and urban planning.

Additional data were collected to construct a composite investor sentiments index from the following sources: Data on an equity share index, equity turnover, credit rating, and foreign participation on equity were obtained from Nairobi Securities Exchange(NSE) database and periodical releases. The data on the government bond rate and term structure was drawn from the Central Bank of Kenya databases. Data on consumer expenditure and the unemployment rate were sourced from the Kenya National Bureau of Statistics. Finally, a data abstraction tool presented in 00was used to extract and compile the necessary data for analysis.

The main reason for collecting data from multiple sources, which is triangulation, was to achieve reliability of the quantifiable data and subsequent validity of the results (Downward and Mearman, 2007) and confidence in the conclusions (Bryman, 2012). More data collection leads to a better measurement of the result subject to its reliability and credibility, especially if the source is not systematically biased (Leuffen, Shikano, & Walter, 2013). The study encountered some gaps while extracting data that needed to be addressed by obtaining more data from alternative sources to fill the missing data points. The measures included linking and combining the data from multiple sources. Therefore, data triangulation created an opportunity to compare a wide range of data on the variables of interest side by side ensuring that the data collected covered all the

years. In this way, the richness of the available information was enhanced, ultimately improving the validity and reliability of the study.

3.8 Data Collection Procedure

Firstly, a research permit was acquired from NACOSTI that enabled data utilisation from various sources. Secondly, multiple government agencies and a private company were notified of the intention to collect data from their databases and statistical abstracts for the period of reference. Thirdly the researcher extracted data from various published statistical abstracts, economic survey reports, and other published estimates. The process included retrieving existing documents, such as policy documents, official statistics, economic abstracts and program records, planning documents, and minutes from meetings. Finally, the data collected was summarised and recorded in a data abstraction tool presented in Appendix III and cleaned accordingly in readiness for analysis.

3.8.1 Operationalisation and Measurement of Variables

The variables under study were operationalized and measured, as shown in Table 3.3. The dependent variable is housing prices, while the independent variables comprise interest rate, per capita income, inflation, construction cost, and credit supply. The moderating and mediating variables are represented by investor sentiments and housing supply, respectively. The study period was from 2005Q3 to 2018Q4. The operationalisation and measurement of variables evolved from and was supported by academic and empirical literature.

Table 3.3: Operationalisation of Study Variables

Type of Variable	Variable	Operationalization	Measurement
Dependent Variable	Housing prices	The weighted average asking price of the standard mix of residential properties.	Housing Price Index.
Independent Variables.	Per Capita Income	The after-tax income to households divided by the total population.	GDP Per Capita.
	Interest rate	The opportunity cost of capital to financiers.	Commercial Banks' weighted Average Lending Rate.
	Inflation	The relative change in overall price levels.	Inflation rate.
	Construction Cost	The cost of producing houses.	Residential Building Total Cost Index.
	Credit Supply	The value of loans disbursed to the real estate sector.	The Volume of Credit to the Real Estate Sector
Moderating Variable	Investor Sentiments	The market participants' beliefs about future asset prices and investment risks that are not based on the current information set.	Composite Sentiment Index.
Mediating Variable	Housing Supply	The supply of new houses into the market.	Value of Residential Housing Permits Issued.

Source: Researcher (2020)

3.9 Data Analysis and Presentation

The study used descriptive and inferential statistics to analyse data aided by E-Views 10 software. Descriptives were used to reduce, summarize, and distribute the data alongside inferential statistics. Inferential statistics included the Pearson correlation as

well as the linear and nonlinear autoregressive analysis. The linear and non-linear autoregressive distributed lag (ARDL) models were estimated at a 0.05 significant level ($\alpha = 0.05$). The study further conducted trend analysis to illustrate how the study variables evolved and the association between them.

Before analysis, various diagnostic tests were carried to ascertain the suitability of the time-series data for empirical analysis and to deal with the violation of time series assumptions. These diagnostic tests included: normality, stationarity, cointegration, serial correlation, heteroscedasticity, multiple structural breaks, and stability tests. Equally, the optimum number of lags was checked using four criteria. The study then estimated the two empirical models: An autoregressive distributed lag (ARDL) and nonlinear ARDL models.

The empirical analysis involved four stages. Firstly, the stationarity of the time series was examined along with the optimal lag length. ARDL bound test of cointegration does not require a unit root pre-test but is more preferred where variables are integrated of different orders (Nkoro & Uko, 2016). However, the methodology does not apply with I (2) variables, which justified the need to test for stationarity. Secondly, a linear ARDL model was implemented to ascertain linear cointegration between housing market fundamentals and house prices. At this stage, the short-run and long-run linear relationships could be detected through the F-statistic (Wald test). Thirdly, a nonlinear ARDL model was estimated to assess asymmetric cointegration between housing market fundamentals and house prices. The final stage involved evaluating short- and

long-run asymmetric relationships based on the Wald test and dynamic multiplier graphs.

Additionally, the study examined the moderating effect of investor sentiment using Whisman and McClelland's (2005) two-step approach by estimating equation 3.6 and 3.7. Before evaluating the moderating effect, the study constructed a composite investor sentiments index using the orthogonalisation regression approach. Hence, orthogonalised regressions of five indirect investor sentiment were combined into a composite sentiment index by applying principal component analysis, as explained in Appendix IV. Finally, the study examined the mediating effect of housing supply using Baron and Kenny's (1986) four-step approach. In the process, the study hierarchically estimated Equation 3.2, 3.8, and 3.9. Finally, the empirical results were presented in tables, graphs, and statistical parameter estimates.

3.10 Diagnostic Tests

Diagnostic tests show the robustness of the estimated coefficients by confirming that parameter estimates are not biased, checking for wrong functional form, parameter instability, and measurement error. By virtue that the study used time-series data, strong trends, and non-random disposition of the series may undermine some econometric tests leading to a type I error (Brooks, 2008). Consequently, the study carried out the ARDL model pre-analysis test of stationarity and multiple structural breaks advocated by Pesaran, Shin, and Smith (2001). Further, the cointegration test was carried out to examine the long-run convergence of the study variables. Moreover, the study carried out tests of normality, serial correlation, and heteroscedasticity.

These tests were carried out to examine whether the error term is independent and identically distributed. Finally, stability and specification error tests were carried out to determine whether the estimated model's parameters are stable. These tests are discussed hereunder.

3.10.1 Stationarity Test

Unit root in a time series leads to a spurious regression where the standard assumption for asymptotic analysis would not be valid (Brooks, 2008). The study employed the Augmented Dickey-Fuller (ADF) and Philip and Peron (PP) test to assess each variable's time series property at levels and differences. For the two tests, the null hypothesis that the variable is not stationary was carried out against the alternative hypothesis that the variable is stationary at a 0.05 significance level. If computed ADF or PP-values were more than the critical values, the null hypothesis would be rejected (Gujarati, 2003). If the variable becomes stationary at the first difference, it would be classified as integrated order one. Additionally, If ADF and PP tests produced different results, the variables were subjected to Kwiatkowski Phillips, Schmidt, and Shin's (1992) (KPSS) test as a confirmation. For KPSS, the null hypothesis would be rejected if the KPSS statistic would be more than 0.05 significance level.

3.10.2 Cointegration Test

Cointegration is a linear combination of nonstationary random variables. The cointegration test helps in estimating equilibrium in systems with unit root variables. The study employed a bound ARDL test of cointegration reliant on the F- statistic. Under the ARDL bound test, a null hypothesis ($H0: \delta_1 = \delta_1 = 0$), that is,

cointegration among variables does not exist is tested against the alternative hypothesis ($H0: \delta_1 \neq \delta_1 \neq 0$) that cointegration exists. The null hypothesis will be rejected if the P-value is above the upper boundary. If the P-value lay below the lower boundary, the null hypothesis would not be rejected. However, if the P-value lay between the two boundaries, no inference could be drawn, and other criteria would be used to conclude (Pesaran, Shin, & Smith,2001)

3.10.3 Multiple Structural Break Test

A structural break is an abrupt change in an economic time series due to variations of either economic regime, policy directions, or external shocks (Perron, 2005). In the presence of a significant break, the power of cointegration relations can be reduced. The study used Bai and Perron's (2003) test for multiple structural breaks at unknown breakpoints. The null hypothesis of no structural break in the data was tested against an unknown number of structural breaks. If a significant breakpoint is inferred from examining the data, a dummy variable would be assigned to the deterministic components.

3.10.4 Normality Test

The normality test is used to determine if a data set is well modeled by a normal distribution (Field, 2009). The study adopted Jarque – Bera (JB) tests and a normality graph. The null hypothesis (H_0) that the disturbances are normally distributed was tested against the alternative hypothesis that disturbances are not normally distributed. The null hypothesis will not be rejected if the calculated statistic is not significant (P-value> 0.05). If the normality test failed, non-parametric statistical methods would be

used as they do not assume normality. Additionally, if a few extreme residuals cause nonnormality, then a dummy variable could be used to remove those observations (Brooks, 2008) effectively.

3.10.5 Heteroscedasticity

Heteroscedasticity occurs when disturbances have unequal variances independent of t (Baum & Schaffer, 2013). If the data is heteroskedastic, standard errors would be wrong, which leads to misleading inferences. The study employed Bresusch Pagan (B-P) test for heteroscedasticity. B-P test creates a chi-distributed statistic with the null hypothesis (H_0) that the error term is heteroscedastic against an alternative hypothesis that the error term is homoskedastic. If the LM- statistic exceeds Chi-squared critical values ($LM > \chi^2$), H_0 would be rejected, providing sufficient evidence of heteroscedasticity. Alternatively, if the computed P-value is less than the significance level, the null hypothesis would equally be rejected. If data is heteroscedastic, alternative methods such as GLS that consider heteroscedasticity would be employed (Asteriou & Hall, 2007). Alternatively, logarithmic transformation or the use of standard error estimates would be used to rectify that violation.

3.10.6 Autocorrelation Test

Autocorrelation is a condition in which error terms of explanatory variables have a covariance (Brooks, 2008). The serial correlation presence means the coefficient estimates would be unbiased but inefficient, and R^2 would be overestimated. In that case, the regression would underestimate the coefficients' standard error (Wooldridge, 2010). The study employed the Breusch-Godfrey (BG) LM (Lagrange Multiplier) test

to check for the presence of autocorrelation. The null hypothesis (H_0) of no first-order serial correlation exists against the alternative that serial correlation exists in the residuals was examined. The null hypothesis of no serial correlations in the residuals would not be rejected if the LM test's P-value is greater than the critical value. If the autocorrelation assumption is violated, appropriate transformation such as the Generalised Least Square (GLS) procedure would be used to remedy the violation.

3.10.7 Residual Stability Test

Stability tests are conducted to establish the stability of estimated model parameters. The study used the cumulative sum of residuals (CUSUM) and CUSUM Squared tests due to Brown, Durbin, and Evans (1975). The CUSUM test is based on the cumulative sum of residuals within significance lines (Greene, 2003). The null hypothesis of parameter stability is tested against an alternative hypothesis of parameter instability. If the residual plot of estimates lies within the 0.05 significance band, the residuals are stable. Model instability would be inferred when the cumulative sum lies outside the critical boundaries.

3.10.8 Specification Error Test

The study conducted a Ramsey Regression Equation Specification Test (RESET) to assess whether the model's functional form was well specified (Asteriou & Hall, 2007). The test identifies omitted variable data transformation biases. The presence of specification errors invalidates the inference procedures as the estimators would be biased and inconsistent. The null hypothesis of the correct specification was tested against the misspecification. If the computed F-value is significant at the specified

significance level, the null hypothesis would not be rejected, indicating that the model is misspecified. However, if the calculated statistic is not significant (P>0.05), the null hypothesis is rejected, showing an excellent functional form of the model (Brooks, 2008).

3.11 Ethical Consideration

Ethics is a system of moral principles and standards of conduct that govern an individual's conduct of an activity (Centre for Instruction Research Technology, 2017). Ethical consideration promotes the study's primary objective of truth, knowledge, and minimisation of errors by prohibiting data fabrication, falsification, and misrepresentation (Resnik,2015). The study considered ethics by obtaining a research permit from NACOSTI before utilising secondary data from public and private sources. The researcher also obtained consent from these institutions by making them aware of the type of data to be collected, the purpose it would be put to, and how it would affect these institutions directly or indirectly. Confidentiality of the data collected was upheld by not sharing any of the data collected and using it for academic purposes only. Additionally, materials and comments from other authors were acknowledged through citations and references in the thesis.

CHAPTER FOUR

RESEARCH FINDINGS AND DISCUSSION

4.1 Introduction

In this chapter, a descriptive analysis of study variables, the research findings, subsequent interpretation, and discussion of the result are presented. The first part of this chapter presents the descriptive and trend analysis that provides the study variables' characteristics and evolution over time. The second part documents the inferential statistics, which comprises pre-estimation and post-estimation diagnostic tests applicable to the dynamic autoregressive models. The final part delves into the estimation result, subsequent interpretation, and tests of the research hypotheses.

4.2 Descriptive Analysis

This section presents descriptive statistics for each variable under study. The descriptives include the mean, median, standard deviation, skewness, kurtosis, and trend analysis. Analysing the series allows the study to figure out each variable's underlying distribution relative to normal distribution. The frequencies are quarterly for the period covering 2005Q4 to 2008Q4. The relevant descriptive statistics are presented in Table 4.1.

As shown in Table 4.1, the mean value of the housing price index over the study period was 328.28 points, with a standard deviation of 76.18. The minimum and maximum values were 175.3 and 421.33 points, respectively. The standard deviation was less than the mean value, which indicates a small dispersion from the mean. The distribution of housing prices is negatively skewed (-0.597) and leptokurtic (Kurtos=

2.182>0), implying that they have thicker tails than normal distribution density with the same mean and variance (Brooks, 2008). This result indicates that housing prices tend to move to the long mean value and are more prone to price appreciation

Table 4.1: Descriptive Statistics

	Housing Price Index	Per Capita Income	Interest Rate	Inflation Rate	Construction Cost Index	Credit Supply
Mean	328.28	101,472.6	15.15	7.82	6,368.1	524,004.2
Median	342.23	976,33.4	14.21	6.88	6,004.9	527,774.0
Maximum	421.33	182,572.7	20.22	19.18	9,161.8	1,118,113.
Minimum	175.30	392,73.02	12.61	2.71	4,144.7	96,384.0
Std. Dev.	76.18	416,92.2	2.02	4.10	1,571.3	367,965.7
Skewness	-0.5976	0.40708	0.97	1.25	0.488	0.238380
Kurtosis	2.182	1.972612	2.84	3.65	1.835	1.613163
Observations	54	54	54	54	54	54

Source: Research Data (2020)

The result presented in Table 4.1 indicates that the average interest rate was 15.15 percent over the study period, with a minimum of 12.61 percent and a maximum of 20.22. The standard deviation was 2.04 percent, which connotes a relatively small dispersion from the mean. The range of interest rates indicates that the housing market was characterised by periods of expansion and contraction in interest rates during the study period. The results suggest that the mean inflation rate was 7.82 percent, with a standard deviation of 4.10 percent. The minimum recorded inflation rate was 2.71

percent, and the maximum was 19.18 percent. The result indicates a wide variation from the mean. The highest recorded growth in inflation was in 2008 and 2011. The inflationary pressure in these periods can be attributed to external shocks such as higher oil prices, depreciation of a shilling against other currencies, and the crisis in the Eurozone (World Bank, 2017).

The result in Table 4.1 equally indicates the mean construction cost index was 6368.1 points ranging between 4144.7 and 9161.8 points, with a standard deviation was 1,571.3. The result indicates a significant divergence in the cost of construction from its mean. As measured by the value of credit to the real estate sector, credit supply has a mean of KES. 524 million with a minimum and maximum value of KES. 96.3 million and KES 1,031 million, respectively. The standard deviation was KES. 367.9 million, which indicates a significant variation in credit supply to the real estate sector over the study period.

4.3 Trend Analysis

This section illustrates the trends and evolution of the study variables over time using a line graph and Kernel density curves on the y-axis.

