OPTIMAL PRICING, HOUSING DEMAND AND SUPPLY IN KENYAN URBAN AREAS: THE CASE OF NAIROBI COUNTY

KAREMA SAMUEL WANYEKI

A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF APPLIED ECONOMICS IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTERS OF ECONOMICS (FINANCE) IN THE SCHOOL OF ECONOMICS OF KENYATTA UNIVERSITY.

DECEMBER, 2015
DECLARATION

This research proposal is my original work and has not been presented for any other award in any university.

Signature: .................................................. Date: 10-12-2015

Karema Samuel Wanyeki

B.COM (Finance)

K102/24469/2013

We confirm that this research project was undertaken under our supervision.

Signature: .................................................. Date: 10-12-2015

Joseph M. Muniu (PhD)

Lecturer, Department of Applied Economics

Kenyatta University

Signature: .................................................. Date: 10/12/15

Paul M. Gachanja (PhD)

Senior Lecturer, Department of Economic Theory

Kenyatta University
DEDICATION

To my Wife Sarah and my daughter Ashley Waiyego
ACKNOWLEDGEMENT

I thank God for His enduring love and mercies. It’s through His favour and mercies that has seen me this far, lifting me up again when I failed and in my lowest moments that left me thinking of quitting. He restored hope where I had lost hope,

I also would like to say a big thank-you to my supervisors; Dr. Gachanja and Dr. Muniu for their continued support, encouragement, and supervision always directed to the improvement of this project. You were there to guide and to correct me where needed, the journey was long but you never got tired, you walked with me to the end, May God bless you.

I would also like to thank my family, my parents; Mr and Mrs Karema, my Brothers and my Sisters for their unending love, support and motivation that kept me going. The sacrifices they made to see to see my school fees paid in time and to see me in school always will never go unrewarded.

I would also like to send a word of appreciation to my friends and colleagues, Kiiru Andrew, Daudi Meah, Gachara Peter and others for all your efforts and input in this paper to see it improved to its best.
TABLE OF CONTENTS

DECLARATION ...................................................................................................................... ii
DEDICATION ..................................................................................................................... iii
ACKNOWLEDGEMENT ...................................................................................................... iv
ABSTRACT ........................................................................................................................ vii
LIST OF TABLES ............................................................................................................... viii
LIST OF FIGURES ............................................................................................................. ix
DEFINITION OF TERMS ...................................................................................................... x
ABBREVIATIONS ............................................................................................................... xi
  1.1 BACKGROUND OF THE STUDY ............................................................................... 1
  1.2 HOUSING DEMAND ............................................................................................... 4
  1.3 INCOME DISTRIBUTION ......................................................................................... 7
  1.4 HOUSING SUPPLY .................................................................................................. 8
  1.5 PROBLEM STATEMENT .......................................................................................... 12
  1.6 Research Questions: ................................................................................................. 13
  1.7 Main research objective: ........................................................................................ 13
  1.8 SIGNIFICANCE OF THE STUDY .......................................................................... 14
  1.9 SCOPE OF THE STUDY ............................................................................................ 15
  1.10 ORGANIZATION OF THE STUDY ...................................................................... 15

CHAPTER TWO ................................................................................................................ 16
LITERATURE REVIEW ..................................................................................................... 16
  2.1 Introduction................................................................................................................. 16
  2.2 Theoretical Literature .............................................................................................. 16
    2.2.1 Labour Market Search Theory and the Housing Market ................................... 16
    2.2.2 The Irrational Exuberance Theory ..................................................................... 18
    2.2.3 Demand and Supply Theories and the Classical Price Theory ......................... 20
  2.3. Empirical Literature ................................................................................................ 21
  2.4 Literature Overview .................................................................................................. 25

CHAPTER THREE ............................................................................................................ 27
RESEARCH METHODOLOGY ......................................................................................... 27
  3.1 Introduction................................................................................................................. 27
  3.2 Research design ......................................................................................................... 27
ABSTRACT

The need to have shelter is indispensable to humanity. The price at which it is provided to them should be favorable and affordable to all as well as its availability. This study recognized that despite the establishment of the National Housing Corporation that is meant to provide affordable housing to the low and middle income sectors, house prices were still rising due to the deficiency in supply. This study intended to determine optimal pricing, demand and supply functions of housing in urban Kenya. The study used quarterly data on housing prices, demand and supply collected from 2003 to 2013. This research study used available data on the price fundamentals and employed a simultaneous equations model under two stage least squares regression to determine the pricing, demand and supply functions that would help curb the imbalance between housing demand and supply. This study however found that housing prices are mainly influenced by the levels of income, number of bedrooms and the cost of construction as the demand is influenced by income, number of bedrooms and interest rate. The study also found that housing supply is mainly influenced by the house prices and majorly constrained by the cost of construction. The study therefore sees need for and recommends use of alternative building materials that will see house prices come down as well as see an increase in the supply levels. This would see an increase in housing supply and also mean that the houses supplied are affordable which would reduce the excess demand in the lower and middle income market sectors by increasing the supply of low cost housing in the sectors.
LIST OF TABLES

Table 1.0: Kenya’s Housing Market status ------------------------------- 2
Table 3.0: Income Level Ranges---------------------------------------------- 32
Table 4.1: Stationarity Results------------------------------- 37
Table 4.2: Regression Results for the Pricing Model------------------------ 40
Table 4.3: Regression Results for the Demand Model------------------------ 43
Table 4.4: Regression Results for the Supply Model------------------------ 47
LIST OF FIGURES

Figure 1.1: Kenya Annual Housing Requirements------------------------------- 6
Figure 1.2: Kenya Urban Income Distribution---------------------------------- 7
Figure 1.3: Supply of housing to different income groups in Kenya--------- 10
Figure 1.4: Kenya Average Value of Housing------------------------------- 11
Figure 4.1: Demand model stability results------------------------------- 45
Figure 4.2: Supply model stability results---------------------------------- 48
DEFINITION OF TERMS

Cost of Construction- This refers to the cost incurred in the process of preparing for and constructing buildings and it includes planning, designs and financing and continues until the structure is ready for occupancy.

Fundamentals - these are the major factors or determinants of housing demand, supply and prices.

Affordable Housing - a house that a consumer can easily buy without compromising the financial integrity of the buyer and the society he supports or represents. The housing costs and prices are within the buyers reach.

Irrational Exuberance- is when investors are so confident that the price of an asset will increase; they lose sight of its underlying value. They get into a bidding war, driving housing prices up to levels unattainable by the prospective or target buyers.

Optimal- this is the level of housing price and quantity at which any level above or below will lead to disequilibrium in the housing market.

Price Bubble- This is when house prices are increasing only because people expect prices to go up, and not because the fundamental drivers of house prices are changing.

Relative Price- is the price of a house in terms of a related dwelling unit; say a rental house unit.
ABBREVIATIONS

GoK- Government of Kenya

OECD- Organization for Economic Co-operation and Economic Development

2SLS- Two Stage Least Squares
CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

The real estate industry in Kenya has been experiencing high growth over the years. For the period 2006 to 2010 the sector accounted for more than 5 percent of Kenya’s GDP (African Economic Outlook, 2012). However, from 2012 there has been a slowdown in the sector’s growth as it became progressively ensnared between galloping rises in the prices of land and construction materials, and slowing demand at the top-end of the market where construction has been concentrated. At the same time, the high demand in the middle and low income sectors of the market far remains unmet. This blow to the real estate market comes at a time when the rapid growth in mortgage activity is providing a new source of middle income housing demand that is underpinning the sector’s growth prospects.

Kenya continues to grapple with ongoing housing shortages as the country’s real estate industry builds tens of thousands of homes a year out of the over two hundred thousand units demanded. This may even worsen with time due to the rising cost of building materials and land prices. With time, the sharp contraction in building could set in train a new round of house price rises putting properties out of reach as it is only less than 11 percent of Kenyans can presently afford a mortgage in the current mortgage market, (World Bank, 2011).
According to the Central Bank Mortgage Policy Survey (2010), the total number of mortgage loans in the country as at end of 2009, stood at around 14,000. Kenyans are left to compete for limited mortgage funds thus raising the standards for qualifications to access.

