# Factors Influencing Housing Supply in Nairobi County

**By**

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**October, 2016**

## DECLARATION

I hereby declare that this is my original work and that to the best of my knowledge has never been presented in any other university or institution for the award of any degree.

**Candidate:**

Signed…… Date……

Mr. Billy Isadia Akelola

Reg Number; X50/66085/2013.

**Approval;**

This Research project has been forwarded for examination with my approval as University supervisor.

Signed……. Date……

Dr. Kennedy Osoro.

## DEDICATION

My dedication goes to my entire family, especially my mum, Mrs. Abigael Nyabera and my brothers, Allan and Duncan for their firm support by encouraging and constantly reminding me to keep working hard all through the period of my studies. Their inspirations and positive advice ensured that I accomplished this task. I appreciate them dearly.

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## ABBREVIATIONS

| | |
|---|---|
| **AfDB** | African Development Bank |
| **CAHA** | Center for Affordable Housing Finance in Africa |
| **USD** | US Dollars |
| **GoK** | Government of Kenya |
| **UN** | United Nations |
| **UNDP** | United Nations Development Program |
| **GDP** | Gross Domestic Product |
| **1st HoP** | First House Ownership Plan |
| **NHC** | National Housing Corporation |
| **OECD** | Organization for Economic Co-operation and Development |
| **OLS** | Ordinary Least Square |
| **LL** | Lag Length |
| **LR** | Likelihood Ratio |
| **FPE** | Final Prediction Error |
| **AIC** | Akaike Information Criterion |
| **HQIC** | Hannan-Quinn Information Criterion |
| **SBIC** | Schwarz Bayesian Criterion |

## ABSTRACT

In this study, we adopted the "Stock-flow'' model, previously used by Elizabeth Steiner on the Swiss housing market, which is a multivariate linear regression model that uses the OLS method to establish the possible relationships that exist between housing supply and the various independent variables. Using data for a period between 1984 and 2014, significant pre and post-estimation regression tests were done to try and establish the joint relationship between population in Nairobi County, mortgage cost, income per capita, per unit construction cost and the unit price of land as independent variables and the dependent variable which is housing supply in Nairobi County. The results showed that construction costs and mortgage interest rates were negatively correlated to the housing supply, while price of land was found to be positively correlated with the levels of housing supply in Nairobi County.

# CHAPTER ONE: INTRODUCTION

## 1.1 Background to the Study

Housing supply shortage is a universally recognized problem. In Kenya, the objective of providing decent housing was included in the first National Development Plan of 1964 to 1970, all through to the ninth National Development Plan of 2002 to 2008. The Kenyan constitution was amended with a number of clauses in order to legally entrench housing among other rights to be enjoyed by persons, clearly making it the responsibility of governments to provide proper housing facilities that enhance better living conditions.

Going by the UN-HABITAT, (2000) report, steps have been covered which elaborate in detail the right to adequate housing. In Kenya, the constitution expressly identifies housing as one of the economic and social rights that everyone is entitled to. All persons, according to the Kenyan constitution have the right to adequate housing of acceptable sanitation standards, (The constitution of Kenya, Chapter 4, Part 2, and Article 43).

The welfare of human beings is a factor that is determined by the state in which they are being housed. All sets of generations, both present and future have their lifestyles determined by the location of their homes, the architecture of the houses and how such designs will fit into the environments in which they live in and the cultures that they practice. These are considerations which influence their social and economic wellbeing. Therefore, housing is so critical to sustainable development, (UN-HABITAT, 2012).

The cost of housing is too high. This includes renting or the financial outlay towards construction of structures for ownership, which take up the largest percentage of a households' budget. The economic value of a house and speed at which the value deteriorates accounts for the largest percentage of investments for individuals (World Bank, 2011). It is also expected that when the budget on housing is relaxed, households become more able to comfortably meet the costs of accessing other basic necessities of life such as good education, health and food. (Wadrip et al. 2011). Consequently this enhances economic development, as households are able to engage in other meaningful economic activities such as employment and entrepreneurship.

Despite housing being an essential human need, its provision is constrained by the cost involved and personal budget limitations. This situation is aggravated by the rapid urban population growth world over, predominantly in the developing countries. Urbanization brings with it industrialization and hence employment opportunities. The general population growth in urban centers is rapid. This is contributed to by the migration of persons in huge streams towards urban centers in search for employment.

Africa is experiencing rapid urbanization, a factor that is really affecting lifestyle in many city centers, and indeed the whole economic aspects of African countries, (Tibaijuka, 2005). As large cities grow in Africa, so are socio-economic problems such as infrastructural and services insufficiencies, inadequate housing, overcrowding and insecurity. Empirical studies have highlighted that the raise in number of city dwellers has brought about a difficulty in finding proper housing, utilities, supplies, health and education services in countries like Burkina Faso, Tanzania, Kenya, Ethiopia just to mention a few. This has in effect led to the sprouting of

settlements such as slums and backyard shacks, (UNDP, 1996). The global estimate of slum-dwellers population has hit the one billion mark, (UN-HABITAT, 2003).

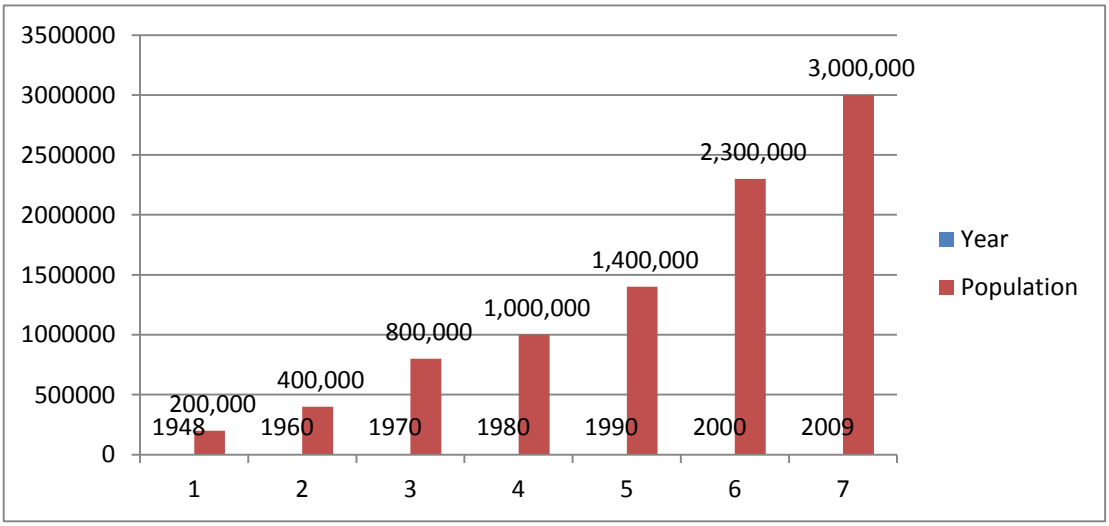
Empirical evidence indicate that the growth in Kenya's GDP since independence has brought about an increase in population in the urban centers in search of employment, but with the same is an increase in housing shortage. Indeed there has been a stiff growth of the mid-level and low income earning majority who cannot access affordable housing. Going by the African Development Bank research, Africa's middle class stood at 34.3% as of 2010, growing from 26.2% in 1980 (AfDB, 2011). This class accounts for 44.9% of the Kenyan population. To these changes, housing has not remained idle. The global picture of Africa depicts that as the middle class number rises, cities follow suite, harboring a ratio of 1:4 African. Cities in Africa continue to home over 40,000 people daily (UN-Habitat, 2011).

### 1.1.1 Housing Situation in Kenya

Housing plays an important role on the lives of Kenyans and the economic performance of the country as a whole. There are several historical and structural factors that highlight a situation in housing, most notably in the urban centers. Kenya has, and continues to experience an ever growing population in the city centers caused by the rural-urban migration of persons in large numbers in search of employment opportunities. From figure. 1.1, we can see a rapid growth of population in Nairobi from a low of only 0.2 million in 1948 to a sky high of 3 million in 2009. By the year 2012, the annual growth in Kenya's population was approximated at 4.2%. As a result, the annual increase in need for houses in the Country was 206,000 units. The urban centers contributed 82,000 units to this requirement. The relevant ministry for housing had in

2011 estimated the level of housing supply to be at 50,000 units implying that there was an enhanced shortfall of 156,000 units. By then, there was already an accumulated shortfall of two million units in backlog. According to CAFA (2011) and CAHF (2012), there was an additional shortfall of 85,000 units to the supply of houses. This deficit means that a huge population did not have access to adequate housing at the ruling prices, hence turned to informal housing accommodation. It was approximated that one million of Nairobi's population lived in slums, whereby only 3% lived in permanently walled houses with piped water and electricity (World Bank, 2011).

**Figure 1.1: Urban Population Trend, Nairobi**




*Source: Kenya Population Census, various years*

The cost of construction has had a sharp rising trend over the years. The cost of cement and iron sheets or tiles for instance has been steadily increasing. This translates to high building costs. The materials used to construct rental units are mainly cement and there has been no research on

cheaper ways for construction. House owners can only recoup these costs by charging exorbitant rents. House prices in Nairobi are considered to be unaffordable, at least according to the Centre for Affordable Housing Finance in Africa (2012) report. In 2012, what was considered a cheap house in Kenya costed USD 22,350. This prices can be considered as too high, compared to other middle earning Sub-Saharan African Countries.