4.3.1 Trends in the Housing Price index

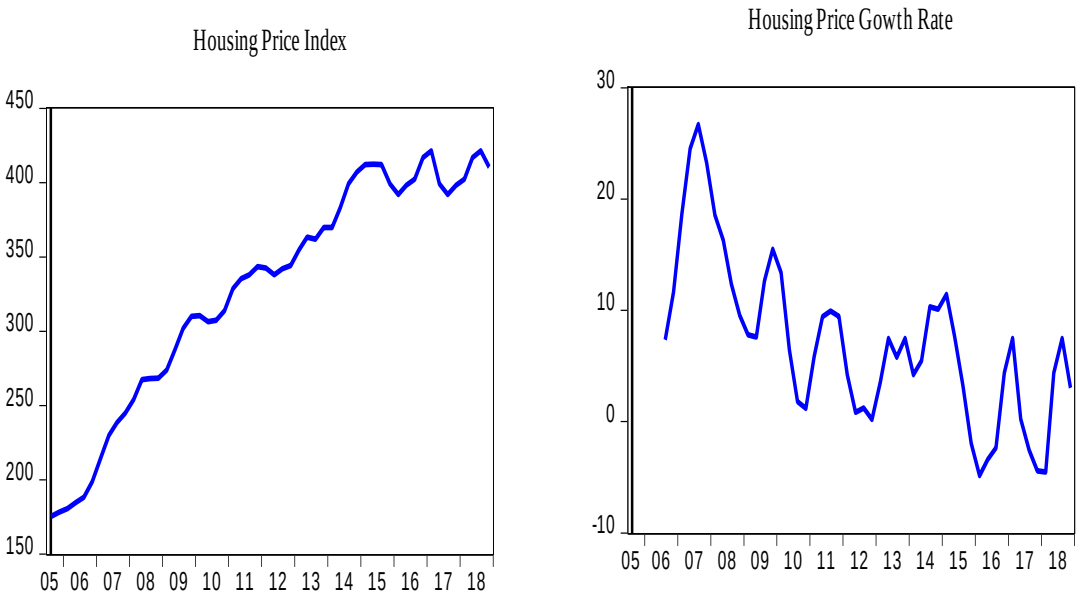

Figure 4.1: Trends in the Housing Price Index

Source: Research Data (2020)

Figure 4.1 highlights how housing prices have evolved over the study period. The outcome of Figure 4.1 indicates that housing prices have been on an upward trend and continues to increase. On average, the housing price index suggests that Nairobi City County saw a positive growth during the study period averaging 4 percent per annum. The highest growth was recorded in quarter four, 2008, at 23 percent. However, housing prices recorded negative growth in quarter one of 2016 (-5 percent) and a quarter one in 2018. Despite some instances of negative growth in prices, houses maintained an upward trend. This can be attributed to a refined property market explained by strong economic growth, relatively stable inflation, and limited land availability. These factors push prices up coupled with the widening GDP between the demand and supply of housing.

4.3.2 Trends in Per Capita Income

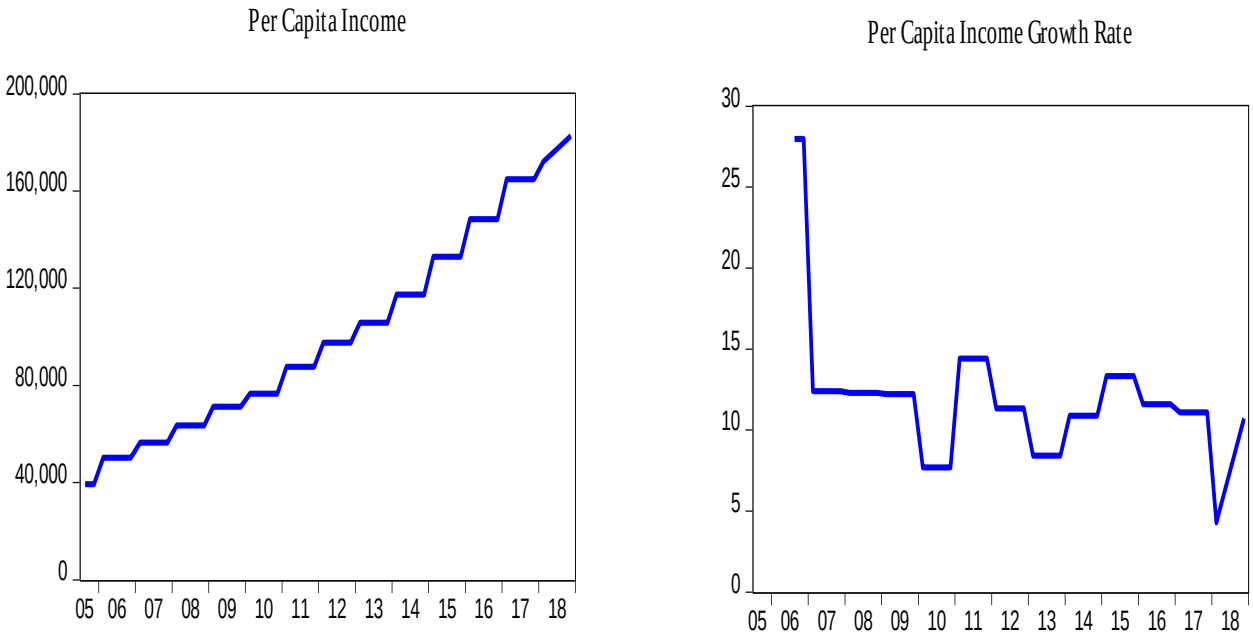

Figure 4.2: Trends in Per Capita Income

Source: Research Data (2020)

Figure 4.2 indicates that per capita income has been on an upward trend and continues to increase over the study period. The per capita income growth rate was over five percent throughout the study period, except for the first half of 2018. According to the Central Bank of Kenya (2017) economic outlook, the growth in per capita income can be attributed to relatively strong macroeconomic settings and positive developments in agriculture, manufacturing, construction, real estate, and insurance sectors. GDP grew gradually from about 5 percent in 2005 to about 7 percent in 2007. It decelerated to an all-time negative growth of 2 % in 2008 due to several shocks, including post-election violence, followed by a slow recovery in 2009. GDP rebounded back in 2010, recording a growth of 8.4 percent but immediately slowed down to 6.0 percent in 2011.

Since 2011 Kenya has posted a stable and superior performance with a GDP growth rate averaging 0.05 between 2011 and 2018.

In the recovery phase, volatility remained high, exacerbated by political uncertainty and global economic crisis. According to World Bank (2018), the fluctuation in GDP growth has been attributed to various factors, such as political shocks, exogenous shocks (such as the global financial crisis, drought, global oil prices), and macroeconomic policy shocks aimed at regulating high inflation.

4.3.3 Trends in Interest Rates

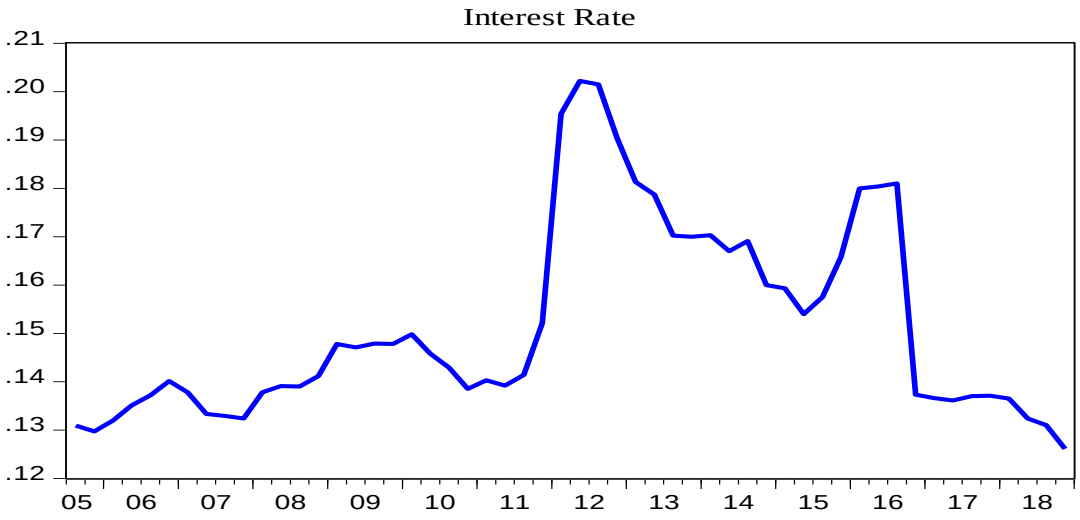

Figure 4.3: Trends in Interest Rates

Source: Research Data (2020)

As demonstrated in Figure 4.3 , there was a significant variability in the interest rate movement ranging between 12.6 percent and 20.1 percent over the study period. The interest rate remained below 15 percent between 2005- 2011 when interest rates rose sharply to peak at 20.1 percent in Quarter three 2012 then dropped gradually. Between 2016 and 2018, interest rates were relatively low and stable at an average of 13.8

percent, attributed to the implementation of interest rate capping laws in 2016. Before 2016, just before introducing interest rate capping laws in Kenya, banks were charging interest as high as 20 percent for loans, which declined to an average of 13.8 percent after 2016. On average, interest rates tend to co-move with the expansion and contraction of credit supply, which may have played a role in facilitating housing market movements.

4.3.4 Trends in Inflation

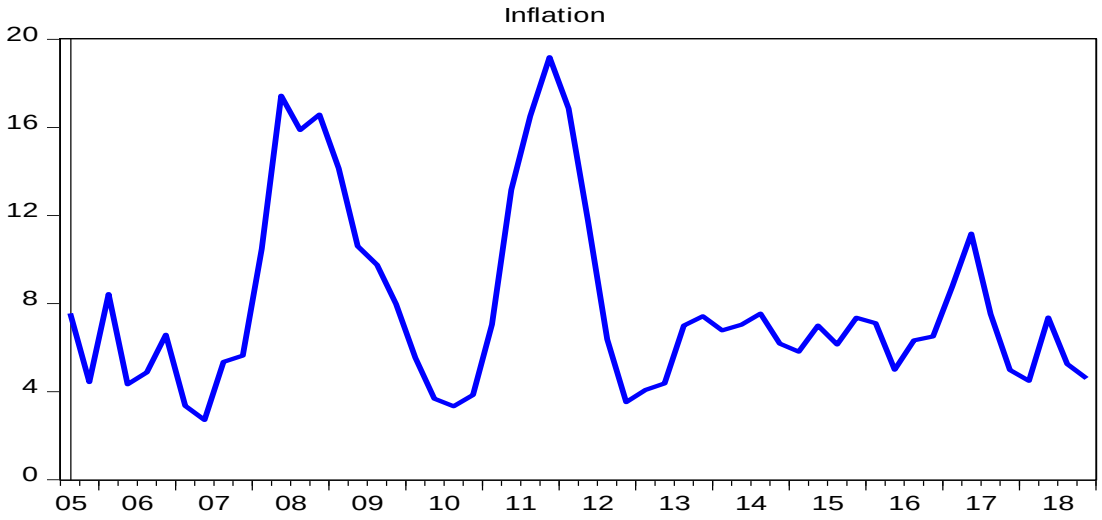

Figure 4.4: Trends in Inflation

Source: Research Data (2020)

Figure 4.4 points out that the evolution of inflation has been cyclical over the study period. However, during the study period, inflation was below 10 percent in most years except for the windows 2008-2009 and 2011-2012, recording the highest in early 2008 and late 2011. The inflationary pressure in 2008 and 2011 could be associated with attributed to the depreciation of a shilling against other currencies, lower than expected rainfall, high oil prices, and the Eurozone crisis. Furthermore, the cyclical

movement in inflation c associated with expansionary and contraction monetary and fiscal policies to mitigate external shocks' adverse effects such as international oil prices, droughts, and cases like the global financial crises witnessed in 2008.

4.3.5 Trends in Construction Cost

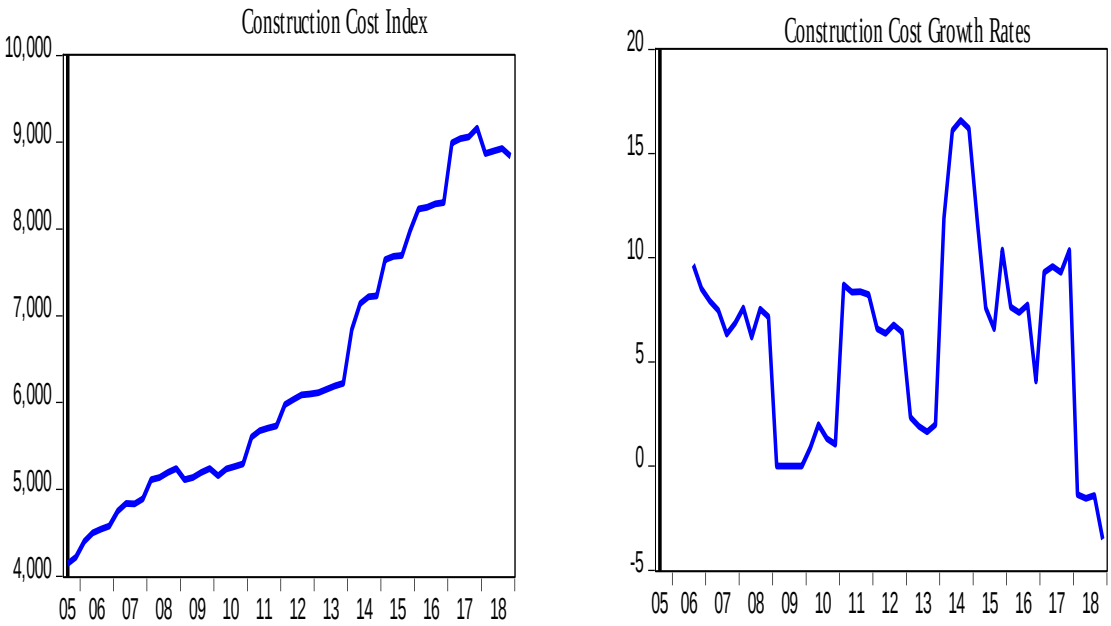

Figure 4.5: Trends in Construction Cost

Source: Research Data (2020)

The result presented in Figure 4.5 demonstrates that construction costs have been on an upward trend characterised by cyclical growth rates. Over the study period, the growth rate averaged 5 percent but was below 10 percent except for 2014 and 2015. Another notable feature is that; construction cost growth has been on a downward trend from the last quarter of 2016 to 2018. The construction cost variation can be associated with the stability of inputs in construction occasioned by the local currency's strength against other currencies. Besides, the changes in the cost of

construction can be associated with the growth in the cost of labour in the building and construction industry.

4.3.6 Trends in Credit Supply

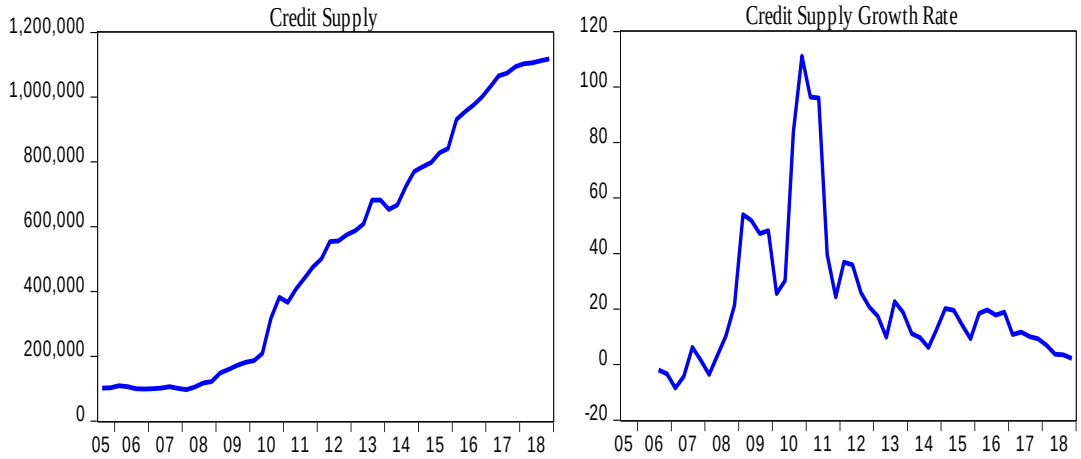

Figure 4.6: Trends in Credit Supply

Source: Research Data (2020)

Figure 4.6 indicates that credit supply has somewhat been volatile and cyclical over the study period. The credit supply grew consistently from as low as 20 percent in 2008, peaking at 100 percent in 2010. However, since the year 2010, the growth rate has continuously decreased, recording the lowest of 2 percent in 2018. In Kenya, credit slowdown may be attributed to strained external financing in 2015 and endogenous factors such interest capping laws that came into effect in 2016 and the increase in risk-free rate of returns due to increased domestic borrowing by the government.

The expansionary and contractionary phases tend to be negatively correlated to inflation and interest rates, indicating that most households prefer credit when interest and inflation rates are low. The growth phases in credit supply between 2011 and 2016

can be attributed to credit market liberalisation and Kenyan credit institutions' innovations, which eased households' access to credit by loosening the financial constraints they faced. The growth in credit supply can also be linked to microfinance institutions' emergence and corporative societies (SACCOs). These institutions came with innovative products meant for low-income and informal sectors who were not eligible for formalised loans. Before 2011, the credit supply was dominated by large banks, and the banking sector was tightly controlled with a rigid interest rate regime. With deregulation and the removal of ceiling provisions, the availability of loans to households became significantly easy.