According to the Central bank of Kenya mortgage market survey (2010) the mortgage market stood at Ksh 61.4 billion with 13,803 loans averaging 4 million. This means that only 13,803 people got a loan to buy a house against the 205,823 who demanded house. This can be seen in Table 1.0;
Table 1.0: Kenya’s Housing Finance market status

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size of Mortgage Market</td>
<td>Ksh 61.4 billion</td>
</tr>
<tr>
<td>Number of Mortgage Loans</td>
<td>13,803</td>
</tr>
<tr>
<td>Average Loan Size</td>
<td>Ksh 4 million</td>
</tr>
<tr>
<td>Typical Interest Rate</td>
<td>14%</td>
</tr>
<tr>
<td>Number of Mortgage Lenders</td>
<td>35</td>
</tr>
<tr>
<td>Mortgages as a Proportion of Total Credit</td>
<td>15%</td>
</tr>
<tr>
<td>Mortgage Credit as a Proportion of GDP</td>
<td>2.5%</td>
</tr>
<tr>
<td>Current Potential Size of Mortgage Market</td>
<td>Ksh 800 billion</td>
</tr>
<tr>
<td>Annual Housing Need</td>
<td>205,823 units</td>
</tr>
<tr>
<td>Current Annual Housing Production</td>
<td>50,000 units</td>
</tr>
<tr>
<td>Number of Houses Needed Over Next 10 Years</td>
<td>&gt; 2.19 million</td>
</tr>
<tr>
<td>Proportion of Urban Population in 2010</td>
<td>1 in 4</td>
</tr>
<tr>
<td>Projected Proportion of Urban Population in 2050</td>
<td>1 in 2</td>
</tr>
<tr>
<td>Proportion of Urban Population living in Slums</td>
<td>1 in 3</td>
</tr>
<tr>
<td>Total Population that Can Afford a Mortgage</td>
<td>2.4 %</td>
</tr>
<tr>
<td>Urban Population that Could Afford a Mortgage</td>
<td>11.0%</td>
</tr>
</tbody>
</table>

The table above shows Kenya’s housing finance market indicating the annual housing needs against the current annual housing production. The gap between the demand and supply is wide standing at around 155,000 units a year, while the available size of mortgage can only be affordable to 11 percent of the urban population to add on the interest rate on those loans that makes it difficult for the middle and the low income earners to access housing finance. The table shows that 1 in 3 people of the urban population live in the slums. This explains the ever expanding slums in urban Kenya and the ineffective demand for housing. There is therefore a need to site new strategies and policies that will see increased production of low cost and affordable housing in Kenya to bridge the big gap between demand and supply.

1.2 HOUSING DEMAND

The demand for housing in Kenya is growing and is mainly driven by the growing population and urbanization. Growing prosperity has also increased the demand for larger and better quality housing. However, despite the growing population and urbanization, demand for urban housing in Kenya is severely constrained by low incomes relative to the high housing costs, and the limited financing options available to most households. In Nairobi, with an estimated population of 3 million people, nearly 60 percent of households live in the slum areas (UN HABITAT 2007). A survey by Giddings, (2007), on these settlements showed that 73 percent of households live below the poverty line. Slums in Mombasa, the second largest town, are also characterized by high levels of poverty, and renting is the predominant tenure.
According to Hass Consult (2013), demand for houses is stronger at the lower end sector of the market, but in this segment financing options are almost non-existent. This has rendered the private sector property market a high end affair due to the ability of the wealthy to purchase property using cash rather than through mortgage or other forms of financing. There is however a lot of concentration in this specific segment of the market by developers as they reach out to make huge profits while the demand in the lower and middle sectors of the market is still growing with no effort to serve the sector of the market as it does not seem much profitable.

Just like most countries in Africa, Kenya has a large housing gap which is growing every year and is increasingly prevalent in urban areas. According to the Central Bank Mortgage market survey of 2010, the current annual housing deficit is estimated at 156,000 units per annum based on the population growth and the internal migration taking place. There is limited data on the current levels of construction but the survey estimated current construction to be around 50,000 units a year. The deficit is largely filled by the growth in slum dwellings and continued self-construction of poor quality traditional housing.

According to the Kenya National Bureau of Statistics (2012), the population of Kenya in 2011 was 41.6 million inhabitants making it the 8th most populous country on the African continent. The population has grown rapidly from just 6 million in 1950, and is forecast to reach 85 million by 2050 (KNBS, 2012). This represents a compound annual growth rate of 2.7 percent. Kenya is a large country in terms of land area and has a
population density of just 69 inhabitants per square kilometer. It is also estimated that the rate of urbanization stands at 32% (World Bank, 2012)

The rapid population growth implies that the need for housing will continue rising. New housing is needed to cover both natural household formations arising from higher birth rates than death rates, but also internal migration. As the population moves away from rural areas into urban areas extra urban housing is required to accommodate the internal migrants.

The Kenyan annual housing requirements are estimated to increase from less than 50,000 units in 1950 to around 300,000 units in 2050 as shown in Figure 1.1;

Figure 1.1: Annual Kenya Housing Requirements

1.3 INCOME DISTRIBUTION

Income is the main determinant of consumer purchasing power. However, income levels in Kenya are both low in absolute terms and also very unevenly distributed. This is a common occurrence in the majority of sub-Saharan Africa. According to the World Bank (2012), 50 percent of urban Kenyan households earn less than Ksh 440,000 in a year, this translates to around Ksh 36,000 per month while only 1 percent of the urban population earns above Ksh 3.4 million per year which translates to around Ksh 283,000 per month as shown in Figure 1.1;

Figure 1.2: Kenyan Annual Urban Household Income Pyramid

![Income Pyramid Diagram]

Source: The International Bank for Reconstruction and Development / The World Bank

With the distributions and the levels of income shown above, there is lack of effective demand. This means that while there is an absolute shortage, and a growing one for
housing in the lower end sector, consumers do not have the means to act on the demand as financing is often not available or unaffordable. Very few people can afford a mortgage loan with such levels of income. Any prospective borrower would require the down payment to purchase a property, as well as sufficient cash to cover taxes, stamp duty and fees which can be as much as 10 percent of the property value. This level of income is earned by less than 3 percent of the total population and exclusively in urban areas. Since the sharp interest rate rises of 2011, the average monthly repayments to buy an apartment have stayed above Sh140,000 a month, despite the subsequent near halving in the Central Bank of Kenya's base rate (Hass Consult, Q3, 2014). As a result, apartment purchasing remains beyond the reach of nearly all professionals, the mortgage repayment exceeds average salaries across pharmacists, accountants, architects, marketers and most other careers. Only executives and managements come close to earning the salaries necessary to reach current Kenyan mortgage repayments.

1.4 HOUSING SUPPLY

Home ownership levels in Kenya are high and comparable to economies in Europe or North America but with a marked split between ownership in rural and urban areas. Sixty nine percent of Kenyans own the houses they live in with 18 percent being in urban areas and 82 percent in rural areas, (Fin Access Survey, 2009). According to the Survey, 70.3 percent of houses in Nairobi are permanent dwellings that are also common on the Coast, where 54.2 percent of houses are of this type.

According to a report released by Kenya Property Developers Association (KPDA) and Hass Consult (2014), Nairobi city alone requires approximately 200,000 housing units
per year in order to sustain the growing middle class by the year 2030. However, only 15,000 units were released into the market in 2013. The cost of construction permits has risen from as low as 0.006% of construction cost to 1.25% of the construction cost (Hass Consult, 2014). Cost of land and its availability are presenting new challenges to property developers. The cost of land in the city is escalating rapidly. The availability of land within Nairobi is also uncertain.

The Kenya’s National Housing Policy that dates back to 2004 was aimed at addressing the deficit in housing supply and in arresting the deteriorating housing conditions countrywide and to bridge the shortfall in housing stock arising from demand that far surpasses supply, particularly in urban areas. This situation has been exacerbated by population explosion, rapid urbanization, widespread poverty, and escalating costs of providing housing.