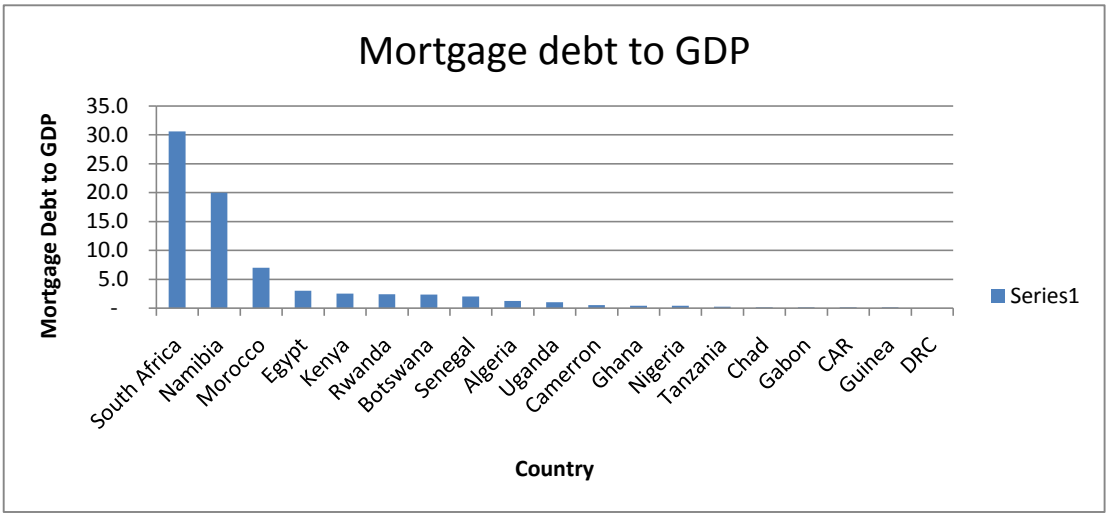
On the other hand, the governments' budgetary allocation towards housing has been shrinking over time. This has led to change in policies which have affected the provision of social housing. The houses that were initially constructed by the government and intended for civil servants became an unmanageable pursuit. The government decided to change its policies, ultimately privatizing the entity and selling off the houses to individuals. The maintenance costs of these houses were massive, resulting into them being neglected. The houses ended up in deplorable conditions. In consequence, this has led to a situation where there is dead stock of houses within the city (State Department of Housing, 2014).

The mortgage structure and regulations in Kenya is such that the high interest on mortgage tend to favor the very high income earners who have ready collateral for the mortgages. This means then that minor players can only manage to secure low mortgage amounts which allow them to construct very few residential units. Due to the lucrative nature of rental business in Nairobi, where the rental houses are built is also a factor for consideration before one decides to undertake construction projects. The target areas are those that attract high rental incomes and so the supply side of housing continues to discriminate against the low end populace in terms of income. Contrary to government initiatives, a look at the supply statistics as of 2008, indications

are that supply of housing is biased towards the high income group which enjoys a 60 per cent supply surplus. On the other hand, the upper middle, lower middle and lower income groups suffer 15 percent, 92 percent and 98 percent deficits respectively, (GoK, 2007).

In **figure 1.2**, a comparative overview of mortgage markets of selected countries in Africa is given, Kenya included. The mortgage debt to GDP ratios is indicative of mortgage accessibility levels. A high ratio shows that mortgage is easily accessible than a low one. In this graph, Kenya is shown to have a low ratio compared to Namibia, South Africa, Morocco and Egypt, hence low mortgage accessibility.

**Figure 1.2: Mortgage debt to GDP**




*Source: PovCalNet database, World Bank; OPIC (2006)*

Access to land in Kenya is a rigid process. This is due to the long duration of time taken to complete land transactions. Most of the land that have expired leases in Kenya are required to revert to the government to be public property. Despite the land policy recommendations in the

National Land Policy, the inadequacy of public land for housing construction is still a persistent issue in the Country (Republic of Kenya, 2009). Numerous land management issues have ruined housing construction efforts. The procedures of land registration, for instance, have continued to be bureaucratic and centralized resulting in a whole expensive affair, inequality in land ownership, landlessness or ownership of uneconomical pieces of land for investment (Republic of Kenya, 2013).

Similarly, the tax arrangement on rental investments in Kenya is not favorable, compared to that given to owner occupied houses. The Kenyan market has some schemes by Housing Finance called the 1stHop10 which targets first time home owners. This product allows savings up to even 10 years and is an open scheme without restrictions as long as the contributor has not owned a property before. A monthly subscription of up to Ksh. 4,000 and Ksh. 1,000 at minimum towards the scheme attracts zero tax. The maximum savings that can be accumulated with interests earned on them being tax exempted is Ksh. 3 million. Such plans are also provided by other mortgage institutions. The schemes have very minimal limitations as on how they can function, but the key point is that interest earned on the savings is tax free and the amount saved is tax deductible. Any withdrawals from the scheme are specifically to be used for housing purchase or construction within a period of 12 months (World Bank, 2011).

Thus, as a result, the price of houses in Nairobi have been increasing over the years and this has made it impossible to acquire rental houses and even if they are bought, the owners want to recoup their investment outlays by charging the tenants extremely high rents. This rents make accessibility of housing a problem, which in turn leads to the middle income earners occupying

the houses meant for the low-income earners. It is because of this that many houses in the high-end residential areas are left unoccupied. In turn, landlords charge discretionary rents, making access to proper housing increasing difficulty (Vuluka & Gachanja, (2014).

## 1.2 Statement of the Problem

The Kenyan mortgage market has experienced a steady growth in periods between 1965 to-date. This is in comparison to other third world countries; Namibia, Zambia, Morocco, Egypt and South Africa included and this can be regarded as near maturity, going by the Sub-Saharan Africa standards. Based on this, an impression can be created that cases of unaffordable houses are substantially being done away with. But there is a serious housing problem, and to the contrary, slums in the urban centers in Kenya continue to grow, an indication that no solution to the problem has been so far effective. In 2012, there was an annual need of 206,000 housing units in Kenya, but only 50,000 units were actually delivered to the market. The result was a huge shortage of 156,000 units, (CAHA, 2012). There is also very limited research focusing of housing supply issues in Nairobi County, and more specifically on the cheaper ways of construction, hence making it difficult to develop effective policy solutions to this problem. This study then seeks to establish the causes of housing supply shortage in Nairobi County despite the impressive performance of the Kenya's mortgage market.

## 1.3 Research Questions

1. What is the housing supply trend in Nairobi County?
2. What factors influence the supply of housing in Nairobi County?
3. What relevant policy implications can be drawn from the study?

## 1.4 Objectives of Study

### 1.4.1 General Objective

The general objective of the study is to establish causes of shortage in the supply of housing in Nairobi County.

### 1.4.2 Specific Objectives

The specific objectives of the study is three-fold; namely

i). To establish the trend of housing supply in Nairobi County.

ii). To determine the factors influencing housing supply in Nairobi County.

iii). To draw policy implications based on the study findings.

## 1.5 Significance of the Study

While there are a number of studies on the demand side of housing supply in Nairobi, this study seeks to cover the gap left by the scanty studies done to establish the causes of housing supply shortages in Nairobi County. With the promulgation of the new constitution, there is an immediate need for localized solutions to existing problems, including housing. Policy recommendations are needed to guide the implementers at the County levels. Solutions that were thought to be workable from the previous policy recommendations seem to have come short of providing effective solutions. Policy recommendations successfully applied in other countries to deal with this very problem have barely been tested in Kenya, hence this study seeks and propose modalities of usage of external solution on the housing supply problem locally.

The study focused on the County's supply side of housing, and the recommendations that shall follow will be directed to both the central government and the County government of Nairobi.

While the levels of governance have changed, key indications are that studies on housing and policy recommendations therefrom need to also change, so as to be effective.

This study also sought to inform the mortgage institutions on the policy recommendations with regards to mortgage seekers needs. We also strived to establish why, despite the existence of the government institutions like the NHC, the efforts to reduce housing shortage within Nairobi County are not effective.

## CHAPTER TWO: LITERATURE REVIEW

### 2.1 Introduction

This chapter is structured into three sections; the first revisits the various economic theories of demand and supply, and how they explain the behavior in the housing market. The second gives brief review of other related studies on housing supply conducted by earlier researchers and the outcomes thereof. The last part provides the general overview of the reviewed literature.

### 2.2 Theoretical Literature Review

This section looks at theoretical literature such as the elasticity of supply, Demand and Supply, price equilibrium in the market, Government control among others.

#### 2.2.1 The Price Elasticity of Supply

The price elasticity of supply examines how quantity supplied responds to price changes. It is expected that when a price of a commodity increases, the supply side of the same react to this changes by increasing its quantities, every other factor affecting supply being held constant. Thus the Percentage Method formula for Price elasticity of supply is:

$$Es = \frac{\text{Percentage Change in Quantity Supplied}}{\text{Percentage Change in Price}}$$

It can also be written as:

$$Es = \frac{\Delta Q/Q}{\Delta P/P}$$

$$Es = \frac{\Delta Q \times P}{\Delta P \times Q}$$

Where;

Es is the price elasticity of supply,

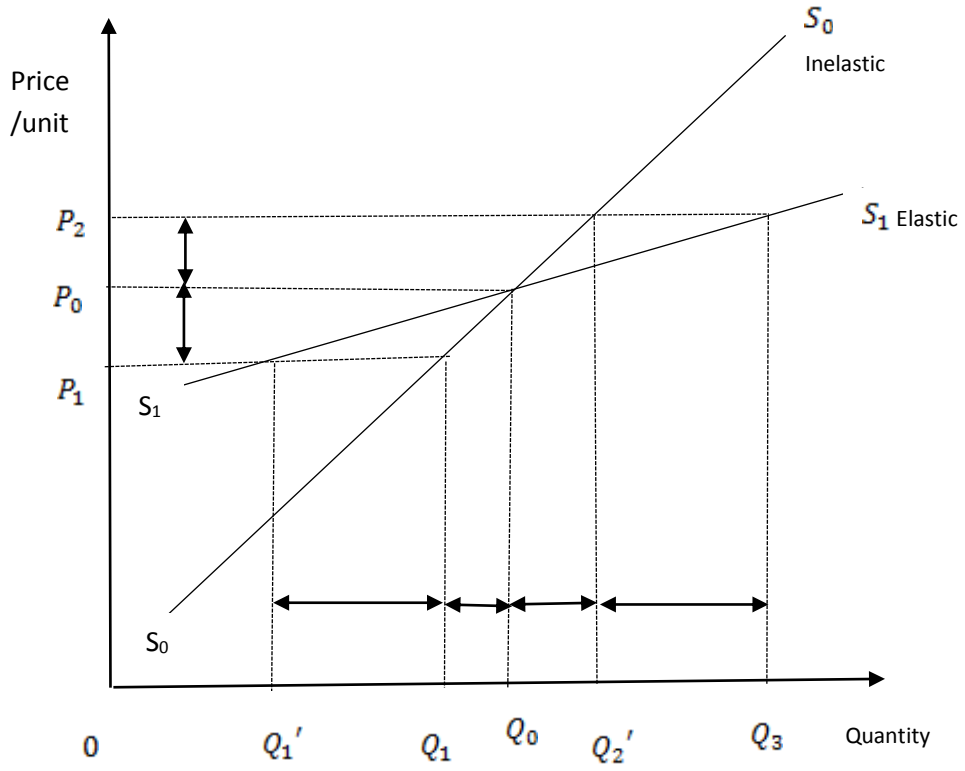
Q, the quantity of a commodity in supply,

P, the price of a commodity in supply,

ΔQ, is the percentage change in quantity of a commodity supplied, and

ΔP represents the change in the price of the commodity in supply.