4.4 Correlation Analysis

This section examines the correlation pattern between market fundamentals and housing prices for the dataset covering 2005 to 2008. The correlation between housing prices and the explanatory variables was established through the Pearson correlation analysis, tested at the 0.05 significance level. The outcome of the analysis is documented in Table 4.2. The result presented in Table 4.2 indicates that the variables of per capita income (Corr.= 0.94, P-value=0.00)) and credit supply (Corr.= 0.92, P-value=0.00) have a strong and positive relationship with housing prices. The result demonstrates that a large proportion of positive income and credit supply changes are passed to housing prices consistent with financial accelerator theories. This result corroborates with Kibunyi *et al*. (2017) findings of a robust positive relationship between income, credit supply, and housing prices in the Kenyan housing market. The result is also in tandem with Igan and Loungani (2012) and Mian and Sufi (2009),

who found a more substantial positive movement between real house prices, credit, and output cycles. The movement of housing prices and credit has been a key feature in modeling financial cycles whereby the peaks are associated with financial crises (Crowe *et al.*, 2011). However, the result does not provide sufficient evidence to infer a causal relationship between the two measures

Table 4.2: Correlation Matrix

	Housing Price	Per Capita Income	Interest Rate	Inflation	Construction Cost	Credit Supply	Housing Supply
Housing Prices	1.00						
	0.000						
Per Capita Income	0.94	1.00					
	0.00	0.000					
Interest Rate	0.40	0.29	1.00				
	0.00	0.03	0.000				
Inflation	(0.00)	(0.11)	0.02	1.00			
	0.99	0.44	0.87	0.0000			
Construction Cost	0.89	0.98	0.20	(0.12)	1.00		
	0.000	0.000	0.14	0.38	0.0000		
Credit Supply	0.92	0.95	0.39	(0.15)	0.92	1.00	
	0.00	0.00	0.00	0.30	0.000	0.000	
Housing Supply	0.85	0.75	0.41	(0.02)	0.69	0.81	1.00
	0.00	0.00	0.00	0.86	0.000	0.00	0.000

Source: Research Data (2020)

The variable of interest rate (Corr. = 0.40, P-value=0.00) exhibits a weak positive relationship with housing prices over the study period. The finding suggests that

interest rate and housing prices are weakly dependent on each other. However, it can be argued that a decrease in interest rates dampens housing prices. The positive correlation is contrary to the theoretical explanations and economic intuitions (Demary, 2010) and the expected negative relationship. However, the outcome presented in Table 4.2 is congruent with the assertions of Shi, Jou, and Tripe (2014) and that of Sutton, Mihaljerk, and Subelyte (2017), who reported positive relationships.

Surprisingly, the findings in Table 4.2 suggest that inflation has an insignificant relationship with housing prices (Corr. = -0.0018, P-value=0.99). The result is against the theoretical expectation of a positive relationship. The result may be as a result of central bank interventions against inflationary pressure. This result conflicts with Kuang and Liu's (2015) findings that housing prices and inflation are positively correlated and endogenously determined, and the association is asymmetric. In support of Cesa-bianchi, Cespedes, & Rebucci (2015), the study could not infer any causal relationship between the evolution of Housing prices, inflation, and interest rate. However, to draw efficient conclusions, the relationship was subjected to econometric modeling to trace the effect of isolated shocks.

The correlation analysis results equally show that construction cost (Corr. = 0.89, P-value=0.00) and housing supply (Corr. = 0.85, P-value=0.00) are strongly and positively correlated to housing prices. The result is indicative of a strong co-movement between construction cost and housing prices. The former finding corroborates with Wheaton and Simonton's (2007) and Tsai's (2012) findings that

construction cot and housing prices have a positive relationship. The latter finding agrees with Conefrey and Whelan's (2012) finding that housing supply and housing prices are positively related. The outcome implies that a continuous increase in housing supply in the market will precipitate a surge in housing prices.

4.5 Diagnostic Tests

Before inferences were drawn, diagnostic tests were performed to ensure the optimum model's dynamic specifications' statistical adequacy. These tests show the robustness of the estimated coefficients by confirming that parameter estimates are not biased, checking for wrong functional form, parameter instability, and measurement error. The study conducted various diagnostic tests to choose the appropriate model for the analysis and confirm the study outcome's statistical adequacy. The following diagnostic tests results are presented: stationarity, cointegration, multiple structural breaks, normality, serial correlation, heteroscedasticity test, and model stability test. The model passed all the diagnostic tests indicating that the time series were stationary, the study variables converged in the long run, disturbances were normally distributed, residuals had no serial correlations and were homoscedastic, and the estimated parameters were stable and free of any specification error. The results of these tests are systematically discussed hereunder.

4.5.1 Unit Root Test

Both linear and nonlinear ARDL models do not require pretesting for unit roots. They can be used for variables that are either at level or differences and a combination of variables I (0) and I (1) (Shin *et al*., 2014). However, the models do not apply with I

(2) variables, and the cointegration Wald test requires the critical values to lie within I (0) and I (1) bounds. Hence, the study variables must be either I (0) or I (1) or a combination of the two, a condition that justified stationarity tests. The study carried out Augmented Dickey-Fuller (ADF) and Phillip and Perron (PP) unit root tests. Stationarity would be inferred if the null hypothesis was rejected. In case the two tests' outcome conflicts, Kwiatowski–Phillips–Schmidt Shin (KPSS) test would be employed as a confirmatory test. The result of ADF, PP, and KPSS tests are presented in Table 4.3.

Table 4.3: Unit Root Test Result

			(At levels)			(At First Difference)			
	-	Constant & Trend	t-Stat	*Prob.*		t-Stat	*Prob.*		Conclusion
Housing Price	PP	Constant & Trend	-1.093	*0.920*	n0	-4.172	*0.009*	***	I(1)
	ADF	Constant & Trend	-2.808	*0.201*	n0	-5.834	*0.000*	***	I(1)
	KPSS	Constant & Trend	0.232		***	0.073	n0	n0	I(0)
Per capita Income	PP	Constant & Trend	-15.670	*0.000*	***	-20.56	*0.000*	***	I(0)
	ADF	Constant & Trend	-10.1065	*0.000*	***	-12.466	*0.000*	***	I(0)
	KPSS	Constant & Trend	0.500		***	0.172		**	I(0)
Inflation	PP	Constant & Trend	-2.9083	*0.168*	n0	-5.362	*0.000*	***	I(1)

	ADF	Constant & Trend	-2.9293	*0.163*	n0	-4.148	*0.011*	**	I(1)
	KPSS	Constant & Trend	0.0733		n0	0.029		n0	I(1)
Interest rate	PP	Constant & Trend	-3.3173	*0.074*	*	-6.443	*0.000*	***	I(1)
	ADF	Constant & Trend	-3.7544	*0.027*	**	-4.194	*0.010*	***	I(0)
	KPSS	Constant & Trend	0.049		n0	0.028		n0	I(1)
Construction Cost	PP	Constant & Trend	-1.4412	*0.837*	n0	-6.833	*0.000*	***	I(1)
	ADF	Constant & Trend	-1.4244	*0.842*	n0	-6.833	*0.000*	***	I(1)
	KPSS	Constant & Trend	0.205		**	0.091		n0	I(0)
Credit Supply	PP	Constant & Trend	-6.0968	*0.000*	***	-12.52	*0.000*	***	I(0)
	ADF	Constant & Trend	-6.9982	*0.000*	***	-3.546	*0.047*	**	I(0)
	KPSS	Constant & Trend	0.166		**	0.157		**	I(0)
Housing Supply	PP	Constant & Trend	-4.6956	*0.0021*	***	-21.41	*0.000*	***	I(0)
	ADF	Constant & Trend	-2.6865	*0.246*	n0	-4.700	*0.002*	***	I(1)
	KPSS	Constant & Trend	0.230		***	0.500		***	I(0)
Investor sentiment	ADF	Trend & Intercept	-6.1619	0.000	***	-6.1826	0.000	***	I(0)

	PPP	Trend & Intercept	-3.731	0.006	***	-11.406	0.000	***	I(0)
	KPSS	Constant & Trend	0.0946		n0	--11.406	0.000	***	I(1)
Notes: (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1%. and (no) Not Significant based on MacKinnon (1996) one-sided p-values for ADF and PP and Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1) for KPSS									

Source: Research Data (2020)

Based on the result presented in Table 4.3, the level of integration for per capita income, inflation, and credit supply was consistent for ADF, PP, and KPSS Tests. However, the results were different for interest rates and construction costs. Therefore, in the two cases, the KPSS test result was adopted. The documented result in Table 4.3 brought about the rejection of the null hypothesis of non-stationarity for per capita income, credit supply, and construction cost series at levels, indicating they were integrated order zero (I (0). The null hypothesis of non-stationarity could not be rejected for inflation and interest rate, indicating that the series had a unit root at levels. However, in their first difference, inflation and interest rate series became stationary.

The study inferred that per capita income, construction cost, and credit supply were stationary at levels (I (0), while inflation and interest rate were stationary at first differences I (1). Shin *et al*. (2014) suggested that ARDL is more suitable for variables in different integration levels provided that none of the variables is integrated order two. Hence, the ARDL cointegration approach was adopted with a combination of I (0) and I (1) variables.

4.5.2 Multiple Structural Breaks Test

The study used the Bai and Perron (2003) approach to check for unknown multiple breakpoints and parameter instability. The null hypothesis of no structural breaks in the data was assessed against an alternative of an unknown number of breaks. The result of the test is exhibited in Table 4.4. From the result in Table 4.4, there were four possible breakpoints in 2007Q3, 2008Q2, 2011Q2, and 2012Q2. Consequently, the breakpoints were assigned dummy variables (each for 2007Q3, 2008Q2, 2011Q2, and 2012Q2) and regressed in the base model as part of explanatory variables. The dummies for 2008Q2 and 2011Q2 were significant and were retained thereof.

Table 4.4: Multiple Structural Breaks Test

Schwarz criterion selected breaks:	3
LWZ criterion selected breaks:	2

Breaks	# of Coefs.	Sum of Sq. Resids.	Log-L	Schwarz* Criterion	LWZ* Criterion
0	5	0.605181	43.31805	-4.097964	-3.863051
1	11	0.155812	79.27526	-5.005373	-4.473941
2	17	0.066108	101.9953	-5.413267	-4.564697
3	23	0.031652	121.5121	-5.700283	-4.506404

Estimated break dates:		
1: 2008Q2	2: 2008Q2, 2011Q2	3: 2007Q3, 2008Q2, 2012Q2

Source: Research Data (2020)

The dummies for 2007Q3 and 2012Q2 were found to be insignificant and were dropped from the modelling process. The outcome implies that the breakpoints in

2008Q2 and 2011Q2 significantly impact the direction and magnitude of market fundamentals and housing prices over time. The study observed that the residuals in the model were too large, and normality of the residual series would be rejected at 0.05 significance levels without the dummies.

4.5.3 Cointegration Test

Table 4.5 and 4.6 presents the outcome of the linear and nonlinear ARDL bounds cointegration tests, respectively.

Table 4.5: Linear ARDL Bounds Cointegration Test

F-Bounds Test

Test Statistic	Value	Signif.	I(0)	I(1)
				Asymptotic: n=1000
F-statistic		5.852137	10percent	2.03
k		7	5percent	2.32
			2.5percent	2.6
			1percent	2.96

Source: Research Data (2020)

The linear cointegration test result displayed in Table 4.5 shows that the calculated F- statistic of joint significance for lagged variables at optimum lag length is above the upper bound Pesaran and shin' 1999 critical values at 0.05 level of significance ($\mathrm{F-test} = 5.8521 > \mathrm{Upper}_{Critical\ value} = 3.5$ and $\mathrm{Lower}_{Critical\ value} = 2.32$) Hence null hypothesis of no cointegration was rejected, indicating that long-run relationships existed between housing market fundamentals and housing prices.

Table 4.6: NARDL Cointegration Bound Test Result

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	5.875645	10percent	1.83	2.94
k	11	5percent	2.06	3.24
		2.5percent	2.28	3.5
		1percent	2.54	3.86

Source: Research Data (2020)

The result of the asymmetric cointegration bound test is captured in Table 4.6. The estimated output shows that the F-Statistic exceeds the upper bound Pesaran critical value of 3.24 at 0.05 confidence level ($F-test = 5.876 > Upper = 3.24$ and $Lower = 2.06$). Hence there is evidence of asymmetric cointegration between housing market fundamentals and housing prices.

Additionally, the empirical models' estimation result presented later in Table 4.12, and Table 4.14 indicates that the error terms' coefficients are negative and significant (P=0.000). The error term's significance for both linear and nonlinear ARDL models confirms symmetric and asymmetric cointegration during the study period. Asymmetric cointegration may be the case of hidden cointegration, which cannot be detected by the restrictive linear models. The study then examined the asymmetric effect of housing market fundamentals on housing prices by estimating Equation 3.5, having ascertained asymmetric cointegration.

4.5.4 The Optimum Number of Lags Selection.

Before estimating the ARDL Model, the optimum lag length specification is necessary. Appropriate lag length for endogenous variables is essential to avoid under or over parameterisation due to inappropriate lag selection (Shahbaz, 2015). An unrestricted VAR model was formulated, which was used to determine the optimal lag length for the model. The result of the lag length selection is presented in Table 4.7.

Table 4.7: Optimal Lag Selection Criteria

Observations included: 50

Lag	LogL	RL	EPF	IAC	SICS	ICQH
0	58.94915	NA	0.007050	-2.117966	-1.888523	-2.030593
1	126.0808	115.4664	0.000501	-4.763230	-4.495547	-4.661295
2	130.8647	8.036998	0.000431	-4.914587	-4.608664	-4.798090
3	134.4607	5.897473*	0.000389*	-5.018428*	-4.674264*	-4.887369*
4	135.0228	0.899402	0.000396	-5.000913	-4.618509	-4.855291

Source: Research Data (2020)

Based on the result presented in Table 4.7, three lags were selected based on FPE, AIC, HQIC, and SCIC lag-order selection criteria.

4.5.5 Normality Tests

The test of normality was examined using the normality graph and Jarque Bera (JB) test. The results are shown in Figure 4.7.

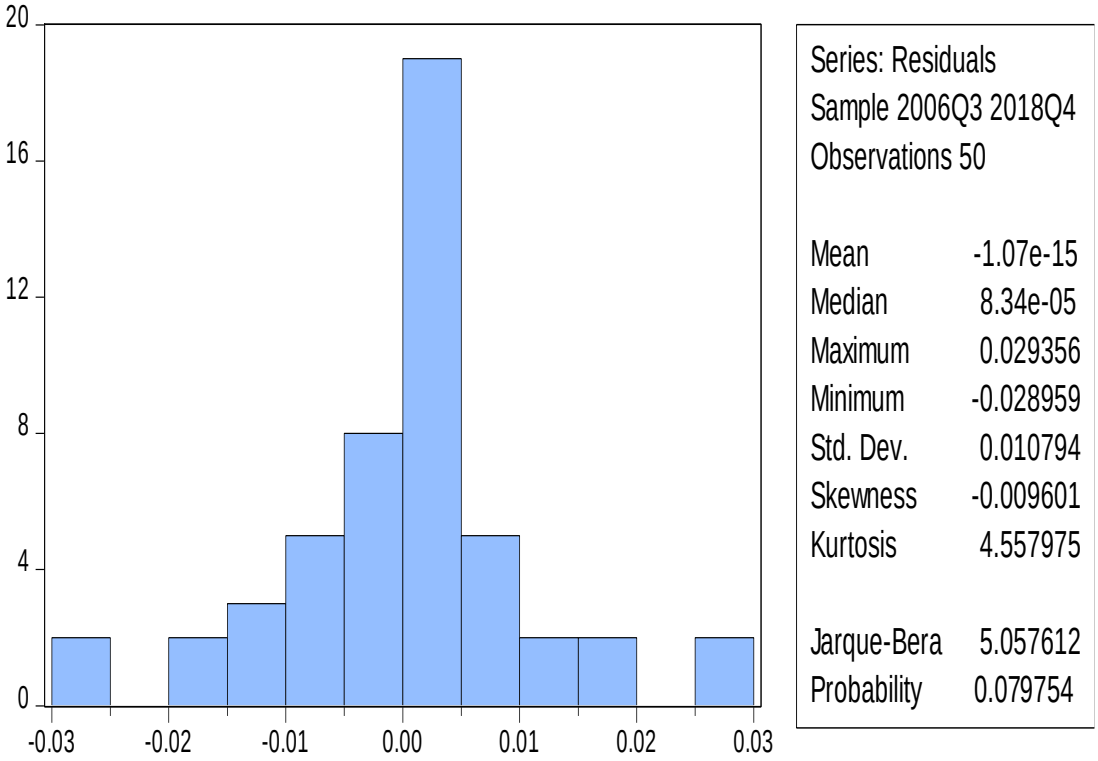

Figure 4.7: Normality Test Output

Source: Research Data (2020)

The results presented in Figure 4.7 indicates that the JB statistic was not significant (P= 0.079). Hence the study failed to reject the null hypothesis and suggested that the data followed a normal distribution. Furthermore, values of skewness (-0.009) lay within the normality bound (-2 and 2). However, the value of kurtosis (4.55> 3) was more than the recommended (3), an indication that the distribution was leptokurtic relative to the normal distribution.

4.5.6 Autocorrelation Test

The study used the Breusch-Godfrey Lagrange Multiplier (LM) test to assess whether the residuals were autocorrelated. The outcome of the test is presented in Table 4.8.

Table 4.8: Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.425929	Prob. F(3,22)	0.7364
Obs*R-squared	2.744649	Prob. Chi-Square(3)	0.4327

Source: Research Data (2020)

As shown Table 4.8, the LM-statistic was above the critical value (P= 0.7364), indicating that the residuals were not statistically significant. Hence, the null hypothesis could not be rejected. The outcome implies that the residuals were not autocorrelated. Therefore, the standard error of the estimate was appropriate for testing the significance of the coefficients.