Contrary to government efforts and initiatives, a look at the supply statistics as at 2008 indicate that supply of housing is biased towards the high income groups which enjoys a 60 per cent supply surplus. The upper middle, lower middle and lower income groups suffer 15 percent, 92 percent and 98 percent deficits respectively as shown in the Figure 1.3; (GoK, 2007).
Figure 1.3: Supply of housing to different income groups in Kenya

![Graph showing supply of housing to different income groups in Kenya]

Source: GoK 2007

With the high demand, buyers are left to go for these few supplied houses thus pushing up housing prices. Property prices at the top end of the market can average as much as Ksh 20 million with some properties selling for much more. According to Hass Consult property index (2014), prices in the 'upper and middle' sectors of the Kenyan property market has also been rising with the average price in this sector rising from Ksh 15 million in 2006 to Ksh 20 million in 2010. This represents a compound annual growth rate of 7.5 percent. The average value of a property has gone from Ksh 7.1 million in 2001 to over Ksh 19 million in 2010. This is a tripling in value and an annual average
compound growth rate of around 12.5 percent (Hass Consult property index, 2014). These trends in housing values are shown in Figure 1.4;

**Figure 1.4: Average Value of Housing**

![Average Value of Housing](image)

*Source: Hass Consult 2014*

The average value of a house has gone from Ksh 7.1 million in December 2001 to Ksh 25.6 million in September 2014. The average value for a 4-6 bedroom house is currently 36.5 million while the average value for a 1-3 bedroom house is currently Ksh 11.8 million (Hass Consult property index, 2014). However, these prices can only be affordable to the high income earners. According to KPA (2014), only 15,000 houses were released to the market in 2013 against the 200,000 houses demanded. If all these houses were supplied to the top end sector of the market neglecting the middle and low income needs, this sector of the market may be getting saturated with excess supply.
There is therefore a need to address the situation and also consider the middle and lower segments of the market where the demand far exceeds supply.

1.5 PROBLEM STATEMENT

The need to have shelter is indispensable to humanity. Every Kenyan would wish to own a house to avoid the burden of paying house rent every month. Access to adequate and decent housing units decreases with the increase in population, scarcity of fixed assets like land, escalating house prices and the rising cost of living. Kenya’s real estate has been booming with the rising houses prices attracting more investors to the sector to tap the expected huge profits from the investment. However, according to Kiberenge (2012), Kenyan real estate industry would be on the verge of crisis following reports that many developers are unable to sell off houses due to unaffordable prices putting off prospective buyers. Kenya’s urban annual housing demand is estimated at about 150,000 units with an estimated annual average supply of only 35,000 units (Matindi 2009). The supply of housing in urban Kenya is biased towards the high income group market segment which enjoys a 60 per cent supply surplus while the upper middle, lower middle and lower income groups suffer 15 percent, 92 percent and 98 percent deficits respectively (GoK, 2007).

According to a report released in 2014 by planning and housing executive committee of Nairobi County, demand for housing in Nairobi had risen to 80,000 units annually by 2014. Investors need to know the optimal demand and supply and the optimal price that will bridge the widening gap between supply and demand for housing. Increasing the level of houses supplied for middle and low income earners will see property prices come
down as there is also a need to ensure that the housing units are provided at an affordable price.

Few studies have been done on this area. A study by the Johannesburg-based Centre for Affordable Housing Finance in Africa showed that, due to the high and ever rising housing prices, affordability still remains a challenge. As the house prices are still rising, an average Kenyan earns around 36,000 per month (World Bank, 2010), against the required Ksh 140,000 monthly payment for a mortgage to buy an apartment (Hass Consult 2010). The income that can afford to pay for such mortgages is earned by less than 3 percent of the total population. However, studies done on this area have failed to distinguish between the demand and supply of rental houses and individually owned houses. This study therefore seeks to determine the optimal pricing, demand and supply functions of individually owned houses and to guide investors on which segment of the market to concentrate more efforts on where demand is more acute.

1.6 Research Questions:

This research seeks to answer the following questions:

i.) What is the optimal pricing of housing in the urban areas of Kenya?

ii.) What is the optimal demand and supply of housing in the urban areas of Kenya?

1.7 Main research objective:

To determine optimal pricing demand and supply functions of housing in urban Kenya
Specific Objectives:

i.) To determine the optimal pricing function of housing in Nairobi Kenya

ii.) To determine the optimal demand and supply functions of housing in Nairobi Kenya

1.8 SIGNIFICANCE OF THE STUDY

The study was justified by the increase in population and high urbanization that led to the increase in demand of housing in urban Kenya. This study was also called for by the low supply of housing as compared to the high demand. This mismatch between demand and supply of housing had led to the increase in house prices in the country.

Despite the high demand and increased prices, many investors in this sector being private investors would wish take an advantage of the situation to maximize on their returns and profitability levels but they are also limited by the increased cost of construction and limited availability of finances hence reduced supply of housing. This leads to a continued rise in housing prices as buyers are left to go for the few built available houses.

This study is useful to house developers as it guides them to know on which area exactly to concentrate on and where their services are required and not to focus on higher returns that may lead them to counting losses. The study will also be useful to the National and County governments as it will guide them in setting up guidelines that will govern housing construction and pricing in the country to help avoid the feared housing bubble that may see the country’s economy collapsing.
1.9 SCOPE OF THE STUDY

This study focused on the impact of the mismatch between demand and supply of housing in the urban Kenya, specifically Nairobi, on the housing price levels. The study also focused on housing supply in an urban area especially in the high income sector where the high prices are only affordable and thus limiting the supply to the sector and neglecting the demands of middle and low income levels.

1.10 ORGANIZATION OF THE STUDY

This project has five chapters. Chapter one introduced the research study, its basis and its objectives. Chapter two provides a review of relevant theoretical and empirical literatures and also presents an overview of literature. The research design and research methodology are presented in chapter three while the findings and discussion of the results are in chapter four. Chapter five presents the summary, policy recommendations and areas of further research.
CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents the theoretical and empirical literature on studies done on the demand, supply and pricing of houses.

2.2 Theoretical Literature

This section addressed and looked at the works of other researchers and their findings that helped guide and helped add value to this research study.

2.2.1 Labour Market Search Theory and the Housing Market

Search theory has been applied widely in labour economics to explain why labour markets do not clear, since at any point in time there are jobless workers who search for work (unemployment) and firms that look for workers (vacancies).

In the search and matching models of the labour market such as those developed by Burdett and Mortensen (1980) and Pissarides (1985), workers depart from jobs in response to an exogenous shock and then find new employment from among the vacancies so created. Since job search is time consuming, costly and uncoordinated decisions about job acceptance determine vacancy duration. When a job seeker and an employer are matched, the wage is determined by the tightness of the labour market, i.e., the ratio of unemployed workers to the number of vacancies. Equilibrium in the labour
market (unchanging unemployment rate) implies that the inflow from employment into unemployment equals the outflow from unemployment to employment.

The search and matching models from the labour market have been applied to housing reflecting the existence of a number of parallels between the housing market and the labour market.

Similar to the labour market, the coexistence at any point in time of a stock of vacant houses (high supply) and a pool of buyers (high demand) searching for houses suggests that the housing market may not clear immediately. In the housing market, as in the labour market, the number of vacancies (or “unoccupied houses”) and the time it takes to sell a home both vary over time. Wheaton (1990) was the first to apply search theory to the housing market. In his paper, Wheaton notes that the assumption in labour market matching models of fixed jobs and workers fits well with the housing market’s stock-flow character where prices adjust in the short run to equate demand to a fixed stock.

Wheaton (1990) developed a model which yields a strong theoretical inverse relationship between vacancy and prices. In the model, houses and households become mismatched in response to a shock. The prospect of remaining mismatched determines the search effort while sellers’ reservation prices are determined by expectations about sales time and the cost of holding housing units. Higher vacancy in this model increases sale time, lowers seller reservations, speeds up search time and results in lower market prices. Over time, new units are added to the stock and vacancy adjusts until the marginal cost of such units equals the expected price, the price discounted by expected sales time. The vacancy rate at which the expected price equals the marginal cost is the market’s long-term structural
The model explains the coexistence of vacancy and prices due to transactions costs in the search process.

2.2.2 The Irrational Exuberance Theory

The irrational exuberance theory by Shiller (2000) analysed speculative behaviour of the market participants that repeatedly leads to stunning price movements in housing markets in which speculative demand for houses is influenced by heterogeneous expectations. Irrational exuberance is when investors are so confident that the price of an asset will increase they lose sight of its underlying value. They get into a bidding war, driving prices up to levels that cannot be supported by fundamentals.

If everybody thinks that house prices will go up, house prices could go up only because more people try to buy now, expecting capital gains from owning a house. When house prices are increasing only because people expect prices to go up, and not because the fundamental drivers of house prices are changing, the increase is commonly called a bubble. When increases in house prices are a bubble, there is no reason for prices to stay at a higher level. If people suddenly start thinking that house prices will drop, house prices could actually drop. Shiller (2007) discusses a variety of factors that contribute to bringing about such irrational exuberance, including cultural and psychological factors.

Piazzesi and Schneider (2009) survey evidence to analyze expectations used the Michigan Survey of Consumers, which is a useful data set for this purpose because it asks respondents about current and future house prices. According to Piazzesi and Schneider (2009) study, the proportion of households that are optimistic about future house prices is
about 9 percent, on average. However, what is more interesting is that they also find that the proportion of such optimistic households increased from 10 percent to 16 percent during a house-price boom.