**Figure 2.1: Price Elasticity of Supply**




**From figure 2.1** the vertical axis from origin O represents the prices of commodities, while the horizontal axis represents the quantities supplied in the market at given prices. The market is assumed to be competitive and the producers in this case react very quickly to any slight changes in prices of commodities by supplying more commodities when prices increase and conversely

reduce these quantities when prices reduce by any single unit. Line S0-S0 represents an inelastic supply curve, which is much steeper. At initial price P0, the quantity supplied is Q0. When the price of the commodity supplied increases from P0 to P2, the producers react by increasing supply from the initial Q0 to Q2. In order to establish the responsiveness of changes in quantities supplied to the equal change in the price P0-P2, which is price elasticity in this case, we divide the change in quantities supplied with the change in price. Equally, this response can be demonstrated in the same manner when prices for the commodity reduces. On the other hand, line S1-S1 represents an elastic supply curve, which is flatter than when the response is inelastic. Likewise, at the initial price P0, the quantity supplied is Q0, just like in the case where supply reaction to price changes is inelastic. When the price for a unit quantity of the same commodity changes from P0 to P2, for an elastic supply function, the producers react by increasing the quantities they supply much more than when the supply is inelastic. The supply in this case increases from Q0-Q3, which is much more than Q0-Q2 when supply was inelastic. The elasticity of supply to price changes when supply is elastic similarly computed by dividing the change in quantity supplied from Q0-Q3 to equal change in price from P0-P2.

Housing is a commodity supplied in the market just like any other, therefore its supply is expected to react to changes in prices in a manner similar to other supplies. One of the aims of this study is to establish why despite the favorable changes in house prices, there is still a persistent housing problem in the urban centers of developing countries, meaning that housing supply behaves in an inelastic manner.

### 2.2.2 Price Equilibrium of Demand and Supply

A state of market equilibrium occurs when the quantity of product demanded equals the quantity supplied at the prevailing market conditions. At market equilibrium, according to typical price theory, prices are exclusively determined competitively by the forces of demand and supply, hence there is no need to deviate from the prevailing prices. Whatever quantity of a commodity is supplied in a market is what the buyer and seller have agreed upon, under the prevailing market conditions. The law of supply postulates that supply of commodities is high according to how high its' price is, every other factor determining supply being held constant, hence a direct relationship between price and supply.

**Figure 2.2: Price at Equilibrium Demand and Supply**

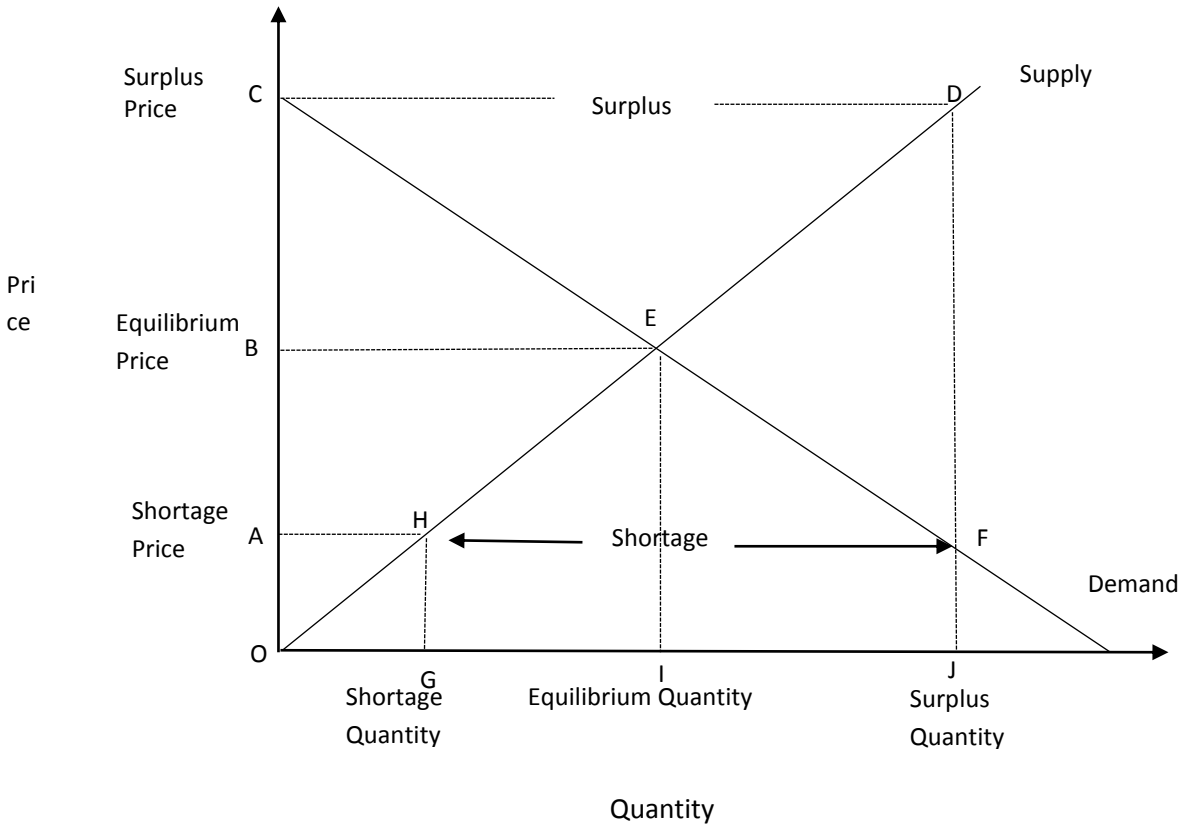


Figure. 2.2 represents the equilibrium price and quantity determination in a competitive market through the interaction between the demand and supply of a commodity in the market. Line OJ represents the quantities supplied while line OC shows the various prices prevailing in the market. Line CEF represents the demand curve, which shows a reduction in demand with a unit increase in prices while line OED represents the supply curve where we see an increase in quantities supplied with a unit increase in the prices of a commodity. In perfectly competitive market situation where there is a willing-buyer and willing-seller situation, the market is said to have obtained equilibrium at the point of interaction between demand and supply represented by the intersection at point E. The quantities supplied and demanded at this point is on a willing-buyer willing-seller basis, hence the prices charged and the quantities exchanged are said to be equilibrium ones.

### 2.2.3 Government Control

A market is seen to have achieved Pareto Optimality when at minimum certain conditions are satisfied including existence of purely private goods, non-existence of external forces influencing the market, market agents being price takers and have access to complete market information. In addition, production and consumption are assumed to experience diminishing returns. The effect of deviation from the conditions that result in Pareto Optimality can be individually observed when the assumptions are relaxed one after the other. The overall effect of the deviations is called market failure. The state can only be able to adjust the sub-optimal market allocation of resources that results from the violations of the assumptions by way of direct intervention, William, et al, (2012). This is because it is extremely difficult to implement corrective measures to resolve the violations of the conditions that ensure Consumer Equilibrium, hence Pareto

Optimality. The housing market can behave in a manner consistent with the developing urban centers, such that supply is constrained and the population left un-attended becomes so huge that they end up living in the rapidly growing low-cost slums houses. The government in such instances is forced to intervene to try and correct these market failures by subsidizing the rents and at times supply low cost houses to the poor slum dwellers.

### 2.2.4 Interest Rate Theory

Interest rate is the cost of borrowing funds for investment purposes or any other use. Regarding investment, the cost of an investment is that of capital borrowed to finance a specific project. The amount of loan one is willing to take out from a financing institution is largely dependent on the interest rates charged. The more costly the loans get, the more the effort borrowers will put in to avoid signing up for them. According to Keynesian theory, lenders are more willing to forego their savings when the riskiness of doing so is low, meaning higher interest rates are more secure for them hence enhancing their willingness to lend out funds, but borrowers would also only be willing to go for more credit when interest rates are lower. This creates unwillingness on the part of investors to undertake certain projects, or they would take the loans in bits which are insufficient, hence delaying the completion of the projects. The rate of Treasury bill is one of the factors that explain the shifts in supply volume of houses in the market, Vuluka and Gachanja, (2014).

### 2.2.5 The Urban Spatial Theory

According to Christaller (1994), population growth trends in an area, more often, and in a direct manner determine how and where constructions of new houses are done. It also states that stock

of housing units determine the prices of land, contrary to the notion that building construction activity determines the prices of houses. An increase in the prices of building will therefore initially realize big returns, causing the supply of houses to gradually increases beyond some defined levels. As stocks of units pile up, the prices of land simultaneously raises which eventually swallows up the extra returns (Dipasquale, 1994). In effect, the levels of new construction shifts downwards and normalizes.