4.5.7 Heteroscedasticity

The study tested for heteroscedasticity by conducting the Breusch–Pagan (B-P) test. The result is presented in Table 4.9.

Table 4.9: Heteroscedasticity ARCH Test

Heteroscedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	1.415298	Prob. F(24,25)	0.1970
Obs*R-squared	28.80176	Prob. Chi-Square(24)	0.2277
Scaled explained SS	12.80949	Prob. Chi-Square(24)	0.9692

Source: Research Data (2020)

As indicated in Table 4.9, the calculated statistic exceeded the critical value (P= 0.1970). Hence the null hypothesis could not be rejected, implying that the residuals

were homoscedastic. Therefore, the standard error of the estimates is appropriate for testing the significance of the coefficients.

4.5.8 Residual Stability Test

In line with Pesaran *et al*. (2001), the study used the coefficient stability cumulative sum of residuals (CUSUM) denoted (QS) and CUSUM Squared denoted (QS^2) stability tests to examine the structural stability of coefficients. Suppose the plot of QS and QS^2 graph lies within the critical bounds, then the coefficients are stable. The results of QS and QS^2 are presented in Figure 4. 8 and Figure 4. 9 respectively.

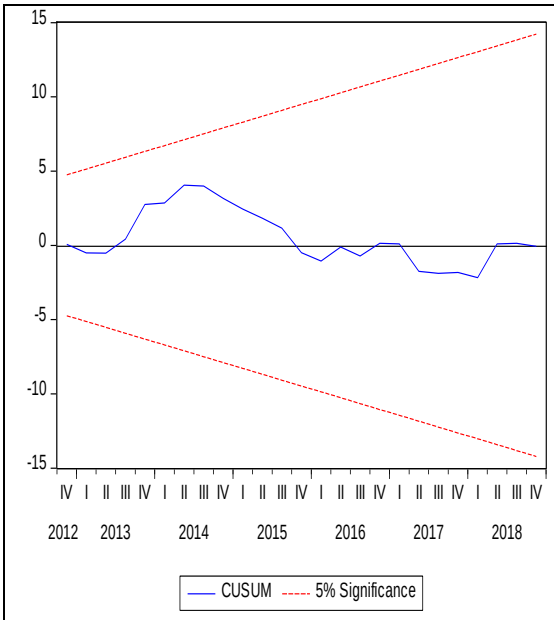

Figure 4. 8: CUSUM Output

Research Data (2020)

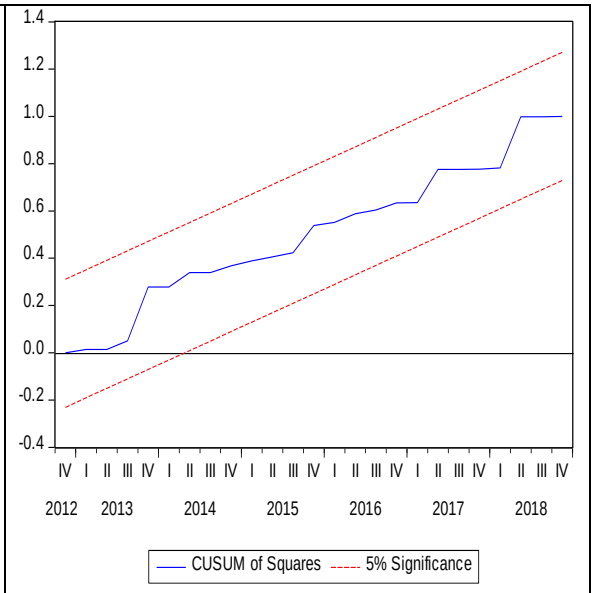

Figure 4. 9: CUSUM Squared Output

Source: Research Data (2020)

In view of Figure 4. 8 and Figure 4. 9, the plot of both QS and QS^2 lied within the upper and lower critical bounds at 0.05 significance level. The figures for QS and QS^2 indicates that there was no statistical evidence of change in the stability of the

coefficients. Hence the study failed to reject the null hypothesis that all the coefficients in the model are stable. Hence, the outcome provides sufficient evidence that coefficients are stable, and the model estimates are reliable for inference testing.

4.5.9 Specification Error Test

Further, the study used Ramsey Regression Equation Specification Error Test (RESET) to determine whether there are any omitted variables and whether the model's function form is well specified. The outcome of the test is presented in Table 4.10.

Table 4.10: Ramsey RESET Test Result

Omitted Variables: Squares of fitted values

	Value	df	Probability
t-statistic	1.238888	24	0.2274
F-statistic	1.534842	(1, 24)	0.2274

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	0.000343	1	0.000343
Restricted SSR	0.005709	25	0.000228
Unrestricted SSR	0.005366	24	0.000224

Source: Research Data (2020)

The result of the RESET test presented in Table 4.10 reveals that the computed F-statistic is not significant (F- value = 0.2272). The study, therefore, rejects the null hypothesis that the model has omitted variables at a 0.05 significance level, which indicates that the model is well specified.

4.5.10 Long Run and Short Run Asymmetry Tests

The short-run and long-run Wald tests were implemented to examine house prices' asymmetric adjustment to market fundamentals changes. The null hypothesis of symmetry in the long run and the short run was tested against the alternative hypothesis of asymmetry in Equation (5). The short-run and long-run asymmetry results are summarised in Table 4.11, panel A and B, respectively.

Table 4.11: The Short Run and Long Run Asymmetric Tests

PANEL A					
Short Run asymmetry					
Variables	$W_{SR}(INC)$	$W_{SR}(INT)$	$W_{SR}(INF)$	$W_{SR}(CC)$	$W_{SR}(CRED)$
F statistic (Prob)	-.1773 (0.0805)	.1075 (.0001)	8.677 (0.0041)	4.673 (0.0262)	1.765 (0.0834)
PANEL B					
Long Run asymmetry					
Variables	$W_{LR}(INC))$	$W_{LR}(INT)$	$W_{LR}(INF)$	$W_{LR}(CC)$	$W_{LR}(CRED)$
F statistic (Prob)	7.341 (0.0109)	2.4199 (0.1299)	11.64 (.0021)	3.123 (0.0437)	4.776 (0.0325)
(Note) This table reports the results of the long run and short run symmetry tests for the effect of each explanatory variable on housing prices. W_{LR} denote the Wald statistic for the long run symmetry.W_{SR} corresponds to the Wald statistic for the short-run symmetry. The numbers in brackets are associated with P-values, * indicate rejection of the null hypothesis of symmetry at the 5% significance level					

Source: Research Data (2020)

The result presented in Table 4.11 panel A rejects the null hypothesis of the short-run symmetric effect of interest rate (P=0.000), inflation(P=0.0325), and construction cost (P=0.0262) since the values are below the critical value. However, for income (P=0.0805) and credit supply (0.0834), the null hypothesis cannot be rejected since their calculated F-statistic is above the critical value. Based on the long-run result presented in Table 4.11 panel B, the null hypothesis of the asymmetric effect of per capita income, inflation, construction cost (0.0437), and credit supply, in the long run, is rejected. This is because the F-statistics for per capita income (P=0.0109), inflation(P=0.0021), construction cost, and credit supply (0.0325) are less than the critical value. The outcome provides evidence of long-run asymmetry for these variables. For the interest rate, the null hypothesis cannot be rejected since the calculated F-statistic(P=0.1299) is above the critical value, which rules out asymmetry in the long run.

4.5.11 Asymmetric Dynamic Multipliers

Figure 4.15 presents the cumulative dynamic multipliers obtained in regards to Equation (5). The multiplier indicates the adjustment of house prices to equilibrium in the long run following a one percent change in per capita income, interest rate, inflation, construction cost, and credit supply. The asymmetric curve (Broken Redline) indicates the difference between the dynamic multipliers associated with each explanatory variable's positive and negative shocks at a 5% significance level.

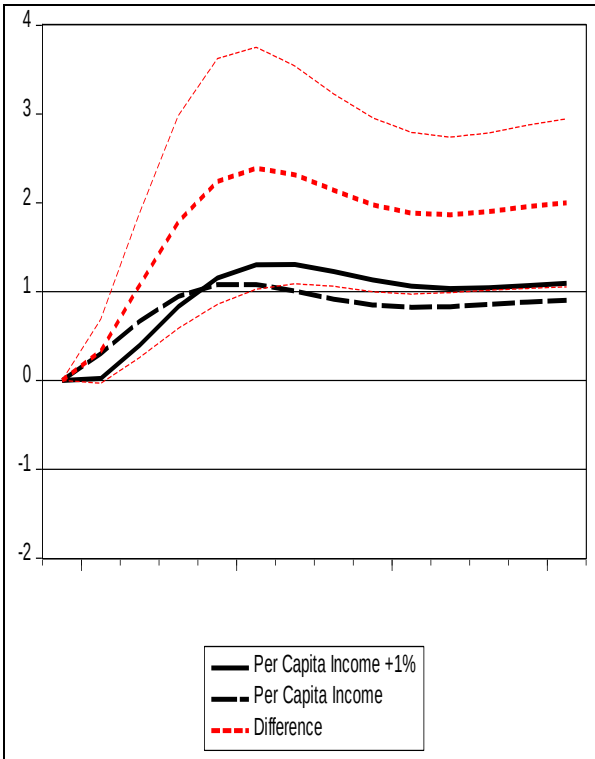

Figure 4.10: Per Capita Income Asymmetric Dynamic Multiplier graph

Source: Research Data (2020)

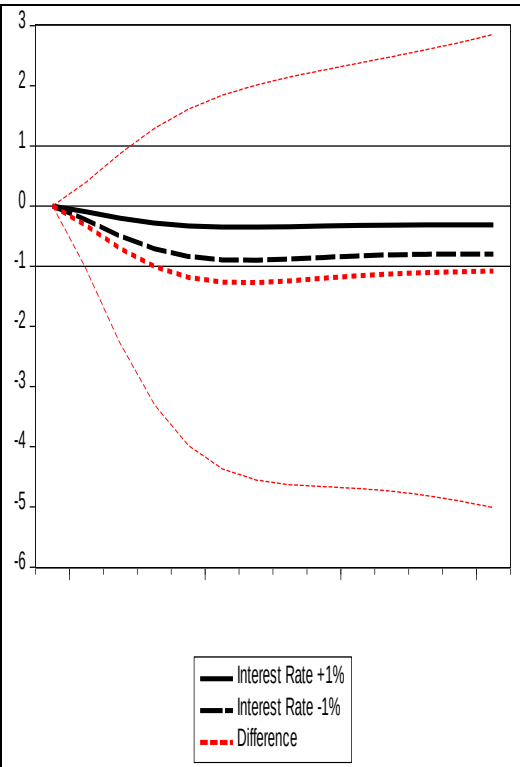

Figure 4.11: Interest Rate Asymmetric Dynamic Multiplier graph

Source: Research Data (2020)

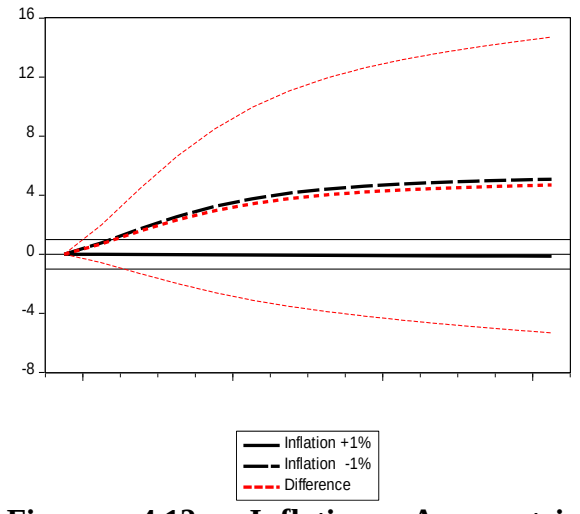

Figure 4.12: Inflation Asymmetric Dynamic Multiplier graph

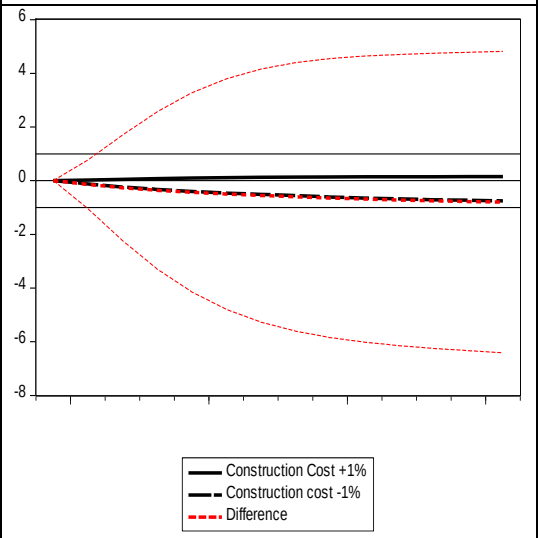

Figure 4.13: Construction Cost Asymmetric Dynamic Multiplier

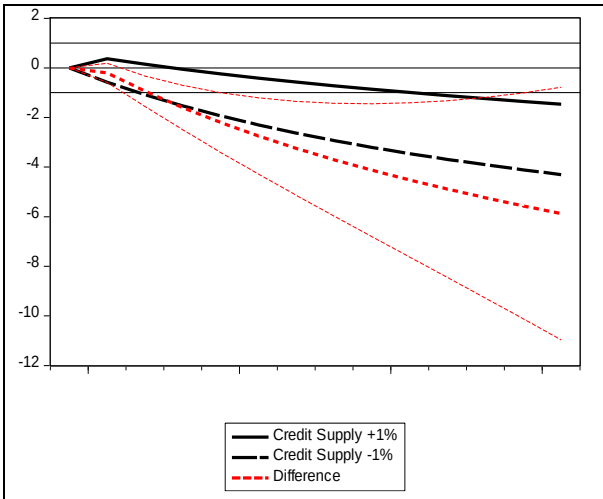

Figure 4.14: Credit Supply Asymmetric Dynamic Multiplier

Note: The black line in bold shows the indicates the positive effect of the independent variables on house prices. The black line in dashes represent the negative effect. The double red line in dashes proxy the short line asymmetry. The single red line in dashes represent the asymmetry bounds.

Figure 4.15: Asymmetric Dynamic Multipliers

Source: Research Data (2020)

Figure 4.10 indicates an inverse relationship between per capita income and housing prices in the short run but negatively affects the long run. Equally, a significant asymmetric response of house prices to positive and negative per capita income changes is detected in the short run and the long run with a gradual reaction. It is shown that the response to positive shocks dominates the short run while the response to negative shocks dominates the long run. The decrease is gradual, with a smooth equilibrium correction after five quarters.

Figure 4.11 illustrates the pattern of house prices adjustment to their new long-run equilibrium due to interest rate innovations. As shown in Figure 4.11, interest rate and house prices are negatively related in both horizons. In this respect, the effect of positive shocks dominates in both the short and long run. Equally, Figure 4.11 indicates a new equilibrium will be reached after approximately 3-5 quarters following

a shock in interest rate. Figure 4.12 depicts the dynamics of convergence to the long-run equilibrium of house prices following a unitary positive or negative inflation variation. Figure 4.12 exhibits a positive relationship between inflation and house prices in both horizons dominated by negative shocks. The multipliers graph gives further evidence of asymmetric effects of per capita income, interest rate, and inflation on house prices.

Figure 4.13 depicts the dynamics of convergence to the long-run equilibrium of house prices following unitary positive or negative variations in construction cost. As shown in Figure 4.13, construction costs and housing prices are negatively linked in the long run. In both horizons, positive shocks to construction costs do not affect house prices. In this respect, the effect of negative shocks dominates both horizons. The decrease is gradual, with a smooth equilibrium correction after about 5-6 quarters. Figure 4.14 indicates an inverse relationship between credit supply and housing prices in both horizons. Equally, a significant asymmetric response of house prices to positive and negative credit supply changes is detected, with positive shocks dominating in both horizons. However, there is no evidence of correction to equilibrium.

4.6 Hypothesis Testing

This section presents the results of hypothesis testing. The study considered a set of seven hypotheses about the effect of housing market fundamentals on housing prices in Nairobi City County. Each of the first five hypotheses was subdivided into two sub hypotheses denoted (a) to assess the linear effects and (b) to assess the nonlinear

impact of housing market fundamentals on housing prices. All the study hypotheses were tested at a significance level of 0.05, and the outcomes are captured hereunder.

4.6.1 Linear Effect of Housing Market Fundamentals on Housing Prices

This section discusses the study sub-hypotheses (1a-5a) estimated by a linear ARDL Model Equation (3.2). The short-run and long-run estimation results of linear ARDL are presented in Table 4.12 and 4.13, respectively, and were interpreted concurrently. The short-run dynamics are presented in an Error Correction Model (ECM) Table 4.12, while the long-run dynamics are captured in Table 4.13. The ECM shows the feedback of the short-run deviation of house prices from the long-run equilibrium and other short-run dynamics.

