GROWTH OF HOUSING PRICES IN KENYA AND ITS DYNAMIC RELATIONSHIP WITH SELECTED MACROECONOMIC VARIABLES

STEPHEN GITHAE NJARAMBA

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other University or any other award.

Signature:……Date……

Stephen Githae Njaramba

B.A Economics (Hons), M.A. Economics

K96/CTY/22806/2012

We confirm that the work reported in this thesis was carried out by the candidate under our supervision.

Signature…….……...Date……

Dr. Paul Gachanja

Department of Economics Theory

School of Economics

Kenyatta University

Signature…….……..Date…….

Dr. Charles Mugendi

Department of Economics Theory

School of Economics

Kenyatta University

DEDICATION

To

My parents and my family

ACKNOWLEDGEMENTS

To God I give thanks for the opportunity, the strength and energy to come this far. Secondly I am indebted to my supervisors Dr. Paul Gachanja and Dr. Charles Mugendi for the immense support, guidance and contribution in making this thesis to be what it is. I would want to appreciate a lot of support and guidance received from Dr. Onono, Dr. Maingi, Dr. Ouma and Dr. Kariuki during the process of coming up with the thesis. I will forever remain indebted. I also thank the other lecturers in School of Economics, Kenyatta University for their invaluable contributions they gave in realization of the thesis. I also say thank you to my classmates who gave a lot of support during and after the course work. The prayers and support from my family and friends are appreciated. Finally I am thankful to Kenyatta University through the School of Economics for the opportunity and support in my studies. To you all I say, God bless you.

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ABBREVIATIONS AND ACRONYMS

ABMT	Appropriate Building Materials and Technologies
ADF	Augmented Dickey-Fuller
AfDB	African Development Bank
AIC	Akaike Information Criterion
ARDL	Autoregressive Distributed Lags
CAHF	Centre for Affordable Housing in Africa
CBK	Central Bank of Kenya
CPI	Consumer Price Index
CSHSF	Civil Servants Housing Scheme Fund
DOLS	Dynamic Ordinary Least Square
DW	Durbin Watson
ECM	Error Correction Model
ECT	Error Correction Term
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
HIDP	Housing Infrastructure Development Programme
HIQ	Hannan-Quinn information criterion
KIPPRA	Kenya Institute of Public Policy and Research Analysis
KNES	Kenya National Economic Survey
KNBS	Kenya National Bureau of Statistics
KPSS	Kwiatkowski-Phillips-Schmidt-Shin
Ksh	Kenya Shilling

KSUP	Kenya Slum Upgrading Programme
LR	Likelihood Ratio
LTV	Loan to Value
MWALD	Modified Wald Test
NBFI	Non-Banking Financial Institutions
NHC	National Housing Corporation
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Squares
PEV	Post Election Violence
PP	Phillips-Perron
SBC	Schwarz's Bayesian Criterion
SIC	Schwarz information criterion
UK	United Kingdom
US	United States
VAR	Vector Auto-Regressive
VAT	Value Added Tax
VECM	Vector Error Correction Model
WB	World Bank

OPERATIONAL DEFINITION OF TERMS

Bank lending refers to the total amount of credit facilities given to households in a period of one year.

Financial crises refer to a situation in which there are increasing loan defaults in the financial sector resulting from declined housing prices.

Housing bubbles refers to housing prices above the price reflected and determined by market fundamentals.

Housing markets in this study is represented by supply and demand for residential types of houses for purposes of selling, buying and renting.

Housing prices refers to average selling price of three types of residential houses in major urban centers in Kenya. These include Mansions, Bungalows and Apartments. The price includes the price of land the housing stand on.

Macroeconomic instability refers to a situation where macroeconomic environment is less predictable and can take the form of volatility of the key macroeconomic variables.

Private Capital Inflows consist of net inflows of investment from foreign individuals to acquire a lasting management interest in the domestic economy.

User cost of housing refers to the costs the households incur from consuming housing services either through owner occupied housing or through renting housing. The user cost include: housing repair, security services, mortgage loans servicing and land rates.

ABSTRACT

In Kenya housing prices are considered high and have still continued to rise. This has made housing affordability and access a preserve of the top income earners. Consequently, large population live in houses with reduced access to clean water, sanitation, unreliable and unhealthy energy sources, increased exposure to diseases and low levels of financial security. Arable land is also being converted to residential centers which is constraining on public goods provision and agricultural output. The government of Kenya has struggled to make housing affordable and also to encourage housing access and homeownership. This effort has not been quite successful since the housing prices continue to rise and also declining access to descent housing. The variables the housing prices respond towards and could inform the policies to manage the housing prices are not clear. Housing prices behavior have also been known to influence business cycle dynamics by affecting aggregate expenditure and also the performance of the financial system through their effect on the profitability and stability. The purpose of this study was therefore to analyze the variables the housing prices respond to both in short-run and in long-run. The study also examined the dynamic relationship between housing prices and selected macroeconomic variables. In doing this, the study used time series data for the period 1960 to 2015 and adopted an ARDL and VAR models. The ARDL and VAR models were selected since the housing prices behaves differently from other goods' prices, and as such, previous values of housing prices and other variables used were required to explain current behaviors. The ARDL model is best suited for small sample size and has a capacity to estimate short-run and long-run dynamics. The ARDL model also has no burden of establishing the order of integration and it distinguishes dependent and explanatory variables. With ARDL, it is possible to use differing optimal number of lags among the variables. For VAR, the study used Toda and Yamamoto (1995) methodology. This is a modified version of granger causality test based on augmented VAR modeling. The study findings show that the sources of housing prices growth include household consumption expenditure, construction cost and property taxes both in the short-run and long-run. Private capital inflows and households' indebtedness have a positive transitory effect to the housing prices. Against the popular view, supply of housing have no effect on housing prices. For the dynamic relationship between housing prices and the selected macroeconomic variables, the results indicate that the housing prices dynamically relate with the selected macroeconomic variables. The study therefore concludes that housing prices have a positive contemporaneous impact on the selected macroeconomic variables indicating the existence of mutually reinforcing cycles between the housing prices and the selected macroeconomic variables. Therefore, there is need to observe the housing prices to avoid the cost that could result in case of instability in the housing market.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Housing is one of the basic human needs besides food and clothing in a society. It is one of the most basic human rights and an essential component of adequate standard of living (Demary, 2009). Further, adequate and affordable housing is not only necessary for security and comfort, but also critical in fostering social cohesion and development of a nation as it provides independence, privacy and amenity. Moreover, the housing purchase is linked to the purchase of other goods, not just through obvious household items such as furniture and so on, but through the purchase of neighborhood, local government services and workplace accessibility. Beyond its socio-cultural elements, housing is also a critical driver of economic development as a result of its forward and backward linkages with other economic development processes since the purchase of a house is as much an investment decision as well as consumption decision (Stiglitz, 1990). In addition, households with modest means need safe and suitable housing that they can afford. When housing is affordable, low and moderate income families are able to put nutritious food on the table, receive necessary medical care, and provide reliable care for their children (Wardrip, Williams & Hague, 2011).

Even though housing market may account for a relatively small share of national income in an economy (Housing contribution to GDP averages between 15 to18 percent in the developed economies), its economic importance is however disproportionate to

GDP share. This is largely because it tends to be one of the most cyclical components of aggregate demand (Egebo, Richardson & Lienert, 1987). The cyclical behavior of housing market is due to housing prices that are subject to short-run variability rarely matched by other consumer durable goods. This is due to the fact that, demand shifts rapidly while supply changes slowly (Giussani & Hadjimatheou, 1991). Housing prices are also related to personal savings, consumption and investment decisions (Green & Hadjimatheou, 1990). In addition, for an economy, housing is the major asset in the households' portfolio. As such, its price is tied closely to the cost and availability of credit and so, to government monetary policy (Giussani & Hadjimatheou, 1991).

The purchase of housing is also an attractive instrument of wealth accumulation especially due to tax provisions, (Arnott, 1997; Hendershott, 1980). Also, the relatively high housing prices mean rental market exists. Therefore changes in housing prices are likely to affect the distribution of wealth in favor of homeowners and older households (Giussani & Hadjimatheau, 1991).

The distinction in the demand and supply factors that drive real housing prices is between those that have a longer-term influence and those that affect shorter-term dynamics. Factors that are mainly noted to influence the demand for housing over longer horizons include growth in household disposable income, shifts in demographic factors, permanent features of the tax system that might encourage home ownership as opposed to other forms of wealth accumulation, and the availability of credit. In addition, the availability and cost of land, the cost of construction and investments in

the improvement of the quality of the existing housing stock are often taken as the longer-term determinants of housing supply (Tsatsaronis & Zhu, 2004). Housing prices, however, are intrinsically local in character (Tsatsaronis & Zhu, 2004). As such, the growth of the housing stock can be constrained in the short-run as a result of a number of factors that may include the length of the planning and construction phases and the inertia of existing land planning schemes.

The foregoing suggests that distinctive national factors can lead to significant differences in the dynamics of housing prices across countries. One set of such factors relates to the prevailing conditions in the provision of financing for the purchase of housing both by local citizens and foreign citizens. Another factor that may affect the housing prices is the specific transaction cost framework such as the level of value added tax, stamp and registration duties and inheritance taxes.

There is usually uncertainty about future prospects that follows periods of heightened volatility in housing prices. This uncertainty tends to lead to a more cautious response of housing construction due to; shifts in demand, change in financial sector balance sheet, shifts in households decisions on consumption and foreign citizens participation. To caution on this uncertainty, there is a need for empirical framework to analyze the main forces that drive aggregate house prices in any country. These forces are then used to inform policies in response to the effects of housing prices volatility.

Understanding factors determining housing prices and the volatility is important because the housing prices tend to display boom-bust episodes, which implies above trend growth in prices that is followed by sharp reversal. This has an implication to the macroeconomic variables (Demary, 2009). The macroeconomic variables in return influence macroeconomic stability through their effects on aggregate expenditure (consumption) and performance of the financial system (Tsatsaronis & Zhu, 2004). This was the experiences of the macroeconomic instability in the years 1980s to the year 2009 in developed and developing economies where housing prices were subject to short-run variability rarely matched by prices of other consumer durable goods. The experience was that housing market can have serious connection with commercial banks' lending, large private capital inflows and aggregate demand (consumption). These connections can have a pronounced impact on the macroeconomic stability (Antipa & Lecat, 2009; Apergis & Rezitis, 2003; Balchin, 2009; Collyns & Senhadji, 2002).

In Kenya, housing is a dominant component of wealth for a typical household (Vuluku & Gachanja, 2014). It accounts for 25 percent of aggregate household wealth (Republic of Kenya, 2015). It is particularly an important component of wealth for middle-class households in the country as it accounts for 70 per cent of their wealth (Centre for Affordable Housing in Africa (CAHF), 2012).

The housing prices have more than tripled between the year 2000 and 2014 in Kenya. Over this period, average prices for 1 to 3 bedrooms in the country rose by a factor of 5

from just below Ksh 2 million to Ksh 10 million. Prices for units with 4 to 6 bedrooms rose from about Ksh 10 million in the year 2000 to Ksh 31 million in the year 2015 (Hassconsult, 2015). The average housing prices growth for all types of residential housing in Kenya from the year 2000 to 2015 are shown in Figure 1.1

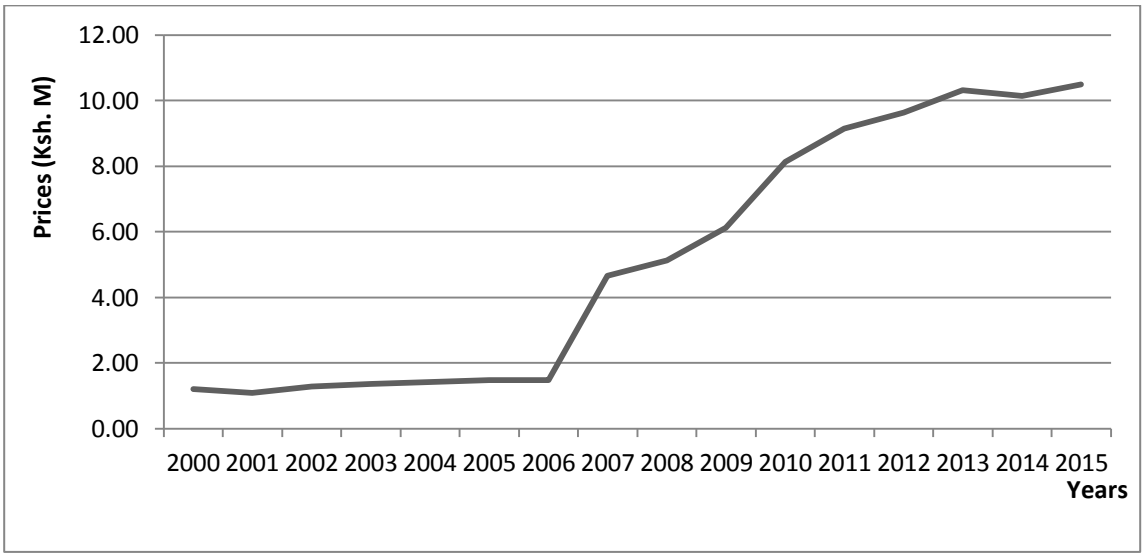
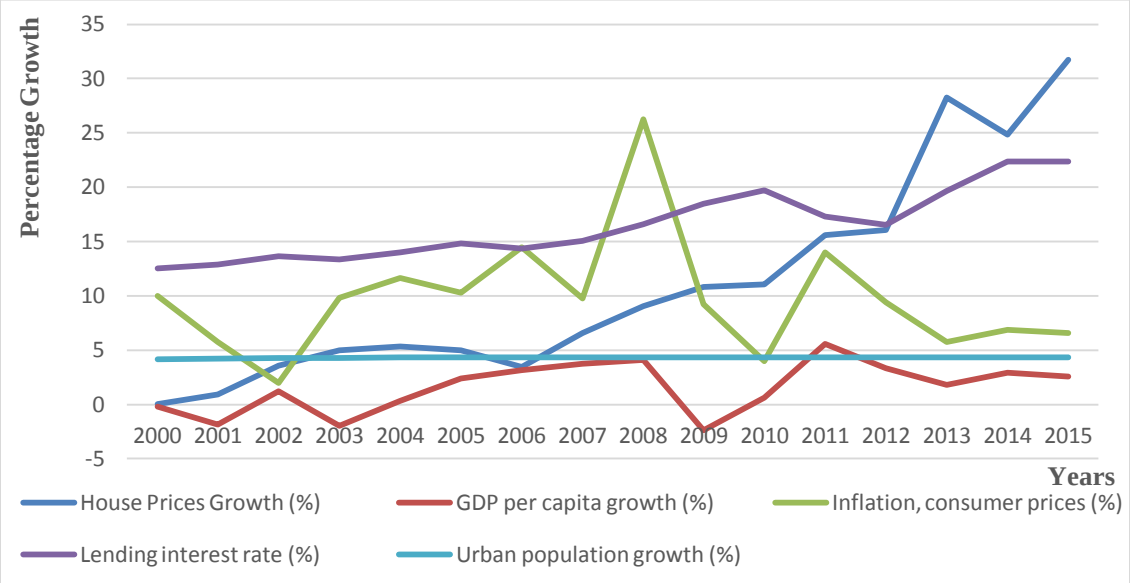


Figure 1.1: Average Housing Prices Growth in Kenya (2000-2015)
Source: Author's computation using data from KNBS

Figure 1.1 shows the growth in housing prices between the year 2000 and 2015. Vertical axis shows the housing prices in million Kenya shilling. The figures for the housing measured the average selling price for three types of residential houses for middle and upper sections of the major urban centers in Kenya. The three types of houses include apartments, bungalows and maisonettes. The average selling price was estimated using the year 2000 values as the base year. The figure indicates a rapid growth of housing prices especially after the year 2005. The cause of this growth has not been established. However, popular views have been attributing the growth to the increase in middle income population in the country (Vuluku & Gachanja, 2014).