Motivated by this evidence, Piazzesi and Schneider (2009) proposed a theory whereby some households' expectations are driven by momentum. When house prices are increasing for a while for some reason, these momentum households can keep house prices going up for a bit longer, because they believe that house prices will keep increasing, based on their recent experience, and they behave like households with irrational exuberance.

Kahn (1987) had proposed a theory as to how house prices are linked to expectations. When the economy is growing faster, people's income increases faster, and thus, future rents rise faster. He assumed that house prices today reflect future rents because if you buy a house today, you don't need to pay higher rents in the future. Therefore, if income and thus rents are expected to grow faster, people try to buy rather than rent a house today. Consequently, house prices go up today just because of a positive change in expectations about future income growth. According to Kahn's theory, expectations for sustained high income growth were the driving force for the increase in house prices.

Following the definition of demand, where effective demand is defined as the willingness and ability of households to pay for housing, then, the high demand of housing that is experienced in the country can be seen to be induced by the overoptimistic speculators and investors who often borrow more than what can be supported by their earnings.
These investors buy the built houses at the high end estates expecting to resell the houses at higher prices.

2.2.3 Demand and Supply Theories and the Classical Price Theory

The demand and supply theories are attributed to Alfred Marshall. According to Marshall (1890), supply and demand is an economic model of price determination in a market. The theory says that in a competitive market, the unit price for a particular good, or other traded item such as labor or liquid financial assets, will vary until it settles at a point where the quantity demanded (at the current price) will equal the quantity supplied (at the current price), resulting in an economic equilibrium for price and quantity transacted.

The classical price theory also assumes a competitive market where prices are determined by forces of demand and supply with no government intervention in price determination. The quantity supplied in a market is the amount of goods that sellers are willing to produce and sell under given circumstances. These include; the cost of inputs in the production process, the cost of labor, the price of capital, technology and expectations of future prices. Supply would then imply the relationship between quantity supplied and the price of the good ceteris paribus. The law of supply states that when the price of a good rises and everything else remains the same, the quantity of goods supplied also rises. There is therefore a direct relationship between supply and price.

The housing market can therefore be conceived in the same way as the market for any other good which is competitive in nature. A house is thus a private good to which the owners have control over. However, it can be viewed as a merit good which cannot be left purely to the market for ethical and political reasons (Oxley & Smith, 1996). At the
same time, governments influence the housing market through policy. This is mainly because the housing market is prone to market failure since conditions necessary for efficient market allocation do not exist as consumers act in their own interest due to effects of externalities (Maclennan, 1982). Increased output of housing units implies increased price, since price and supply have a direct relationship. If housing supply is inelastic new construction in the market is negatively related to input price. In the housing market, inputs are combined by supply side agents to produce housing services. Relative prices may encourage producers in the housing market to increase supply or not and suppliers of input to increase or reduce input production to this sector. Entry into the production process has little barriers with the main constraint lying in the input supply process (Mayo et al. 1986). Additionally, government regulations may restrict competitive input allocation say finance.

2.3. Empirical Literature

House price studies have a long history. Initially, the focus of the interest was on the explanation of prices from features of the property, such as location, size, amenities, age, etc. More recently, the dynamics of housing prices has attracted a lot of interest. With immediate adjustment, prices would always reflect all the currently available information, and price changes could be attributed to the arrival of new information.

Girouard, et al. (2006) did study to determine the role of fundamentals in housing pricing development in OECD countries with a review of the links between a possible correction of housing prices and real activity and concluded that the size and duration of the current real house price increases; the degree to which they tended to move together
across countries; and the extent to which they disconnected from the business cycle were unprecedented. They also said that the overvaluation of real house prices could only apply to a relatively small number of countries. However, the extent to which these prices looked to be fairly valued depended largely on longer-term interest rates remaining at or close to their low levels. If house prices were to adjust downward, the historical record suggests that the drops might be large and that the process could be protracted, given the observed stickiness of nominal house prices and the current low rates of inflation.

Klyuev (2008) used both the fundamentals model and an asset pricing approach in a study of the US housing market, where prices were linked to real rents and interest rates, the models indicated substantial overvaluation in the US housing market starting from 2001. Klyuev also examined the short-run dynamics of house prices but he did not find a statistically significant error-correction relationship in which house prices respond to the gap between actual and equilibrium home prices. This approach started by estimating a model of the housing market based on fundamentals where prices were determined by factors such as income, interest rates, demand and supply forces and demographics. As a result, Klyuev (2008) suggested that the extent of over or undervaluation estimated using fundamentals based models may not be a good predictor of future house price changes. Rather Klyuev argued that the inventory to sales ratio, by providing a measure of the imbalance between supply and demand in the market, was a more important determinant of short-run changes in house prices.

Ahuja et al. (2010) conducted a dynamic OLS regression analysis showing the impact of different fundamentals on the house prices in Chinese cities and concluded that real
income per capita, real mortgage interest rate, wealth level, past land prices and the
degree of urbanization could partly explain significant long-term house price trajectories.
In their paper Ahuja et al. also developed a second analysis based on an asset pricing
approach where they calculated benchmark prices. The authors concluded that there were
little deviations of the actual prices from these benchmarks. In addition they assessed the
increasing prices to be not persistent and the governmental measures to have been
working. However Ahuja et al. (2010) also pointed out that there were long-run structural
problems that needed to be solved such as the lack of alternative investments for the
Chinese people and the low real interest rate.

Giovanni and Zheng (2012) used a user-cost model of the housing market to study how
information dispersion about local economic conditions affects the equilibrium price of
housing. The study found that the higher equilibrium housing price is, the larger the
difference in expectations about future house prices, the reason being that all agents face
a short-sale constraint in housing and derive utility from consuming housing services.
Therefore, those who hold pessimistic expectations about future prices decided to rent to
avoid capital losses, while those who have optimistic expectations decided to buy in
anticipation of future price increases. The result was that the equilibrium price of owner
occupied houses reflected only the expectations of optimists and was, thus, higher and
more volatile relative to an environment of homogeneous information.

Chepsiror (2012) did a study to investigate the challenges of housing development for the
low income population in Kenya using random stratified sampling of a 100 employees as
the sample size. The study indicated that the motivation behind players involvement in
the housing industry in Eldoret town included maximum profit motive, social need motive, government incentives and availability of low cost building materials and technologies. The findings also indicated that the challenges faced by the housing developers included low return on investment, rising cost of land, complex land acquisition process, high interest on capital finance, scarcity of land with infrastructure and outdated planning regulations.

Waronja (2014) used hedonic pricing model to predict prices in the real estate sector in Kenya and found out that the real sales price of a house in Nairobi over the 2000 to 2012 period was positively impacted by income, number of bedrooms, the presence of either; a gym, sauna or swimming pool. The price was found to be inversely impacted by the age of building, distance from the central business district, inflation and interest rates.

Chow (2014) studied housing prices in urban China using a simultaneous equations framework and showed that the rapid increase in the urban residential housing price was explained by the forces of demand and supply, with income determining demand and cost of construction affecting supply. He applied the standard theory of consumer demand supplemented by a partial adjustment mechanism to explain the demand for and supply of urban residential housing in China. The demand for housing was explained by real income and relative price. The supply of housing was explained by relative price and the cost of construction. The interaction of demand and supply explained the annual price of urban housing at the aggregate level in China and helped dispel the notion that urban housing prices in China were rapidly driven up by speculation.
2.4 Literature Overview

The above reviewed literature has given an in-depth analysis of the housing prices and the factors that determine the increases in housing prices. This is following to changes in the forces of demand and supply, demographic factors, costs of production, consumer expectations about price levels, consumers' income, tastes and preferences and changes in prices of related goods in our case here being renting rather than buying own house.

Klyuev (2008) analyzed the fundamental factors and variables that explain the rises in houses price levels and found that the major factors are the same ones that influence demand and supply of houses. Also, Chow (2014) examined the forces of demand and supply that explained the rise in housing prices in urban China. This justifies the use of the variables that will be used in the next chapter to explain the changes in prices of housing and quantity supplied. The results will help to determine the optimum house price levels and the optimum quantity supplied. This is to bridge the gap in the housing market and to derive an equilibrium level in the same market.