Table 4.12: The Short Run Linear ARDL Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.093907	0.018934	-4.959738	0.0000
Δ (Housing Price(-1))	0.535830	0.116800	4.587601	0.0001
Δ (Housing Price (-2))	-0.349452	0.118121	-2.958435	0.0057
Δ(Per Capita Income)	-3.859217	0.890193	-4.335258	0.0001
Δ (Interest Rate)	-1.980228	0.528287	-3.748391	0.0007
Δ (Interest Rate (-1))	-0.191070	0.377629	-0.505972	0.6162
Δ (Interest Rate (-2))	0.726510	0.381129	1.906208	0.0654
Δ (Inflation)	0.134301	0.071871	1.868646	0.0813
Δ (Credit Supply)	-0.024052	0.014836	-1.621269	0.1145
Δ (Dummy_11Q2)	0.054773	0.018868	2.902914	0.0065
Δ (Dummy_11Q2(-1))	0.052160	0.017721	2.943445	0.0059
ECT(-1)*	-0.116634	0.021121	-5.522236	0.0000

Source: Research Data (2020)

Table 4.13: The Long Run Linear ARDL Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Per Capita Income	-37.26222	20.82428	-1.789364	0.0827
Interest Rate	-7.854519	7.374563	-1.065083	0.2946
Inflation	-0.038787	0.018895	-2.052717	0.0481*
Construction Cost	0.905656	0.637210	1.421284	0.1646
Credit Supply	-0.086828	0.179921	-0.482587	0.6326
Dummy_08Q2	0.544567	0.167611	3.248997	0.0027*

EC = LNHPI - (-37.2622*Per Capita Income -7.8545*Interest Rate -0.0388
+ *Inflation

+ 0.9057*Construction Cost -0.0868*Credit Supply + 0.5446*Dummy_08Q2

Source: Research Data (2020)

The result presented in Table 4.12 indicates that the coefficient of the lagged error correction term (ECT) is negative (-0.117) and significant (P=0.000). The outcome implies that house prices adjust to the long-run equilibrium, with approximately 12 percent of the adjustment taking place in one quarter. Such an adjustment seems reasonably slow. The result confirms Posedel and Vizek (2011) early studies, which concluded that house price behaviours are persistent.

4.6.1.1 Per Capita Income and Housing prices

The results presented in Table 4.12 indicate that per capita income significantly impacts house prices (P=0.001) in the short run. However, as shown in Table 4.13, the

impact is negative and not significant in the longer term (P= 0.0827). Hence the study rejected the null sub hypothesis in the short run. However, the study failed to reject the null sub hypothesis, in the long run, indicating that per capita income has no significant effect on housing prices in Nairobi City County in the long run. The findings are in line with Fraser *et al*. (2012) finding of a long-run relationship between income and real house prices. However, the relationship varies over time, depending on whether the nature of income shocks is permanent or transitory. Contrary, the study is inconsistent with Kishor & Marfatia,2017) finding that only the permanent income changes impact house prices.

The possible explanation is that since most houses are bought on credit, the amount lent by financial institutions depends on the purchaser's disposable income and the rate of interest. Hence, the amount secured depends on the proportion of income attributed to mortgage loan repayment and the mortgage term. Eventually, this value determines the demand for housing. However, there is a widening inequality in household incomes whereby fewer high-income households dominate the purchasing power. This observation precipitates a higher demand for houses in Kenya, coupled with the Kenyan economy's sluggish performance over the study period. Hence, it plausible to insinuate that the income levels are uneven in the environment of unstable interest rates, credit liberation, and the recent monetary tightening by policymakers.

4.6.1.2 Interest Rate and Housing prices

The short-run result presented in Table 4.12 indicates that the effect of interest rate on housing prices is positive and significant in the current quarter (P= 0.0007) that

becomes positive and significant in the following two-quarters (P=0.006). However, as shown in Table 4.13, the effect is not significant in the long run (P = 0.2946). Hence the study rejected the second sub hypothesis in the short run but failed to reject the null hypothesis in the long run. The short-run result indicates that a 1 percent increase in interest rate leads to a 1.98 percent decrease in house prices but increases house prices by 0.726 percent after two quarters. However, in the long run, the effect of interest rate on housing prices is insignificant.

The outcome corroborates with Adams and Fuss (2010) finding that short term interest rates negatively impact housing prices. However, the results are incongruent with the Kishor and Marfatia (2017) findings that interest rates do not significantly impact housing prices in the short-run in 10 out of 15 counties. The short-run result corroborates with Goodhart and Hofmann's (2008) finding. The study found that the real interest rate is mean-reverting, suggesting that the impact of shocks to interest rate would not be strong for forward-looking agents.

The possible explanation for the short-run outcome is that, when interest rates are high, households face liquidity problems, diminishing houses' demand. Consequently, the long term interest rates would bring about a switch of capital to fixed income asset, which decrease the demand for houses and prices. In the Kenyan context, the outcome would be linked to the fact that most housing developments are more for investment purposes than owner-occupation in Nairobi City County. Therefore, the market is dominated by investors and arbitragers who intend to trade their houses when prices increase for capital gain in the future. However, the long-run finding is counter-

intuitive because housing affordability is pegged on the cost of mortgages dependent on the prevailing interest rate. Conversely, the counter intuitiveness may be justified because high-interest rates witnessed in Kenya reflect future expectations about economic activity expansion incorporated in higher housing prices.

4.6.1.3 Inflation and Housing prices

The short-run result presented in Table 4.12 indicates that the effect of inflation is not significant in the short-run (P=0.0813). However, as shown in Table 4.13, the effect of inflation on housing prices is significant and negative (P= 0.048) in the long run. Therefore, the third sub hypothesis that inflation does not have a significant linear effect on housing prices could not be rejected in the short run. In the long run, the null hypothesis was rejected. Contrary to the study's expectation, the result indicates that an increase in inflation will lead to a decrease in house prices in the long run.

The long-run outcome contradicts Kuang and Liu's (2015) and Demary's (2010) findings of a positive relationship between inflation and housing prices. The study equally contradicts Iacoviello and Neri (2010), who found a reverse causality from housing prices to inflation. The study found that inflation changes do not affect housing prices, but changes in housing prices have significant effects on inflation. The short-run result contradicts Kosgei and Rono (2018), finding that inflation negatively impacts house prices in the short run.

4.6.1.4 Construction Cost and Housing prices

The results illustrated in Table 4.12 and Table 4.13 show that the variable of construction does not carry significant coefficients in the short-run (P>0.05) and the

long run (P= 0.1646), respectively. The result also indicates that the effect of construction cost on housing prices is negative in the long run. As a result of this finding, the fourth sub hypothesis could not be rejected in both horizons. The result implies that the construction cost does not affect the formation of house prices in Nairobi city county. The outcome contradicts Krakstad and Oust (2013) and Glaeser *et al*. (2006) findings that the cost of residential construction causally and negatively affects the supply of new houses, thereby increasing houses' prices.

The study outcome agrees with Wheaton and Simonton (2007), finding that construction cost does not significantly affect existing houses. This is because the cost of materials and workers' salaries are incorporated in the construction cost index, affecting housing replacement cost in turn, influenced by inflation. The study outcome is equally in line with Tsai (2012), finding that housing prices lead the construction cost in the short run, and construction cost significantly follows the lagged housing price. This is grounded in the belief that house price appreciation drives up housing supply and the derived demand for construction costs.

4.6.1.5 Credit Supply and Housing prices

Table 4.12 and Table 4.13 presents the short run and long run results, respectively. The outcome indicates that credit supply has no significant effect on housing prices in the short-run (P= 0.11) and the long run (P= 0.6326). The results led to the failure to reject the fifth hypothesis that credit supply significantly affects housing prices. The result indicates that credit supply has no significant linear effect on housing prices in Kenya. The long-run outcomes disagree with Minne (2015) and Adelino *et al.* (2012)

findings. The former found strong evidence to infer that housing demand and, by convention, housing prices are mainly driven by the enhanced capacity to obtain credit coupled with economic growth and historically low interest in Dutch. Similarly, the latter study found that a higher credit supply significantly leads to higher house prices. The short-run outcome equally disagrees with Xiao and Devaney's (2016) findings that extended credit supply significantly affects house prices, and there is a positive feedback effect of lagged credit supply.

The possible explanation of the outcome can be associated with bidirectional casualty found in the literature. For instance, Wachter (2016) found that housing and credit markets are interlinked because most houses are bought on credit. Levitin and Watcher (2013) assert that innovations in financial markets enable households to smooth their housing consumption by reducing investment risk, ultimately leading to higher housing prices. However, the result may be justified since the significant share of buying power accrues to the fewer middle and high-income households in Kenya. Hence, the households who can secure funds to purchase a house are fewer, thus reducing the credit supply's significance on housing prices.

4.6.2 Nonlinear Effect of Housing Market Fundamentals on Housing Prices

This section discusses the study sub-hypotheses (1b-5b) as estimated by a nonlinear ARDL (NARDL) model outlined in Equation (3.4). Table 4.14 and Table 4.15 presents the short run and long run NARDL estimation outcomes, respectively. It noteworthy that the models' outcomes are interpreted and discussed concurrently in subsection 4.5.2.1 to 4.5.2.5.

Table 4.14: The Short Run Nonlinear ARDL Result

ECM Regression

Case 3: Unrestricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.0233	0.634019	11.07744	0.0000
Δ (Housing Price(-1))	0.454785	0.168027	2.70662	0.0162*
Δ (Per Capita Income_ Negative Partial Sum)	0.751404	0.615528	1.22074	0.2410
Δ (Per Capita Income Negative Partial Sum(-1))	0.582437	0.371820	1.56645	0.1381
Δ (Per Capita Income _Positive Partial Sum)	-0.350586	0.225309	-1.55602	0.1405
Δ (Per Capita Income _Positive Partial Sum (-1))	-0.851687	0.214829	-3.96447	0.0012*
Δ (Interest Rate_ Negative Partial Sum)	0.738498	0.418081	1.76639	0.0977**
Δ (Interest Rate_ Positive Partial Sum)	1.513278	0.953421	1.58720	0.1333
Δ (Interest Rate_ Positive Partial Sum (-1))	4.625369	1.412477	3.27465	0.0051*
Δ (Inflation_ Negative Partial Sum)	-13.41076	3.360972	-3.99014	0.0012*
Δ (Inflation_ Positive Partial Sum)	0.747123	0.376373	1.98505	0.0657**
Δ (Construction Cost_ Positive Partial Sum)	-0.204981	0.122724	-1.67025	0.1156
Δ (Construction Cost_ Positive Partial Sum (-1))	-0.378373	0.147342	-2.56799	0.0214*
Δ (Credit Supply_ Negative Partial Sum)	-0.577749	0.268030	-2.15553	0.0478*
Δ (Credit Supply_ Negative Partial Sum (-1))	-0.553697	0.263587	-2.10062	0.0530**
Δ (Credit Supply_ Positive Partial Sum)	1.457238	0.344962	4.22433	0.0007*
Δ (Credit Supply_ Positive Partial Sum (-1))	-0.788840	0.382915	-2.06009	0.0572**
ECT (-1)*	-0.1351048	0.122211	-11.0550	0.0000*

Source: Research Data (2020)

The short-run result presented in Table 4.14 attests that the error correction term was negative and significant (P=0.0000). The result demonstrates that housing prices tend to adjust to equilibrium at a speed of 13.5percent in one quarter. As shown in Table

4.14, the adjusted $R^2 = 0.711$ indicates that approximately 71 percent of housing price variations are explained within the model. Decomposing housing market fundamentals into positive and negative partial sums increased the model's explanatory power.

Table 4.15: The Long Nonlinear ARDL Result

Levels Equation
Case 3: Unrestricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Per capita _Negative Partial Sum	-0.06450	0.37767	-0.17080	0.8667
Per capita _Positive Partial Sum	0.48972	0.20990	2.33304	0.0340
Interest Rate _Negative Partial Sum	1.66545	0.34617	4.81107	0.0002
Interest Rate_ Positive Partial Sum	-2.58094	0.60265	-4.28263	0.0007
Inflation_ Negative Partial Sum	-10.6711	1.43310	-7.44615	0.0000
Inflation_ Positive Partial Sum	0.13615	0.14977	0.90901	0.3777
Construction Cost Negative Partial Sum	2.25557	0.55157	4.08933	0.0010
Construction Cost _Positive Partial Sum	0.13430	0.07187	1.86864	0.0813
Credit supply_ Negative Partial Sum	0.39541	0.17437	2.26764	0.0386
Credit Supply_ Positive Partial Sum	1.20383	0.17423	6.90910	0.0000
Dummy_07Q4	-0.00532	0.03689	-0.14430	0.8872

EC = LNHPI - (-0.0645*Per Capita Income_ N + 0.4897*Per Capita Income_ P + 1.6655*Interest Rate_N -2.5809*Interest Rate_P + 2.2556*Construction Cost_ N +0.1343*Construction CostI_ P - 10.6711*Inflation_ N + 0.1362*Inflation_ P + 0.3954* Credit Supply_ N + 1.2038*Credit Supply_ P -0.0053*Dummy_07Q4)

Source: Research Data (2020)

4.6.2.1 Per Capita Income and Housing prices

The short-run NARDL result presented in Table 4.14 indicates that the coefficient of positive partial sum of per capita income is negative and not significant in the current

quarter (P= 0.1405) but significant in the next quarter (P= 0.0012). The coefficient of negative partial sum of per capita income is positive and not significant (P= 0.2410). Since the coefficients of positive and negative change in per capita income carry different signs and magnitude, the result indicates an asymmetric effect of per capita income on housing prices in the short run. Moreover, the findings attest that only the increase in per capita income does affect housing prices in the short run as the series has at least one significant coefficient. However, the short-run Wald statistic (P=0.0805) presented in Table 4.11 indicates that the differences in house prices' response to negative and positive shocks to income are not statistically significant, therefore ruling out the short run asymmetric adjustment.

The long-run result presented in Table 4.14 indicates that the coefficient of positive partial sum of per capita income is positive and significant (P= 0.034). In contrast, the coefficient of negative partial sum of per capita income is negative but insignificant (P= 0.866). The outcome indicates that both increase and decrease in per capita income causes an increase in house prices in the long run. Since the coefficients' magnitude is different, it indicates an asymmetric effect of per capita income on housing prices. Besides, an increase in per capita income is more associated with housing prices than a decrease in per capita income. The significant long run Wald statistic (P=0.0109) presented in Table 4.11 confirms that the long run asymmetry exists. The dynamic multiplier graph presented in Figure 4.10 equally indicates that the positive shocks to per capita income on housing prices dominate the short run while the negative shocks

dominate the long run. The decrease is gradual, with a smooth equilibrium correction after five quarters.

The study outcome partially supports Ghodsi (2017) finding of significant asymmetric effects of income on housing prices in all the states in the USA in the short run. The study also found significant asymmetric effects of income on house prices in at least 21 states in the long run. The study concluded that both increase and decrease in income significantly affect housing prices in most USA states. Equally, the study finding compliment Nneji *et al*. (2013) findings that income positively impacts housing prices in the steady regime, unlike the boom regime, a clear indication of asymmetry. The outcome also supports the lifecycle permanent income hypothesis in the Nairobi City County housing market due to the more significant impact of per capita income on housing prices in the long run than in the short run. In such a case, there would be more savings and less housing consumption in the short run, which implies that the vast majority of market participants are savings for investment through aggregate demand.

4.6.2.2 Interest Rate and Housing Prices

The short-run NARDL result captured in Table 4.14 attests that the positive partial sum of interest rate is positive and not significant in the current quarter (P=0.133) but significant in the next quarter (P= 0.005). The coefficient of negative partial sum of interest rate is positive and insignificant (P= 0.0977). The variance in the short-run estimates' size and significance supports the asymmetric effect of interest rate on housing prices in the short run. Besides, the short-run asymmetric adjustment is

supported by the significance of the short-run Wald test statistic of interest rate (P=.0001) presented in Table 4.11. The result also indicates that a change in housing prices is more linked to an increase in interest rate as the positive partial sum carries a larger coefficient than a decrease in interest rate.

The long-run NARDL result presented in Table 4.15 indicates that the positive partial sum of interest rate is negative and significant (P= 0.0007). In contrast, the coefficient of the negative partial sum is positive and significant (P= 0.0002). The finding suggests that, in the long run, a 1 percent increase in interest rate leads to a decrease in property price by 2.58 percent. In comparison, a 1 percent decrease leads to a rise in expected prices of 1.67 percent holding other factors constant. Since the increase and decrease in interest rate have significant effects of different magnitudes, the long-run asymmetric causality is inferred. However, the long run Wald statistic is not significant (P=0.1299). This is a demonstration that the long-run asymmetric adjustment is not significant. Equally, as demonstrated by the asymmetric dynamic multiplier graph in Figure 4.11, the effect of positive shocks to interest rate dominates in both the short and long run. Lastly, house price tends to reach a new equilibrium after approximately 3-5 quarters.