### 2.2.6 Ricardian Rent Theory

The theory works on the assumption that housing construction can only be done on land that is available, and that land availability is fixed, because it's a fixed resource. It also states that land has a derived demand, since the supply of land is fixed. Its demand in this case results from the demand for housing. From the derived demand for land, it can be concluded that the price of land is determined by the interaction between forces of housing demand and supply that bring about an equilibrium price of land. From the theory still, it can be said that the high prices of houses push the prices of land high too, the converse being equally true. On the other hand, the neoclassical theory states that land is a factor of production which is used as an input and not an output for distribution. The neoclassical theory therefore observes that land can be put into a number of uses, and that a rational producer would only choose to put it into the most productive use (Meen, 2001). This in essence means that builders will construct housing units whenever they feel it is profitable to do so, otherwise, they opt for other investments that fetch higher returns.

### 2.2.7 Identity-Based Political Economy Model

According to Dafe (2009), when doing economic planning in the urban areas, factors critical for consideration include land, housing and other basic services. Ideally though, in the allocation of these resources, the decisions essentially become political. This is so because politicians are in the very decision making platforms and will always act in a manner that will favor their re-election to office. They use this offices to distribute public resources in ways that everybody's livelihood is improved or do it selectively, targeting interest areas, individuals or groups. This resources; land, and housing are so expansive in character such that when allocated once can benefit a large group of beneficiaries in a chosen area. They again are so visible such that when a political actor does an allocation, it can easily be attributed to him, hence improving his chances of being re-elected. Lastly, by the very nature of limitedness in their supply, individuals can easily create opportunities for exploiting rents. Rents on this resources are possible because of the existence of minimal marginal costs.

## 2.3 Empirical Literature Review

Wondimu et al. (2011), conducted a study into the policies put in place to relax the demand for housing in Addis Ababa, a city faced with numerous constraints as a result of the rapid urbanization. The results associated with the urbanization, for instance included shortage in housing and a rampant growth of the informal sector. The conclusion of the study was that policies put in place to ease the housing problem influence the supply of housing to the low-income earners in the long run. A similar study with similar findings was conducted by Andrews, Sánchez and Johansson (2011) on housing markets and structural policies in OECD countries.

Ajanlekoko et al. (2001) analyzed the financial and infrastructural implications on sustainable housing development in Nigeria. The study established that availability of infrastructure had a direct impact on the level of housing supply. One major aspect of urban problem with respect to housing, from the study, therefore was found to be the poor state of the infrastructure.

Lind, et al. (2003), using data of between 1995 and 2001 studied how rent regulations affected new constructions in Sweden. The findings were that tenancy regulations determine the production levels of rental units. On the other hand, Steiner, et al. (2010), in conducting a study of the Swiss housing market sought to analyze the causes of disequilibrium in housing market, prices of houses and rental unit investments within a stock-flow framework. The paper conducted an econometric analysis on various determinants of housing stock, rental units' investment and prices of houses in Switzerland. The finding of the study showed that housing prices are important in explaining the evolution of residential investment, hence stock.

Similarly, Tsenkova et al. (2008), conducted a study into the guidelines for the provision of low cost housing in Europe, North America and Central Asia. The analysis was done based on available information including reports by the government, UN-HABITAT Global Reports on Human Settlements and State of the World cities reports. This study established that the irreversible urbanization processes and the ever increasing poverty levels in some cities had affected the affordability and availability of housing. This also caused massive shortages of land for construction of affordable housing units. The conclusion was that policies put in place affect the supply of houses, hence in line with conclusions in other similar studies.

Subsequently, Hernández and Owyang (2012), conducted a study to confirm whether legal regulations on affordable housing played a role in the boom of subprime securities in the period between 2004 and 2006 using a regression discontinuity approach on some institutional evidence. Evidence analyzed showed that the affordable housing legislations and objectives influenced the mortgage market, hence the level of investment in housing.

Kuttner et al. (2012), in trying to confirm findings of other studies on the relationship between interest rates and house prices, reviewed a number of studies, discovering new evidence relating to the question. The study argued that the effect interest rates has on house prices appears to be modest. An analysis of data with 'User-cost-model' brought out the conclusion that there is minimal impact of interest rates on housing prices. The study's estimates were broadly consistent with results from other methodologies, including simple OLS regressions and error-correction models.

Mashoko et al. (2012), conducted a study on how low-income urban housing delivery schemes contributed to the housing problem in the city of Mutare, Zimbabwe. The paper observed that the housing waiting list had continued to grow by the year and the land for housing development shrunk yearly as well. The study concluded that housing supply has a causality effect with the level of income for the majority of the populations targeted.

Quigley et al. (2002), studied transaction costs and housing markets seeking to establish the significance of transaction costs in the market. The study was done using a simple transaction costs model. The conclusion was that presumably households take transaction costs into account

in choosing between home ownership and rental status. This finding were in line with other studies conducted before; hypothesizing that transaction costs is key determinants in the housing investments decisions.

A study on the changing forces in the markets of houses in African in 2013 by the African Development Bank sought to identify the main hindrances to the prosperity of the market. The results were intended to help to establish modalities of private sector engagement in the delivery of affordable houses. The focus of the study was building technologies, the disequilibrium between demand and supply, building related costs, mortgage accessibility, availability of land for construction, the financial and technical capacity of the developers and the necessary infrastructure needed to facilitate housing development. All the analyzed factors influence the supply of housing in the market, as per the findings of the study. These findings are similar to those in a study conducted by Vuluka & Gachanja, (2014) on the supply side aspects of residential housing for low income earners in Kenya.

A World Bank study in 2011 focusing on how to develop the Kenyas' mortgage market in order to expand the supply of affordable housing did an analysis based on survey of all the 45 banks in Kenya, then. It pointed to a constraint to the further growth in the mortgage market, basically establishing a weakness in the mortgage market which caused inaccessibility to sufficient finances from the mortgage lending institutions for the delivery of houses. The conclusions thereof were similar to those arrived at in the study into theoretical and empirical evidence on how mortgage market innovations would affect the OECD housing market particularly housing investment by Hung, et al. (2009).

An analysis in the Economic Policy Reforms, (2011) report on OECD countries sought to find out how policies on housing could be shaped such that the supply of adequate housing to citizens could be realized. This report noted that by this, improvements in the livelihoods of individuals and stability would be realized in the economies. The findings noted that strict rental regulations are associated with lower quantity and quality of housing, and their benefits to tenants are not certain. The analysis also established that liberalization of financial markets significantly lowers housing costs and widens borrowing opportunities. The overall effect of this being a substantial expansion in the accessibility to mortgage loans.

Barke et al. (2004) undertook a review of the supply of housing in Britain with an object to provide policy recommendations on how to secure a future in the housing needs. The review identified land as a factor that affects housing supply. High house prices were also identified as another factor that lowers demand, inevitably pricing out individuals in the market. When housing supply and costs was analyzed, an objection to the construction of new houses was raised because there was a shortage of market for affordable housing. The influence various policies had on housing were considered in the review, analyzing their impact on housing supply, with the number of taxes noted to have an influence on decisions in housing and land markets.

### 2.4 Overview of the Literature Review

Most of the literature reviewed indicated that the performance of the mortgage market, population numbers, rental regulations, housing policies and prices are the major determinants of housing investment levels. This study appreciated that there were other possible factors that also determine the supply of housing and therefore, in addition to the above mentioned, income levels

of residents, land cost, interest rates and building costs were considered in trying to close the gap that was left by the previous researches.

Previous studies were mostly country or region specific, and so, the policy recommendations posited by them are not immediately applicable in differing situations. It is also notable that most of those studies dwelt on the demand side of housing; a few studies on the supply applied the transaction, utility cost or regression discontinuity approaches. Based on the above, only, a limited number of variables could be included in the models, hence limiting the number of variables of study to a single one at a time. As a result, incomprehensive policy recommendations were drawn. This study was a little different in that it adopted the 'stock-flow' model, which allowed a number of variables to be measured at the simultaneously.

Most of the earlier studies did not carry out certain pre-estimation tests to check for unit root hence leading to spurious regression results. This study took care of this, just in order to do away with spurious regression results. Given the developments that have taken place in the market and also noting that most of the studies were done at least a decade and a half ago, this study aimed to take care of the new developments and offer the most workable policy recommendations that would be appropriately applied in dealing with the housing problem in Nairobi County.

Additionally, there are very few studies on housing in Nairobi County. The few that were conducted focused on construction cost, mortgage interest rates and on how to improve the mortgage market. This study also sought to fill the gap left by including other factors that were

envisioned to possibly affect housing supply, and make policy recommendations that would guide players in the housing market in applying better approaches in dealing with housing shortage in the County.

## CHAPTER THREE: METHODOLOGY

### 3.1 Introduction

This chapter describes the econometric model used in conducting the study. It elaborates the framework upon which the model is developed and used in the analysis of the data, the type of data that was used, their sources and the period that the study covered. The statistical tests on the variables and estimation techniques used to establish the cause-effect relationship between the dependent and independent variables are also explained. A justification of the use of the model of choice is provided, and lastly, the description of variables included in the model of study is also done.

### 3.2 Theoretical Framework

The study adopts the ‘’stock-flow’’ model as used by Elizabeth Steiner to study the impact of changing prices on housing investments in the Swiss market. With this model it’s possible to analyze different scenarios in order to forecast potential progress in the housing market (Steiner et al., 2009). The model can also be used to distinguish between the stock of housing, which is sticky in the short run, and the levels of residential construction, which speedily react to adjustments in macroeconomic conditions. By introducing the regression disequilibrium approach, the different rates of adjustments of variables in the housing market can be accurately captured.

The ‘Stock-flow’ model as used in this study is a multivariate linear regression model that seeks to predict the response value of housing supply to a set of selected predictors. We shall first

revisit the multiple linear regression model for one determinant variable, and then proceed to a case where there are more than a single response variable.

We first let X1, X2 and X3 be a set of n predictors assumed to cause a movement in the Y variable, which in this case is Housing Supply……...……...(i)

In trying model the sample regression function, the essence is to measure the population parameters $\beta_0$, $\beta_1$, $\beta_2$, $\beta_3$, $\beta_n$ and μ in the model……(ii)

The regression model of the sample just becomes a sample model representing the population model obtained, as it is obtained from a population sample, hence generating different estimates. The sample regression function is given by;

$$\hat{y}_i - \hat{\beta}_1 + \hat{\beta}_{2x2i} + \hat{\beta}_3 X_3 + ..... + \hat{\beta}_k X_{ki} \qquad i = 1,2,..... \text{ (iii)}$$

With this expressing, we are allowed to calculate the fitted values of $(\bar{y}_i)$ for each value of $y_i$.