The possibility of a housing price bubble in the Kenya housing market has been an active topic of discussion in both the popular press and academia. A housing price bubble is defined as a situation when growths of the housing prices are not supported by changes in their fundamentals (Stiglitz, 1990). The main cited fundamentals include inflation, personal income, building costs, demographic changes, housing adjustment costs and lending rates (Apergis & Rezitis, 2003; Antipa & Lecat, 2009). The issue of housing bubble is of interest to Kenya because a bursting bubble in housing prices could lead to a decrease in the value of household wealth and severe negative impact on consumption and national output. A housing price bubble could be in place in Kenya if the housing prices are overvalued. This is the case if: house prices are above their long-term trend level, housing prices cannot be explained by its fundamental factors or/and models of the housing market predict falling real house prices in the future. Figure 1.2 shows the relationship between the housing prices and some of the housing price



fundamentals in Kenya.

Figure 1.2: Growth in Average Housing Prices and its Fundamentals (2000-2015)
Source: Author's computation using data from KNBS

Figure 1.2 shows the trend in housing prices growth and the growth in some of the housing prices fundamentals between the year 2000 and 2015. Between the periods, Inflation Consumer Price Index (CPI) fluctuated between 4 and 27 percent, reaching pick in the year 2008 during the Post-Election Violence (PEV). Other than the PEV period, the CPI was below 15 percent. Urban population growth remained stable and below 5 percent. Over the period, the lending rates remained above ten percent and shown an increasing trend. A low lending rate is necessary so as to create demand for housing both as investment tools and as residential facilities. Growth in population and per capita income, which are expected to increase demand for housing and thereby affect housing prices positively, remained relatively stable and below 5 percent as shown in the Figure 1.2

Cost of construction is basically guided by availability of funds. This is because the cost of housing is not something that can be raised through households saving (Antipa & Lecat, 2009). A loan from commercial banks and other financial institutions is required. Low lending rates that create demand for housing would therefore be expected to push up the demand and hence the housing construction costs and the adjustment costs (Antipa & Lecat, 2009). As earlier noted, the cost of lending has remained well above 10 percent per annum. The drivers of the housing prices growth or even their effect on various features of the economy therefore are not unclear. The factors pushing up the

housing prices and its inter-relation with its fundamentals in Kenya are uncertain and also whether the growth in housing prices is a boom or a bubble.

Like many other emerging markets, Kenya had struggled to provide basic housing for its poor and middle income households (Vuluku & Gachanja, 2014). For the units of housing in the market, the actual prices are way above what the majority of buyers and renters are willing and able to pay. The implication of this high price is that populations that are not catered for (or could not afford given prevailing prices) had to turn towards informal housing. This has resulted in the burgeoning of slums and the related social ills including insecurity and poor standards of living in the urban centers (Wanyama, 2012).

The affordability of a decent housing has remained an elusive dream for majority of Kenyans who cannot even afford rent in formal housing systems (Vuluku & Gachanja, 2014). As a result, most urban dwellers have resorted to settling in informal settlements which lack construction fabric, basic infrastructure and security. Consequently, approximately 55 percent of the urban population in Kenya lives in informal settlements with a density of 250 shanties per hectare (Homeless International, 2010). Some of the population has chosen to settle far away from their places of work, spending long hours in commuting, inadequate social infrastructure and dirty environment (Vuluku & Gachanja, 2014).

Alongside the economic growth rates registered between the year 2000 and 2015, the Kenyan middle class has been growing too. The country's middle class reached 44.9 per

cent of the total population by the year 2011, up from 26.2 per cent in 1980 (African Development Bank (AfDB), 2011). This phenomenon is accompanied by strong growth in consumption expenditure and demand for public goods and services. This has exerted more pressure on housing demand. As a result, investment in the housing sector shows high returns and consequently, the areas surrounding urban centers has seen changes of land use from farming to residential centers. This has led to a decline in agricultural production as investors take advantage of increasing demand and high returns (Njaramba, 2011). The farms on the outskirts of the major urban centers in the country are giving way to apartment blocks or high-end gated communities. In addition, the development of road bypasses and new highways has led to massive subdivision of mainly freehold private, cooperatives and institutional land. High-end market self-controlled housing estates have emerged at a fast rate, some with no provision of infrastructural services like access roads and sewer lines and this has led to serious challenges especially in densely populated areas. The creation of new housing estates therefore has led to constrained provision of public goods (Njaramba, 2011; Wanyama, 2012; Vuluku, 2014; Hassconsult, 2015).

There is broad global acceptance that access to decent, affordable and adequate housing is a human right and an important component of the right to adequate standard of living. In Kenya, this is further reaffirmed by subsequent international instruments that Kenya is party to (Republic of Kenya, 2015). To achieve this, Kenya government has tried to develop policies to address affordability and access. During Kenya's pre-independence period, the government evolved instruments to regulate access to housing resources.

The policy aimed, among other things, to enable access to land and provision of adequate housing at the lowest possible cost. It also addressed issues to do with increased research in locally available building materials and construction techniques, mobilization of resources for housing development through aided self-help and co-operative efforts and housing for civil servants (Republic of Kenya, 2013).

The National Shelter Strategy of the Year 2000 advocated for a policy change where the Government facilitated other actors to invest in housing. This was informed by the remembrance of the international year of shelter for the homeless in the year 1987. The policy necessitated a shift from direct provision to an enabling approach (Republic of Kenya, 2013).

The formulation of Session Paper No.3 of 2004 on National Housing Policy in the year 2004 was intended to arrest the deteriorating housing conditions and to bridge the shortfall in housing stock by clearly identifying key stakeholders and outlining their role towards the housing delivery process. The policy adopted the role of enabling strategy, guided by the principles of partnership and participation by all partners in accordance with their comparative advantages. In this approach, the National and local Governments were to play a central role in provision of affordable social housing for renting to the low-income segments (Republic of Kenya, 2004).

From the year 2003, the Kenyan Government embarked on strengthening the housing sector by increasing its budgetary allocation that made housing development budget

move upwards to about Ksh. 4.3 billion in the year 2013 as compared to nearly nil in the year 2003 (Republic of Kenya, 2013). The Government also recognized the private sector as the engine of housing development and continued to play the role of enabler, partner and catalyst in the housing delivery process. In this connection, areas that required intervention by both the public and the private sector were identified in order to make housing more affordable and especially to the low income households. To this end, the following programmes were put under implementation in the Ministry of housing: Kenya Slum Upgrading Programme (KSUP) with the aim of improving the informal settlements; Revamping of National Housing Corporation (NHC) and Rural and Peri-Urban Housing Loans**.**

The revamping of rural and peri-urban housing programme was in order to give loans to persons in the rural and peri-urban areas who would wish to develop or improve their housing. The Government had also injected additional equity towards better capitalization, cash flows and improving availability of loanable funds; Housing Infrastructure Development Programme (HIDP) which was established to open up new areas for housing development and complement private sector development in reducing the cost of housing delivery; Appropriate Building Materials and Technologies (ABMT) where the Government was promoting use of locally available low cost appropriate building materials and technologies in order to reduce the cost of housing; Civil Servants Housing Scheme Fund (CSHSF) which started in the year 2004 with the aim of providing housing loan facilities to civil servants for the purposes of purchasing or

constructing residential houses and developing housing units for sale and for rental by civil servants (Republic of Kenya, 2015).

Kenya Vision 2030, the country's long-term plan, in its economic and social pillars has also recognized the housing sector as a critical component of sustainable development in the country (Republic of Kenya, 2010).

The above policies and programmes were expected to ensure progressive realization of the right to accessible, adequate and reasonable housing for every person as per the Constitution of Kenya (2010). The policies were also intended to arrest the rapid rise in housing prices countrywide by bridging the shortfall in housing stock arising from demand that far surpasses supply particularly for low-income housing in urban areas. However, the housing sector is still characterized by inadequate, unaffordable and indecent housing, low-level of urban home ownership, extensive inappropriate dwelling units including slums, squatter settlements and above all rapid growth in housing prices (CAHF, 2014; Republic of Kenya, 2015).

The policies and macroeconomic reform that started in the year 2000, together with a focus on infrastructural development and new areas for residential centers opening up, has only served to make demand for housing to increase and the housing prices to experience growth. As CAHF (2014) noted, put against average earnings the price of housing is considered high, and can only be afforded by the top income earners.

1.2 Housing Prices and Selected Macroeconomic Variables.

The housing prices behavior has influenced not only business cycle dynamics, by affecting the aggregate expenditure, but also has affected performance of the financial system through their effect on the profitability and stability of financial institutions (Mishkin, 2007). Large swings in housing prices ends in a devastating crash as was witnessed in many countries in the past. Countries that tended to experience the most severe declines in consumption once housing prices started to fall also were the countries which experienced the largest increase in households' leverage and the fastest rise in housing prices (OECD, 2004). In addition, housing purchase generally requires external financing. Therefore, the cost of credit and the conditions under which it becomes available plays a major role in shaping the pattern of housing prices dynamic and vice versa (Mishkin, 2007).

Understanding the behavior of housing price and how it dynamically relates to macroeconomic variables is of key interest to policy makers charged with maintaining prices and financial stability in a country (Mishkin, 2007). Of particular importance from a policy perspective, is the relationship between housing prices and the households' indebtedness, private capital inflows and households consumption expenditure. The variables were noted to have had severe connection with the housing prices in the economies that experienced turbulences in the housing market (Hyun, Jong & Myung, 2013)

In Kenya, households' consumption expenditure has increased as the housing prices continued to grow. As figure 1.3 shows, the households' consumption expenditure increase is in similar direction with housing prices rise.

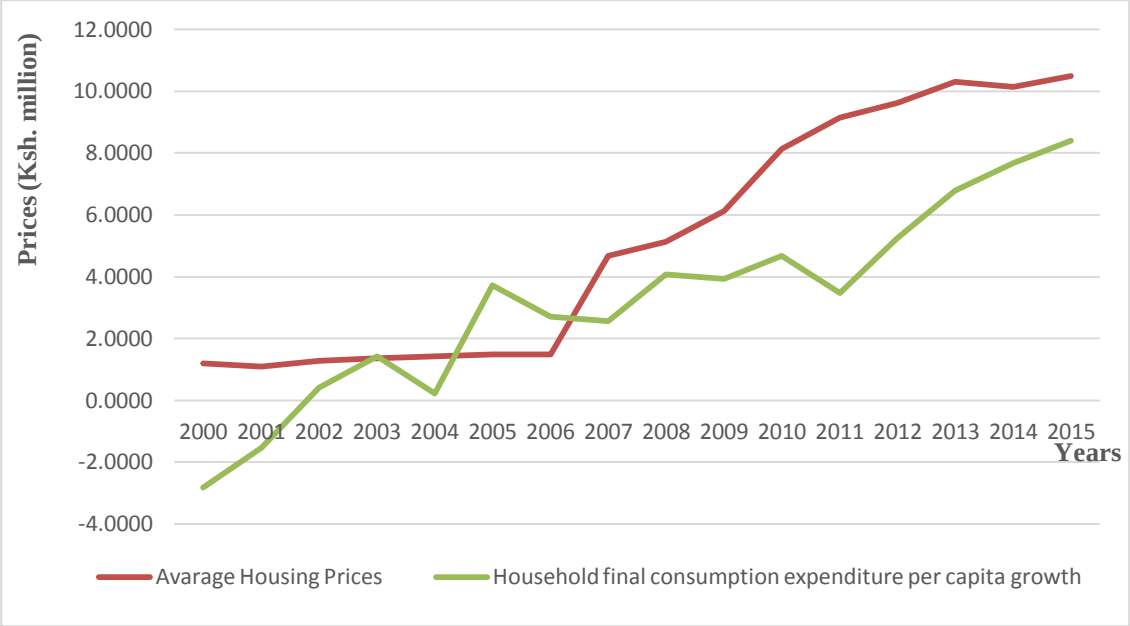


Figure 1.3: Households Consumption Expenditure and Average Housing Prices (2000-2015)
Source: Author's computation using data from KNBS

Figure 1.3 shows that households' final consumption expenditure per capita growth rose from negative in the year 2000 to above eight growth rate in the year 2015. The prices were based on the year 2001 prices. The average housing price also increased from 1.2 million to 10.5 million during the same period. Whether this growth in households' consumption expenditure and growth in housing prices are related is a concern. Rising house prices could stimulate consumption by increasing households' perceived wealth, or by relaxing borrowing constraints (Guglielmo and Ricardo, 2011).

The households' indebtedness in Kenya is also noted to have been rising. According to credit channel of housing market, housing prices growth has a capacity to lead to

household consumption expenditure increase (Mishkin, 2007). However, according to life Cycle view, when housing prices rise, households' consumption expenditure should fall due to higher deposit requirements on housing purchase (Modigliani & Ando, 1957).

For housing buyers in Kenya, the money needed to buy a house is not something they get from their savings. The large sums involved means that a loan has to be acquired to buy the property. In addition, commercial banks in Kenya accept housing as collateral for loans taken by households. The households benefit from higher loans to housing value which means higher liquidity in the market. Once the households translate higher housing prices into loans and consequently to consumption expenditure, then households save less (Filipa, Towbin & Wieladek, 2011).

To meet the demand for loans, commercial banks in Kenya have developed sophisticated and competitive financial products such as credit derivatives, full 100 per cent mortgage financing and asset-backed securities to attract borrowers. In order to increase their profitability, commercial banks and non-banking financial institutions have also moved to housing and consumption lending to increase their base. In this respect, Kenya commercial banks are reported to have had financed an estimated 500,000 houses between the year 2003 and the year 2010 (CAHF, 2012). It is therefore expected that housing prices and household debt could be closely related as figure 1.4 indicates. This is because housing is used as collateral for commercial bank loans by the households.