The study outcome resonates with Chowdhury and Maclennan's (2014) findings of the varying impact of interest rate on housing prices over the boom and burst periods, a clear indication of asymmetry. The study found that the negative effect of interest rate on housing prices was stronger during boom periods than during recessionary periods. The outcome supports Simo-Kengne *et al*. (2013) findings that contractionary

monetary policy does not have neutral effects on house prices. The impact of shocks on monetary policy would be more pronounced in a bear market than in bull regimes.

The possible explanation was linked to the user cost theory, which stresses the significance of the cost of capital and market speculation in housing price determination. The study's outcome provides evidence that with expectations of a fall in interest rates, people expect higher housing prices that lower the user cost of housing and result in higher house prices (Simo-Kengne *et al*., 2013). The observation that shocks to monetary policy has larger effects when interest rates are falling supports the theoretical models that emphasise the implication of the information asymmetry during recessionary market regimes.

4.6.2.3 Inflation and Housing prices

The short-run NARDL outcome presented in Table 4.14 points out that the coefficient of positive partial sum of inflation is positive and significant (P= 0.000). In contrast, the negative partial sum of inflation is negative and significant (P= 0.000). Therefore, in the short run, negative shocks to inflation significantly affect house prices as it carries at least one significant coefficient. The result supports the asymmetric relationship due to the difference in housing price response to positive and negative inflation changes. The outcome is further supported by the significance of the short-run Wald test (P=0.0041) of inflation shown in Figure 4.12.

The long-run NARDL output presented in Table 4.15 reveals that the positive partial sum of inflation is positive and not significant (P= 0.377). In contrast, the negative partial sum of inflation is negative and significant (P= 0.000). The outcome attests that

a decrease in inflation prompts an increase in house prices while an increase in the inflation rate does not impact prices in the housing market, holding other factors constant. The result indicates that inflation has asymmetric long-run effects on housing prices due to differences in house prices' reaction to inflationary shocks. The outcome equally suggests that housing prices tend to react more to a decrease in inflation that increases inflation in the long run. The finding is confirmed by the significance of the long run Wald test (P= 0.0021) of inflation. The asymmetric multiplier graph presented in Figure 4.12 equally depicts a positive relationship between inflation and house prices dominated by negative shocks in both horizons. Lastly, it worth noting that house prices tend to reach a smooth new equilibrium after about 6-7 quarters, as shown by the dynamic multiplier graph.

The study finding contradicts Katrakilidis and Trachanas' (2012) results of a significant asymmetric effect of inflation and a stronger impact of positive changes to inflation than negative changes in the short run. They also found that during inflationary periods, house prices in Greece quickly adjust to changes in inflation changes in the short run than in the long run. However, the short-run finding is congruent with Yeap and Lean's (2017) findings that housing prices respond asymmetrically to shocks in inflation in the short run but contradict their long-run result that housing prices respond to changes in inflation symmetrically. The long-run finding is equally consistent with Kuang and Liu's (2015) findings that the effect of inflation on housing prices is asymmetric in the long run, where the impact of inflation on housing prices is stronger than the effect of house prices on inflation. Therefore,

the long-run result is partly consistent with prior expectations that when inflation is increasing, economic agents hedge their investment against inflation by investing in real estate.

Nonetheless, the possible explanation would be linked to Demary's (2010) argument that the central bank's response to inflationary shocks by tightening the monetary policy translates to higher financing costs. Consequently, households would shift their portfolios and increase their consumption expenditure, affecting housing prices through the aggregate demand. The result has a policy implication since, in developing economies like Kenya, inflation is directly linked to the consumers' ability to buy goods and services. This is so because investors' purchasing power declines as inflation increases, which adversely affects construction costs and economic activity.

4.6.2.4 Construction Cost and Housing prices

The short-run NARDL outcome presented in Table 4.14 indicates that the effect of an increase in construction cost is negative and not significant (P=0.11) but becomes significant in the following quarter (P =0.0214). The effect of a decrease in construction cost is not reported by the model, indicating that it does not affect housing prices. Therefore, the result suggests that only the increase in construction cost is associated with house price changes in the short run. The result equally indicates an asymmetric relationship since housing prices only respond to positive shocks in construction costs. However, the Wald test statistic(P=0.0834) presented in Table 4.11 reveals that the asymmetric adjustment is not statistically significant.

The long-run NARDL result presented in Table 4.15 indicates that the positive partial sum of the construction cost is positive and not significant (P= 0.081). In contrast, the negative partial sum of the construction cost is positive and significant (P= 0.0018). The findings demonstrate that in the long run, a decrease in construction cost is associated with a 2 percent increase in housing prices while an increase in construction cost has no significant effect on housing prices, holding other factors constant. The result indicates an asymmetric impact of construction on housing prices with a decrease in construction costs more associated with house price changes while the positive changes have a lesser relationship with house prices. The significant Wald test statistic (P=0.0325) presented in Table 4.11 further confirms the asymmetric adjustment of housing prices due to changes in construction cost. Besides, the asymmetric dynamic multiplier graph in Figure 4.13 indicates that the effect of negative shocks to construction cost dominates in the short and long run. Lastly, house price tends to reach a new equilibrium after approximately 5- 6 quarters.

The study finding agrees with Tsai (2012), who found a nonlinear relationship between housing prices and construction costs. Therefore, the study outcome can be attributed to the attractiveness of new house development profit expectations by investors facing higher construction costs. Higher profit expectations encourage investors to continue investing in new houses despite the higher costs of construction. Moreover, construction costs can indicate the factors that allow new house development to adjust to demand quickly. The findings may be construed to mean that, at an aggregate level, the shocks to construction cost partly explain movement in house price. This is an

indication that housing prices are partially forward-looking and not set in an efficient market. Consequently, in the market where construction costs are generally lower, some construction still occurs, especially in city sections where housing demand is higher. Even when house prices are higher than construction costs for all houses, the development will still occur in sections of the city where the ratio of house price to construction cost is highest.

4.6.2.5 Credit Supply and Housing prices

The short-run NARDL results presented in Table 4.14 indicate that the positive partial sum credit supply coefficient is positive and significant (P= 0.0007). In contrast, the coefficient of negative partial sum of credit supply is negative and significant (P= 0.0478). The result indicates that in the short run, a 1 percent increase in credit supply leads to a 1.40 percent increase in housing prices, while a 1 percent decrease leads to an increase in housing prices by 0.577 percent. The finding is further supported by the significant short-run Wald test (P=0.0262) presented in Table 4.11 and the variance in house prices' reaction to increase and decrease in credit supply. The outcome attests that both increase and decrease in credit supply prompts an increase in house prices.

The long-run NARDL estimation result presented in Table 4.15 indicates that the positive partial sum of credit supply is positive and significant (P= 0.000) and the negative partial sum (P= 0.0386). The result illustrates that both increase and decrease in credit supply positively affect house prices. Still, housing prices are more associated with an increase in credit supply than a decrease. The result demonstrates that a 1 percent increase in credit to the real estate sector results in a 1.2 percent increase in

housing prices. Decreasing credit leads to a 0.39 increase in housing prices, holding other factors constant. The Wald test statistic (P=0.0437) further confirms asymmetric adjustment of housing prices to credit supply changes in the long run. The asymmetric dynamic multiplier graph in Figure 4.14 also support asymmetric adjustment with positive shocks dominating in both horizons. However, there is no evidence of correction to equilibrium.

The outcome supports Anenberg *et al*. (2013) findings that an increase in credit supply accounts for almost half of an increase in house prices while a contraction in credit supply accounts for a higher decrease in house prices and new construction. The study outcome can be explained using the loss aversion theory due to Kahneman and Tversky (1979). The theory contends that economic agents' attitude towards gains and losses is asymmetric, and the agents more often tend to derive less satisfaction from gaining than losing. Therefore, sellers in the real estate industry may be hesitant to realise capital losses when prices fall and choose not to trade when the market conditions are unfavourable.

4.6.3 Test for Moderation Effects

The sixth hypothesis sought to assess investor sentiments' moderating effect on the relationship between housing market fundamentals and housing prices in Nairobi City County, Kenya. Consequently, Whisman and McClelland's (2005) moderation approach was adopted by estimating two hierarchical regressions (3.6) and (3.7). However, before testing the moderating effect, the study had to extract a composite measure for investors' sentiments from five direct sentiment indicators, as illustrated

in Appendix IV, followed by implementing the outlined two steps (3.6) and (3.7). In the first step, investors' sentiment was introduced as an independent variable in the model of housing prices. In the second step, investors' sentiment was modelled as a moderator variable. The short and long-run moderating effect of investor sentiments is summarised in Table 4.16 and Table 4.18 panel A, respectively.

A range of formal diagnostic tests such as autocorrelation, heteroscedasticity, normality, and model stability tests were conducted, and the results are summarised in Table 4.18 Panel B. The three models passed all the diagnostic tests. Therefore, the models' residuals were homoscedastic and not serially correlated. The models were equally stable with no specification error, as confirmed by stability tests (Ramsey RESET test and CUSUM graphs). Additionally, the three models' error correction terms were negative and significant, indicating the existence of long-term equilibrium. When investors' sentiment was introduced as a moderating variable, the R-Squared increased from 0.756 to 0.95. This suggests that investors' sentiment and housing market fundamentals combined have higher explanatory power on housing prices than before, accounting for 95.7 percent of the change in house prices in Nairobi City County, Kenya.

The short-run test of moderation result summarised in Table 4.16 indicates that the coefficient of investor Sentiment (the moderator) is positive and significant (P= 0.000) in the first step and the second step (P= 0.000). This observation indicates that investor sentiments can directly impact housing prices. The result further indicates that the interaction effects of investor sentiments and all the explanatory variables were

significant. As shown in Table 4.16, the interaction term between investor sentiments and per capita income is negative and significant (P= 0.000) but positive and significant in the following quarter (P = 0.000). Likewise, the coefficient of interaction between investor sentiments and the interest rate is negative and significant (P= 0.000) but positive and significant in the following quarter (P = 0.000).

Table 4.16: The Short Run Test of Moderation Result

	Step1 (Model 3.2)	**Step 2 (Model 3.7)**
	Short Run	**Short Run**
Dependent variable	Housing Price	Investor sentiment
	Beta(Prob.)	Beta(Prob.)
C	-0.967(0.0000)*	10.06843
Δ (Housing Price (-1))	0.263(0.0072)*	0.3050(0.0000)*
Δ (Per Capita Income)	2.017(0.0164)*	-4.454(0.0000)*
Δ (Per Capita Income (-1))	-13.665(0.0000)*	
Δ (Per Capita Income (-2))	-5.7542(0.0000)*	
Δ (Interest Rate)	3.451(0.0000*	-2.211(0005)*
Δ (Interest Rate (-1))	4.479(0.0000)*	
Δ (Interest Rate(-2))	3.465(0.0000)*	
Δ (Inflation)	-0.0075(0.0001)*	-0.0080 (0.0005)*
Δ (Inflation (-1))		-0.0047(0.0000)*
Δ (Construction Cost)	-0.179(0.0076)*	-0.204(0.0000)*
Δ (Construction Cost (-1))	-0.5546(0.0000)*	
Δ (Construction Cost (-2))	-0.2236(0.0071)*	
Δ (Credit Supply)	0.0210(0.0312)*	
Δ (Credit Supply(-1))	-0.0439(0.0019)*	-0.045(0.0000)*
Δ (Investors Sentiment)	0.0189(0.0000)*	3.330(0.0000)*
Δ (Investors Sentiment (-1))	-0.0139(0.0000)*	-1.099(0.0000)*
Δ (Investors Sentiment * Per Capita Income)		-7.363(0.0000)*

Δ (Investors Sentiment *Per Capita Income (-1))		7.844(0.0000)*
Δ (S Investors Sentiment *Interest Rate)		-3.438(0.0000)*
Δ (Investors Sentiment *Interest Rate (-1))		2.314(0.0000)*
Δ (Investors Sentiment *Inflation)		-0.008(0.0000)*
Δ (Investors Sentiment *Inflation (-1))		0.003(0.0000)*
Δ (Investors Sentiment *Construction Cost)		-0.1957(0.0000)*
Δ (Investors Sentiment * Construction Cost(-1))		0.1187 (0.0000)*
Δ (Investors Sentiment *Credit Supply)		0.068 (0.002)*
Δ (Investors Sentiment *Credit Supply(-1))		0.132(0.0046)*
Δ (Dummy_14Q1)	0.0386(0.0015)*	0.0811 (0.0000)*
Δ (Dummy_14Q1(-1))	0.0789(0.0000)*	0.0272 (0.0004)*
Δ (Dummy_08Q1)	0.058798(0.0011)*	0.130434 (0.0000)
Δ (Dummy_17Q1)	-0.0546(0.0000)*	-0.5065 (0.0046)*
Δ (DUmmy_17Q1(-1))	0.0200(0.0822)	

Source: Research Data (2020)

It is further shown that the coefficient of interaction between investor sentiments and the inflation rate is negative and significant (P = 0.000) but positive and significant in the next quarter (P-value= 0.000). The outcome further indicates that the interaction effect of investor sentiments and construction cost is negative and significant (P = 0.000) but positive and significant in the next quarter (P= 0.000). Finally, the interaction between investors' sentiment and credit supply is positive and significant (P = 0.002) and the following quarter (P = 0.0046).

Table 4.17: Summary of the Short Run Test of Moderation

Analysis	Coefficient	Result	Decision
Short-run			
Step One: Equation 3.6	Investor Sentiment	Significant 0.0189(0.000)	Direct Effect
Step2: Equation 3.7	Investor sentiments * Per capita Income	Significant -7.363(0.0000)*	Direct/Moderates
	Investor sentiments * Interest rate	Significant -3.438(0.0000)*	Direct/Moderates
	Investor sentiments * Inflation	Significant' -0.008(0.0000)*	Direct/Moderates
	Investor sentiments *Construction Cost	Significant -0.195 (0.000)*	Direct/Moderates
	Investor sentiments * Credit Supply	Significant 0.068(0.002)*	Direct/Moderates

Source: Researcher (2020)

The study failed to reject the null hypothesis that investor sentiment has no significant moderating effect on the relationship between housing market fundamentals and housing prices in the short run. The decision is based on the analysis of the short-run test of moderation result and the decision criteria set out in Table 3.1. The coefficient of investors' sentiment as a moderator in the first step was significant, and the interaction terms of all housing market fundamentals prices were significant in the second step. Hence, investor sentiment's moderation effect cannot be inferred in the short run as the outcome indicates a direct effect of investors' sentiment.

The findings of a direct effect of investor sentiment on housing prices in the short run support Ling *et al*. (2010) findings that investors' sentiment has a significant positive effect on commercial real estate markets in the short run. Therefore, the conclusion is consistent with greater limits to arbitrage, information asymmetry, and short sale

constraints that characterise real estate markets. The short-run outcome is equally compatible with Marcato and Nanda's (2016) assertion that sentiment indicators in the residential real estate sector convey important information in house price determination, possibly transmitted through a change in the underlying demand shifters.

Table 4.18: The Long Run Test of Moderation Result

	Step1(Model 3.6) long Run	**Step 2 (Model 3.7) Long Run**
Dependent variable	(Housing Prices)	Housing Supply
	Beta(Prob.)	Beta(Prob.)
Per Capita Income	-41.082(0.3106)	-9.602 (0.0194) *
Interest Rate	-14.231(0.5359)	-1.61 (0.4349)**
Inflation	-0.0196(0.5809)	-0.0021 (0.1651)
Construction Cost	3.4959(0.3848)	-0.980 (0.0001)*
Credit Supply	0.9736(0.2605)	00.109(0.0005)*
Investor Sentiment	0.3050(0.3286)	6.759(0.0005) *
Investor Sentiment * Per Capita Income		-35.196(0.0000)*
Investor Sentiment * Interest Rate		--11.32 (0.0007)*
Investor Sentiment *Inflation		0.0233 (0.0001)*
Investor Sentiment *Construction Cost		--0.741 (0.0006)*
Investor Sentiment _*Credit Supply		-0.128 (0.4567)**
Dummy_14Q1	-0.4807(0.4620)	0.1557 (0.0000) *
Dummy_08Q1	0.0694(0.8509)	0.0179 (0.6808)
Dummy_17Q2	-0.0324(0.8622)	-0.0196 (0.0475)*
Panel B: Diagnostics		
F-Statistic	189.2(0.000)*	44.79(0.00)*
Adjusted R^2	0.756	0.957
ECT-1	-0.0453(0.00)*	-0.69(0.00)*
Serial Correlation LM Test:	2.32(0.3019)	6.24(0.2312)
ARCH Test:	4.39(0.7938)	3.45(0.1829)

Ramsey RESET	1.98(0.1532)	2.01(0.6272)
QS(QS2)	S(S)	S(S)
F_Bounds Test	3.87(2.14,3.3)	11.30(2.06,3.24)
S denotes stable: * denotes significant at 5percent S.L** at 10percent SL. Figures in parenthesis represent P-Values		

Source: Research Data (2020)

The outcome of the long-run test of moderation summarised in Table 4.18 indicates that the moderating variable's coefficient (investor sentiments) in step one is positive and insignificant (P= 0.305). However, in the second step, the investor sentiments coefficient is positive and significant (P= 0.005). This result gives early indications of the moderating effect and absence of a direct effect. The estimation outcome further indicates that the moderating variable's interaction effects (investor sentiments) with all the explanatory variables are significant except for credit supply. As shown in Table 4.18, investor sentiments and per capita income interaction term's coefficient between is negative and significant (P=0.000). Equally, the coefficient of interaction between investor sentiments and the interest rate is negative and significant (P=0.000).