In the sample regression model, $\hat{\beta}_1$ , $\hat{\beta}_2$ , $\hat{\beta}_3$ ..... $\hat{\beta}_k$ are the estimators of the parameters;

$\beta_1$ , $\beta_2$ , $\beta_3$ ..... $\beta_k$

We now call the residuals to the difference between $\hat{y}_i$ and $y_i$, i.e.

$$\hat{\mu}_1 = y_i - \hat{y}_i = y_i - \hat{\beta}_i - \hat{\beta}_2 X_2 - \hat{\beta}_3 X_3 ..... \hat{\beta}_k X_{ki} ..... \text{ (iv)}$$

The residual value $\hat{\mu}_i$ in other terms is the difference between sample value and its fitted values.

The matrix form below alternatively expresses the system of equation in (iv).

$$\hat{y} = \begin{bmatrix} y \\ \hat{y}_2 \\ \hat{y}_u \end{bmatrix} \qquad \hat{\beta} = \begin{bmatrix} \hat{\beta}_1 \\ \hat{\beta}_2 \\ \hat{\beta}_3 \\ \hat{\beta}_k \end{bmatrix} \qquad \hat{\mu} = \begin{bmatrix} \hat{\mu}_1 \\ \hat{\mu}_2 \\ \hat{\mu}_u \end{bmatrix}$$

For all observations in the sample, the corresponding fitted model will be as follows;

$\hat{y} = X\hat{\beta}$ ..... …….. (v)

The residual vector is equal to the difference between the vector of observed values and the vector of fitted values. That is to say,

$\hat{\mu} = y - \hat{y} = y - \hat{\beta}\, x\, \hat{\beta}$ ……..…….……. (vi)

Proceeding to obtain the OLS estimate, we denote S to the sum of squared residuals as follows,

$S = \hat{\sum}_{i=1}\ \hat{\mu}_1^{\,2} = \hat{\sum}_{i=9}\ \left[y - \hat{\beta}_1 - \hat{\beta}_2 X_{2i} - \hat{\beta}_3 X_{3i} .....\hat{\beta}_k X_{ki}\right]^2$ …… (vii)

In order to apply the Least Square Criterion in the model of multiple linear regression, we first calculate the derivatives from S with respect to each $\hat{\beta}_i$ in expression (vii).

$$\frac{\partial s}{\partial \beta}\frac{\partial s}{\partial \hat{\beta}} = 2\hat{\Sigma}_{i=1}\left[y_1 - \hat{\beta}_1\ \hat{\beta}_2 X_{2i} - \hat{\beta}_3 X_{3i} \ldots\ldots\ldots\ldots\ldots \hat{\beta}_k X_{ki}\right]\ [-1]$$

$$\frac{\partial s}{\partial \hat{\beta}_2} = 2\hat{\Sigma}_{i=1}\left[y_1 - \hat{\beta}_1 - \hat{\beta}_2 X_{2i} - \hat{\beta}_3 X_{3i} \ldots\ldots\ldots\ldots\ldots \hat{\beta}_k X_{ki}\right]\ [-X_{2i}]$$

$$\frac{\partial s}{\partial \hat{\beta}_3} = 2\hat{\Sigma}_{i=1}\left[y_1 - \hat{\beta}_1 - \hat{\beta}_2 X_{2i} - \hat{\beta}_3 X_{3i} \ldots\ldots\ldots\ldots\ldots \hat{\beta}_k X_{ki}\right]\ [-X_{3i}]$$

$$\frac{\partial s}{\partial \hat{\beta}_k} = 2\hat{\Sigma}_{i=1}\left[y_1 - \hat{\beta}_1 - \hat{\beta}_2 X_{2i} - \hat{\beta}_3 X_{3i} \ldots\ldots\ldots\ldots\ldots \hat{\beta}_k X_{ki}\right]\ [-X_{ki}]$$

…… (ix)

The least square estimators are obtained by equating the equations (ix) to 0 or matrix notation

$X^1\ x\hat{\beta} = X^1 y$ ……..(x)

Proceeding to expand the matrix notation in order to obtain the OLS estimators, we arrive at the Supply function in equation (xi), hence out multivariate supply function;

$\hat{y}_i = \hat{\beta}_i + \hat{\beta}_2 X_{2i} + \hat{\beta}_3 X_{3i} + \ldots\ldots\ldots\ldots + \hat{\beta}_j X_{ji}$ …… (xi)

### 3.3 Empirical Model

This study will consider population, mortgage cost, household income, construction cost and price of land as the independent variables.

The model is expressed in functional form shown in the equation;

**Y=** $\beta_0 + \beta_{1X_{ppln}} + \beta_{2X_{lir}} + \beta_{3X_{ipc}} + \beta_{4X_{ccst}} + \beta_{5X_{ldcst}} + \boldsymbol{\mu}$

Where; **Y** is the housing supply or housing stock, **Xppln** the population in Nairobi County, **Xlir** the mortgage cost or mortgage interest rates, **Xipc** Household incomes within Nairobi County, **Xccst** the construction costs of houses in the County, **Xldcst** the price of land and **μ** represents the error term.

$\beta_0, \beta_1, \beta_2, \beta_3, \beta_4$ and $\beta_5$ are the parameters to be estimated.

### 3.4 Definition of Variables

**Housing supply**

Housing supply is measured using housing stock. This refers to the number of newly constructed units ready for occupation. Data on housing supply is expressed in unit numbers.

**Population**

Population refers to the total number of persons living in a country, city, district, area, or a community of inhabitants of a place. This data is obtained by conducting population census.

**Mortgage cost**

Mortgage cost is measured by interest rate charged on loans issued by the mortgage lending institutions.

**Household Income**

This is a measure of the combined incomes of everyone that is sharing a particular household or residence. This study adopted GDP per capita as a proxy for income in Nairobi to measure the effect income has on the housing supply in Nairobi County. This index is measured by dividing

the GDP of region by the total number of population in that specific area. GDP per capita is used to determine the productivity of a person in a place.

**Construction costs**

This cost is measured by the sum of all the inputs involved in putting up a housing unit on per square meter basis. Total construction costs specifically includes architectural fee, acquisition of construction permits, hiring of labour, cost of land and of all materials required in the building process; cement, ballast, iron sheets, paint, nails, wiring among others.

**Price of land**

This refers to the monetary value at which land is traded in the market on a willing-buyer willing-seller basis.

**Table 3.1: Postulated signs of the explanatory variables**

| Dependent Variable | Independent Variables | Expected Sign |
|---|---|---|
| Housing Supply | Population | -ve |
| | Mortgage cost | -ve |
| | Household income | +ve |
| | Construction costs | -ve |
| | Price of Land | -ve |

### 3.5 Data Description

The study used time series secondary data running from 1984 to 2014. This period was preferred due to availability of data on the variables, which have been measured consistently. The data on the determinant variables was obtained from Kenyan economic Surveys, Ministry of Lands and Planning, World Bank database, the County Government of Nairobi and other relevant government regulatory bodies' publications.

### 3.6 Estimation Procedure

This study adopted the OLS method in trying to establish the relationship that exists between supply of housing and the independent variables. The OLS method was adopted because data on the independent variables were easily observable and the relationship between this variables and the dependent variable could be easily established linearly by fitting the data using a criterion that minimizes the sum of errors. A simple regression line could also be easily obtained using this estimation method.

#### 3.6.1 Unit Root and Stationarity Test

Unit Root tests are conducted during the process of developing econometric models with an objective of establishing the order of integration between variables. The reason behind this is that if variables happen to be integrated of order 1 and above, it leads to distributions which are not standard and, or regression results which are spurious. Another reason for conducting unit root test is to establish the characteristics of the variables before constructing the model to be used in econometric analyses. These tests are used to categorize series as either stationary or non-stationary. When non-standard distributions or spurious result come about, and the series of data

appear to be non-stationary, the original hypothesis is rejected only if there is tangible evidence for rejection. Meaningful statistical inferences can then be made using model, after classifying the variables as either stationary, non-stationary integrated and also establishing the trend. Augmented Dickey-Fuller test was used to test for unit root and stationarity.

### 3.6.2 Co-integration Test

When two or more time series share a common stochastic movement, they are understood to be co-integrated. Such a relationship between variables occurs when they have a unit root. A co-integration test is essential if one intends to construct relationships that are empirically reasonable, and it could only be sensible to continue modelling with the variables if no evidence of co-integration is found. Johasen co-integration test was conducted to check on the co-integration levels between the variables, after unit root was established. Empirically, a VAR model is formulated with lags and dummy variables in order to make any residuals become white noises. If the co-integration procedures are not conducted, the variables used in the time series could lead to a spurious regression problem, which occurs if non-stationary series are regressed on each other.

### 3.6.3 Vector Error Correlation Model (VECM)

VECM is a model used for the observation and analysis of more than one statistical outcome variable at a time. In conducting VECM estimations, one specifies and estimates a VAR model for the multivariate time series that are integrated, computing likelihood ratio tests to establish the number of co-integration relations and the number of co-integrations. So, one always checks if the VAR model appropriately describes the multivariate time series, then proceeds to further

steps only if it does. The model ensures stationarity of economic variables before being differenced initially. This is in order to establish whether the error an individual lagged economic variable may have any significant long-term causality effect on the independent variable.

### 3.7 Diagnostic Tests

#### 3.7.1 Multicollinearity and Normality Test

When a regression model includes a number of factors that happen to be correlated to the response variable, and at the same time to each other, multicollinearity is said to be in existence. This in essence implies that some factors are not meaningful to the regression model, hence redundant. Standard errors of the coefficients become higher when multicollinearity is established, meaning that coefficients for some independent variables might not be significantly different from 0. These tests are normally done in order to identify outliers, which are data set elements that exceptionally stand out from the rest, and in this cases dummy variables are included to act as the controls.