Figure 1.4: Growth in Average Housing Prices and Households' Indebtedness (2000-2015)
Source: Author's compilation using data from KNBS and CBK

As observed in Figure 1.4, the country was also experiencing substantial growth in households' indebtedness. Private credit uptake growth rate rose from negative in the year 2000 to over 10 percent in the year 2015. Out of this growth, housing credit uptake grew from 5.3 per cent in the year 2009 to 12.5 per cent in the year 2014 (Republic of Kenya, 2015). Whether this credit expansion to private sector had a relationship with housing prices in Kenya was an investigative issue. The interdependence can influence boom-burst cycles in an economy and increase fragility of financial sector (Oikarinen, 2009). A combination of falling housing prices and an increase in the number of households facing problems of servicing loan payments causes severe solvency problems among commercial banks and other financial institutions in an economy.

Private capital inflows are also increasingly becoming an important source of external financing for Kenya. These inflows are used to help the country fill the savings-investment resource gap and also play a critical role in promoting research and development, employment creation and economic growth. The Government of Kenya has endeavored to create an enabling environment in order to attract and retain foreign investments. Despite the measures taken to promote foreign investment, lessons from the years' 2008 and 2009 global financial and economic crisis and the 2011 sovereign debt crisis had shown that, while foreign investments has become increasingly important for developing economies, they are also sources of vulnerabilities to the economy (Syricha, 2013). The ratio of private capital inflows to gross domestic product in Kenya during the study period increased significantly together with the housing prices as shown by figure 1.5

Figure 1.5: Growth in Average Housing Prices and Private Capital Inflow in Kenya (2000-2015)
Source: Author's computation using data from KNBS and CBK

As the housing prices were rapidly growing, the private capital inflows grew from negative 0.7 percent in the year 2000 to 43 percent in the year 2015. The composition of this capital inflow into housing market however has not been established. Large flows of capital from outside usually leads to lower replacement and user cost of capital and could be the result of increased demand for housing (Syricha, 2013). Also noted was that out of the country's total mortgage, lenders received an estimated 17 per cent of its business from the foreign investors (CAHF, 2012).

The strong growth in housing price in Kenya has therefore been accompanied by strong increase in household's consumption expenditure, household's indebtedness and private capital inflows. These observations raise the question whether observed increase in the selected macroeconomic variables is merely the effect of common driving force or it reflects a direct link between the variables and housing prices.

1.3 Statement of the Problem

Since the year 2000, housing prices in Kenya have increased by over 300 percent in real terms especially in the urban centers and rapidly continues to grow. As a result of the growth, housing ownership is way above the majority of buyers and renters capacity to pay. Consequently, over 60 per cent of the country's urban population lives in slums with no permanent houses, water, electricity, social amenities nor security (World Bank, 2011; Wanyama, 2012).The agricultural lands surrounding urban centers are also being converted to residential centers so as to tap from high returns coming from housing

investments. This has consequently affected agricultural production and public goods provision adversely (AfDB, 2011; Njaramba, 2011).

Theoretically, long periods of historically low nominal interest rates, low supply of housing and demographic changes are often cited as the economic fundamentals that causes the increase in housing prices (Apergis & Rezitis, 2003; Antipa & Lecat, 2009). However, in Kenya, the nominal interest rate remains high and the ratio of the housing stock to population has been relatively stable during the study period (Republic of Kenya, 2016). The growth in housing prices has also outpaced the increase in consumer prices during the study period (Republic of Kenya, 2004, 2009, 2012, 2014, 2015; Hassconsult, 2015). The policies and macroeconomic reforms that started after independence together with infrastructural development that aimed at ensuring accessible and adequate housing in Kenya have not managed to stabilize nor reduce housing prices in Kenya (Republic of Kenya, 2010, 2013, 2014, 2015; CAHF, 2012). It is therefore not clear how housing prices respond towards the fundamental variables in the short-run and in the long-run, which could inform the policies to reduce the prices and enhance accessibility. With the growth in housing prices, it is also observed that there are increases in private capital inflows, household's consumption expenditure and households' indebtedness in the country. These variables have been noted to influence boom-burst episodes, which implies above the trend growth in housing prices, which is followed by a sharp reversal, in the housing prices (Demary, 2009). This raises the questions of whether observed increases in the variables are related to housing prices, and if there are links, what direction of causation exists. In historical perspectives, the

rise in these macroeconomic variables and housing prices boom and bust had been a significant part of macroeconomic instability experienced in developed and emerging economies (Syricha, 2013; Hyun, Jong, & Myung, 2013; Favilukis,Kohn, Ludvigson & Nieuwerburgh, 2011; Guglielmo & Ricardo, 2011). Since there are observed high growth in housing prices in Kenya, understanding the interconnections with the macroeconomic variables could help in putting in place mechanism to avoid the economy facing such macroeconomic instability.

Previous studies on housing prices and macroeconomic variables in Kenya (Njiru & Moronge, 2013; Kigige & Omboi, 2011; Muriuki, 2013, Matindi, 2013; Hassconsult, 2009) have shown that changes in households' indebtedness, changes in population and income levels affect housing prices. These studies in their modeling assumed unidirectional relationship where housing price was used as a dependent variable. In addition, these studies did not incorporate consumption and capital inflows in their estimated models and thus did not analyze the possibility of macroeconomic instability resulting from the housing prices. In this regard, the studies models have ignored the dynamic interconnection between housing prices and macroeconomic variables. Moreover, it is not clear from any of the studies which variables housing prices gravitate towards in the long-run which could then inform policies to mitigate instabilities arising from high housing prices. To caution on uncertainty that would come in periods of housing prices instability, there is need for empirical framework to analyze the main forces that drive aggregate housing prices in Kenya and the dynamic

response of housing prices to financial sector balance sheet, households' decisions to consumption and foreign citizens' participation in the housing market.

1.4 Research Questions

The study provided answers to the following questions:

i. What are the sources of housing prices growth in Kenya?
ii. What is the dynamic relationship between housing prices and households' indebtedness in Kenya?
iii. What is the dynamic relationship between housing prices and private capital inflows in Kenya?
iv. What is the dynamic relationship between housing prices and households' consumption expenditure in Kenya?

1.5 Objectives of the Study

The main objective of the study was to analyze the sources of housing prices growth in Kenya and examine its dynamic relationship with selected macroeconomic variables in Kenya. Specifically the study aimed at:

i. Analyzing the sources of housing price growth in Kenya.
ii. Examining the dynamic relationship between housing prices and households' indebtedness in Kenya.

iii. Examining the dynamic relationship between housing prices and private capital inflows in Kenya.

iv. Examining the dynamic relationship between housing prices and households' consumption expenditure in Kenya.

1.6 Significance of the Study

The results from this study are of interest to the Government of Kenya in the light of the current policy debate in Kenya regarding housing affordability and how to tackle the exponential growth in housing prices especially in urban areas. With the rate of increase in house prices in Kenya, it is also of interest to investors in understanding the trend and variables that housing prices gravitate to both in the short-run and in the long-run. In particular, the study is important to financial sector in regards to analyzing the risk posed by housing sector to financial stability. The study will also add to the literature in housing market dynamics that currently is far from consensus.

1.7 Scope and limitation of the Study

The study confined itself in analyzing the main sources of housing prices growth in Kenya and establishing the dynamic relationship between housing prices and macroeconomic variables. In doing this, the study used data for the period 1960 to 2015 for housing prices, consumption, households' indebtedness, private capital inflows in Kenya and other variables used in the estimations. The period was long enough in order to capture the dynamics of the variables used in the study's analysis. The macroeconomic variables were selected based on their historical relationship with

housing prices, especially in the economies where housing market have experienced instability. Other variables like housing decision on location, speculation in housing market and monetary policy effect on housing prices were not captured in the study's analysis based on the data availability. In addition, variables like construction costs were not available in their various components.

1.8 Organization of the Study

Chapter one discusses the background of the study, the statement of the problem, the research questions and the study's objectives, the significance of the study, the scope and organization of the study. Literature review is presented in chapter two, while chapter three presents the methodology. Chapter four presents and discusses empirical findings and chapter five presents the summary, conclusions and policy implications of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Theoretical Literature Review

This chapter presents theoretical literature, empirical literature and review of these literatures. Under theoretical literature, theories touching on housing market equilibrium, determinant of housing prices and on dynamic relationship between housing prices and macroeconomic variables are discussed. Under empirical literature, studies on sources of housing prices growth and dynamic relationship between housing prices and the selected macroeconomic variables are reviewed.

2.1.1 Life-cycle model of household consumption

According to the life-cycle model of household consumption by Modigliani and Ando (1957), a permanent increase in housing prices gives rise to an increase in household consumption spending and households' indebtedness when homeowners make smooth their consumption spending over their life time. Together with this wealth effect, collateral effect also affect housing prices due to the fact that housing are often used as collateral for loans since they are immobile and cannot easily be put out of a creditor's reach. As a consequence, higher housing prices not only induce households to spend and borrow more, but also enable them to do so by enhancing their borrowing capacity.

The effect of a growth in households' wealth brought about by change in housing prices is however not clear a priori. This is due to the fact that a permanent rise in housing prices will have a positive wealth and collateral effect on house-owners. The permanent

rise in housing prices will also have a negative income effect on renters. These tenants will have to pay higher rents. The rise in housing prices will as well have a negative effect to a prospective house buyer who will now have to save more for their intended housing purchase. Therefore, those who have already satisfied their housing requirements will gain from housing prices increase, while those that are yet to own a home will loose from increase in housing prices.

Another group of losers from growth in housing prices will be those that are young and those yet to be born since they are yet not earning for themselves. This group cannot save more, or lower their current consumption.

From this analysis, there is an asymmetry between gainers and losers. Which of the effect will dominate in the market? There are effects that works in favor of a positive wealth or collateral effect of housing prices on households' consumption expenditure and which work against. The housing prices growth affects wealth and collateral by affecting consumption spending and also aggregate investment. This could imply adjustments in the manner in which credit is demanded and supplied. This again gives a potential causal link between housing prices and households' indebtedness. Housing prices may influence credit demanded and supplied through the effects on wealth and consumption and also through Tobin's q effects on investment. The collateral effects could also have an impact on the credit supplied. More effect of credit supply may come through the effect of housing prices on the balance sheets for commercial banks. Such an effect may come directly from commercial banks' wealth on property and indirectly

from the effect of higher loan to value ratio as housing is used as collateral by households when securing credit. An exogenous change in credit supply, which may results from financial liberalization, may result to increase in housing prices in return. The housing prices can also be seen as price of assets where it is expected based on the discounted future stream of housing returns.

A rise in supply of credit reduces opportunity cost of capital and this stimulates current and expected future economic activities. When this happens, housing prices will grow because of rise in the expected return on housing resulted from the reduced discounting factor. A rise in the credit availability will therefore give rise to the demand for housing because households are now not constrained in their borrowing. With supply of housing being fixed in the short-run because of the time taken to complete new housing units, the increased demand will result to growth in housing prices. The effects to the housing prices or to the households consumption spending and indebtedness is however not conclusive. The total effect will depend on the dominant effect between the effect to home owners and to the tenants.

2.1.2 Perfect Competitive Theory of Housing Market

Alonso (1964) visualized the housing market graphically by use of supply and demand curves which describes the interaction between the housing prices (on the vertical axis) and the quantity of housing supplied and demanded (on the horizontal axis). Buyers' and renters' demand for housing is represented by a downward-sloping curve which implies that they will demand more at lower prices while suppliers' reaction is

represented by an up-sloping curve which implies that sellers will put more housing in the market at higher prices. The equilibrium housing price for the housing market is therefore established at the point where the two curves intersect indicating a stable housing price. At this price, the amount of houses demanded and also supplied to the market are equal, and therefore at that price, the buying and selling price is set, and that the market is said to clear. For this theory, as with many other consumer goods, the basic view of housing is that it functions in a perfect competitive market. The determinants of housing prices therefore are said to be the interaction between the demand and supply of housing. But the assumption that housing stock is a capital good that is related and adjustable to the demand and supply may not hold in the real housing market. Housing market like some other markets is subject to market imperfections. In addition, as much as the theory gives direction in the consideration of demand and supply as determining housing prices, it does not give the specific variables affecting the demand and supply, which are then to be handled by policy makers in management of housing prices.

2.1.3 The Tobin's q Theory of Housing Prices.

Following Tobin (1972), if the expected future marginal product of capital increases, the desired level of capital increases. In the case of housing market, the equivalent analysis is that the higher the housing prices (explicit or implicit) households are willing to pay due to growth in the demand for housing, the higher the marginal return in the housing market and the housing investment demand will to go up. Therefore, as the relative housing prices increase, investment in housing will increase as well thereby

increasing supply. Households will be willing and able to pay higher prices if their expected future income is higher or if there is an increase in the number of households that demand for housing. This eventually bids up the housing prices. Therefore, expected higher income or increases in household expectations lead to higher demand for housing. An increase in relative housing prices will then bid up investment in housing market.

The user cost concept in this theory is one of the key factors in determining housing prices. This is because it provides another source of shifts in the demand curve for housing. For instance, if the real interest rate on mortgage loans declines, then the cost of financing housing purchase declines and the user cost of housing falls, so households will be in a position to buy new or bigger or spacious housing. Therefore a decline in real mortgage rates leads to a higher demand for housing, a higher relative price of housing, and an increase in housing investment. Therefore, higher expected income or increases in household formation lead to higher Tobin's q and hence increase in relative housing prices and higher residential investment. The theory therefore captures the role of investments and demand in the housing market under the assumption of developed financial and property market (frictionless market). Current study used the same theory but incorporated more variables and considered a market with relatively more frictions.

Another theory attached to Tobin's q theory is theory by Stahl, (1985) on microeconomic analysis of housing markets. It expounds on the component of user cost by capturing expected rate of change in the real price of the capital asset. In the context

of housing, this term is the expected rate of change in real housing prices, and it can be a very important source of changes in housing demand. If households expect housing prices to appreciate, then the user cost declines, causing the demand for housing to increase. The relative price of housing will then rise, and residential investment will increase (Stahl, 1985).

Putting it in another way, if housing market is expected to be a good investment, demand for land and construction materials will increase and the demand for new housing will increase. Hence, expected real appreciation of housing prices leads to a higher demand for housing, a higher relative price of housing, and an increase in housing investments. Based on this, housing demand can be affected by financing frictions. If lenders loosen lending standards and so make loanable funds more available to households, then financing constraints become less binding and households that otherwise would have been unable to purchase housing will now be able to. Therefore, looser financing constraints lead to a higher demand for housing, a higher relative price for housing, and an increase in housing investments.

By use of a similar reasoning, tighter financing constraints lead to a lower demand for housing, a lower relative housing price, and a decrease in housing investment. The theory therefore suggests that the reason for the growth in housing prices is due to changes in the user cost brought about by expectations and financial liberalization. However, the effect of expectations and loose financial conditions in the theory's modeling on housing prices is still inconclusive.