Additionally, the coefficient of interaction between investor sentiments and the inflation rate is positive and significant (P=0.0007). In contrast, the interaction term of investor sentiments and construction cost is negative and significant (P =0.006). Conversely, the interaction term between investor sentiments and credit supply is negative but insignificant (P= 0.4567). The results are summarised in Table 4.19.

Table 4.19: Summary of Long Run Test of Moderation

Analysis	Coefficient	Result	Decision
Long Run			
Step1: Equation 3.6	Investor Sentiments	Significant 0.305061(0.3286)	Indirect Effect
Step2: Equation 3.7	Investor sentiments* Per capita Income	Significant 35.19658 (0.000)*	Moderates
	Investor sentiments* Interest rate	Significant -11.3265(0.000)*	Moderates
	Investor sentiments * Inflation	Significant 0.02337 (0.0001)*	Moderates
	Investor sentiments*Construction Cost	Significant -0.74121 (0.0006)*	Moderates
	Investor sentiments * Credit Supply	Significant -0.1280 (0.456)**	Does not Moderate

Source: Researcher (2020)

Based on the analysis of the long-run test of moderation result and the decision criteria set out in Table 3.1, the study rejected the null hypothesis that investor sentiments have no moderating effect on the relationship between housing market fundamentals and housing prices in the long run. This is because the coefficient of investor sentiments as a moderator in the first step was not significant, and the interaction coefficients of all housing market fundamentals and housing prices were significant in the second step. The result confirms the inference that investors' sentiment has a significant

moderating effect on the relationship between housing market fundamentals and housing prices in the long run.

In the long run, the moderation test outcome supports Jin *et al*. (2014) assertion that non-fundamental-based consumers' sentiments significantly explain residential real estate prices in the USA, which are inversely related to the future housing prices. The authors suggested that consumer sentiments influence future house prices downwards, leading to euphoric behaviour in the housing market. The study outcome equally supports Ling *et al*. (2010) conclusions that real estate markets are prone to sentiment-induced mispricing due to arbitrageurs' inability to enter the market due to short sale constraints in periods of overvaluation and credit constraints during undervaluation periods.

However, the outcome is inconsistent with Fama's (1970) classical efficient market hypothesis, which excludes the chance that investor sentiment can significantly influence asset prices. As depicted in this study, housing prices may be driven by investors' attitudes towards the market rather than variations in housing market fundamentals and the irrational expectation of future movement in house prices. In contrast, the outcome agrees with the noise trader theory due to DeLong, Shleifer, and Waldman (1990), which asserts that excessive trading based on noisy signals not related to market fundamentals push prices away from their intrinsic value. This theory demonstrates that housing market participants are far from being rational.

4.6.4 Test for Mediation Effects

Concerning the seventh hypothesis, the study sought to determine the mediating effect of new house supply on the relationship between housing market fundamentals and housing prices in Nairobi City County, Kenya. The study adopted four causal steps to the mediation process due to Baron and Kenny (1986). Housing market fundamentals were presumed to affect housing supply, which was assumed to cause housing prices. For complete mediation, housing market fundamentals' causal effect on housing prices controlling for housing supply would be zero. The study further assumed no common causes of housing price changes that cannot be measured to validate the model estimates. The study also assumed that housing price does not affect housing market fundamentals. The four steps were validated by running models in equation 3.2, 3.8, and 3.9.

In the first step, the base model, equation 3.2, was estimated to determine whether housing market fundamentals significantly affect housing prices. This step establishes whether there is an effect that can be mediated (Kenny, 2015). In the second step, equation (3.8) was estimated by regressing the housing market fundamentals against the housing supply (the mediator variable). In the third step, the housing supply variable was introduced as an independent variable together with housing market fundamentals and regressed against housing prices (Equation 3.9). Because both variables are presumed to be caused by the same housing market fundamentals, the housing supply was controlled to establish the housing supply effect on housing prices. The final step entailed deciding whether new housing supply completely, partially, or

does not mediate the relationship between housing market fundamentals and housing prices. The short-run and long-run tests of mediation results are presented in Table 4.20 and Table 4.22, respectively.

A range of formal diagnostic tests such as autocorrelation, heteroscedasticity, normality, and model stability tests were conducted, and the outcomes are summarised in Table 4.22 Panel B. The outcome indicates that the three models passed all the diagnostic tests. Therefore, the models' residuals were homoscedastic and not autocorrelated. The models were also stable with no specification error, as confirmed by stability tests (Ramsey RESET test and CUSUM graphs). The result in Table 4.22 Panel B further indicates that R-Squared for the three models is over 50 percent indicating that independent variables had high explanatory power on the dependent variables. Additionally, the three models' error correction terms were negative and significant, indicating the existence of long-term equilibrium.

Table 4.20: The Short Run Test of Mediation Result

	Step1 (Equation 3.2)	**Step2 (Equation 3.12)**	**Step3 (Equation 3.13)**
	Short Run	**Short Run**	**Short Run**
Dependent variable	**Housing Prices**	**Housing Supply**	**Housing Prices**
	Beta(Prob.)	**Beta(Prob.)**	**Beta(Prob.)**
Constant	-0.093(0.000)*	13.22(0.0002)*	-0.0492(0.000)*
Δ(Housing Prices(-1))	0.535(0.0001)*		0.0905(0.0000)*
Δ (Housing Prices(-2)	0.349(0.0057)*		.0838(0.0014)*
Δ (Per capita Income)	-3.85(0.0001)*	11.133(0.4684)	0.0851(0.7357)

Δ (Per capita Income (-1))			-3.265(0.0004)*
Δ (Per capita Income (-2))			-2.343(0.0001)*
Δ (Interest Rate)	1.980(0.0007)*	23.538(0.129)	-3.892(0.0000)*
Δ (Interest Rate (-1))	-1.980(0.6162)	35.059(0.018)*	1.7953(0.002)*
Δ (Interest Rate (-2))	0.726(0.0654)*	-3.5234(0.6868)	2.2760(0.0004)*
Δ Inflation		0.115(0.0043)*	-0.009(0.0000)*
Δ (Inflation (-1))		0.137(0.004)*	0.0054(0.0010)*
Δ (Inflation (-2))			0.0044(0.002)*
Δ (Construction Cost)			0.118(0.0922)**
Δ (Credit Supply)	-.0022(0.1145)	-0.0004(0.999)	-0.020(0.0494)*
Δ (Credit Supply(-1))			0.0190(0.1164)
Δ (Credit Supply(-2))			0.0406(0.0058)*
Δ (Housing Supply)			0.0395 (0.0001)*
Δ (Housing Supply(-1))			-0.0325(0.001)*
Δ (Housing Supply(-2))			-0.012(0.0291)*
Dummy_2007Q3			
Dummy_2008Q1			-0.4523(0.000)*
Dummy_2010Q4		0.3648(0.3572)	
Dummy_2011Q2	0.0547(0.0059)		

Source: Research Data (2020)

The outcome of the first step, in the short run, was discussed in section 4.5.1. It was shown that the effects of per capita income and the interest rate on housing prices were significant. In contrast, the effects of inflation, construction cost, and credit supply were not significant. The result satisfies the first mediation condition, which indicates that there is an effect to be mediated in the short run.

The result of the second step, in the short run, is presented in Table 4.20. The outcome indicates that, in the short run, the effects of interest rate and inflation on housing prices are significant. In contrast, the results of per capita income, construction cost, and credit were not significant. The outcome demonstrates that the effect of per capita income on housing supply is positive and not significant (P= 0.4684). At the same time, that of interest rate is significant and positive in the following quarter (P= 0.0187). It is also demonstrated that the effect of inflation is positive and significant (P= 0.004) while the effects of construction cost and credit supply (P= 0.999) were not significant.

In the third step, the outcome indicates that, in the short run, the effect of housing supply (the mediator variable) and all the housing market fundamentals are significant except for per capita in which became significant in the subsequent quarter. In particular, the effect of the housing supply is negative and significant (P= 0.0013) and the next quarter (P= 0.029), while the effect of per capita income is only significant in the following quarter ((P= 0.004). Additionally, it is shown that the effect of the interest rate is negative and significant (P= 0.0000) but negative in the next two quarters (P = 0.002). The result equally reveals that the effect of inflation is negative and significant in the current quarter (P= 0.000) but positive and significant in the next two quarters (P= 0.001). Further results indicate that the construction cost's effect is positive and not significant (P= 0.0910). Finally, the result presented in Table 4.20 shows that the effect of credit supply on housing prices is negative and significant (P=0.0494) but positive and significant in the next two quarters (P=0.0058).

Table 4.21: Summary of Short Run Test of Mediation

Analysis	Coefficient	Result	Decision
Short Run			
Step One: Equation 3.12	Per capita income and interest rate	Significant	Mediation is possible
	Inflation, construction cost, and credit supply	Not Significant	
Step2: Equation	Interest rate and inflation	Significant	Partial Mediation
	Per capita income, construction cost, and credit supply	Not Significant	
Step 3	Per capita income, interest rate inflation, construction cost, and credit supply(Mediator)	Significant	
Step 4	Decision making		

Source: Researcher (2020)

The fourth step of the Mediation process entails deciding whether the mediating variable (housing supply) completely, partially, or does not mediate the relationship between housing market fundamentals and housing prices in the short run. The combined result of the three steps satisfies the partial mediation criteria outlined in Table 3.2. This is because the effect of market fundamentals is not significant in the first step except inflation. Additionally, partial mediation is supported as the effect of housing supply (the mediator variable), and all other explanatory variables on housing prices are significant in the third step. Furthermore, the relationship between market fundamentals and housing prices were reduced. Still, it remained significant in the third step when the housing supply was introduced as a predictor, elucidating to a partial mediation. The study, therefore, rejected the seventh null hypothesis that

housing supply has no significant mediating effect on the relationship between housing prices and housing market fundamentals in the short run.

Table 4.22: The Long Run Test of Mediation Result

	Step1 (Model 3.2)	**Step 2 (Model 3.8)**	**Step3 (Model(3.9)**
	long Run	**Long Run**	**Long Run**
Dependent variable	**(Housing prices)**	**(Housing Supply)**	**(Housing Prices)**
	Beta(Prob.)	Beta(Prob.)	Beta(Prob.)
Per Capita Income	-37.26 (0.0827)**	42.5677 (0.2595)	0.32008 (0.9709)
Interest Rate	-7.8545 (0.2946)	-26.09 (0.10)	-13.721 (0.0000)*
Inflation	-0.00387(0.041)*	0.0273 (0.3763)	-0.0.037 (0.0000)*
Construction Cost	0.9056 (0.1646)	-1.59 (0.0241)*	0.689(0.0000)*
Credit Supply	-0.088(0.6326)	0.653 (0.0105)*	- 0.546790.0051)*
Housing Supply			0.2241 (0.0000)*
Dummy_07Q3	0.108373 ( )	0.768 (0.0032)*	
Dummy _08Q1			0.3099 (0.0000)*
Dummy _08Q2	0.5445(0.0027)*		
Dummy _11Q3			0.2542 (00000)*
Dummy _11Q2	0.22(0.0857)*		
Panel B: Diagnostics			
F-Statistic	2.00572		0.996853
Adjusted R^2	0.7765	0.5616	0.665638
ECMt-1	-0.116(0.000)*	-0.04843(0.000)*	-0.36271(0.000)*
Normality Test	0.85(0.65)	4.35(0.523)	0.39(0.2621)
Serial Correlation LM Test:	1.67(0.9752)	4.94(0.1485)	(3.34)0.9012
ARCH Test:	0.261(0.6093)	5.41(0.1538)	8.23(0.234)
QS(QS2)	S(S)	S(S)	S(S)
RESET Test	1.051(0.230)	0.34(0.1323)	3.12(0.104)
NOTE: S denotes stable:* denotes significant at 5percent S.L** at 10percent SL			

Source: Research Data (2020)

In the long run, the result of the first step was presented in Table 4.13 and discussed in section 4.5.1. It was found that, in the long run, the effects of per capita income,

interest rate, cost of construction, and credit supply are not significant, an indication that there is an effect to be mediated. The outcome of the second step presented in Table 4.22 indicates that the effects of construction cost and credit supply were significant. In contrast, the effects of interest rate, inflation, and per capita income are not significant. As shown in Table 4.22, the effect of per capita income on housing supply is positive and not significant (P=0.2595) and that of interest rate (P= 0.10). The effect of inflation is positive and not significant (P= 0.3763), while the effect of construction cost is negative and significant (P= 0.0273). Finally, it is shown that the effect of credit supply is positive and significant (P= 0.0032) in the long run.

The outcome of the third presented in Table 4.22 indicates that the effect of the housing supply (the mediator variable) and all the housing market fundamentals on housing prices are significant except for per capita income. Particularly, the effect of housing supply is positive and significant (P= 0.0000), while the effect of per capita income is positive but not significant (P= 0.9709). The effect of interest rate is negative and significant (P= 0.0000) and inflation (P= 0.000). Finally, the study outcome indicates that the effect of the construction cost on housing prices is positive and significant (P= 0.0000) while that of credit supply is negative and significant (P=0.0051).

Table 4.23: Summary of Long Run Test of Mediation Result

Analysis	Coefficient	Result	Decision
Long Run			
Step One: Equation 3.12	Inflation	significant	Mediation is possible
	per capita income, interest rate, cost of construction and credit supply	Not Significant	
Step2: Equation	Per capita income, Construction cost, and credit supply	Significant	
	Interest rate and Inflation	Not significant	
Step 3	interest rate inflation, construction cost and credit supply	Significant	
	Per capita income,	Not significant	
	Housing supply	Significant	
Step 4	Conclusion		Partial Mediation

Source: Researcher (2020)

The fourth step entails deciding on the existence of complete, partial, or no mediation in the long run. The outcomes of the three steps satisfy the partial mediation decision criteria two outlined in Table 3.2. This because, in the first step, the effects of all explanatory variables on housing prices are not significant except for inflation. Besides, the outcome of the second step indicates that the effect of three variables, per capita income, construction cost, and credit supply on housing supply (the mediator), are significant. Finally, partial mediation is supported since, in the third step, the effects of housing supply (the mediator) and all the explanatory variables on housing prices are significant.

Additionally, the relationship between market fundamentals and housing prices was reduced but remained significant in the third step when the housing supply variable was introduced as a predictor variable. Hence the study rejected the sixth null hypothesis that housing supply has no significant mediating effect on the relationship between housing prices and housing market fundamentals in the long run. Based on the preceding arguments, the study concluded that the housing supply has a partial mediating effect on the relationship between housing market fundamentals and housing prices in the long run.

The outcome of the partial mediating effect of housing supply on the relationship between housing market fundamentals and housing prices in the short run and long run supports Paciorek's (2011). The study found that when housing supply cannot keep pace with demand shocks such as innovations in income and interest rate quickly and cheaply, the changes would be manifested in housing prices. The study also corroborates Conefrey and Whelan's (2012) findings that market fundamentals such as GDP growth and interest rate other than housing supply have a small impact on housing price dynamics after controlling the housing supply. This observation suggests that variations in the demand factors on housing prices depend on the supply environment, such as available land, the fixed and marginal cost of building, and the time taken to build a house.

The outcome is also consistent with the findings of Vuluku and Gachanja (2014) and Grimes and Aitken (2010). The former found that interest rate, cost of supply, and inflation levels are among the variables that cause housing supply in Nairobi City

County in Kenya. The latter found that housing supply elasticity suppresses variations in house prices due to housing demand shocks. Finally, it can be argued that supply constraints such as the availability of developable land, regulation, and physical controls can raise the housing market volatility through housing price sensitivity to demand conditions.

CHAPTER FIVE

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

5.1 Introduction

This chapter highlights the conclusions and recommendations of the thesis. Firstly, the study outlines a summary of the main findings. Secondly, conclusions are drawn based on the documented results. Thirdly, the study documents the policy implication of the findings and the recommendations thereof. Finally, the study highlights the study's contributions to knowledge, the limitations encountered, and areas for further research.

5.2 Summary of Findings

This study aimed to assess the housing market fundamentals' effect on housing prices in Kenya Nairobi City. The study employed linear and nonlinear ARDL models on quarterly data from 2005 to 2008 using an explanatory research design supported by positivist' philosophy. Firstly, the study presented the conceptual and theoretical issues of the study. Secondly, an overview of the methodology used was presented. Thirdly, the study examined the linear and nonlinear effect of housing market fundamentals on housing prices. Fourthly, the study considered the moderating and mediating effect of investor sentiment and housing supply on the relationship between housing market fundamentals and housing prices, respectively. Lastly, the study tested the hypotheses, presented conclusions, the implications of the study, the recommendations thereof, and the avenues for enhanced studies. A summary of the key study findings is given hereunder.