In order to demonstrate the credibility of OLS estimators, it is important to establish the level of multicollinearity. In observing this procedure, we measured multicollinearity using Variance Inflation Factor (VIF), which assesses how much the variance of an estimated regression coefficient increases if the selected predictors are correlated. To deal with multicollinearity, if it occurs, we dropped the variables that are highly correlated from the model. This study measured VIFs for serial autocorrelation and Shapiro-Wilk (SW) Test for normality to determine whether sample data was consistent with specific distribution.

### 3.7.2 Heteroscedasticity Test

Heteroscedasticity is adjudged to be existing in a collection of random variables if there are sub-populations that have differing variances from the rest. Heteroscedasticity renders regression analysis problematic because it could cause the statistical tests of significance that assume the standard errors to be uncorrelated and uniformly distributed to be invalid. In the presence of heteroscedasticity for instance, the least square estimators could still remain un-biased, but the true values of variances and covariance will be underestimated, hence being inappropriate. This means that the statistical assumption of the classical linear regression model that there is not heteroscedasticity is breached hence the variances of the estimators are not the lowest and the OLS estimators could not be the BLUE (Best Linear Unbiased Estimators). With standard errors that are biased, inaccurate inferences could be made, leading to wrong hypothesis results where the researcher at a certain level of significance fails to reject the null hypothesis when in real sense it was not representative of the actual population. We ran Breusch-Pagan test in this study to test for presence of heteroscedasticity.

### 3.7.3 Serial Correlation Test

Serial correlation occurs when over a number of time intervals, a statistical relationship arises between a variable and itself. It more often is realized in repeating patterns, when a variable affects its own future outcomes, hence becoming its own predictor. The relationship between observations of the same variable over specific periods of time can be done by the use of serial correlation such that if a variable's serial correlation is measured to be zero, this implies that there is no correlation, hence each observations can be done independent of one another. On the other hand, if a variable has its serial correlation inclined toward 1, the observations are adjudged

to be serially correlated, and hence its past values determine its future observations. Essentially such variables have patterns that are not randomly distributed. To test for serial correlation, this study conducted the Breusch Godfrey test.

### 3.7.4 Granger Causality

According to Granger causality, if a signal X1 causes a signal X2, then past values of X1 must contain information that helps predict X2, in addition to any information that exclusively predicted the past values of X2. Granger causality was developed in a process called Granger causality test, which is used to determine if there exists a significant effect of combined dependent variables on the independent variables. This study conducted this test to check whether any combined independent variables defined in the 'Stock-flow' model had a causality effect on the housing supply in Nairobi County.

## CHAPTER FOUR: EMPIRICAL RESULTS

### 4.1 Introduction

In this chapter, results of empirical analysis are presented. The chapter discusses descriptive statistics of the data, diagnostic tests and reports on the regression results.

### 4.2 Descriptive Statistics

Descriptive statistics of the data series is shown in table 4.1. Descriptive statistics of housing supply in Nairobi County, income per capita, lending interest rates, construction costs, land cost/ price of land and population is illustrated. Distribution of a series can be determined by evaluating various statistical measures as shown in table 4.1.

**Table 4.1: Descriptive Statistics**

| Variable | Observation | Mean | Standard Deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| hss | 31 | 14085.84 | 17929.52 | 1972 | 65454 |
| ipc | 31 | 496.7742 | 298.563 | 174 | 1227 |
| lir | 31 | 19.32258 | 6.65 | 13 | 36 |
| ccst | 31 | 18160.03 | 11178.54 | 1403 | 35800 |
| Ldcst | 31 | 7137396 | 7741298 | 134903 | 2.71e+07 |
| ppln | 31 | 2201537 | 827169.4 | 1039923 | 3767652 |

The total observations considered in this study were 31 with five variables (one dependent and four independent variables). Range is obtained from the difference between the maximum value

and minimum value. The standard deviation shows the spread of the values from the mean and is important for comparison purposes. For example the data shows that land cost has a larger spread as compared to other variables. Housing supply has a standard deviation of 17929.52, income per capita has 298.563, lending interest rate has 6.65, cost of construction has 11178.54 and population has 827169.4.

### 4.3 Correlation Matrix

Correlation of the variables is examined in the table 4.2.

**Table 4.2: Correlation matrix**

| | Hss | ipc | Lir | Ccst | ldcst | Ppln |
|---|---|---|---|---|---|---|
| hss | 1.0000 | | | | | |
| ipc | 0.9292 | 1.0000 | | | | |
| lir | -0.2474 | -0.3528 | 1.0000 | | | |
| ccst | 0.7390 | 0.8138 | -0.0657 | 1.0000 | | |
| ldcst | 0.9507 | 0.9635 | -0.2624 | 0.8399 | 1.0000 | |
| ppln | 0.8331 | 0.8985 | -0.2392 | 0.9312 | 0.9239 | 1.0000 |

From Table 4.2, we observe the relationship existing between various variables used in this study. There is a positive association between housing supply and income per capita, cost of construction, land cost, and population. On the other hand, there is a negative association between housing supply and lending interest rate. Income per capita is positively related to cost

of construction, land cost and population. Conversely, there is a negative association between income per capita and mortgage lending interest rate.

### 4.4 Diagnostic Test

#### 4.4.1 Stationary Test

Stationarity means the variable is integrated of order zero and therefore inference is applicable. However, presence of a unit root lead to spurious regression which renders inference inapplicable and therefore the model cannot be used in forecasting. The unit root test was done by use of the Augmented Dickey Fuller Test on the individual variables. The test results are as shown in table 4.3.

**Table 4.3: Test for Stationarity (First Difference)**

| Variables | Test statistic | 1% critical level | 5% critical level | 10% critical level |
|---|---|---|---|---|
| D1lnhss | -6.205 | -3.723 | -2.989 | -2.625 |
| D1ipc | -2.924 | -3.723 | -2.989 | -2.625 |
| D1lir | -5.375 | -3.723 | -2.989 | -2.625 |
| D1ccst | -6.410 | -3.723 | -2.989 | -2.625 |
| D1ldcst | -5.090 | -3.723 | -2.989 | -2.625 |
| D1ppln | 0.517 | -3.723 | -2.989 | -2.625 |

Table 4.3 shows that all the variables became stationary after first difference except income per capita and population. This means that all the variables except income per capita and population

have one unit root or are integrated of order 1 that is I (1). Income per capita and population were further differenced and the results are as shown in table 4.4

**Table 4.4: Test for Stationarity (Second Difference)**

| Variables | Test statistic | 1% critical level | 5% critical level | 10% critical level |
|---|---|---|---|---|
| D2ipc | -7.344 | -3.730 | -2.992 | -2.626 |
| D2ppln | -4.309 | -3.730 | -2.992 | -2.626 |

Table 4.4 shows that the two variables became stationary after second difference an implication that they are integrated of order two, that is I(2). The study dropped variables that were integrated of order two and only considered those that were integrated of order one for Cointegration test. Cointegration test is discussed in section 4.4.2

### 4.4.2 Lag Length Selection

Before testing for Cointegration it is important to identify lag length. The VAR lag selection criteria is discussed in table 4.5.

**Table 4.5: Vector Autoregressive Lag Selection Criteria**

| Selection-order criteria<br>Sample: 1988 - 2014 | | | | | | Number of observation = 27 | | |
|---|---|---|---|---|---|---|---|---|
| Max rank | LL | LR | Df | P | FPE | AIC | HQIC | SBIC |
| 0 | -844.372 | | . | | 2.3e+22 | 62.8424 | 62.8995 | 63.0344 |
| 1 | -763.306 | 162.13 | 16 | 0.000 | 1.9e+20* | 58.0227 | 58.3081* | 58.9826* |
| 2 | -751.322 | 23.968 | 36 | 0.090 | 2.8e+20 | 58.3202 | 58.8339 | 60.0479 |
| 3 | -746.657 | 9.3301 | 36 | 0.899 | 8.2e+20 | 59.1598 | 59.9019 | 61.6555 |
| 4 | 907.910 | 67.873* | 36 | 0.000 | 3.7e+20 | 57.8312* | 58.8016 | 61.0948 |

From table 4.5, LR criteria shows that 4 lags should be considered. FPE criterion shows that 1 lag should be chosen. Regarding AIC, HQIC and SBIC, the guideline is that the lower the value the better the model. In this case the AIC criteria show that 4 while HQIC and SBIC show that one lag should be chosen. Since three out of the five criteria recommend 1 lag, the study will therefore consider 1 lag.

### 4.4.3 Johansen Test of Cointegration

After identifying lag length, it is important to check whether there is long run relationship among the variables (cointegration) or not. To ascertain this, Johansen test of Cointegration was adopted and the results are as shown in table 4.6.

**Table 4.6: Johansen Test for Cointegration (Trace statistics Model)**

| Maximum rank | Parms | LL | Eigenvalue | Trace statistic | 5% critical Value |
|---|---|---|---|---|---|
| 0 | 4 | -862.88978 | . | 38.58* | 47.21 |
| 1 | 11 | -853.84293 | 0.45290 | 20.49 | 29.68 |
| 2 | 16 | -845.57822 | 0.42362 | 3.96 | 15.41 |
| 3 | 19 | -843.84001 | 0.10942 | 0.48 | 3.76 |
| 4 | 20 | -843.59938 | 0.01591 | | |

From table 4.6, it is evident that there is no Cointegrating vector between the variables. At maximum rank 0, the null hypothesis is that there is no cointegration where the alternative hypothesis is that there is cointegration. Since the trace statistic at this point (38.58) is less than the critical value at 5 percent level of significance (47.21), the null hypothesis is not rejected, an indication that there is no cointegration. These results therefore show that the variables have short run association-ship and thus VAR framework should be adopted.

### 4.4.4 Multicollinearity

To test for multicollinearity, Variance Inflation Factors (VIF) was examined. For VIF values greater than 10, multicollinearity is deemed to be present (Nachtscheim, 2004). The VIF are calculated as shown below.