2.1.4 Search Theory and the Housing Market

Wheaton (1991) developed a model that indicated a strong theoretical inverse relationship between vacancy and housing prices. The model explains that there exist a relationship between housing vacancy and housing prices as a result of transactions costs in the search for housing process. The search and matching model is likened to the labor market. In the labor market economics, the search theory is applied to explain why labor markets do not clear. Since at any given point in time there are workers searching for work and firms looking for workers, then the labor market does not clear. In a similar manner, the existence at every point in time of unoccupied housing and different costs housing and at differing areas, with a number of buyers and renters searching for housing could suggest that the housing prices are not stable. The prices will keep on shifting depending on vacant housing and buyers and renters movements. Wheaton (1991) consequently observed that the theoretical framework in labor market that deals with matching models of workers with the available jobs in the labor market, conforms well to the housing market. This is a case of stock-flow characteristic in which housing prices do adjust in the short run to equate the demand and supply where the housing stock is fixed.

In the housing market, just as in the labor market, the number of vacant houses, space, quality and the time it takes to have them sold changes depending on market factors and shocks. The buyers will be in search for the best prices, spaces and quality, which will

set the short-run prices. Therefore in the search theory, the number of housing and the number of households are mismatched only in responses to shocks. The prospect of remaining mismatched in the short-run reinforces the search efforts while the suppliers' reservation prices will be based on expectations about the time it would take to sell and the cost incurred in holding the housing units. Higher vacancy according to Stahl (1985) model will increase the time it takes to sell a housing unit. This will eventually lower the suppliers' reservations prices, speeds up the time taken for search which in the end results in decrease in housing prices. With time, new housing units are supplied to the housing market and vacancy increases until the cost of supplying such units will equal the selling or the expected prices (the price discounted by expected sales time).

The rate of vacancy which the expected housing prices equal the cost of producing the unit of housing is therefore the market's long-term stable price. This model is consistent with a positive correlation of housing sales and housing prices in the housing market. A shift in demand for housing will imply that the market becomes mismatched which changes sales and prices. An increase in demand will mean more difficulty for housing buyers to locate a suitable housing match, the increase in demand will be propagated into the following periods. The theory therefore takes that, the reason for housing prices increase will emanate from the fact that supply of housing will not adjust fast enough to meet the increased demand. The theory therefore concludes that, shifts in the demand for housing to be the sole reason for housing prices instability as the supply will not adjust in the short run to meet the changes in demand. In the long run however, the housing prices adjust with the adjusted supply to equate to the marginal cost. The theory

supports the hypothesis that the housing prices do not correspond to marginal cost in the short-run and it takes time to complete a new housing unit and respond to increased demand. The theory captures the role of expectation formation but has missed on the effect of an oversupply in response to an increased demand that may lead to housing prices declining below their marginal costs or as commonly referred, bubble-bursting.

2.1.5 Horizontal and Positive Sloping Long-Run Housing Supply Curve Theory

Shiller (2005), in the theories of horizontal housing supply curve, indicated that the real housing prices would remain fairly constant in both short-run and long-run periods. This theory is as illustrated through use of Figure 2.1.

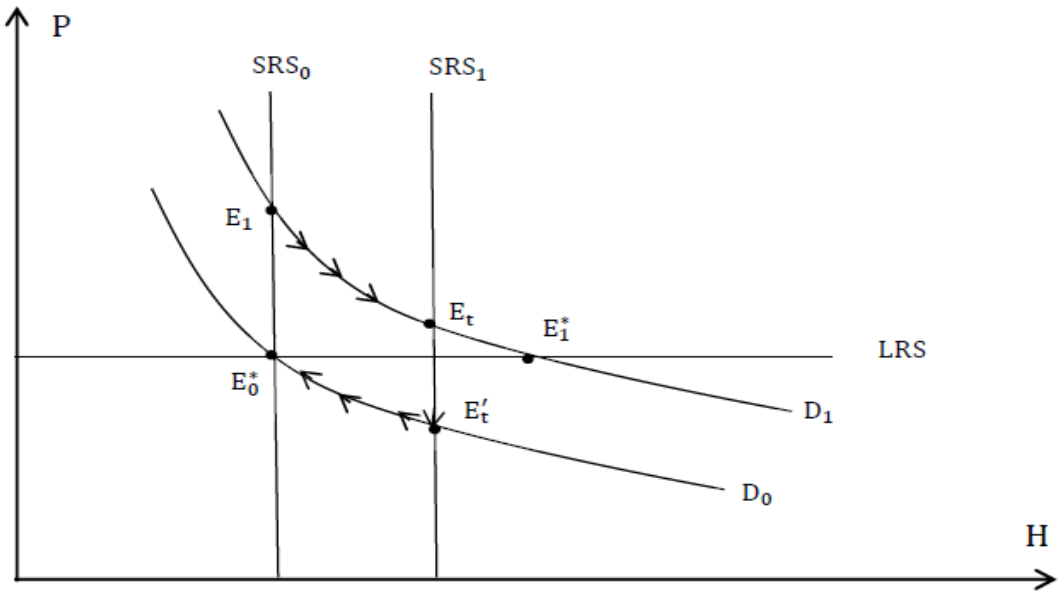


Figure 2.1 Dynamics of the housing market
Source: Shiller, (2005)

From the figure 2.1, the horizontal axis shows the stock of housing (H) while the vertical axis shows the real housing prices (P). The horizontal curve labeled LRS shows

a constant marginal cost of supplying a housing unit. When the housing price goes beyond this marginal cost, it becomes profitable to supply an extra unit. That is, the selling price of a unit of housing exceeds that of producing it. Housing suppliers add to the stock of housing by building new housing. But when the price of existing housing is below the LRS, the cost of constructing a new home exceeds the selling price. Consequently, the suppliers will face a loss which makes the construction activity not attractive and, as a result, the housing supplies will stagnate. The vertical curves SRS_0 and SRS_1 are short-run housing supply curves. The curves indicate that the housing stock existing at a point in time is fixed. The downward-sloping curves D_0 and D_1 are demand curves. The curves show that the demand for housing will vary with the housing prices. At higher housing prices, less housing units will be on demand and vice versa.

What housing buyers and renters demand is a flow of housing services. This could reasonably be taken that the consumption of housing services is directly proportional to the stock of housing which is measured along the horizontal axis. The annual cost of housing services provided by a unit of housing with a market price P is assumed to be CP, where C is taken to be the user cost of housing. The user cost of housing will depend on the market interest rate, property taxes, maintenance costs etc. If the user cost of housing (C) is constant, the cost of housing services (P) will then be proportional to the housing prices. A reduction in housing prices will therefore induce a higher demand for housing services. This is indicated by the negative slope of the demand curves in Figure 2.1. The demand for housing will depend also on other factors such as

disposable incomes, credit availability, and other variables. If households' income goes up, an equivalent of reduction in the lending rates (thereby the user costs), the demand for housing will go up at a given level of housing prices, and the demand curve for housing therefore will shift to the right.

The theory illustrates the market forces that will tend to keep housing prices in line with real construction costs in the long-run. Taking an initial situation in the housing market to be given by the equilibrium point noted as (E^*_0) in the Figure 2.1. This point is a long-run equilibrium point where housing demand is equated to the housing supply and where the marginal cost of building a new house is just equal to the cost of acquiring an existing housing of the same size, location and quality. In this long-run equilibrium point, the construction of new housing unit is just sufficient to make up for the depreciation of the existing housing stock. This means that the aggregate housing stock will remain constant in the short-run.

Let at a given point of equilibrium in the Figure 2.1, time t_1, households' disposable income goes up such that the housing demand curve shifts outwards from demand curve (D_0) to demand curve (D_1). In the short-run the housing stock will be fixed at (SRS_0) because it will take time to build and to add to the existing stock of housing. On impact, housing prices will have to increase from supply curve (E^*_0) to supply curve (E_1) in order to clear the housing market. In this new short-run equilibrium, the prices of existing housing will exceed the cost of building new housing. This will drive construction activity above the levels necessary to compensate for depreciation of the existing housing stock. As additional housing units will be added to the current stock of

housing, the short-run supply curve (SRS) gradually will shift to the right hand side so that housing prices will gradually be forced back towards their original level. If there will be no further disturbances occurring, this adjustment process will continue until the housing market reaches a new and long-run equilibrium at point (E^*_1) as shown in the Figure 2.1. At this point the housing stock will increase, but prices will be forced back in line with construction costs.

Alternatively, if at equilibrium (E_t), where the housing market was in short-run equilibrium at that point, if the consumers' disposable income fell back to its original level such that the demand curve shifted back to equilibrium (E_0), then, in the short-run housing prices had to fall from equilibrium (E_t) to equilibrium (E'_t) where existing stock of housing were cheaper than new supply of housing. This means that construction activity fall below the level needed to maintain the housing stock, so the short-run supply curve gradually shifts to the left. The process continues until the housing market is back in the original long-run equilibrium at point (E^*_0) where housing prices are equal to construction costs (Shiller, 2005).

The theory as illustrated in Figure 2.1 indicate that real housing prices tends to be constant in the long-run. This implicitly assumes that the prices of land does not increase more than other prices and that labor productivity in the construction sector increases in line with productivity in all other sectors. Because the supply of land is fixed, it would be hard to increase the supply of land that will be used for housing supply purposes without pushing up the real land prices. Since land is a scarce resource,

the long-run supply curve in the housing market should be positive sloping. This should be as depicted by Figure 2.2:

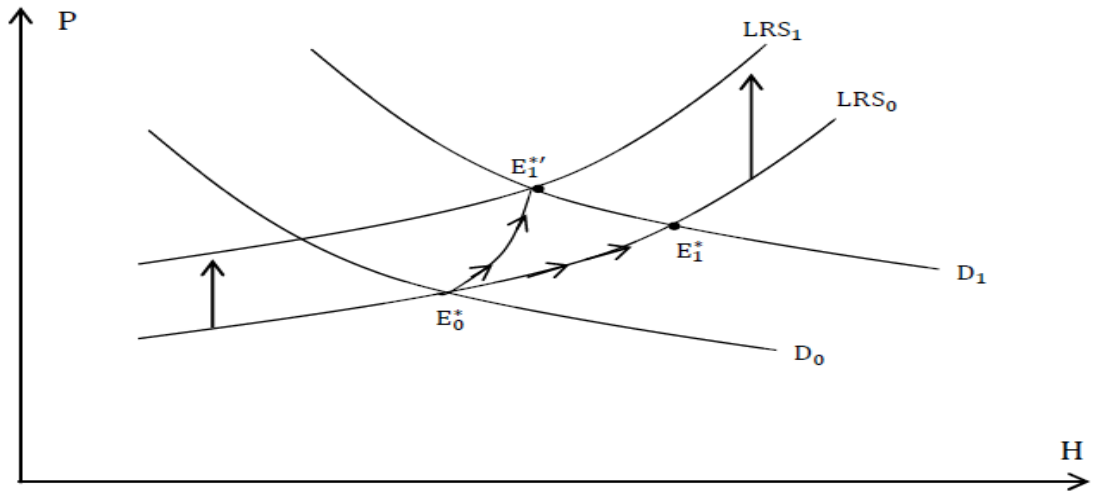


Figure 2.2: Equilibrium in the housing market under land scarcity
Source: Shiller, (2005)

Based on Figure 2.2, if the supply of new housing increases, the demand for land also increases. With total land supply being fixed, the real price of land has to go up so that the land market is cleared. Construction firms react to this by economizing on the use of land. This could be, for example, by erecting taller apartment buildings, but there is probably a limit to the possibilities of substituting buildings for land in the housing sector. As households' income grows, it shifts the housing demand curve to the right hand side (D_1), the housing prices move up along a rising long-run housing supply curve due to an increase in the real price of land. This is illustrated by the movement from equilibrium point (E^*_0) to another equilibrium point (E^*_1) in Figure 2.2. Again, the long-run growth of output in other sectors is likely to raise the total demand for land. This drives the relative prices up. Because of this, the real cost of supplying a new

housing unit goes up even if the demand for land used for housing did not change. From Figure 2.2, the long-run housing supply curve shifts upwards from supply curve (SRS_0) to supply curve (SRS_1). The long-run growth process thus take the market from the equilibrium (E^*_0) to equilibrium point ($E^{*\prime}_1$) rather than equilibrium point (E^*_1) (Shiller, 2005).

The other assumption in the horizontal long-run housing supply curve in Figure 2.1 was that labor productivity in the housing market evolved in line with productivity in the rest of the economy. But if productivity in the building industry is lower than the other sectors, it is to be expected that the industry's unit labor costs will rise at a faster rate than elsewhere in the economy. This is by assuming that the wages of construction workers have to increase at the same rate as the average wage level. This is because construction firms could not otherwise attract labor given their lower growth in labor cost. Construction costs would then rise at a higher pace than the general prices level. Such a trend provides a further reason why the long-run supply curve shifts upward in the long-run.

The Shiller, (2005) theory therefore attributes the growth of housing prices to fixed inputs in the housing production and increase in labor costs. Due to these factors, the housing supply curve is positively sloping. Where the supply of land is economized by electing taller building and no change in labor demand, the supply curve is vertically slopping. The theory however assumes uniformity of workers. In many developing

market, labor market is characterized by varying attributes and not substitutable through the various production sectors. In addition, the theory does not capture the effect of government policies to the housing prices dynamics.

2.1.6 Transmission of Housing Price fluctuations to the Real Economy

Mishkin (2007) theoretically gave the direct connection between the housing prices movement and the macroeconomic variables to occur through residential housing investments. Increases in housing prices increase the housing prices in relation to the cost of supplying it. That is, Tobin's q for residential housing investments increases. New supply of housing gets higher returns if housing prices grow above the cost of supplying. Investment in the housing will thereby have a positive relationship with housing prices. In addition, the collateral valuation of housing affects the ability of firms and individuals to acquire loans from commercial banks for purposes of investment or/and funding consumption. This gives rise to a possible and positive relationship between housing prices, housing investments, households' indebtedness and households' consumption expenditure. This link could be through collateral effect on wealth and access to credit by borrowers as a result of housing prices increase. Housing prices will affect the demand for credit through the wealth effect on households' consumption expenditure and through Tobin's q effects on housing investment.

The case of housing as collateral will also affect credit supply by the commercial banks which in turn give rise to higher housing prices given the commercial banks' balance sheet. Such an effect may result directly through banks' property wealth, and indirectly

via the effect on the value of loans secured by housing. An external change in commercial banks' credit supply such as those driven by financial liberalization might then lead to an increase in housing price. This growth in housing price could be seen as those of asset pricing, whose returns are based on expected future stream of discounted returns. Growth in credit supply reduces the lending rate and in return the discounting factor which results to stimulation of current and future expected returns on economic activity. This leads to increased demand for housing as an investment tool as well as increased housing services consumption since households are not credit constrained. Since the supply for housing is fixed in the short-run as it takes time to construct new unit of housing, the increase in demand will be absorbed by increase in housing prices.

This theoretical consideration suggests that there is reasonable ground to believe that there could be a multidirectional linkage between housing prices, commercial banks credit facilities, households' consumption expenditure and the wider economy. However, while this theoretical consideration gives a tentative indication, it does not allow a definite conclusion. In the absence of fully fledged theoretical models integrating all the possible linkages between housing prices, credit, households' consumption expenditure and the other macroeconomic variables as have been described above, the issue of concrete inter linkages ultimately has to be addressed empirically and this is the driving force behind the current study.