From Chepsiror (2012) study, the challenges outweighed the motivations to the house developers and thus this explains the reason behind the low provision for low and middle income earners. Waronja (2014), also just predicted the real estate prices in urban Kenya but did not determine a specific price that would motivate developers to enhance increased supply of housing to curb the imbalance between demand and supply. This study therefore seeks to determine and optimum price of housing in urban Kenya that will
be at least attractive to housing developers and thus trigger increased housing supply to curb the high deficit in housing supply.
CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction
This chapter presents the research design and the procedure that was followed to achieve the research objectives. The chapter constitutes theoretical framework of the study, the empirical model to be used, definition and measurement of variables and the study area. Data type and sources, research instruments, preparation for data analysis and how the data will be analyzed.

3.2 Research design
This study was non-experimental and thus was more quantitative rather than qualitative. This approach was used in order to gain a better understanding and possibly enable a better and more insightful interpretation of the results. This research problem could best be studied through the use of simultaneous equations.

3.3 Theoretical framework
The focus of this study was to determine optimal supply and pricing of housing in urban Kenya. The model was based on supply and demand theories usually attributed to Alfred Marshall who described supply and demand model as an economic model of price determination in a market. Marshall concluded that in a competitive market, the unit price for a particular good will vary until it settles at a point where the quantity demanded by consumers (at current price) will equal the quantity supplied by producers (at current price), resulting in an economic equilibrium for price and quantity. Also the neo-classical theory of demand and supply stated the major variables determining the demand of a
commodity to be the relative price, income and price of a related commodity. From these factors, the major factors determining the demand for the total stock of own housing as measured by housing space are; real income and relative price. The consumer demand model can be presented as follows:

\[ Q_d = f(P, Y) \]  \hspace{1cm} (3.1)

The quantity of houses demanded is negatively related to the relative price but positively related to the level of relative income. The same income and price variables are assumed to affect the demand for own houses by government units and commercial enterprises that provide subsidized housing to their employees. The quantity of housing is measured in per capita terms to avoid the scale effect of an increase of population. Demand theory applies to the behaviour of a representative consumer, it explains mean demand of consumers by mean income and relative price.

The quantity of housing units supplied is explained by the price variable and the cost of construction as represented below:

\[ Q_s = f(P, C) \]  \hspace{1cm} (3.2)

The quantity supplied is positively related to the price level but negatively related to the cost of construction. Since the quantity variable includes both new construction and the amount of existing housing made available for sale, the price elasticity of supply under our theoretical framework is smaller than the elasticity of supply of new housing alone.
3.4. Empirical Model

The empirical model is a simultaneous equation model derived Chow (2014) in determining housing prices in urban China. The model is also guided by the argument from the framework above. The quantity variable includes both new construction and the stock of existing housing made available for sale.

Following the argument in the theoretical framework, from equations 3.1 and 3.2 the demand and supply equations can be written as:

**Demand:** \[ q_t = b_0 + b_1y_t + b_2p_t + b_3nob_t + b_4rir_t + u_t \]  \quad (1)

**Supply:** \[ q_t = a_0 + a_1c_t + a_2p_t + a_3inf_t + u_t \]  \quad (2)

Where \( q_t \) denotes housing space per capita, \( y_t \) denotes real disposable income per capita, \( p_t \) denotes relative price of housing, \( c_t \) denotes real construction cost, \( nob_t \) denotes the number of bedrooms, \( rir_t \) denotes real interest rate and \( inf_t \) denotes inflation.

Both demand and supply equations were approximated by linear function.

Equations (1) and (2) are two simultaneous equations where the quantity and price are endogenous in the system. The parameters were estimated by the method of two-stage least squares (2SLS). First, the reduced-form equations for the endogenous variables as functions of exogenous variables were estimated. Second, the structural equations were estimated by replacing the observed endogenous variables with their estimates from the first-stage regressions.
Solving the structural equations gave the reduced-form equations for the endogenous variables $q_t$ and $p_t$.

$$
p_t = d_0 + d_1y_t + d_2c_t + d_3nob_t + d_4rir_t + d_5inf_t + v_t \quad \ldots (3)
$$

Reduced-form equation (3) will be used to explain the rapid rise in the price of urban housing in Kenya by the forces of demand and supply.

Denoting the predicted value of $p_t$ from equation (3) by $p_t^*$, the study applied least squares in the second stage to estimate the demand and supply equations (1) and (2) by replacing $p_t$ with $p_t^*$.

**Demand:**  
$q_t = b_0 + b_1y_t + b_2p_t^* + d_3nob_t + d_4rir_t + u_t \ldots (4)$

**Supply:**  
$q_t = a_0 + a_1c_t + a_2p_t^* + a_3inf_t + u_t \ldots (5)$

Where $q_t$ is quantity demanded or supplied, $y_t$ is the real income, $c_t$ is the cost of production and $p_t$ is the optimal price of a housing unit.

### 3.5 Definition and measurement of variables

**Real income**—this was the income of an individual after taking into consideration the effects of inflation on the purchasing power. Average monthly real income of individuals was used to determine their demand for housing. Data on disposable income of urban residents was collected from the Kenya Bureau of statistics reports.
Price—this was the price of a single unit of a house as given by the general prevailing market housing price index, that is, it is a ratio of two prices. Therefore, the relative price of housing was given by price of housing divided by a general price index.

Data on sales price of commercialized individually owned houses were calculated by dividing total sales revenue of commercialized individually owned houses by total floor space sold. Both series were found in online database of Hass Consult for the period of 2004 to 2014.

The price variable \( P \) is the ratio of the above price series divided by the urban CPI (2000 = 100) presented in HassConsult in a table on Annual average sale of all properties.

Cost of construction—expenses incurred by a contractor for labor, material, equipment, financing, services, utilities e.t.c, plus overheads and contractor’s profit. Data on construction cost was collected from the Residential Building costs index, 2003-2013 from the Kenya National Bureau of Statistic. Since this price index took 1982 as the base year, the study calculated a price index accordingly taking its value in 1986 as 100.

The cost variable \( c \), is the ratio of this price index divided by the same urban CPI. It was pointed out that some other important components of construction cost were omitted due to data availability. These included operational cost, land purchasing price and related expenditures. Land cost in particular accounts for a sizable proportion of the total cost in major cities. This justifies the need for primary data collection from the key developers and real estate agents.
Quantity demanded- was the number of individually owned housing units that the consumers demanded to be put in the market for their purchase. Data on the number of housing units demanded was collected from the ministry of land and housing, National Housing Corporation and the Nairobi County, Ministry of Planning and Housing.

Quantity supplied- was the number of housing units put into the market by developers for sale. Data on the number of housing units supplied was collected from the Ministry of Lands and Housing, the National Housing Corporation and the Nairobi county ministry of planning and housing.

3.6 Study Area

The research was a case study on Nairobi County which is the capital city of Kenya. This county has a number of estates faced with high housing demands and others with excess housing supply. These estates were defined by the levels of income, from the top end estates dominated by the high income earners to middle class estates dominated by median income earners to low income estates or slums mainly dominated by the low income earners. These different levels of income were defined by the National Bureau of Statistics 2014 as follows:

Table 3.0: Income Level Ranges

<table>
<thead>
<tr>
<th>Title</th>
<th>Income in Ksh.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Income</td>
<td>-23,000</td>
</tr>
<tr>
<td>Middle Income</td>
<td>23,999 – 120,000</td>
</tr>
<tr>
<td>High Income</td>
<td>120,000 and above</td>
</tr>
</tbody>
</table>

These different levels of incomes were addressed as per their housing needs and the level of supply to their demands.

The city is also inhabited by different investors and developers in the real estate sector who were the major suppliers of housing. These agents were examined to determine the factors that affect their supply of housing in the urban Kenya.

3.7 Data Type and Source

This research study used quarterly time series data from the year 2003 to the year 2013. This secondary data was collected from the available and reliable sources like Kenya Bureau of Statistics, Hass Consult and National Housing Corporation.

3.8. Data Collection and Refinement Procedures

The secondary data that was used for this research study will be collected using data collection schedules from the sources stated in (3.7) above.

Before processing the responses, data preparation was done on the completed collection schedules by cross checking the completeness of the data, coding, entering and finally analyzing the data. Data stated in different units was converted to the same unit of measurement for efficiency. Due to the large values of the data and for easy estimation and interpretation of the coefficients, the data was transformed into logarithmic form and thus the coefficients were explained as elasticities.
3.9 Time series analysis

Data on variables used in this study are those observed and recorded over the period 2003-2014. Regression analysis based on time series data implicitly assumes that the underlying time series are stationary so that the classical t-statistic and F-statistic are used to test hypotheses (Gujarati, 2004). However, most economic time series data often exhibit strong trends and the regression of one time series on one or more time series variables can give nonsensical or spurious results. Such spurious regression is avoided if the time series involved are all stationary or if they are non-stationary but cointegrated.