**Variance Inflation Factors**

$$VIF = \frac{1}{1 - R^2}$$

Where VIF= variance inflation factor

$R^2$= coefficient of determination

1/VIF= tolerance

The VIF values are shown in table 4.7

**Table 4.7: Multicollinearity**

| Variable | VIF | 1/VIF |
|---|---|---|
| Ldcst | 20.41 | 0.048990 |
| Ppln | 17.45 | 0.057291 |
| Ipc | 16.92 | 0.059104 |
| ccst | 9.69 | 0.103162 |
| Lir | 1.59 | 0.627895 |
| Mean VIF | 13.21 | |

From table 4.7, it is evident that land cost, population in Nairobi and income per capita had VIF greater than 10, an implication that there is multicollinearity. Construction cost and lending interest rate had VIF of less than 10, an implication that there is no Multicollinearity. To correct for the problem of multicollinearity, the variables were differenced.

### 4.4.5 Heteroscedasticity

Using Breusch-Pagan test, results are as shown in table 4.8.

**Table 4.8: Test for Heteroscedasticity**

| Breusch-Pagan / Cook-Weisberg test for heteroscedasticity |
|---|
| Ho: Constant variance |
| Variables: Fitted values of Housing Supply in Nairobi County |
| chi2(1) = 30.84 |
| Prob> chi2 = 0.0000 |

The results reveal presence of heteroscedasticity since the p-value of 0.0000 is significant which leads to rejection of the null hypothesis. This was corrected by use of robust standard error regression.

### 4.4.6 Serial Correlation

Breusch Godfrey test was used in testing for serial correlation. The results are as shown in table 4.9.

**Table 4.9: Serial correlation**

| Breusch-Godfrey LM test for autocorrelation | | | |
|---|---|---|---|
| lags(p) | chi2 | Df | Prob> chi2 |
| 1 | 2.054 | 1 | 0.1519 |
| $H_0$: no serial correlation | | | |

The test results reveal absence of serial correlation since the p-value of 0.1519 is insignificant thus leading to the acceptance of the null hypothesis.

### 4.4.7 Normality

In testing for normality of the error term, Shapiro Wilk test was used. The results are shown in the table 4.10. The null hypothesis in this situation indicates that the error term is normally distributed whereas the alternative hypothesis indicates that the error term is not normally distributed.

**Table 4.10: Test for Normality**

| Variable | Obs | W | V | z | Prob>z |
|---|---|---|---|---|---|
| res | 31 | 0.70582 | 9.582 | 4.682 | 0.00000 |

The probability value in table 4.10 is significant thus leading to rejection of the null hypothesis. This therefore implies that the residuals are not normally distributed. To correct the study used a log-linear model.

## 4.5 Vector Autoregressive (VAR)

From table 4.6, the Johansen test for cointegrations suggests absence of cointegration. This implies that the model could be feasibly employed with the VAR framework. Results for VAR framework are as shown in table 4.11.

**Table 4.11: VAR Regression Results**

| Dependent Variable : Natural log of housing supply<br>Method : VAR<br>Sample : 1985 – 2014 | | | | |
|---|---|---|---|---|
| | Coefficient. | Standard error | Z | P>z |
| L1hss | 0.46** | 0.16 | 2.83 | 0.005 |
| L1lir | -0.018 | 0.013 | -1.35 | 0.177 |
| L1ccst | -0.000038* | 0.000014 | -2.62 | 0.009 |
| L1ldcst | 2.52 | 3.30 | 0.77 | 0.444 |
| Cons | 4.41 | 1.29 | 3.43 | 0.001 |
| R-squared = 0.8499<br>P>chi2 = 0.0000* | | | | |

Where *, ** indicates significance at 1% and 5% level of significance respectively.

The final estimation model after running the regression tests for the models specification is;

$$lnhss = 4.41 + 0.46lnhss_{t-1} - 0.018lir_{t-1} - 0.000038lccst_{t-1} + 2.52ldcst_{t-1} \ldots\ldots\ldots\ldots (xii)$$

Where

$lnhss$ is natural log of Housing supply,

$lnhss_{t-1}$ is lag one of housing supply in first difference,

$lccst_{t-1}$ is lag one of per unit construction cost in the first difference,

$ldcst_{t-1}$ is lag one of land cost in the first difference, and

$lir_{t-1}$ is lag one of mortgage lending interest rate in the first difference.

The interpretation of the model is that for every unit increase in the lending mortgage interest rates, the supply of housing decreases by 0.018 units, every other factor influencing housing supply being held constant, whereas for every unit increase in the cost of construction, the supply of housing reacts by reducing by 0.000038 units, every other factor affecting housing supply being held constant. On the other hand, the coefficient of the cost of land implies that for every unit increase in the cost land, the supply of housing increases by 2.52 units every other factor influencing housing supply being held constant. Additionally, the regression results established that the level of housing supply in the preceding year is a predictor of the number of houses to be supplied in Nairobi County in the current year by an increase of 0.46 units for every unit that was produced in the previous year.

## 4.6 Interpretation of the Results

The results reveal that regression performed well in terms of goodness of fit and overall significance with a coefficient of determination of 0.8499 and probability value of 0.0000. The coefficient of determination means that 84.99 % of the variation in housing supply is explained by the explanatory variables in the model. Probability value of (0.0000) implies that the variables in the model are jointly significant in explaining housing supply at 1% level of significance.

The results further reveals that lag one of housing supply is positive and individually significant in influencing housing supply at 10 percent level of significance. In addition, lag one of lending interest rate is negative and individually insignificant in influencing housing supply. Further, lag one of construction cost is negative and individually significant in influencing housing supply at one percent level of significance.

The results further reveals that lag one of land cost is positive but insignificant in influencing housing supply. Having estimated VAR model, the study investigated Granger Causality to determine the direction of short-run causality. The results are as shown in table 4.12.

**Table 4.12: Granger causality Wald tests**

| Equation | Exclude | chi2 | df | Prob > chi2 |
|---|---|---|---|---|
| lnhss | lir | 1.8187 | 1 | 0.177 |
| lnhss | ccst | 6.8501 | 1 | 0.009 |
| lnhss | ldcst | 0.5853 | 1 | 0.444 |
| lnhss | All | 16.623 | 3 | 0.001 |

From table 4.12, p value for all the independent variables is significant, an implication that their coefficients are not zero. This implies that there is a short-run causality running from construction cost, lending interest rates and land cost to housing supply.

### 4.7 Discussion of the Findings

The coefficient of lag one of supply of houses is positive and significant. This has an econometric indication that the supply of houses in the previous year signals an increased demand thus leading to an increase in supply of the houses in the current year. Suppliers of houses will invest in more constructions in the proceeding period because of speculation.

The coefficient of lag one of the mortgage interest rate is negative and significant. This finding conforms to economic theory since high interest rate makes mortgage expensive and therefore

firms that rely on it may find it difficult to borrow thus reducing housing supply. This finding is in line with a study by Kuttner et al. (2012), in trying to confirm findings of other studies on the relationship between interest rates and house prices, hence the ultimate supply of houses. The study found a negative relationship between mortgage lending interest rate and housing supply.

The coefficient of lag one of cost of construction is negative and significant. This finding conforms to economic theory since high construction cost makes construction projects expensive to undertake thus encouraging investors to forgo housing investment for other projects. This finding is in line with a study on the changing forces in the markets of houses in African done in 2013 by the African Development Bank. The study sought to identify the main hindrances to the prosperity of the housing market, and amongst a few other factors, construction cost was found to have a negative correlation with the supply of houses.

The coefficient of lag one of land cost is positive but insignificant. The findings are not in line with economic theory which indicates that land cost negatively influences housing supply. The results further contrasts results of earlier study by Grimes et al, (2012) which analyzed new housing supply responsiveness to price dynamics including land prices. The study found that an increase in the price of land hikes the overall construction costs, hence reducing housing supply. This clearly establishes a negative causality effect between land price and housing supply.

# CHAPTER FIVE: CONCLUSIONS AND POLICY IMPLICATIONS

## 5.1 Introduction

This chapter presents a summary of the study and policy recommendation based on the findings of the study. The chapter is comprised of three sections namely; summary and conclusions of the study, policy implications and recommendations, limitations of the study and recommendation of areas for future research.

## 5.2 Summary and Conclusions of the Study Findings

Previous studies have demonstrated that housing plays a key role in the socio-economic development of economies by contributing to their respective GDPs. In the developing nations, mostly in the Sub-Saharan Africa, housing has been established to be a critical problem, considering the high rate of urbanization, the increasing rural-urban migration of people in search for jobs and the resultant rampant growth of urban slums and back shacks, resulting into many low-income earners without adequate housing facilities. Several factors from previous literature were considered possible to the determination of the supply of housing including; Land prices, population growth in the urban centers, mortgage cost, construction costs, household incomes, building codes and rental control policies among others.

Considered individually, either positive or negative causality effects were established between the selected independent variables and the housing supply levels in the various case studies. The World Bank report on how to improve Kenya's mortgage market for instance established that mortgage interest specifically was critical in the delivery of low cost housing, hence suggested ways of improving the mortgage market performance.

Nairobi being a Sub-Saharan city facing a rampant growth in cases of inadequate housing since Kenya attained independence demonstrated by the rapid growth of slum areas, this study sought to establish the possible factors that cause the observed shortage of supply of houses in the County. Over a period between 1984-2014 (31 years), secondary time series data on population in Nairobi county, mortgage interest rates, land price, construction cost and income per capita were regressed on that of housing supply over the same period to determine their was a joint significance on the quantities of houses supplied in Nairobi County. To eliminate any elements of bias, several pre and post-estimation tests were conducted as proposed in the study. Hypothesis were tested at 1%, 5% and 10% significance levels. The regression results finally showed that only mortgage interest/ lending rates, construction cost and land prices/ costs were jointly significant in the determination of supply of housing in Nairobi County at 1% significance level, despite literature indicating the other variables to be independently significant.

Lastly, in order to ensure that there is adequate supply of housing in Nairobi to cater for the rapidly growing population and to eradicate the growing slum issue, serious consideration should be taken of the statistically jointly significant variables according to the study findings.