2.1.7 Home Equity Extraction/Mortgage Equity Withdrawals Theory

Home equity extraction tries to provide an explanation of the link through which rising housing prices can stimulate consumption spending**.** According to Mishkin, (2007), the central problem in credit market is asymmetric information. Commercial banks are reluctant to avail loans since they have difficulties determining whether a borrower has the resources to repay the loan and, if the loan is made, whether the borrower will engage in risky behavior that lowers the ability for the loan to be repaid. Availability of collateral reduces these information problems. This is because collateral that is easily valued and easy to take control significantly reduces losses to the commercial banks if the borrower defaults on the loan and decreases the incentives for the borrowers to take on excessive risk. If residential housing related loans are readily available to households, then a rise in housing prices necessarily leads to more potential collateral for the households, which will improve both the amount and terms of credit available to them. The importance of growing housing prices in relaxing credit constraints and stimulating consumer spending is dependent on the efficiency of mortgage markets that enable home-owners to overcome credit constraints. In countries with developed mortgage markets or housing collateralized lending, consumer spending may therefore be more sensitive to increases in housing prices. However, for countries whose mortgage market is not fully developed, the link between housing prices and credit market is an empirical question.

2.1.8 The global savings glut hypothesis

This implies high capital inflows from other markets into the domestic market that depresses long term interest rates. The hypothesis is defined by works done by

Bernanke and Mark (2005), Mendoza, Quadrini and Rios-Rull (2007), Bernanke (2008), Caballero, Farhi and Gourinchas (2008) and Caballero and Krishnamurthy (2009) which contends that, a possible event for the Asian financial crisis in the late 1990s that led to an increase in savings in developing countries, notably China and emerging Asia was in search for safe, high-quality financial assets that their own economies could not provide. Because of the development, high returns and safety of U.S. Treasury and Agency markets, those savings did find their way to the U.S. market. Since the savings in developed nations remained roughly unchanged by these events, this resulted into an increase in savings in developing nations and caused an increase in the world-wide savings. This gave rise into the global savings glut. The global saving glut hypothesis links the capital inflows patterns to the rise in U.S. housing prices. That is, low interest rates that were driven in part by the capital inflows were the key forces behind the higher housing prices during the housing boom. This therefore indicates that there exists a link between credit and housing prices that arise via housing wealth and collateral effects on credit demand and credit supply, and through results of credit supply fluctuations on housing prices. Therefore, with increased capital inflows, the domestic interest rates are suppressed increasing demand for housing. The hypothesis however is not conclusive.

2.2 Empirical Literature

2.2.1 Sources of Growth in Housing Prices

Charles (1970) used the hedonic pricing approach to disaggregate the location, structural and neighborhood attributes of a housing. The study tested for these

individual attributes influence on housing prices growth. Under the assumption that the attributes of housing cannot be priced explicitly, the study made use of hedonic regression to analyze the housing's implicit prices. In hedonic pricing, the individual dependent variables are regressed onto the independent variables, the selling price of the house. The implicit prices that were used were according to the market's valuation of each of the housing attributes. The housing attribute were considered generic and was priced the same for all houses that had similar attributes. The study finding was that the housing price is the sum of the implicit attributes. The results were appealing given the different attributes to the housing units. This modeling approach however ignored the practical world of uncertainty, speculation, purposeful behavior and also left out forces of demand and supply.

Dipasquale and Wheaton (1994) studied on the Markets for Real Estate Assets and Space in U.S. The study used a stock-flow model in analysis of U.S. housing market. The study's results gave evidence that housing market takes several years to clear. Through extension of the traditional stock-flow framework, the study analyzes whether housing prices converge to the equilibrium over the years. It used an equation for a housing market clearing price determined by demand variables and the actual stock flow. The study estimated the equation for investment in the residential housing whereby construction was a dependent variable and housing prices was an independent variable. Other variables like level of the existing stock and an array of cost shifters were also used as exogenous. The study concluded that residential investment increases when housing prices increase. The long-run supply elasticity was shown to be higher

than in the short-run. The study however was unidirectional and did not address the endogeneity issues. That is, the changes in housing prices could be affected by the level of housing investment in an economy. The current study addressed this gap by using ARDL model and determined the effect of flow of housing stock to the housing prices.

Apergis and Rezitis (2003) studied the dynamic effects of the macroeconomic variables on the housing prices in Greece. By use of Vector Autoregressive modeling, the findings suggested that the changes in housing prices respond to the lending rates, inflation, employment and money supply. The study found interest rates, inflation and the employment rate to be the most important variable in explaining housing prices while money supply was insignificant. Emanating from the study's findings, the main causes of the financial crisis in Greece in the year 2008 were: the excessive demand of housing, the consequent decline in demand and increasing stock of housing, tight monetary policy that raised the interest rates, negative prospects for the future performance of the housing market, rising unemployment, adverse economic environment the excessive tax burdens of the private property. The study concluded that the main drivers of housing prices in Greece and the financial crises are the six mentioned factors. The current study applied the methodology to Kenya where the housing market has not experienced instability.

Antipa and Lecat (2009) used annual data from 1975 to 2007 to identify factors that affect housing prices growth in France and Spain, using an Error Correction Model (ECM). The findings show that real disposable income, interest rates, demographic

changes, the housing finance system and lax borrowing conditions play major parts in determining housing prices. The study also noted that the housing price increase in the U.S. in the early 2000s was caused by fundamental determinants such as increases in household income and decreases in mortgage rates. The study's results showed housing prices in the countries to be about 20 percent overvalued compared with the level explainable by fundamental determinants, but that the extent of overvaluation is reduced when the eased borrowing conditions are considered. The current study used similar approach for Kenya and also incorporated other variables.

Acharya et al. (2009) used Probit model and data for the period, 2007 to 2009 to analyze the U.S. year 2009 financial crisis. The study analysis shown that risk related not only to commercial banks and business institutions that had high risk exposure, but also the commercial banks that had less capital base, were larger in size, greatly relied on short-term credit funding and were also aggressive in their credit growth. The study observed that in the context of the sub-prime crisis, historically low interest rates fueled credit expansion and consequently the housing price booms that were experienced in the U.S. and U.K. from the year 1997. In the UK, the study noted, the housing boom was accelerated by rising demand for housing together with inadequate housing supply and between the years 1997 – 2007, total households' indebtedness relative to GDP rose from 50 percent to 80 percent. The lending decisions were then driven by the fact that high Loan to Values was defendable since continued housing price appreciation would erode borrowers' debt burdens.

In the US, lending patterns were similar but driven by the need to direct credit to previously excluded social classes. The study however only looked at the demand factors in the housing market. It identified demand shifting factors to include stock of housing in a given period of time, cost of mortgage, price expectation, foreign demand for housing in the domestic market and the demographic changes. The current study borrowed the identified variables by Acharya et al. (2009) and included them to cater for the demand side of housing market to avoid misspecifications problem and also carried the study under different economic environment. The current study also used VAR modeling technique to capture the housing market dynamics.

Kigige and Omboi (2011) studied the factors influencing housing prices in Meru County of Kenya based on data from a cross sectional survey of real estates. The variables used were incomes of real estate investors, location, demand and realtors influence on the housing prices. The size of the population was 15,844 for the five selected areas of Meru County. From the data, a sample of 390 real housing owners was selected by stratification for the selected sample and then selecting the respondent by using simple random selection technique. The findings showed that income contributes around 70 percent of the variation in housing price. Demand for housing contributes approximately 20 percent of the change in housing price. Location and type of Realtors were found not to be significant in determining housing price. The factors considered explained up to about 70 percent of variations in the housing prices. The results were only applicable to a small section of the country. The current study used quantitative data analysis using time series data for the whole country to investigate factors influencing growth in housing prices.

Madsen (2011) used Tobin's q theory to develop a model of housing prices for the industrialized countries. The model was then used to show that change in the lending rate, population changes and per capita income have transitory effects on housing prices while the sources of housing prices growth in the long run are brought about by prices of developed land, VAT, property taxes, and construction costs. While taxes traditionally influenced housing price via the user cost channel, the study shows that taxes affects housing price in the long-run via the acquisition cost channel of housing. For this reason, taxes have an effect on housing price that is quite different from that of user cost based model. Madsen (2011) used data spanning four centuries for the Netherlands, one and half century for the US and Norway and about half a century for the rest of the countries. Estimation was done through the use of dynamic ordinary least squares (DOLS) estimator which requires variables to be integrated of the same order. The current study used similar approach but made use of ARDL modeling for different integrated variables and also used time series data in analyzing the sources of housing prices growth in Kenya.

Panagiotidis, Kontonikas and Montagnoli (2015) sought to determine the macroeconomic factors affecting housing price in Greece. The study was informed by the collapse of housing market in the country and the consequent recession which created chain reaction that affected most of the economic sectors of the Greek economy. This collapse of the housing market raised the question whether housing prices reflects its fundamentals. The study examined the macroeconomic variables likely to be closely

associated to the housing market, and employed the two stages Vector Error Correction Models (VECM). The VECM takes into account independent variables and allow short-run and long-run dynamics by avoiding endogeneity problems. The direction of causality between housing prices and the macroeconomic variables, together with the long-run relationship between housing prices and these variables were also investigated. The empirical analysis for the Greek Housing Market employed monthly data for the period 1997:M1 to 2013:M12. The study found that the main reasons for the housing prices rise in the period 1997-2002 were the households' indebtedness brought about by deregulation of the banking sector, the convergence of the Greek economy with the rest of the euro zone bringing about increased capital inflows, the prosperous macroeconomic environment resulting to increased income, the inflation decline and the lending rates decrease. This study was useful in exposing appropriate variables to consider when analyzing housing market. The study was carried out in a relatively developed market and also under the condition of unstable market emanating from the housing prices boom burst. The current study, after borrowing the variables of interest from the Panagiotidis, Kontonikas and Montagnoli (2015), also made use of ARDL modeling.

2.2.2 Housing Prices and Households' Consumption Expenditure

Aoki, Proudman and Vlieghe (2004) studied the relationship between the housing prices, households' consumption expenditure and monetary policy using a financial accelerator model in the developed economies. The study found that housing serve two purposes. They serve as shelter to the households and again serve as security to

decrease the lenders' costs that are related to borrowing. According to the study, these connections amplifies and propagates the impact of monetary policy shocks to the investment in residential housing, to the housing prices and then to the households consumption expenditure. The study also analyzed the effect of structural changes in loans market. This is the case if transaction costs of additional borrowing against housing equity are decreased. Such changes will increase the effectiveness of the monetary policy shocks on the households' consumption expenditure but will lower the effectiveness of the monetary policy shock on housing prices and investment in the housing under specific conditions. The conclusion was that the housing prices play a role since the housing is used as a security when borrowing from commercial banks so as to reduce the cost associated with borrowing in financing investment in housing and households' consumption expenditure. The study serves to show that housing is used as collateral in accessing funds from the commercial banks. The funds are then used for purposes of smoothening consumption. However, the link between housing prices and credit facilities is not conclusive to all economies as it is based on specific countries' economic conditions.

Campbel and Cocco (2004) investigated how housing prices affected households' consumption expenditure in United Kingdom (UK), through use of micro data. The study found that, rising of housing prices could stimulate households' consumption expenditure through increase in the households' perceived wealth, or by reducing borrowing constraints. The study investigated the response of household consumption expenditure to housing prices using UK micro data. It estimated a large effect of

housing prices on households' consumption expenditure for older homeowners, and the smaller effect, that was not different from zero, for younger generation. The finding is consistent with heterogeneity in wealth effects across the groups. The study concluded that as the population age and become more concentrated in the old homeowners group, total consumption expenditure become more responsive to housing prices. Together with this, regional housing price affects regional households' consumption expenditure growth. Changes in housing price is correlated with changes in households' consumption expenditure, in particular for the households that are more likely to be constrained when it comes to borrowing. However, this effect is driven by national rather than regional housing prices and is important for renters as well as homeowners. This suggested that UK housing prices are correlated with total financial market conditions and the households' consumption decisions. The modeling failed to address the endogeneity of the variables used. In addition, the study was carried out in a developed financial market. Current study used VAR modeling to avoid the endogeneity of the variables problem and also tested the causality under developing financial market environment.

Muellbauer and Murphy (2008) by use of modern version of the Friedman–Ando–Modigliani consumption function found that there is a collateral effect when housing prices rise and positive equity is translated into higher household borrowing. This, the study argued, is important in explaining the empirical reality of higher households' consumption expenditure following housing prices appreciation which is contrary to predictions based on the life cycle hypothesis. In the life cycle hypothesis view, when

housing prices rise, households' consumption expenditure should fall due to higher deposit requirements on housing purchases. Thus the credit channel is an important reason as to why increased housing prices may lead to higher households' consumption expenditure. In poorly developed credit markets, Muellbauer and Murphy argued that households cannot translate positive equity into loans and consequently housing prices appreciation is associated with lower households' consumption expenditure. Conversely in deep mortgage markets, greater competitiveness means borrowers benefit from higher loan to value ratios and thus need to save less to finance new housing purchases. Moreover, existing homeowners can release equity easily due to the depth of credit markets. In combination, these effects lead to an increase in households' consumption expenditure when housing prices rise. This study was useful in demonstrating that once the impact of housing prices to households' consumption expenditure is positive, then the credit effects override the deposit effect.

Guglielmo and Ricardo (2011) studied households' consumption expenditure, wealth, stock and housing return using data from emerging markets. In the study, through the use of consumer's utility maximization and use of consumer's budget constraint, the study indicated that the residual of the non-stationary relationship among households' consumption expenditure, aggregate wealth, and per capita income predicts the housing prices. The study used quarterly data for a panel of 31 emerging economies and found that, when households expect their housing prices to increase in future, they will in the short run allow their consumption expenditure to increase. In regard to return on housing, when housing asset is complementary to stocks in the stock market, then

investors will react in a similar manner. If, on the other hand, the rise in the exposure through risky asset is attained by decreasing the amount of wealth held in the form of housing stock, given that the stock and housing asset are substitutes, then the households will in the short run reduce their consumption expenditure. The study, inconclusively, indicated that housing prices affects households' consumption expenditure positively. The effect of households' consumption expenditure to housing prices however was not shown. Current study used a bidirectional and dynamic analysis to bridge this gap.

2.2.3 Housing Prices and Households Indebtedness.

Kohn (2007) estimated Error Correction Models to test whether household indebtedness results from collateralized debts by use of housing assets. The study was informed by the fact that, households' indebtedness had increased greatly in major developed countries, and that this had resulted to changes in the tax codes, demographic structures, relaxed financial regulation, low interest rates and housing prices increase. The study findings were that housing prices played the role of financial accelerator that propagated shocks to the entire economy, since households were borrowing money on the collateral of their housing assets. The study concluded that household indebtedness and housing prices are closely related with each other in these countries. The current study used a similar approach to investigate the housing prices effect on households' consumption expenditure in the context of a developing market.