3.9.1 Data Stationarity

Each variable was tested for the presence of a unit root, using the formal statistical tests to detect non stationarity. The Augmented Dickey Fuller (ADF) test procedures as explained by Dickey and Fuller (1979) and Mackinnon (1991) will be used.

3.9.2 Co-integration analysis

The time series data used in this analysis was non-stationary with stochastic trends. A linear regression using non-stationary time series may generate spurious correlation (Granger and Newbold, 1974). First a cointegration test to show that these series are indeed cointegrated was employed. Second, using a VECM model specification (Engle and Granger, 1987), the study estimated the cointegration relationships among the variables comparable to the reduced-form regressions. The cointegration relationships followed the reduced-form equations (3) and (4). Thus, estimation of the VECM models provided alternative estimates of the reduced-form regressions.
3.10 Data Analysis

This section discusses the techniques that were used to analyze data and test the variables. Data collected are analyzed using descriptive statistics in guidance of the research questions and research objectives. To achieve objective one, the study first estimated the linear reduced form equation (3) above, in explaining the optimal pricing function of houses as influenced by the variables affecting demand and supply of housing.

To achieve the second objective, the study estimated the reduced form simultaneous equations (4) and (5) in explaining the optimal demand and supply functions of houses as determined by the variables that influence demand and supply of houses.
CHAPTER FOUR

DATA ANALYSIS AND DISCUSSION OF FINDINGS

4.1 Introduction

This chapter presents stationarity results of all the variables, cointegration results of the demand and supply models, and the regression results of the pricing, demand and supply models. The chapter also presents diagnostic tests done on the models and a discussion of the regression results.

4.2: Stationarity Results

This study intended to determine the optimal pricing, demand and supply functions. The study used times series data and since most time series data are known to be non-stationary, the study used Augmented Dickey Fuller (ADF) to determine whether the variables were stationary at levels or if the data needed to be differenced and the results are presented in Table 4.2.
Table 4.1: Stationarity Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>ADF unit root test at level</th>
<th>ADF unit root test at first Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>t-statistic</td>
<td>Critical Value</td>
</tr>
<tr>
<td>Qd</td>
<td>-6.386901</td>
<td>-2.948404</td>
</tr>
<tr>
<td>Qs</td>
<td>0.015593</td>
<td>-20933158</td>
</tr>
<tr>
<td>Price</td>
<td>-2.533259</td>
<td>-2.931404</td>
</tr>
<tr>
<td>Number of bedrooms</td>
<td>-3.056107</td>
<td>-2.931404</td>
</tr>
<tr>
<td>Income</td>
<td>-2.018111</td>
<td>-2.933158</td>
</tr>
<tr>
<td>Real interest rate</td>
<td>-1.968494</td>
<td>-2.948404</td>
</tr>
<tr>
<td>Cost of construction</td>
<td>-1.941281</td>
<td>-2.931404</td>
</tr>
<tr>
<td>Inflation</td>
<td>-2.589435</td>
<td>-2.933158</td>
</tr>
</tbody>
</table>

The tests showed that the time series for all the variables were non stationary at levels using 5 percent significance level apart from the quantity demanded. The first difference did not exhibit unit root which means data was stationary at first difference.

4.3: Cointegration Results

The data was further tested for cointegration which proved a long run relationship among the variables. Cointegration results are presented in sections 4.3.1 and 4.3.2.
4.3.1: Demand model Cointegration test results

Included observations: 42 after adjustments
Trend assumption: Linear deterministic trend
Series: QD GENR_P INCOMEY NOB RIR
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

<table>
<thead>
<tr>
<th>Hypothesized</th>
<th>Trace</th>
<th>0.05</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of CE(s)</td>
<td>Eigen value</td>
<td>Statistic</td>
</tr>
<tr>
<td>None</td>
<td>0.658239</td>
<td>79.56116</td>
</tr>
<tr>
<td>At most 1</td>
<td>0.416682</td>
<td>34.46809</td>
</tr>
<tr>
<td>At most 2</td>
<td>0.153523</td>
<td>11.82914</td>
</tr>
<tr>
<td>At most 3</td>
<td>0.089232</td>
<td>4.828909</td>
</tr>
<tr>
<td>At most 4</td>
<td>0.021277</td>
<td>0.903284</td>
</tr>
</tbody>
</table>

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

The results presented in Table 4.3.1 shows that there is a long run relationship between quantity demanded and the variables that determine quantity demanded as included in the model since the trace statistic is greater than the critical value, the Null Hypothesis $H_0 = r = 0$ and Alternative $H_1 = r \geq 1$ was rejected because Trace Stat $(79.56116) > (69.81889)$ and P-Value $= 0.68% < 5%$
4.3.2: Supply Model Cointegration test results

Included observations: 42 after adjustments

Trend assumption: Linear deterministic trend

Series: QS COST GENR_P INF

Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

<table>
<thead>
<tr>
<th>Hypothesized</th>
<th>Trace</th>
<th>0.05</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of CE(s)</td>
<td>Eigenvalue</td>
<td>Statistic</td>
</tr>
<tr>
<td>None *</td>
<td>0.434723</td>
<td>51.06056</td>
</tr>
<tr>
<td>At most 1</td>
<td>0.327395</td>
<td>27.10211</td>
</tr>
<tr>
<td>At most 2</td>
<td>0.142408</td>
<td>10.44501</td>
</tr>
<tr>
<td>At most 3 *</td>
<td>0.090686</td>
<td>3.992700</td>
</tr>
</tbody>
</table>

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

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

The results presented in Table 4.3.2 shows that there is a long run relationship between quantity supplied and the variables that determine supply as included in the model since the trace statistic is greater than the critical value, the Null Hypothesis $H_0 = r = 0$ and Alternative $H_1 = r \geq 1$ was rejected because Trace Stat $(51.06056) > (47.85613)$ and P-Value $= 2.42\% < 5\%$. 

39
4.4 Empirical Results

This study sought to determine the optimal pricing, demand and supply functions. Estimation for the demand and supply functions was achieved using a two stage least squares method. In the first stage the price model was estimated which generated price \( p^* \) used in the estimation of the demand and supply functions. The regression results for the reduced price function, demand and supply functions are presented in section 4.4.1, 4.4.2 and 4.4.3 respectively.

4.4.1 Optimal pricing for housing in urban Kenya

The first objective of the study was to determine an optimal pricing function for housing in urban Kenya. To achieve this objective, the housing price was regressed against income, interest rate, number of bedrooms and cost of construction. The regression results are presented in Table 4.2

Table 4.2 Regression results for the pricing model

|                      | Coef.    | Std. Err. | T      | P>|t|  | [95% Conf.Interval] |
|----------------------|----------|-----------|--------|------|----------------------|
| Income               | 1.45833  | 0.011417  | 127.73 | 0.000| 1.4359531.4807       |
| interest rate        | 0.000841 | 0.0000775 | 1.08   | 0.278| -0.0000678.000236    |
| No of bedrooms       | 0.0037522| 0.0008327 | 4.51   | 0.000| 0.0021202.0053842    |
| Cost of construction | 4.990278 | 0.0450958 | 110.66 | 0.000| 4.9018925.078664     |
| Constant             | -7.296645| 0.1201714 | -60.72 | 0.000| -7.532177 -7.061114  |

RMSE = 0.0039786, Chi² = 16929.24, R² = 0.9973, P = 0.0000
The pricing model was subjected to specification test before interpretation of the coefficients to confirm if the model was well specified and could be used for estimation of the demand and supply models. Ramsey RESET test was performed at 5 percent level of significance and indicated that the test-statistic for the pricing model was equal to 0.745239 with probability equal to 0.4606 which is greater than 0.05 meaning that the model was correctly specified. Therefore the variables in the model were used to generate price p* used in the demand and supply models.

The pricing model has an adjusted R-squared of 0.9973. This implies that 99.73 per cent of the variation in house prices are explained by the explanatory variables used in the model. The probability of not rejecting the null hypothesis that there is no statistically significant relationship between the dependent variable and independent variables is 0.0000 (prob<0.05). This implies that pricing model is statistically significant at 5 per cent level of significance.