### 5.3 Policy Recommendations

Kenya has committed itself to ensuring that all its citizens have equal access to adequate housing by the implementing clauses in the constitution to this effect, ensuring accessibility to land for house construction through titling, rental charges control and the development of low-cost housing among other policy guidelines. Despite this efforts, there is still no significant improvement in the housing shortage situation, mostly in the urban centers where a rampant

growth of slums and street families is witnessed. In order to improve this situation, this study recommends additional policies that will put more checks to better control the construction cost, mortgage lending rates and land prices as key factors that need careful planning.

Regarding construction costs, the relevant government planning ministry and key stakeholders need to appreciate that there is an ever increasing cost of house construction over the years which makes construction unaffordable, hence affecting the supply of low cost housing. Research needs to be conducted on cheaper ways of putting up houses, since the existing pre-colonial building codes which are still under implementation prescribe expensive raw materials. Such include cement, bricks/ blocks and metal materials. There is also need for a comprehensive review of the building codes, which allow the approval of residential building plans using low cost material technologies such as clay which is readily available and needs no industrial processing for it to become usable. In summary, cheaper technologies such as KOTO building technology which provides efficient, timely, affordable & innovative housing and building solutions should be fully embraced.

On the next front, this study recommends, after establishing mortgage cost to be significant on the levels of housing supply, that the government and the mortgage lending institution should implement monetary policies that effectively control the movements of this rates. From the study, mortgage interest rates have demonstrated erratic trends, moving rapidly high, stabilizing in some years, and also shortly moving low. The study further recommends that the mainstream mortgage institutions should create financial structures where secondary mortgage lending institutions are allowed to develop and operate under similar financial lending regulations that

control the mainstream mortgage lending institutions, but with lesser stringency. This will allow for easy and cheaper access to mortgage by small scale players in the house construction industry or even for individuals who are seeking to build private residences. The ministry of finance should seek to implement monetary policies that put ceiling of mortgage lending rates charged by commercial banks in order to curb the exploitative tendencies by such banks towards borrowers hence making such loans very expensive and inaccessible.

Lastly, the government, through the ministry of lands should devise and implement policies that regulate land valuation and pricing. The study has established a positive correlation between prices of land and supply of housing which could be explained purely by the attractive land prices which induce the land owners into willingness to give up their land to prospective residential house constructors. From the turn of 2009, land speculation has driven up prices of land. This has also been driven up by the fact that real estate developers are continuously anticipating a rise in the demand for houses through populations increase. In turn, mortgage institutions have also been actively issuing out mortgages for house construction as a result of this. It is on the basis of this that this study recommends that there should be a revision in land policy to ensure that in as much as there is land speculation, government should be involved in land price negotiations through its institutions so as to ensure that land prices are fair and attractive, but still do away with land speculation.

### 5.4 Limitations of the Study

The main objective of conducting this study was to establish the main causes of shortage of housing supply in Nairobi County. In order to successfully carry out this research, data covering

a period 1984-2014 for the selected dependent and independent variables was collected. One major limitation of this study which really delayed the analysis of the data, was the slow rate at which data could be obtained. Most of the data required several levels of approval before the author could be allowed access to. Even after access, these data were found to have been haphazardly maintained in hard copies hence necessitating a manual searching from archives. Additionally, a number of variables did not have their data readily broken down to units required for estimation. The unit price of land and the unit cost of construction in square meters, for instance were found to have been maintained in values of the units of land being transacted on and values of constructing a unit building respectively. This necessitated further tabulations to attain the required units of measurement. Despite the mentioned challenges, the study still attained its objective and is informative as expected.

### 5.5 Areas for Further Research

Room for further research has been opened by the constraints encountered in the collection and usage of the data in this study. More accurate analysis of the same nature using more reliable data can produce more accurate and reliable results suitable for better policy recommendations. In addition, more research can be conducted on the effects of prices of houses and Rents charged on various categories of houses on the supply of houses in Nairobi County. This areas have been identified by this study as possible ones for further research because they were dropped in the modelling stage because it was anticipated that data on them would be hard to come by. With this study, the housing policy formulation implementation will be well informed for better management of the slum situation in the County and other geographical areas.

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# APPENDICES

## Appendix 1: Regression Results at Level

```
. reg lnhss ipc lir ccst ldcst ppln
```

| Source | SS | df | MS | | |
|---|---|---|---|---|---|
| Model | 33.6879873 | 5 | 6.73759747 | Number of obs | = 31 |
| Residual | 5.74302575 | 25 | .22972103 | F( 5, 25) | = 29.33 |
| | | | | Prob > F | = 0.0000 |
| Total | 39.4310131 | 30 | 1.3143671 | R-squared | = 0.8544 |
| | | | | Adj R-squared | = 0.8252 |
| | | | | Root MSE | = .47929 |

| lnhss | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| ipc | .0026448 | .0012056 | 2.19 | 0.038 | .0001619 | .0051278 |
| lir | .0258114 | .0166183 | 1.55 | 0.133 | -.0084146 | .0600374 |
| ccst | -.0000394 | .0000244 | -1.62 | 0.118 | -.0000896 | .0000107 |
| ldcst | -1.33e-08 | 5.11e-08 | -0.26 | 0.796 | -1.19e-07 | 9.19e-08 |
| ppln | 1.02e-06 | 4.42e-07 | 2.31 | 0.029 | 1.11e-07 | 1.93e-06 |
| _cons | 5.626997 | .7910837 | 7.11 | 0.000 | 3.99773 | 7.256265 |

## Appendix II: Unit Root Test Results

```
. dfuller lnhss

Dickey-Fuller test for unit root                    Number of obs   =        30

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)             -1.072           -3.716            -2.986           -2.624
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.7263


. dfuller D.lnhss

Dickey-Fuller test for unit root                    Number of obs   =        29

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)             -6.205           -3.723            -2.989           -2.625
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000


. dfuller D.lnhss

Dickey-Fuller test for unit root                    Number of obs   =        29

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)             -6.205           -3.723            -2.989           -2.625
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000


. dfuller ipc

Dickey-Fuller test for unit root                    Number of obs   =        30

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)              2.714           -3.716            -2.986           -2.624
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.9991
```

```
. dfuller ipc

Dickey-Fuller test for unit root                    Number of obs   =        30

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)             2.714            -3.716            -2.986           -2.624
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.9991


. dfuller D.ipc

Dickey-Fuller test for unit root                    Number of obs   =        29

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)            -2.924            -3.723            -2.989           -2.625
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0427


. dfuller D.D.ipc

Dickey-Fuller test for unit root                    Number of obs   =        28

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)            -7.344            -3.730            -2.992           -2.626
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller lir

Dickey-Fuller test for unit root                    Number of obs   =        30

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)            -1.482            -3.716            -2.986           -2.624
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.5424
```

```
. dfuller D.lir

Dickey-Fuller test for unit root                    Number of obs   =        29

                                 ———— Interpolated Dickey-Fuller ————
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
——————————————————————————————————————————————————————————————————————————
 Z(t)            -5.375            -3.723            -2.989           -2.625
——————————————————————————————————————————————————————————————————————————

MacKinnon approximate p-value for Z(t) = 0.0000


. dfuller ccst

Dickey-Fuller test for unit root                    Number of obs   =        30

                                 ———— Interpolated Dickey-Fuller ————
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
——————————————————————————————————————————————————————————————————————————
 Z(t)            -1.167            -3.716            -2.986           -2.624
——————————————————————————————————————————————————————————————————————————

MacKinnon approximate p-value for Z(t) = 0.6876

. dfuller ccst

Dickey-Fuller test for unit root                    Number of obs   =        30

                                 ———— Interpolated Dickey-Fuller ————
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
——————————————————————————————————————————————————————————————————————————
 Z(t)            -1.167            -3.716            -2.986           -2.624
——————————————————————————————————————————————————————————————————————————

MacKinnon approximate p-value for Z(t) = 0.6876


. dfuller D.ccst

Dickey-Fuller test for unit root                    Number of obs   =        29

                                 ———— Interpolated Dickey-Fuller ————
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
——————————————————————————————————————————————————————————————————————————
 Z(t)            -6.410            -3.723            -2.989           -2.625
——————————————————————————————————————————————————————————————————————————

MacKinnon approximate p-value for Z(t) = 0.0000
```

```
. dfuller ldcst

Dickey-Fuller test for unit root                    Number of obs   =        30

                                 ---------- Interpolated Dickey-Fuller ----------
                    Test         1% Critical       5% Critical      10% Critical
                  Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)                3.181          -3.716            -2.986           -2.624
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 1.0000
```

```
. dfuller ldcst

Dickey-Fuller test for unit root                    Number of obs   =        30

                                 ---------- Interpolated Dickey-Fuller ----------
                    Test         1% Critical       5% Critical      10% Critical
                  Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)                3.181          -3.716            -2.986           -2.624
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 1.0000
```

```
. dfuller D.ldcst

Dickey-Fuller test for unit root                    Number of obs   =        29

                                 ---------- Interpolated Dickey-Fuller ----------
                    Test         1% Critical       5% Critical      10% Critical
                  Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)               -5.090          -3.723            -2.989           -2.625
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000
```

```
. dfuller ppln

Dickey-Fuller test for unit root                    Number of obs   =        30

                                 ---------- Interpolated Dickey-Fuller ----------
                    Test         1% Critical       5% Critical      10% Critical
                  Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)               23.534          -3.716            -2.986           -2.624
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 1.0000
```

```
. dfuller D.ppln

Dickey-Fuller test for unit root                   Number of obs   =        29

                                 ---------- Interpolated Dickey-Fuller ----------
                    Test         1% Critical       5% Critical      10% Critical
                  Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)                0.517          -3.723            -2.989           -2.625
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.9854
```

```
. dfuller D.ppln

Dickey-Fuller test for unit root                   Number of obs   =        29

                                 ---------- Interpolated Dickey-Fuller ----------
                    Test         1% Critical       5% Critical      10% Critical
                  Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)                0.517          -3.723            -2.989           -2.625
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.9854
```