Goodhart and Hofmann (2008) investigated the relationship of housing prices, money and lending rate based on 17 industrialized nations' quarterly data over a period from the year 1970 to the year 2006. The study was based on a fixed-effects panel VAR estimation. The findings of the study were that: there is a significant multidirectional linkage among housing price, monetary values and the macroeconomic activities; that the relationship between housing prices and monetary variables was found to be stronger over the period from 1985 to 2006; The effects of shock to money supply and credit was found to be higher when the housing market is booming. In addition, the results showed that shock to housing prices, credit and money supply together have significant effects on economic activity and aggregate prices. Shocks on domestic income, the inflation and lending rate are in turn found to have significant effects on housing prices, money supply and credit. By including more variables, the current study developed VAR model and established the relationship between housing prices and households' indebtedness in a developing economy by use of time series data.

Gimeno and Martinez-Carrascal (2010) estimated Error Correction Models of the housing prices in Finland and Spain, did show that housing prices and households' indebtedness are interdependent. A rise in housing prices led to an increase in bank credit and hence to an increase in households' indebtedness. The study found that the effect of household indebtedness on housing prices had increased since the currency crisis. Similar modeling was used in the current study for Kenya but more variables ware included to avoid misspecification and also used Toda Yamamoto test for granger causality to deal with non-stationarity.

Hyun, Jong, and Myung (2013) studied housing prices dynamic with household indebtedness in Korea. The study sought to find the long-run determinants of house prices and analyzed the housing prices dynamic with the Korean data, while taking into account the close relationships between housing prices and household indebtedness. The result of cointegrating regressions showed that the rise in housing prices during the year 2000s in Korea were strongly related with the steep increase in households' indebtedness. And, as the estimated error correcting process revealed, the adjustment in housing prices had been made gradually, as it took about four years for the difference between actual and fundamental (long-run) housing prices to be reduced by half. Again, the mid-run housing prices forecast showed that housing prices were not likely to rise as sharply as they did in the 2000s in near future, when considering the long-term changes in the macro-financial environment. The current study analyzed the relationship between housing prices and households debts in a context where household indebtedness in Kenya has been particularly increasing in a rather short space of time but also treated the two variables as endogenous.

2.2.4 Housing Prices and Capital Inflows

Reinhart and Reinhart (2008) analyzed the relationship between net capital inflows and commercial banks crises by looking at the behavior of housing price in the emerging markets using Error Correction Models. The study looked at the scenario of capital inflows from emerging economies to developed markets preceding economic crisis. The results shows that to a large extent, the flow of capitals surges preceded financial crises

and are driven by foreign citizens demand for a country's housing assets as investment vehicles. The results of Reinhart and Reinhart suggest that housing market collapse precedes crises. With the increase in capital inflows in Kenya, the current study analyzed the dynamic connection between the housing prices and private capital inflow which has the potential of creating crisis.

Filipa, Towbin, and Wieladek (2011) study found that in the run-up to the year 2008 and 2009 global financial crisis, the OECD countries ware characterized by an environment of low interest rates and a rapid increase in housing market activity across these countries. The study made use of Vector Auto Regressive (VAR) model for a panel of 18 OECD countries and examined the effects of capital inflows, monetary policy and financial innovation on the housing sector. The results suggested that both monetary policy and capital inflows shocks had a significant and positive effect on housing prices, credit to the private sector and residential investment. A reduction of 10 basis points in long-term nominal interest rates brought about by an expansionary monetary policy raised the real interest rates and housing prices by about 0.3 percent and 0.2 percent, respectively, after ten quarters and real housing prices by about 0.25 percent after three quarters. A similar reduction in long-term interest rates brought about by a capital inflows increase had a larger effect, with the rise in real interest rates to the households and real housing prices getting to a peak of about 0.4 percent after ten quarters.

The response of the housing prices to private capital inflows shocks was faster and more short-lived, peaking at 0.6 percent after two quarters. The effects of both shocks were higher in countries with a stronger degree of mortgage market development. This suggests that excessive financial innovation may act as a propagation mechanism getting through housing prices and capital inflows. The presence of mortgage-backed securities had a much bigger effect on the transmission of capital inflows shocks. In highly developed mortgage markets, households pledged a larger fraction of their housing assets as collateral, which resulted in higher leverage. When households were highly indebted, they became more sensitive to changes in the value of collateral. The study found that the propagation effect of securitization was stronger for capital inflows than for monetary policy shocks. The response of housing prices to capital inflows shocks was larger and longer-lasting in countries where housing assets securitization was allowed. The explanation was that securitization transformed illiquid, low-grade loans into publicly tradable assets of higher quality which were attractive to international investors. Similar approach was borrowed to investigate the dynamic relationship between housing prices and private capital inflows in Kenya as a developing economy and based on the observed increase in the capital flows into the domestic market

Favilukis, Kohn, Ludvigson and Nieuwerburgh (2011) examined international capital flows and housing prices and showed that countries that exhibited the largest housing prices increase also exhibited biggest and enlarging net inflows of foreign capital that bankrolled sharply higher trade deficits. Using data on credit standards, capital flows,

and interest rates for the U.S. and for a panel of 11 countries using Vector Error Correction model, the study gave evidence on how these variables were related to real housing prices movements. The study hypothesis was that housing prices growth were positively related to a rise in the country's net foreign capital inflows. Fluctuations in housing prices were caused by changing risk premium, which varied endogenously in response to cyclical shocks, the financial market liberalization and its eventual reversal, and capital outflows. The study indicated that, housing prices growth in the boom period was because of a relaxation of credit constraints and decline in housing related transactions costs, both of which reduce risk premium. Conversely, the reversal of the financial market liberalization increased housing risk premium and caused the housing bubble to bust. In contrast to the financial market liberalization, an inflow of foreign money into domestic bond markets played a small role in driving home prices in the study's models despite its large depressing influence on interest rates. A similar result for developing market, whose housing sector has not experienced instability, has not been ascertained.

Syricha, (2013) examined housing price dynamics in the USA, using VAR and VECM models over the period 1973q1 to 2011q4. The study found that the financial crisis in US was attributed to the boom and bust of the housing market in the country. In identifying the main determinants of housing prices in the USA, the study findings were that financial innovation and capital inflows played a major role in housing prices variation. The study found that these effects could be better identified and assessed if more appropriate and accurate indicators of financial innovation and capital inflows

were developed and used. The current study adopted similar methodology in analyzing the dynamic relationship between housing prices and capital inflows in Kenya where the financial market conditions are at the development stages.

2.3 Empirical Literature on Methods

Toda and Yamamoto (1995) procedure which is based on augmented VAR guarantees the asymptotic distribution of the Wald statistic (an asymptotic X^2-distribution), since the testing procedure is robust to the integration and cointegration properties of the process. Alimi, and Ofonyelu (2013) used a bi-variate VAR ($m + d_{max}$) comprising of inflation and lending rate. Following Yamada (1998), the methodology is described as in Equation (2.1)

$$Y_t = \omega_0 + \sum_{i=1}^{k} \theta_i Y_{t-i} + \sum_{i=m+1}^{m+d_{max}} \theta_i Y_{t-i} + \sum_{i=0}^{k+d} \delta_i X_{t-i} + \sum_{i=m+1}^{m+d_{max}} \delta_i X_{t-i} + V_{1t} \quad (2.1a)$$

$$X_t = ¥_0 + \sum_{i=1}^{k} \phi_i X_{t-i} + \sum_{i=m+1}^{m+d_{max}} \phi_i X_{t-i} + \sum_{i=0}^{k+d} \lambda_i Y_{t-i} + \sum_{i=m+1}^{m+d_{max}} \lambda_i Y_{t-i} + V_{2t} \quad (2.1b)$$

Where; X is the rate of inflation, Y denotes lending rate and ω, θ, δ, ψ, φ and λ represent the parameters of the model. d_{max} is the maximum order of integration expected to occur in the VAR system; $\nu_{1t} \sim N(0, \Sigma v_1)$ and $\nu_{2t} \sim N(0, \Sigma v_2)$ are the residuals of the model and $\Sigma v1$ and Σv_2 are the covariance matrices of ν_{1t} and ν_{2t}, respectively. The null hypothesis for non-causality from expected inflation to nominal interest rate is expressed as in Equation (2.2)

$H0$: $\delta i = 0, \forall\, i = 1, 2, ..., m.$ (2.2)

There are two steps that are involved with this estimation procedure. The first step is to determine the lag length (m) and the second one is the selection of the maximum order of integration ($d_{\max}$) for the variables in the system. Measures such as the Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC) and Hannan-Quinn (HQ) Information Criterion are used to determine the appropriate lag order for the VAR. This methodology was employed in the current study when testing for causality. This is because the data used is non stationary and using it at levels was useful for the analysis.

Dritsakis (2011) examined the demand for money in Hungary by use of Autoregressive distributed lag (ARDL) model and cointegration framework. The Autoregressive Distributed Lag (ARDL) model deals with single cointegrating equation as was introduced originally by Pesaran and Shin (1999) and further extended by Pesaran et al. (2001). The ARDL approach has the advantage that it does not require all variables to be I (1) as the Johansen framework and it is still applicable if the variables are I(0) and I(1) in the data set. The bounds test method of cointegration from ARDL model has some advantages in comparison to other methods of cointegration which are the following: All variables in the model are assumed to be endogenous, Bounds test method for cointegration is applied irrespective of the order of integration of the variables. That is, whether they are integrated first order I (1) or I (0), and the short-run and long-run coefficients of the model are estimated simultaneously.

The ARDL bound test is based on the Wald-test (F-statistic). Two critical values are given by Pesaran et al.(2001) for the cointegration test. The lower critical bound assumes all the variables are I(0) meaning that there is no cointegration relationship between the examined variables. The upper bound assumes that all the variables are I(1) meaning that there is cointegration among the variables. When the computed F-statistic is greater than the upper bound critical value, then the null hypothesis is rejected meaning that the variables are cointegrated. If the F-statistic is below the lower bound critical value, then the null hypothesis cannot be rejected meaning there is no cointegration among the variables. When the computed F-statistics falls between the lower and upper bound, then the results are inconclusive.

An ARDL representative model is formulated as in Equation (2.3)

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^{K} \alpha_{ji} \Delta(Y)_{t-i} + \sum_{i=0}^{K} \alpha_{ji} \Delta(X)_{t-i} + \beta_1 Y_{t-1} + \beta_2 X_{t-1} + e_t \qquad (2.3)$$

Where; Δ denotes the first difference operator, α_0 is the drift component and e_t is the residual. α represents the short-run dynamics of the model while βs represent the long-run dynamics. The methodology as applied by Dritsakis (2011) was utilized in the current study to capture the dynamic analysis of the housing model.

Alimi, and Ofonyelu (2013) investigated the relationship between expected rate of inflation and interest rates in Nigeria and also tested the extent to which the Fisher effect hypothesis holds, for the period 1970-2011. The study used Johansen test of

cointegration, ECM and the Toda and Yamamoto (1995) causality testing method. For this to be done, Vector Auto Regression (VAR) based cointegration test as was developed by Johansen (1991; 1995) was utilized. The causality analysis was based on augmented method as proposed by Toda and Yamamoto (1995). This was because the traditional Granger-Causality has some limitations. One reason is, a two-variable Granger-Causality test that does not consider the effect of other variables is prone to possible specification bias. As pointed out by Gujarati (2004), a causality test is sensitive to model specification and the number of lags. This means that an empirical VAR model with two variables, testing for granger causality could suffer from specification bias. Secondly, time series data is in most cases trending. This condition brings the problem of spurious regression. This is because when variables are not stationary, the F-test procedure is no longer valid, as such, test statistics do not have a standard distribution.

2.4 Overview of Literature

From the theoretical literature, there is no definite consensus on the determinant of housing prices. As some of the theories view housing market to operate in a perfect competitive market other conceptualize it in an imperfect market. The expectation of future prices is seen as the cause for housing prices bubble. The theoretical considerations and some of empirical works seem to suggest that there are probably good reasons to believe that there exists a multidirectional link between domestic and foreign money, credit expansion, consumption, expectations and the housing prices which then affect the wider economy. However, while these theoretical considerations

and empirical works give some tentative indications, they do not allow definite conclusions. In the absence of a fully-fledged theoretical model integrating all the potential inter-linkages between housing prices and the macroeconomic variables, the issue ultimately has to be addressed empirically and was the reason behind the current study.

The empirical studies have also found causality between housing prices and households' consumption expenditure, between housing prices and households' indebtedness and between housing prices and capital inflows. However the direction of causality has not been unanimous. The studies have also been carried in the economies where the housing markets have experienced instability. Furthermore, none of these studies dealing with housing and macroeconomic variables are on Kenya housing prices or an economy whose macroeconomic environments are similar to those of Kenya. Empirical studies done on housing prices in Kenya focus on determinants of housing prices. These studies are however deficient by the fact that none incorporated consumption and capital inflows in the estimations. The variables to which housing prices gravitate towards in the long-run have not been identified in these studies. The methods used are also partial equilibrium in nature and therefore do not dynamically capture the interactions between housing prices and macroeconomic variables.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter presents the methodology that was adopted. It includes the research design, the theoretical framework, the model specification, estimation technique, definition and measurement of variables, data sources and methods used in the analysis.

3.2 Research Design

The study utilized non-experimental quantitative research design. This design was employed for the purpose of explaining cause and effect relationship between housing prices and macroeconomic variables. The design was also useful for predictive purposes so as to predict the future status of the macroeconomic variables given the housing prices. The research made use of Tobin's q investment theory to develop the theoretical framework and to specify empirical models. Time series data was used in the models estimation after carrying out the necessary diagnostic tests. The study employed ARDL and VAR modeling approach for purpose of estimation. The models were appropriate given the type of data used in the study. This is because the estimates from the approach are unbiased, efficient and are free from serial correlation and endogeneity problems. The ARDL modeling approach was adopted from Pesaran and Shin, (1999; 2001) and used as applied by Dritsakis, (2011) and Shrestha and Chowdhury, (2005). VAR modeling was borrowed from Toda and Yamamoto (1995) modeling procedure, and used as applied by Alimi and Ofonyeli, (2013).

3.3 Theoretical Framework

The study adopted Tobin's q theory of investment as it provided useful dynamic optimization framework for analyzing the effect that expectation and current conditions

have on investment. Following the procedure by Tobin (1972), investment in housing market is given as a smooth relationship with the exogenous variables and internal adjustment costs. Considering an industry with N numbers of identical firms, the representative firm's real profits at time t, neglecting any costs of acquiring and installing capital, are proportional to its stock of capital, k (t), and the profits are decreasing with the industry-wide capital stock, K(t). The model takes the form of Equation (3.1)

$$TR = \beta(K(t))\,\kappa(t), \text{ where } \beta'(\bullet) < 0 \qquad (3.1)$$

TR is the firm's total revenue. Firm's profits are assumed to be proportional to its capital stock. This implies that the production function has constant returns to scale, output markets are competitive and the supply of all factors other than capital is perfectly elastic. Under these assumptions, if one firm has to have, for instance, twice as much capital stock as another, it will need to employ twice as much of all inputs than the other. This is particularly the case in the housing market. As a result, both its revenues and its costs are twice as high as the other's. The assumption that profits are decreasing in the industry's capital stock means that the demand curve for investment is downward-sloping.