The coefficient associated to income is 1.4583 which is statistically significant at 5 per cent. This means that income has a positive effect on the price of houses. The coefficient means that a percentage change in average income leads to 1.4583 percent change in the house prices. This also means that house prices are elastic to income changes. However, due to the fixity nature of the real estate, house supply may not rise rapidly as the income rises which cause excess demand for houses thus pushing up house prices. These results are similar to Chow and Niu, (2014) findings of a positive relationship between house prices and the level of income in a study of housing price in urban China as determined by demand and supply.
The cost of construction variable also has a positive coefficient equal to 4.9902 which is statistically significant at 5 per cent which means that a percentage change in the cost of construction would lead to a 4.9902 percent change in house prices. Since the coefficient is greater than 1, it means that house prices are elastic to changes in the cost of construction. This rise in the house prices is due to the increase in the cost of construction during the construction period. This could be explained by the fact that most developers or house builders use the conventional materials which are expensive thus pushing up the cost of construction and in turn raising the house value as well as the price. These results confirm similar results by Waronja 2014 and Chow et al., (2011) in a study predicting real estate prices in urban Kenya and a study of residential housing in urban China respectively who found a positive relationship between real estate prices and the cost of construction. The cost of construction could also be increased by the high regulations by the County Government, National Construction Authority, NEMA, and others.

The results also show a positive relationship between the house prices and the number of bedrooms which has a positive coefficient equal to 0.0037522 and it is statistically significant at 5 percent. This means that house prices are inelastic to changes in the number of bedrooms as the coefficient is less than 1. A percentage change in the number of bedrooms leads to a 0.0037522 percent change in the house prices. These results are similar to Waronja 2014, who also found a positive relationship between house prices and the number of bedrooms in predicting real estate prices in urban Kenya.

Interest rate has a positive coefficient equal to 0.0000841 which is insignificant at 5 percent. These results are contrary to expectations as we would expect if interest rates go
up people would not borrow much but instead they would save more which would mean reduction in house purchases and thus reduction in demand and thus house prices.

The estimated results in Table 4.2 shows that the price of urban residential houses can be explained by the variables included in the model (real income $y_i$, real interest rate, number of bedrooms and the cost of construction $c_i$). The coefficients of these variables have the expected signs from demand and supply theories and are statistically significant apart from the interest rate.

### 4.4.2 Optimal Demand and Supply of Housing in Urban Kenya

The second objective of the study was to determine optimal demand and supply functions of housing in urban Kenya. To achieve this objective, the demand and supply models were estimated where in the demand model, quantity demanded was regressed against housing price, number of bedrooms, interest rate and income as the quantity of houses supplied were regressed against the housing price, cost of construction and inflation. The results are presented in Table 4.3 and Table 4.4 respectively.
Table 4.3 Regression Results for the Demand Model

| Coef.       | Std. Err. | T     | P>|t| | [95% Conf.Interval] |
|-------------|-----------|-------|------|---------------------|
| Price       | .0004657  | .0232669 | 0.02 | 0.984               | -.0451366.0460681 |
| no. of      | .0124691  | .0031139 | 4.00 | 0.000               | .006366.0185722  |
| bedrooms    |           |        |      |                     |
| interest rate| .0005335  | .0003034 | 1.76 | 0.079               | -.0000612.0011282 |
| Income      | .3881967  | .0158784 | 24.45| 0.000               | .3570757.4193178 |
| Cons        | 2.231785  | .1447569 | 15.42| 0.000               | 1.9480672.515503 |
| RMSE        | 0.0099336 |        |      |                     |
| R²          | 0.974     |        |      |                     |

The demand model was first subjected to various diagnostic tests before interpretation of the coefficients. These tests included, test for heteroskedasticity, normality test and stability test.

This study used Breusch Pagan heteroskedasticity test at 5 per cent level of significance. The results of the test showed the test-statistic for the demand model was equal to 2.87 and the probability of the test-statistic which is equal 0.0903. This probability is greater than 0.05 leading to the acceptance of the null hypothesis of homoscedasticity against the alternative hypothesis of heteroskedasticity. That is to say that the errors of the demand model have a constant variance and hence, there is no problem of heteroskedasticity.

The model was also tested for normality and Jaque-Berra test was applied which showed that the test statistic for the demand model is equal to 1.860890 with a probability of 0.394378. This probability of test statistic is greater than 0.05 which led to acceptance of null hypothesis of normal distribution of the residuals. Thus the residuals of the demand model are normally distributed.
Finally, a stability test was done. The stability test indicates whether the parameters estimates are stable or not. In this study, the cumulative sum of the residuals test was applied and stability results are presented in Figure 4.1

**Figure 4.1: Demand model stability results**

The CUSUM test results indicated that the demand model was stable since the whole sum of recursive errors are within the two critical lines.

The estimated results in Table 4.3 have an adjusted R-squared of 0.974. This implies that 97.4 percent of the variations in housing demand are explained by the explanatory variables used in the model. The chi-statistic is 1646.68 and the probability of not rejecting the null hypothesis that there is no statistically significant relationship between the dependent variable and independent variables is 0.0000 (prob<0.05). This implies that demand model is statistically significant at 5 per cent level of significance.
From the model, income has a positive coefficient equal to 0.3881 which is statistically significant at 5 per cent. This sign is as expected as an increase in the level of income means an increase in the consumer purchasing power and thus an increase in house demand. This coefficient means that house demand is inelastic to income changes since this coefficient is less than one. The coefficient also means that a percentage change in the level of income leads to 0.3881 percent change in house demand. These results confirm to the law of demand which states a positive relationship between income and demand of a commodity.

The price variable also has a positive coefficient equal to 0.0004657 but it is statistically insignificant at 5 percent. These results differ with the law of demand which states a negative relationship between quantity demanded and the price of that commodity. This is not surprising in Kenyan real estate market. Also, considering that income is highly significant in this case, this means that consumers have sufficient income which can cater for a monthly loan or mortgage repayment and thus allowing them to qualify for loans and mortgages that enable them purchase the houses. Also, since the house supply is far lower than house demand and adding to capability in the purchasing power consumers tend to be insensitive to price changes. Also, if there are speculators in the market who expect house prices to keep on escalating, the case may worsen as they do not consider the current price levels as long as they hope to make huge returns from the sale of the houses in future at higher prices. These results concur to Shiller, (2007) theory of irrational exuberance which analyses speculative behaviour of the market participants who demand a good even at higher prices and Piazzesi and Schneinder, (2009) who
found that households are optimistic that the house prices will keep increasing and thus they buy houses today.

From the model, the number of bedrooms variable has a positive coefficient as expected and is equal to 0.0124 which is statistically significant at 5 percent. The positive coefficient means that a percentage change in the number of bedrooms will lead to a 0.0124 percent change in the housing demand.

Also the rate of interest variable has a positive coefficient equal to 0.00053 which is insignificant at 5 percent. The positive sign is contrary to the expectations because an increase in the level of real interest rates would mean that consumers will not be in a position to borrow more and hence reduction in the purchasing power and thus decline in house demand.

Table 4.4 Regression Results for the Supply Model

| Coef.     | Std. Err. | t     | P>|t|   | [95% Conf.Interval] |
|-----------|-----------|-------|-------|---------------------|
| Price     | 1.620509  | .146458 | 11.06 | 0.000               | 1.3334571.907562 |
| Cost of construction | -8.30059 | .3126753 | -26.55 | 0.000       | -8.913422-7.687758 |
| Inflation | .0008073  | .0025907 | 0.31  | 0.755       | -.0042703.005885  |
| Cons      | 3.303977  | 1.222083 | 2.70  | 0.007       | .90873825.699215   |

RMSE= 0.0737998  Chi²= 977.17
R²= 0.9564       P=0.0000

The supply model was subjected to Jarque-Berra test for normality, tested for heteroskedasticity and was also tested for stability.
A Jarque-Bera normality test results showed that the test statistic for the supply model is equal to 1.860890 with a probability of 0.394378. This probability of test statistic is greater than 0.05 which led to acceptance of null hypothesis of normal distribution of the residuals. Thus the residuals of the supply model are normally distributed. The normality distribution results will be presented in the appendix.

The supply model was also tested for heteroskedasticity and the null hypothesis could not be rejected since the probability of the test was equal to 0.7678 which is greater than 0.05, meaning that the errors of the supply model have a constant variance and therefore no presence of heteroskedasticity.

Finally, the stability test was done. The stability test indicates whether the parameters estimates are stable or not. In this study, the cumulative sum of the residuals test was applied and the results are shown in Figure 4.2
The CUSUM test results indicated that the supply model was stable since the whole sum of recursive errors are within the two critical lines.