Firstly, the study sought to investigate the effect of per capita on housing prices in Nairobi City County. Correlational analysis indicated that per capita income is strongly positively correlated to housing prices. The linear ARDL model showed that per capita income significantly affected housing prices in the short run, but not in the long run. Nonlinear ARDL specifications found an insignificant asymmetric impact of per capita income on housing prices in the short run, which is significant in the long run. The study further found that housing prices only responds to positive income shocks in the long run and lagged income shocks in the short run.

The second objective sought to analyse the effect of interest rates on housing prices in Nairobi City County. Correlation analysis indicated that the interest rate is averagely positively correlated to housing prices. In the short run, the study established a significant linear effect of interest rate on housing prices that is not significant in the long run. Besides, nonlinear ARDL specification outcomes showed that interest rates had a significant asymmetric effect on housing prices in the short run and long run. Additionally, the study found that housing prices are more responsive to positive interest rate shocks than negative shocks in both horizons.

Thirdly, the study sought to establish the effect of inflation on housing prices in Nairobi City County. Correlation analysis revealed that inflation is not correlated to housing prices at a 0.05 significance level. Equally, the study established that inflation had an insignificant linear effect in the short run that became significant in the long run. In the nonlinear ARDL specification, inflation had an asymmetric impact on house prices in the short and long run. Further results indicated that housing prices

react more to a decrease in inflation than increases in both horizons. The fourth objective was to establish the effect of construction cost on housing prices in Nairobi City County. Correlation analysis indicated that construction cost and house prices are strongly positively correlated. The linear ARDL found an insignificant effect of construction cost on housing prices in the short and long run. However, in the nonlinear specification, construction cost had a significant asymmetric impact on housing prices only in the long run. The other result indicates that housing prices only respond to a decrease in construction costs in the long run and a lagged increase in construction in the short run.

Fifthly, the study sought to establish the effect of credit supply on housing prices in Nairobi City County. The outcomes indicate that credit supply and housing prices are strongly positively correlated. In the linear ARDL framework, credit supply had an insignificant effect on housing prices in the short and long run. However, in the nonlinear ARDL specification, credit supply had a significant asymmetric impact on housing prices in the short and long run. Sixty, the study sought to assess the moderating effect of investor sentiments on the relationship between housing market fundamentals and housing prices in Nairobi City County. The study found that investor sentiments had a significant moderating effect on the relationship between housing market fundamental and housing prices only in the long run.

Lastly, the study sought to establish the mediating effect of housing supply on the relationship between housing market fundamentals and housing prices in Nairobi City County, Kenya. The study found that housing supply partially mediates the

relationship between housing market fundamental and housing prices in the short and long run. The study also found that housing market fundamentals and housing prices are cointegrated in both linear and nonlinear specifications. However, the movement towards long-term equilibrium was slow, leading to rejection of the efficient market hypothesis favouring an adaptive expectations hypothesis formed by the Kenyan economic agents regarding the future trend of housing prices.

5.3 Conclusions

Based on the findings of the study, several conclusions are hereby drawn. Firstly, the study concluded that improvement in economic conditions, as measured by per capita income, can boost housing demand resulting in higher house prices in the long run. As such, housing price appreciation can be predictable, based on lagged income information. Secondly, the study concluded that housing prices have strong downward price stickiness due to changes in interest rate. This is because homeowners have the least preferred selling prices or are reluctant to dispose of their properties under particular house prices in recessionary periods.

Thirdly, the study concluded that housing prices react strongly to inflation changes in the short run and rigidly to inflationary pressure, especially when inflation is very high. Given the correlation analysis findings, the study equally concluded that housing as an asset is not strong enough to diversify inflation risk, especially during high inflation regimes in Kenya. The fourth conclusion is that construction cost is crucial in house prices dynamics through its effect on housing supply. Construction will affect the responsiveness of housing supply to demand shocks, which would increase the cost of

new housing, thereby reducing the builder's ability to respond quickly to the market signals.

Fifthly, the study concluded that both the expansion and contraction of credit supply induce future higher house prices. However, the housing price growth can be affected significantly if the credit market is subject to significant shocks and policies. Sixthly, the study concluded that housing price determination is subject to irrational behavior and trends that cannot be fully explained by housing market fundamentals as housing prices formation is moderated by investor sentiment. Seventhly, the study concluded that housing prices formation and development depend on the housing supply environment and constraints that raise the housing market volatility through housing price sensitivity to demand conditions. Overall, the study concluded that the housing market in Nairobi City County is inefficient and characterised by information asymmetry.

5.4 Policy Implications and Recommendations

The outcomes of this study have several policy implications to note. Firstly, the study found that interest rate and inflation have a significant asymmetric effect on housing prices in the short run and the long run. In both horizons, housing price was more responsive to an increase in interest rates and a decrease in inflation. This outcome implies that a policy option for a stable macro-economic environment would be foundational in addressing housing price instability in Kenya. Therefore, the study recommends the Central Bank of Kenya to lower the policy rate as an effective way to ensure affordability in the housing market, thereby crowding in the private sector.

The study also recommends eliminating or reviewing interest rate capping laws that came into effect in 2016. The action would boost the supply of credit to the real estate sector. The central bank of Kenya should simultaneously enhance microeconomic efforts, such as improving universal credit scoring and implementing a moveable asset registry to boost credit supply to the private sector.

Secondly, the study found an asymmetric effect of construction cost on housing prices whereby the housing price adjustment is more sensitive to negative shocks to construction costs than positive shocks. The outcome implies that reducing costs associated with building a house would reduce dwelling and financial risks. Hence, the study recommends the State Department of Housing and Urban Development to facilitate innovations towards incremental and mixed-use housing. The study also recommends harmonising the fee structure and procedures for planning and approval across national and county governments to reduce construction costs. In particular, the government agencies' enforcement mandates and regulations should be synchronised to reduce duplicity and lead time escalation. This process should complement the full implementation of the supporting regulations to the Land Act (2012) and the Land Registration Act (2012), especially the issuance of property titles for multi-story buildings and electronic conveyancing regulations.

Thirdly, the study found an asymmetric effect of credit supply on housing prices where housing prices adjustment is more responsive to positive shocks to credit supply to the real estate sector. This implies an unstable interconnection between credit and housing markets, which would have adverse spillover effects on the local economic stability

going forward. The study, therefore, recommends the financial sector policymakers and regulators to review policies directed at the loan requirements and mortgage availability standards. Specific policy measures should target differential capital requirements for real estate loans and favourable treatment of debt-financed homeownership that suit the local real estate market dynamics. Besides, the Government of Kenya should consider raising the maximum loan to value ratio (LTV) and debt service to income (DSI) ratios for primary residences and first-time home buyers. The measures should be effected alongside a government's specialised guarantee scheme to reduce the lenders' exposure to default risk.

Fourthly, the study found a significant partial mediating effect of housing supply on the relationship between housing market fundamentals and housing prices. This implies that housing market fundamentals impact housing prices through their impact on housing supply. Hence, the study recommends that Kenya's government consider reducing housing supply restrictions in Nairobi city county housing markets and the immediate satellite towns by designing sufficient land for building or allowing optimized lot sizes for strategically identified sites. Simultaneously, the Nairobi City County government should fast track the implementation of revised strategic development zones for infrastructure and residential houses development. Simultaneously, the county government of Nairobi should fast-track the approval of the county's spatial plan. These plans should provide a long-term framework for urban and regional development and guide adequate space allocation to construct critical infrastructure.

Fifthly, the study found a significant moderating effect of investor sentiments on the relationship between housing market fundamentals and housing prices. This implies that investor sentiment would impact housing in a way that does not reflect market fundamentals, and prices can be mispriced relative to rational expectations. The study, therefore, recommends the capital Markets Authority in collaboration with the Institute of Surveyors of Kenya (ISK) to develop a nationwide housing investors' sentiment index to mitigate the systematic risk associated with emotional trading in the real estate sector. The study also recommends the Institute of Surveyors of Kenya (ISK) to consider the proposed sentiment index as an additional component in their decision support tools in the process of valuation. This would enhance their judgment of potential housing market crash and increase certainty in valuation models.

5.5 Contribution to Knowledge

The study makes several contributions to knowledge noteworthy. Firstly, the study adds value to the existing real estate finance theory by documenting the asymmetric effect of housing market fundamentals in housing prices in Nairobi City County, Kenya. New measures were constructed to separate the increase and decrease in housing market fundamentals using the partial sum concept. The study area is unique as it lacks empirical evidence that employs linear and nonlinear models concurrently in the Kenyan context. In that regard, academicians and students alike would use the outcome as a base for enhanced real estate finance research.

Secondly, the real estate finance theory was enhanced by introducing behavioral finance aspects into the housing pricing model. The study explicitly showed how to

quantify investor sentiment using indirect indicators through orthogonalisation. This indicator reflects the agent's expectation about future fundamentals and economic conditions, which are not reflected in other macroeconomic fundamentals. A sentiment index (as a new variable) could help market participants learn more about the interaction between the investors' sentiment and housing market fundamentals. The process poses an opportunity to record how irrational behaviour affects the housing market, an area that has not been expansively explored in Kenya.

Finally, the study adds value to the existing knowledge by substantiating how housing supply mediates the relationship between housing market fundamentals and housing prices. The study showed that the demand-side housing market fundamentals do not have independent explanatory power regarding changes in housing prices but rather impact housing prices through their effect on housing supply.

5.6 Limitations of the Study

The study encountered three notable limitations. Firstly, the study focused on residential housing properties in Kenya's Nairobi City County due to housing data availability. The empirical investigation could have contributed more to real estate finance theory and practice if it incorporated other real estate subsectors such as commercial and industrial real estate subsectors. However, the residential real estate sector has empirically been documented to impact a nation's economy significantly, thus giving a justification for the study's focus. Besides, the residential real estate sub-sector comprises 60 percent of the Kenyan real estate sector.

Secondly, the study used secondary data. This data type could be subject to possible errors and biases associated with the source institutions' adjustment to give a targeted view. Hence data was obtained from reliable and reputable sources, including the Central Bank of Kenya, the World Bank, Kenya National Bureau of Statistics' published reports, and statistical abstracts readily available in the public domain. The study further carried out data triangulation by linking and combining data from these multiple sources to fill inherent gaps. In the process, the richness and consistency of the data were enhanced.

Thirdly, the study relied on a housing price index prepared by Hass Consult Limited. The index was deemed fit for the study as there were no comparable housing price indices that have lasted more than ten years in the Kenyan housing market. Over the years, the housing price index has been relied upon by credible and reputable organisations such as the World Bank, the Central Bank of Kenya, the Kenya Property Developers Association, and the Centre for Affordable Housing Finance Africa in the forecasts of housing prices in Kenya. This added credibility and reliability to the index to measure the dependent variable of the study.

5.7 Areas for Further Research

Firstly, the study found that housing market fundamentals have significant asymmetric effects on housing prices and that the housing market in Nairobi City County is inefficient. Hence there is a need to research whether the persistent upward trends in housing prices indicate a housing price bubble in Kenya. Secondly, the study was faced with a limitation of comparable housing price indices from other counties within

Kenya and at the national level. Therefore, further research should be focused on how to construct national and other counties' housing price indices to promote efficiency in the Kenyan housing market. Finally, based on the recommendations that the government of Kenya should formulate real estate specific macroprudential policies and tools to precipitate a possible housing market crash, there is a need to extend housing market research to investigate whether these measures and fiscal tools can enforce a transition away from significant fall in housing prices in the future.

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APPENDICES

APPENDIX I: RESEARCH AUTHORISATION

KENYATTA UNIVERSITY
GRADUATE SCHOOL

E-mail: dean-graduate@ku.ac.ke

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P.O. Box 43844, 00100
NAIROBI, KENYA
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OUR REF: D86/CTY/31596/15

Date: 1st April, 2019

The Director, General,
National Commission for Science & Technology
P.O. Box 30623-00100,
NAIROBI

Dear Sir/Madam,

RE: RESEARCH AUTHORIZATION FOR MR. DANIEL O. NYACHIRO REG. NO. D86/CTY/31596/15

I write to introduce **Mr. Nyachiro** who is a Postgraduate Student of this University. He is registered for Ph.D. Degree programme in the **Department of Accounting & Finance in the School of Business.**

Mr. Nyachiro intends to conduct research for a Ph.D. thesis entitled, **"Housing Market Fundamentals and Residential Housing Prices in Nairobi City County, Kenya".**

Any assistance given will be highly appreciated.

Yours faithfully,

KENYATTA UNIVERSITY OFFICE OF DEAN 10 APR 2019 GRADUATE SCHOOL P.O. Box 43844-00100 NAIROBI

PROF. ELISHIBA KIMANI
DEAN, GRADUATE SCHOOL

RM/cao

APPENDIX II: RESEARCH PERMIT

THIS IS TO CERTIFY THAT:
MR. DANIEL OMANGA NYACHIRO
of KENYATTA UNIVERSITY, 2675-200
nairobi,has been permitted to conduct
research in *All Counties*

on the topic: *HOUSING MARKET FUNDAMENTALS AND RESIDENTIAL HOUSING PRICES IN NAIROBI CITY COUNTY.*

for the period ending:
25th April,2020

Permit No : NACOSTI/P/19/96343/29646
Date Of Issue : 30th April,2019
Fee Recieved :Ksh 2000

.....
Applicant's Signature

.....
Director General
National Commission for Science, Technology & Innovation

Appendix III

Data Abstraction Tool

	Housing Prices Index	Per Capita Income	Interest Rate	Inflation rates	Construction Cost Index	Credit Supply	Value of permits issued	NSE20 Share Index	NSE trading Volume	Equity market Turnover	NSE Capitalisation	Bond Turnover	T-Bill 3Months	Government Bond 1Year	Government Bond 5Year	Government Bond 10 Year	Unemployment Rate	Foreign participation in equity	Consumption growth
Q3:2005																			
Q4:2005																			
Q1:2006																			
Q2:2006																			
Q3:2006																			
Q4:2006																			
Q1:2007																			
Q2:2007																			
Q3:2007																			
Q4:0007																			
Q1:2008																			
Q2:2008																			
Q3:2008																			
Q4:2008																			
Q1:2009																			
Q2:2009																			
Q3:2009																			

Q4:0009																			
Q1:2010																			
Q2:2010																			
Q3:2010																			
Q4:0010																			
Q1:2011																			
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Q1:2015																			
Q2:2015																			
Q3:2015																			
Q4:0015																			
Q1:2016																			
Q2:2016																			
Q3:2016																			
Q4:0016																			
Q1:2017																			

Q2:2017																			
Q3:2017																			
Q4:0017																			
Q1:2018																			
Q2:2018																			
Q3:2018																			
Q4:0018																			

Source: Researcher (2020)

Appendix IV

Investor Sentiment Construction

A two-stage process introduced by Baker and Wurgler (2006) and applied by Heinig *et al*. (2016) was used to extract investor sentiments composite index. The study used five indirect sentiment proxies that mirror the housing market development through macroeconomic indicators. The five direct sentiment indicators are the Nairobi securities exchange index, the government bond rate, the government term structure, foreign equity participation rate, and credit rating index. Firstly, the study applied orthogonalisation process to the five sentiment proxies to remove the common economic influence. The process involved regressing each of the sentiment proxies against the main factors that influence the economy: GDP, interest rate, inflation rate, level of unemployment, and consumer spending. The second stage entailed combining the standardized residuals of the orthogonalised regression and their lags to provide an index of the irrational unexplained part by applying principal components analysis (PCA). A composite index was formed based on their first principal components with the highest variance explanation. The factor loading for the two ordered components are given in Table A.1.

The result presented in Table A.1 indicates that the first principal component is sufficient to describe the common variance of orthogonalised variables. The first principal component can explain 64 percent of the variations in all five cases.

Table A.1: Composite Index Estimation Result

Factor Method: Iterated Principal Factors
Date: 07/29/19 Time: 06:17
Covariance Analysis: Ordinary Correlation
Sample: 2005Q3 2018Q4
Included observations: 54
Number of factors: Kaiser-Guttman
Prior communalities: Squared multiple correlation
Convergence achieved after 500 iterations

	Unrotated Loadings			
	F1	F2	Communality	Uniqueness
Δ Bond_Turnover_	0.068142	-0.063348	0.008656	0.991344
ΔNSE20	0.575065	0.471857	0.553349	0.446651
Δ Interest Rate Spread	0.043858	0.095253	0.010997	0.989003
10yr_ Govt_Bond	-0.261798	-0.061000	0.072259	0.927741
NSE20	0.421338	0.906904	1.000000	0.000000
ΔEquity_Turnover	0.977882	-0.209159	1.000000	0.000000
Equity_Turnover_	0.741899	0.211908	0.595319	0.404681

Factor	Variance	Cumulative	Difference	Proportion	Cumulative
F1	2.089998	2.089998	0.939415	0.644946	0.644946
F2	1.150582	3.240580	---	0.355054	1.000000
Total	3.240580	3.240580		1.000000	

	Model	Independence	Saturated
Discrepancy	0.151185	2.007268	0.000000
Chi-square statistic	7.861618	104.3779	---
Chi-square prob.	0.4471	0.0000	---
Bartlett chi-square	7.181286	98.02159	---
Bartlett probability	0.5172	0.0000	---
Parameters	20	7	28
Degrees-of-freedom	8	21	---

Source: Research Data (2020)