The main assumption of the model is that firms face costs of adjusting their capital stocks. The adjustment costs are a convex function of the rate of change of the firm's capital stock, $\dot{k}$. Specifically, the adjustment costs, C ($\dot{k}$), satisfy $C(0) = 0$ and $C'(\bullet) > 0$.

These assumptions imply that it is costly for a firm to increase or decrease its capital stock, and that the marginal adjustment cost is increasing in the size of the adjustment.

The model assumes the purchase price of capital goods to be constant and equal to 1. Depreciations of capital are also assumed to be equal to zero. This implies that

$\dot{k}(t) = I(t)$ (3.2)

Where I is the firm's investment and the assumptions imply that the firm's profits at a point in time are as given by Equation (3.3)

$$\Pi = \beta(K)\kappa - I - C(I) \quad (3.3)$$

The firm therefore maximizes the present value of these profits,

$$\left.\begin{aligned} &\text{Max } \Pi = \int_{t=0}^{\infty} e^{-rt}\{\beta(K(t))k(t) - I(t) - C(I(t))\}dt \\ &\text{Subject to:} \\ &k_t = k_{t-1} + I_t \text{ for each t} \end{aligned}\right\} \quad (3.4)$$

Where, Π is the present value of profit and r is the real interest rate and t is time. Each firm takes the path of the industry-wide capital stock, K, as given, and chooses its investment over time to maximize Π given this path.

Since there are infinitely many periods, there are infinitely many constraints. The Lagrangian for the firm's maximization problem is:

$$L = \sum_{t=0}^{\infty} \frac{1}{(1+r)^t}[\beta(K_t)k_t - I_t - C(I_t)] + \sum_{t=0}^{\infty} \lambda_t(k_{t-1} + I_t - k_t) \qquad (3.5a)$$

Where; λ_t is the Lagrange Multiplier associated with the constraint relating current capital stock (κ_t) and lag of capital stock (κ_{t-i}). The Lagrange Multiplier gives the marginal value of relaxing the constraint. That is, it gives the marginal impact of an exogenous increase in capital stock at time (t) on the lifetime value of the firm's profits discounted to time 0. Letting Equation (3.5b) to present the relationship,

$$q_t = (1 + r)^t \lambda_t, \qquad (3.5b)$$

Then q_t shows the value to the firm of an additional unit of capital at time t in time t values. Hence the Lagrangian can be written as in Equation (3.6a)

$$\acute{L} = \sum_{t=0}^{\infty} \frac{1}{(1+r)^t}[\beta(K_t)k_t - I_t - C(I_t) + q_t(k_{t-1} + I_t - k_t)] \qquad (3.6a)$$

The firm's problem is to maximize the continuous-time objective function. The first step in analyzing this problem is therefore to set up the current-value Hamiltonian Equation (3.6b)

$$H[K(t), I(t)] = \beta[K(t)]k(t) - I(t) - C[I(t)] + q(t)I(t) \qquad (3.6b)$$

The variable that can be controlled freely, (I) is the control variable. The variable whose value at any time is determined by past decisions, (κ) is the state variable and the shadow value of the state variable (q) is the costate variable. The first condition characterizing the optimum is that the derivative of the Hamiltonian with respect to the control variable at each point in time is zero. This implies that:

$$1 + C'[I(t)] = q(t) \qquad (3.6c)$$

The second condition is that the derivative of the Hamiltonian with respect to the state variable equals the discount rate times the costate variable minus the derivative of the costate variable with respect to time. This condition is represented by Equation (3.6d)

$$\beta[K(t)] = rq(t) - \dot{q}(t) \qquad (3.6d)$$

The final condition is the continuous-time version of the transversality condition. This condition is that the limit of the product of the discounted costate variable and the state variable is zero. This condition is given by Equation (3.6e)

$$\lim_{n\to\infty} e^{-rt}q(t)K(t) = 0 \qquad (3.6e)$$

Equation (3.6c), Equation (3.6 d) and Equation (3.6 e) characterizes the firm's behavior.

Madsen (2011) used Model (3.6a) to Model (3.6e) so as to allow for optimizing behavior among housing investors. The model also incorporated the influence of

policies in the optimization. Therefore, the model by Madsen is a complete model as it explains how the housing prices are determined and how they interact with residential investments.

Considering the profit (Π) maximization problem of the representative individual investor, where all the variables are in units of individuals, Madsen (2011) modifies Equation (3.4) to form Equation (3.7)

$$\left.\begin{aligned} &\text{Max } \Pi = \int_{t=0}^{\infty} e^{-rt}\{\beta(H_t)h_t - \left[I - \gamma\left(\frac{\dot{h}_t}{h_t}\right)h_t\right](1+\mu)(1+\tau)dt \\ &\text{Subject to:} \\ &\dot{h_t} = I_t - \delta h_t \end{aligned}\right\} \quad (3.7)$$

Where r is the required returns to housing investment, H is the economy wide housing stock, β(H) is the marginal revenue per unit of housing stock which is a declining function of H, h is the housing stock of the individual builder or the individual household, I is real gross residential investment per individual, $\gamma\left(\frac{\dot{h}_t}{h_t}\right)h_t$ is adjustment cost of housing investment, δ is the depreciation rate, μ is the value added tax rate, and $\tau$is stamp duties as a percentage of acquisition costs. A dot over a variable signifies the time-derivative.

$$\gamma(0) = 0, \gamma'(\frac{\dot{h}_t}{h_t}) > 0 \; and \gamma''\left(\frac{\dot{h}_t}{h_t}\right) > 0 \quad (3.8)$$

Equation (3.8) means the adjustment cost is an increasing function of capital. The required returns are given by r = i(1−ø) , where i is the nominal interest rate, and ø is the income tax rate.

Borrowing q_t to be equal to $(1 + r)^t\lambda_t$ from Equation (3.5b), then as earlier defined, q_t shows the value to the firm of an additional unit of capital at time t in time t's values. Maximizing Equation (3.7) under the capital accumulation constraint yields the following first order conditions:

$$\dot{q_t} = (r_t + \delta)q_t - \beta(H_t) + \left[\gamma - \gamma'_h\left(\frac{I_t}{h_t}\right)\right](1 + \mu)(1 + \tau) \qquad (3.9)$$

$$\dot{h_t} = h_t\gamma'^{-1}\left[\frac{q_t}{(1 + \mu_t)(1 + \tau_t)} - 1\right] \qquad (3.10)$$

$$\lim_{n\to\infty} e^{-rt}q_t\, h_t = 0 \qquad (3.11)$$

Where; q_t as earlier defined is the shadow price of housing stock or Tobin's q. Equations (3.9) and Equation (3.10) defines a simultaneous first–order differential equation system and Equation (3.11) is the transversality condition, which ensures that the present value of the total stock of housing at infinity is equal to zero. Equation (3.9) is net investment in residential buildings. In a no-tax world this equation collapses to the traditional Tobin's q-model in which investment is positive if q >1 and vice versa. A value of q that is higher than 1 will then be required in presence of tax for Equation (3.11) to be positive. This is because taxes increase the effective acquisition costs of investment.

From Equations (3.9; 3.10; 3.11), q_t, which is the shadow prices of housing stock is given by the ratio of the current market value of an additional unit of housing stock to its replacement costs (Tobin, 1972). This is because, conventionally, Tobin's q for housing is measured as housing prices deflated by construction costs (Summers, 1981; Poterba, 1991; Abraham & Hendershott, 1996; Meen, 2002). Thus the replacement cost of houses is an average of construction costs and the cost of developed land. These considerations suggest that the shadow price of the housing stock is given by:

$$q_t = \frac{P_t^h}{lc^{\alpha} cc^{(1-\alpha)}} \qquad (3.12)$$

$0<\alpha<1$

Where p^h is the price of a unit of housing, lc is the costs of land per unit of housing and cc are construction costs per unit of housing. Solving Equations (3.10) and Equation (3.12) together gives equation (3.13)

$$P_t^h = \left[\gamma' \left\{\frac{\dot{h_t}}{h_t}\right\} + 1\right](1+\mu_t)(1+\tau) lc^{\alpha} CC^{(1-\alpha)} \qquad (3.13)$$

In steady state, $\gamma' \left\{\frac{\dot{h_t}}{h_t}\right\}$ equals to zero and gives the determinants of housing prices in the long-run as:

$$P_t^{h^*} = \left(1+\mu_t\right)(1+\tau) lc^{\alpha} cc^{(1-\alpha)} \qquad (3.14a)$$

The asterisk means that the variable is in steady state. Equation (3.14a) is the key supply equation and it shows that housing supply prices in steady state follow the direct acquisition costs (cost of land and construction costs), stamp duties and value added taxes because they represent the effective replacement costs of housing supply. Stamp duties and value added taxes increase the effective acquisition costs of housing and, therefore, permanently increase supply prices for the housing. Equations (3.13) and (3.14a) imply that housing supply prices are determined directly by cost of land, costs of construction, tax on properties and the adjustment costs of housing.

Equations (3.13) and (3.14a) can be represented by use of a functional relationship as given by Equation (3.14b)

$$P^{h}_{t} = f(CC, PT, \theta_s) \qquad (3.14b)$$

Where; (CC) is the cost of supplying a unit of housing, (PT) represents property taxes and Θ_s stand for the supply shifting factors. The supply shifting factors are factors directly affecting adjustment costs of housing. They may include costs of lending, supply and access of foreign capital, and generally the financial liberalization (Muellbaur & Murphy, 2008). Financial liberalization can be measured by use of households' indebtedness (Panagiotidis, Kontonikas, & Montagnoli, 2015).

Analyzing the Masden (2011) model using the demand framework is important as this will also give the demand side of housing market (Davis, Fic & Karim, 2012). In this respect, following Davis, Fic and Karim (2012), the housing prices are said to be cointegrated if their fundamental determinants form the long-run relationship. Following the literature reviewed in Chapter 2 (Apergis &Rezitis, 2003; Antipa & Lecat; Madsen, 2011; Panagiotidis, Kontonikas, & Montagnoli, 2015), the demand for housing can be characterized by relationship given by Equation (3.14c)

$$Q_d = f(Y, N, W, UC, \theta_d) \qquad (3.14c)$$

Where; Q_d is the quantity demanded of housing, (Y) represents Per capita income, (N) stands for population, (W) is wealth, (UC) is the user cost of housing and (θ_d) stand for other factors that shift the demand. In this relationship, both income and wealth are potentially influenced by monetary and fiscal policies. On the other hand, the user cost of capital (UC) depends on the price of housing and other variables according to Equation (3.14d)

$$UC = P[(1-T_y)(m+T_p)+ \delta +C_g] \qquad (3.14d)$$

Where; (P) is housing prices, (M) is mortgage rate, (T_y) is income tax rate, (T_p) is property tax rate, (δ) is depreciation rate and (C_g) is capital gains. In the user cost equation, fiscal policy will affect taxes whereas monetary policy will affect mortgage rate.

Combining Equations (3.14b) and (3.14c) and solving for the equilibrium housing prices yields Equation (3.15a)

$$P^h_t = f(CC, PT, Y, N, W, UC, \theta_d, \theta_s) \quad (3.15)$$

Where; the variables in the Equation (3.15) are as earlier defined. The housing prices are therefore determined by the variables given in the right hand side of Equation (3.15)

3.4 Models Specification

Equation (3.15) was the main equation used by the study to specify the estimation equations. From the equation, the housing prices are determined by considering both supply and demand side of the housing market. The housing prices therefore depend on the replacement cost of housing (cost of construction), the property taxes, per capita income, demographic changes, credit facilities (represented by households' indebtedness) and demand by foreign investors/individuals (represented by private capital inflows). The functional relationship for the housing prices is here redefined as in Equation (3.16)

$$(HP) = f\{(HCEXP), (PCGDP), (UPop), (HStc), (PCI), (CC), (PT), (HHI)\} \quad (3.16)$$

Where; HP represents real housing price, (HCEXP) is households' consumption expenditure, (PCGDP) is per capita GDP, (UPop) is the urban population, (HStc) is the

housing stock, (PCI) is private capital inflows, CC is the construction cost, (PT) represents the property taxes and (HHI) is the households indebtedness.

To analyze the sources of housing prices growth, Equation (3.16) was estimated using Auto Regressive Distributed Lags (ARDL) modeling technique (Pesaran and Shin, 1999; 2001) and as applied in Dritsakis, (2011) and Shrestha and Chowdhury, (2005). The importance of ARDL modeling is in its flexibility. It can be applied when the variables are of different order of integration (Pesaran, 1995). The other importance of this approach is that the model takes sufficient numbers of lags to capture the data generating process in a general to specific modeling framework (Laurenceson & Chai, 2003). Since housing prices behaves differently from other goods, previous values of housing prices, as well as of other variables, were required to explain the current behavior. As such, ARDL modeling was the most appropriate as the estimates from the modeling are unbiased, efficient and free from serial correlation and endogeneity problems (Pesaran, Shin & Smith, 2001).