The estimated results in Table 4.4 have an adjusted R-squared of 0.9564. This implies that 95.64 per cent of the variations in housing supply are explained by the housing prices, cost of construction and inflation. The chi-statistic is 977.17 and the probability of not rejecting the null hypothesis that there is no statistically significant relationship between the dependent variable and independent variables is 0.0000 (prob<0.05). This implies that supply model is statistically significant at 5 per cent level of significance.

From the supply model, cost of construction coefficient has a negative sign and is equal to -8.30059 which is statistically significant at 5 percent. This negative coefficient means...
that housing supply is negatively related to the cost of construction, this means that a percentage change in the cost of construction will lead to 8.30059 percent change in house supply. This also means that house supply is elastic to changes in the cost of construction as the coefficient is greater than one in absolute terms. These results are similar to Chow 2014, in predicting housing demand and supply in urban China and Chepsorir 2012, in identifying challenges that developers face in provision of low cost housing in Eldoret town.

The price variable on the other hand has positive coefficient equal to 1.6205 which is statistically significant at 5 per cent level of significance. This means that a percentage increase in house prices leads to a 1.6205 percent increase in the house supply and vice versa. The supply model can be said to be price elastic as the price coefficient is greater than one. This means that the increase in house prices is a motivation to the developers as they are attracted by the favourable house prices holding all other factors constant.

Comparing the cost coefficient and the price coefficient shows that builders are less sensitive to changes in cost of construction than they are to changes in house prices. These results are similar to Burcu, (2009) results in determining demand and supply of real estate market in Turkey.

Inflation on the other hand has a positive coefficient equal to 0.0008073 which is statistically insignificant at 5 percent. These results are similar to Chow and Niu 2014, in predicting housing demand and supply in urban China.
5.1 Introduction

This chapter comprises of the summary of the study and study findings, conclusions, policy implications arising from the findings and data analysis and areas of further studies.

5.2 Summary

This study sought to predict optimal pricing, demand and supply models in Nairobi using a two stage least squares simultaneous equations model. The demand and supply forces play an important role in predicting house prices as the house prices play an equivalent important role as an economic indicator. The house prices predictions were carried out using a simple regression analysis using key variables such as income, cost of construction, number of bedrooms and real interest rate.

Overall, 99.74 percent of the variations in the house prices over the thirteen year period were explained by the variables included in the model. The model showed that the coefficients of the included attributes were significant and of the expected signs. Explaining the variations in the house prices, the model found that, income, cost of construction, real interest rate and the number of bedrooms cause the variations. The real sales price of a house in Nairobi over the 2003 to 2013 period was positively impacted by income, number of bedrooms, real interest rate and the cost of construction.
The higher the income, the higher the house price under the presumption that increase in income increases both savings and investment part which leads to increased house demand thus pushing up prices. In addition, houses built with several bedrooms have higher prices. Real interest rate on the other hand affects the cost of financing and mortgage rate which in turn affects property level costs and thus influences values. An increase in the cost of building materials also increases the cost of construction which significantly increases the total cost of the house to completion thus pushing house developers to set higher prices for those houses.

This study also applied the standard theory of consumer demand to explain the demand for and supply of residential housing in Nairobi. The demand for housing is explained by average income, relative price, interest rate and number of bedrooms while the supply of housing is explained by relative price, the cost of construction and inflation.

In the demand model all the variables coefficients were significant with the expected signs apart from the price variable which was insignificant and had a positive sign contrary to expectations. Although the model shows that 97.38 percent of the variations in the housing demand were caused by the variables included in the model, the price variable had a positive coefficient which is insignificant as it means that it impacts house demand positively which is contrary to expectation. This means that an increase in house prices leads to an increase in house demand. This is not surprising in the Kenyan market as consumers have sufficient income that enables to purchase the houses. This could also mean that the houses are demanded for speculation. Since a house in this case is a basic good, the increase in house prices which translate to increased house demand can be
either due to the increase in the average income, which from the model impacts the housing demand positively as expected. The income variable is one that measures economic growth. A growth in income is associated with good economic periods over which consumer expenditure on housing also increases at ceteris paribus. The trend of the income variable has been one of upward and positive growth despite the many challenges the economy has been undergoing and this has positively contributed to demand for housing.

The supply model showed that 95.64 percent of the variations in housing supply were caused by changes in house prices, cost of construction and inflation. These variables were all significant and had the expected signs. Cost of construction impacts housing supply negatively, this is true because, an increase in the cost of cost of building materials and other construction expenses would limit the developers' capability to build more houses and thus reduction in housing supply. On the other hand a rise in the house prices leads to an increase in the housing supply as the prices are more attractive to developers and a more motivating factor.

5.3 Conclusions

The interaction of demand and supply helped explain the price of urban housing at the aggregate level in Nairobi. If the increase in the price of urban housing was mainly the result of increase in income and not of speculation we can conclude that there will be no any housing bubble in Kenya anytime soon as feared. There is no evidence of a bubble in housing price unless the rate of increase in housing price is proven to be due to speculation.
It is clear that despite the limitations, the simultaneous equation model holds a promise as a very useful tool in the study of housing attributes and their impact on house prices. This approach has not been utilized in Nairobi. Perhaps it is time for researchers and all other stakeholders on the housing industry to give the technique a serious attention and consideration in predicting housing prices, demand as well as the supply. Since the buyers and the sellers have perfect information on the property market, the simultaneous equation model is justifiable and feasible technique of predicting property prices and since the properties manifest a homogeneous characteristic, the implicit prices for attributes can be used to improve the planning, development and construction of houses in Nairobi.

The study has demonstrated that the simultaneous equations approach is useful for research studies on the housing market in Kenya because house prices have proliferated in the last decade, partly due to the high land costs and scarcity of developable land. The implicit price generated from the regression analysis will help give a more accurate portrayal of the price of houses traded in the market.

5.4 Policy Implications

The house prices are determined by the interaction of demand and supply forces as well as the fundamentals as it has been seen in the pricing model. To ensure an optimal house pricing, there needs to be housing supply equivalent to the housing demand. To ensure this, there needs to be sufficient availability of the building blocks for housing development which include land, capital and the market that will see an increase the level of housing supply. To begin with, land requires a significant amount of capital. At the
same time most developers would need to borrow at a cost which goes further to increasing the capital requirement. Secondly the market which includes buyers and house developers needs large sums of money for buyers to purchase the houses and large amounts of money for developers to put up a house. To purchase a house most buyers have to borrow to finance acquisition as the developers borrow to finance building. To ease this burden, the government should put in place partnerships between companies and financial institutions to finance low cost housing for employees or to finance low cost house developers to ensure provision of low cost and decent housing.

The cost of construction has been seen to be one of the major contributing factor to the rise in the housing prices and at the same time a constraining factor to housing supply. There is therefore government needs to encourage the use of readily available alternative building materials apart from the conventional ones while not compromising on quality that will see the cost of construction come down drastically. Households may not be aware about other innovative and cheaper alternative building materials, where and how to get them and at what cost. Awareness creation about the same should be enhanced through; advertisements, documentaries, social media and all other means available to disseminate the information. House developers also need to invent new and cheaper construction technologies.

Similarly Public Private Partnerships should be promoted to allow provision of affordable housing and increased supply. The government could supply land and the private investor deals with putting up the structures. At the planning stage in urban areas let counties adopt mixed land use where proximity to social facilities, place of work and means of
transport is considered. This will aid in reducing the escalating land prices. Additionally, the county governments which are still in the early stages of development should consider proper land use planning from the onset, to dedicate and preserve public land for housing development.

The government should also encourage formation of land banks which in conjunction with the land use planning will help the public sector with instruments to influence the housing market positively for low cost housing and ensure favourable interest rates that will create a new source of financing to house buyers.

5.5 Areas for Further Studies

The housing market is broad and diverse. The area entails different sectors which range from the low income, middle income to high income market sectors which entail both residential and rental housing needs. This study generalized and covered the whole market to get an optimal price for the whole market as one. However these market sectors may need to addressed differently to address the different market demand and supply need and maybe the specific prices for each market sector.

The rental needs of the market also needs to be addressed as an area of interest as not all the urban centre residents may afford to purchase a house and the house needs are not only for own housing but also the tenants have different needs that need to be addressed and put into perspective.
REFERENCES


Gregory C. and Lilin Niu.(2014).“Housing Price in Urban China as Determined by Demand and Supply” Princeton University, China.


Kagochi, J., & Kiambigi, M. (2012). Remittances' Influence on Housing Construction


Matindi N. (2009). Affordable Housing for low & middle income earners in Nairobi-Kenya


Wu, B., & Xie, J. House Prices and Household Saving Rate: Evidence from China. *SSRN Journal*.