The selection of ARDL model was also important because it could be applied for small sample size as well as estimate short-run and long-run dynamics. The ARDL methodology is also relieved of the burden of establishing the order of integration amongst the variables. Furthermore, it distinguishes dependent and explanatory variables, and allows testing for the existence of relationship between the variables. Finally, with ARDL, it is possible to use differing optimal number of lags among the variables (Pesaran, 1995). An ARDL model for housing prices with the regressors

identified in the functional relationship in Equation (3.16) was expressed as in Equation (3.17)

$$HP_t = \beta_0 + \sum_{i=1}^{K} \beta_{ji}(HP)_{t-i} + \sum_{i=0}^{K} \beta_{ji}(HCEXP)_{t-i} + \sum_{i=0}^{K} \beta_{ji}(PCGDP)_{t-i} + \sum_{i=0}^{K} \beta_{ji}(UPop)_{t-i} + \sum_{i=0}^{K} \beta_{ji}(PCI)_{t-i} + \sum_{i=0}^{K} \beta_{ji}(HStc)_{t-i} + \sum_{i=0}^{K} \beta_{ji}(CC)_{t-i} + \sum_{i=0}^{K} \beta_{ji}(PT)_{t-i} + \sum_{i=0}^{K} \beta_{ji}(HHI)_{t-i} + \varepsilon_t \quad (3.17)$$

Where j = 1 to 9

Equation (3.17) gave the general ARDL model which was then rewritten as:

$$HP_t - \sum_{i=1}^{K} \beta_{ji}(HP)_{t-i} = \beta_0 + \sum_{i=0}^{K} \beta_{ji}(HCEXP_{t-i} + \sum_{i=0}^{K} \beta_{ji}(PCGDP)_{t-i} + \sum_{i=0}^{K} \beta_{ji}(UPop)_{t-i} + \sum_{i=0}^{K} \beta_{ji}(PCI)_{t-i} + \sum_{i=0}^{K} \beta_{ji}(HStc)_{t-i} + \sum_{i=0}^{K} \beta_{ji}(CC)_{t-i} + \sum_{i=0}^{K} \beta_{ji}(PT)_{t-i} + \sum_{i=0}^{K} \beta_{ji}(HHI)_{t-i} + \varepsilon_t \quad (3.18)$$

Employing a lag operator, the corresponding equation is:

$$A(L)HP_t = \beta_0 + \beta_j(L^i)(HCEXP)_t + \beta_j(L^i)(PCGDP)_t + \beta_j(L^i)(UPop)_{t-i} + \beta_j(L^i)(PCI)_{t-i} + \beta_j(L^i)(HStc)_{t-i} + \beta_j(L^i)(CC)_{t-i} + \beta_j(L^i)(PT)_{t-i} + \beta_j(L^i)(HHI)_{t-i} + \varepsilon_t \quad (3.19)$$

Where;

$$(\mathrm{L}) = 1 - \sum_{i=1}^{K} \beta_{ji}\text{, and letting } \beta_j(\mathrm{L}^i) \text{ to represent } \sum_{i=0}^{K} \beta_{ji}$$

The distributed lag form of the model that defines long-run relationship was then given as in Equation (3.20)

$$\mathrm{HP}_t = \frac{\beta_0}{\mathrm{A(L)}} + \frac{\beta_j(\mathrm{L}^i)}{\mathrm{A(L)}}(\mathrm{HCEXP}_t + \frac{\beta_j(\mathrm{L}^i)_t}{\mathrm{A(L)}}(\mathrm{PCGDP})_t + \frac{\beta_j(\mathrm{L}^i)}{\mathrm{A(L)}}(\mathrm{UPop})_t +$$

$$\frac{\beta_j(\mathrm{L}^i)}{\mathrm{A(L)}}(\mathrm{PCI})_t + \frac{\beta_j(\mathrm{L}^i)}{\mathrm{A(L)}}(\mathrm{HStc})_t + \frac{\beta_j(\mathrm{L}^i)}{\mathrm{A(L)}}(\mathrm{CC})_t + \frac{\beta_j(\mathrm{L}^i)}{\mathrm{A(L)}}(\mathrm{pt})_t + \frac{\beta_j(\mathrm{L}^i)}{\mathrm{A(L)}}(\mathrm{HHI})_t + \emptyset_t \qquad (3.20)$$

Long-run relationship was inferred if $A(L)$ was not equal to zero. The coefficients of Equation (3.20) gave the long-run estimates. Equation (3.20) was estimated using Ordinary Least Square (OLS) estimation technique after it passed the appropriate diagnostics. In determining the optimal lag length (k), AIC was used.

To analyze the short-run sources of housing prices growth, the general ARDL model given by Equation (3.17) was utilized. The short-run analyses were important since the study needed to make use of time dynamics and also the Error Correction Term (ECT). So as to achieve this, ECT was derived by running a linear regression for Equation (3.21a)

$$\mathrm{HP}_t = \alpha_1(\mathrm{HP})_t + \alpha_2(\mathrm{HCEXP})_t + \alpha_3(\mathrm{PCGDP})_t + \alpha_4(\mathrm{UPop})_t + \alpha_5(\mathrm{PCI})_t + \alpha_6(\mathrm{HStc})_t +$$

$$\alpha_7(\mathrm{CC})_t + \alpha_8(\mathrm{PT})_{t-1} + \alpha_9(\mathrm{HHI})_t + \varepsilon \qquad (3.21a)$$

The residuals (ε) from Equation (3.21a) were lagged one period and then used as the ECT series for Equation (3.21b). The ECT coefficient was to give the speed at which the housing prices adjust toward the long-run growth path in case of a disturbance. The short-run coefficients were estimated based on ARDL model given in Equation (3.21b)

$$\Delta HP_t = \alpha_0 + \sum_{i=1}^{K} \alpha_{1i}\Delta(HP)_{t-i} + \sum_{i=0}^{K} \alpha_{2i}\Delta(HCEXP)_{t-i} + \sum_{i=0}^{K} \alpha_{3i}\Delta(PCGDP)_{t-i} +$$

$$\sum_{i=0}^{K} \alpha_{4i}\Delta(UPop)_{t-i} + \sum_{i=0}^{K} \alpha_{5i}\Delta(PCI)_{t-i} + \sum_{i=0}^{K} \alpha_{6i}\Delta(HStc)_{t-i} + \sum_{i=0}^{K} \alpha_{7i}\Delta(CC)_{t-i} +$$

$$\sum_{i=0}^{K} \alpha_{8i}\Delta(PT)_{t-i} + \sum_{i=0}^{K} \alpha_{9i}\Delta(HHI)_{t-i} + \boldsymbol{\lambda}ECT_{t-1} + \mathcal{E}_t \qquad (3.21b)$$

Where; α_i gave short-run coefficients, λ was the speed of adjustment parameter and ECT was the residuals obtained from the estimated cointegration regression in Equation (3.21a). The equation was estimated using OLS estimation techniques after carrying out the appropriate diagnostics. To determine the optimal lag length (k), AIC was utilized.

To analyze the dynamic relationship between growth of housing prices and each of the selected macroeconomic variables, the study carried out causality and impulse response test. This was achieved by conducting a modified version of the Granger causality test proposed by Toda and Yamamoto (1995). The method is valid regardless whether a series is integrated of order zero, integrated of order one, integrated of order two, non-cointegrated or cointegrated of any arbitrary order. The importance of the Toda and

Yamamoto procedure is that it does not require pre-testing for the cointegrating properties of the system and thus avoids the potential bias associated with unit root and cointegration tests (Rambaldi & Doran, 1996).

Pre-tests for unit root and cointegration might suffer from size distortions, which often imply the use of an inaccurate model for the non-causality test. To prevent some of these problems, Toda and Yamamoto, based on augmented VAR modeling, introduced a Wald test statistic that asymptotically has a chi square (X^2) distribution irrespective of the order of integration or cointegration properties of the variables. The Toda and Yamamoto approach fits a standard VAR model on levels of the variables and therefore makes allowance for the long-run information often ignored in systems that require first differencing (Clarke & Mirza, 2006).

The approach employs a modified Wald test (MWALD) for restrictions on the parameters of the VAR (k) where k is the lag length of the system. The basic idea of the Toda and Yamamoto approach is to artificially augment the correct order, k, by the maximal order of integration, d_{max}. Once this is done, a $(k+d_{max})^{th}$ order of VAR is estimated and the coefficients of the last lagged d_{max} vectors are ignored (Caporale and Pittis, 1999).

To make use of Toda and Yamamoto tests, the study developed bi-variate vector autoregressive (VAR-2) models. This was because VAR has the ability to capture the

dynamic correlations between the variables. VAR models help in the analysis where variables are linked to their own past values and the current and past values of the variables given in the models since it is able to describes the dynamic evolution of a number of variables from their common history (Verbeek, 2004).

In achieving second, third and fourth objectives, Toda and Yamamoto Augmented Granger Causality tests based on Equations (3.22; 3.23: 3.24) were employed.

$$\left.\begin{aligned}(\mathrm{HHI})_t &= \lambda_0 + \sum_{i=1}^{k+d} \lambda_{1i}(\mathrm{HP})_{t-i} + \sum_{i=0}^{k+d} \lambda_{2i}(\mathrm{HHI})_{t\text{-}i} + \epsilon_t \\ (\mathrm{HP})_t &= \gamma_0 + \sum_{i=0}^{k+d} \gamma_{1i}(\mathrm{HHI})_{t-i} + \sum_{i=1}^{k+d} \gamma_{2i}(\mathrm{HP})_{t-i} + \text{ʊ}_t\end{aligned}\right\} \quad (3.22)$$

$$\left.\begin{aligned}(\mathrm{PCI})_t &= \delta_0 + \sum_{i=0}^{k+d} \delta_{1i}(\mathrm{HP})_{t\text{-}i} + \sum_{i=1}^{k+d} \delta_{2i}(\mathrm{PCI})_{t\text{-}i} + \varphi_t \\ (\mathrm{HP})_t &= \Phi_0 + \sum_{i=0}^{k+d} \Phi_{1i}(\mathrm{PCI})_{t\text{-}j} + \sum_{i=1}^{k+d} \Phi_{2i}(\mathrm{HP})_{t\text{-}i} + \omega_t\end{aligned}\right\} \quad (3.23)$$

$$(HCEXP)_t = \beta_0 + \sum_{i=0}^{k+d} \beta_{1i}(HP)_{t-i} + \sum_{i=1}^{k+d} \beta_{2i}(HCEXP)_{t-i} + \varepsilon_t \quad (3.24)$$

$$(HP)_t = \alpha_0 + \sum_{i=0}^{k+d} \alpha_{1j}(HCEXP)_{t-i} + \sum_{i=1}^{k+d} \alpha_{2i}(HP)_{t-i} + \upsilon_t$$

Where; k is the maximum number of lagged observations included in each model which was determined through use of Akaike Information Criterion (AIC), Schwarz information criterion (SIC) and Hannan-Quinn information criterion (HIQ), d is the maximum order of integration of the variables in each of the system, HP is the housing price, (HHI) is household indebtedness, (PCI) is the private capital inflows and (HCEXP) represents households consumption expenditure. $\lambda, \gamma, \delta, \Phi, \beta$ and α are the models parameters. The study used OLS to estimate Equation (3.22), Equation (3.23) and Equation (3.24)

A series is said to granger cause another series if the estimated parameters are statistically significant. Augmented granger causality by Toda Yamamoto was utilized to test for the granger causality. Impulse response functions were also utilized to trace out the time path of housing prices shock on household indebtedness, private capital inflows and households consumption expenditure after confirmation of causality.

3.5 Definition and Measurement of Variables

Housing price (HP) referred to the real average price of three types of residential houses in Kenya (Apartments, Bungalows and Mansionettes) per year in million Kenya shilling from 1960 to 2015. That is, the real value of all the new private dwelling housing supplied in each year, divided by the total supply in the same year. It was

composed of the reported value of new and completed private residential houses in major urban centers of the country.

Households' Consumption Expenditure (HCEXP): This was the ratio of household final consumption expenditure to GDP in Kenya per annum. The variable excluded the public sector expenditure.

Urban Population (UPop) represented the total number of individuals living in urban centers of Kenya**.** The variable was given as a percent of total population. The variable represented the population that was capable of putting pressure on housing demand in Kenya.

Construction Costs of Housing (CC): provided a measure of average cost of putting up a new house. It indicated the cost of supplying a new house into the market, also known as replacement cost. It was used so as to show the extent to which the housing prices responded to the cost of construction. The variable was composed of real cost of labor, real cost of building materials, real cost of land and costs of building plans approval by the local governments. The average real costs from the major urban centers of the country were given in million Kenya shilling.

Housing Stock (HStc): Housing Stock data captured the supply of housing in each period. It was used to capture the supply side of housing market. The variable was captured as a percent of urban population.

Property Taxes (PT): Property taxes is the amount of tax collected by the national and county governments from residential houses in the country. The taxes included land rates, transfer charges, ownership processing fee construction approval and inspection fee. The variable was measured as a percentage of GDP.

Per Capita Gross Domestic Product (PCGDP) is the real income associated with an individual that can determine the affordability of a potential housing purchase. It was expected that high levels of real per capita income would push the housing prices up. The data was given on annual basis and in million Kenya shilling.

Private Capital inflows (PCI) represented the net inflows of investment to acquire a long lasting management interest in an enterprise or assets that was located in Kenya. It referred to the movement of foreign funds to Kenya by citizens of foreign country. It excluded Portfolio investment**,** borrowings and remittance. The variable was represented by net foreign direct investment (Net-FDI) which captured the difference between inflows of FDI and outflows of FDI in acquiring lasting management in local assets. The variable was measured as a percent of real GDP.

Household indebtedness (HHI): This represented the domestic credit supplied to households by the Kenya based commercial banks. The variable included all locally operating commercial banks credits to the economy on annual basis, with the exception of credit supply to the public sector. The variable represented the real credit to the

households and was measured as per cent of real GDP in each year from the year 1960 to 2015.

3.6 Target Population

The target population for the housing sector was urban information based on urban sectors in Kenya as defined by Kenya National Bureau of Statistics (KNBS). The information used in the study for urban population, housing Stock, property taxes and construction costs was also for the urban centers of the country as reported by the Kenya National Bureau of Statistics for each year. The study considered data for the whole country for private capital inflows, household indebtedness, households' consumption expenditures and per capita GDP.

3.7 Data type and source:

To achieve the objectives of the study, secondary annual time series data was used for all the variables. Data for the period 1960 to 2015 was obtained from various sources. The housing prices data, urban population data, construction costs of housing and housing stock data were collected from KNBS's statistical abstracts and Kenya National Economic Survey (KNES) Reports. Households' consumption expenditure data, Per capita gross domestic product data, private capital inflows and households' indebtedness data were collected from World Bank African Development Indicators and Central Bank of Kenya.

3.8 Data Collection and Cleaning

Secondary annual data was collected from various sources. Housing prices, construction costs and per capita GDP data were nominal and in raw forms and were in different currencies. The series were transformed to real values and into local currency. Other series were transformed into percentage form. The data used is presented in Table A1.1 of Appendix 1

3.9 Time Series Properties

3.9.1 Testing for Stationarity of Data

In order to establish the stationarity properties of the series used in the study, Augmented Dickey-Fuller (ADF), Philip Peron (PP) and KPSS tests were carried out. For the ADF test, the following equation was estimated

$$\Delta P_t = \mu + \beta t + \gamma P_{t-1} + \sum_{i=1}^{T} \emptyset_i \Delta P_{t-i} + \varepsilon_t \qquad (3.25)$$

Where; μ is the drift parameter, t is the trend variable and T is the maximum number of lags in ΔP_{t-i}. The maximum number of lags was determined by use of Akaike Information Criterion (AIC) and Schwartz Criterion (SC). ε_t represents the white noise error term. The test for stationarity entails testing $H_O: \gamma = 0$ for unit root against the alternative hypothesis that $H_A: \gamma < 0$ for no unit root in the series using ADF test at 5 percent level of significant. If the null hypothesis is not rejected, the series contains unit root and therefore not stationary. If however, the null hypothesis is rejected, then the time series contained no unit root and hence stationary. If the series contained a unit

root, its first difference was subjected to another test for stationarity. If stationary at first difference, the conclusion was that the series was integrated of order one (Green, 2008; Gujarati, 2004; Dickey & Fuller, 1979).

The series were also tested for unit root using Phillips – Perron (PP) test. This was because the test has a higher power of detecting non stationarity compared to ADF. The PP test took the form of Equation (3.26)

$$\Delta P_t = \theta_0 + \sum_{i=1}^{m} \delta P_{t-i} + \varepsilon_t \qquad (3.26)$$

Where; ΔP_t is the first-difference variable, i represents the number of truncating lags. θ and δ are coefficients and ε_t is the white noise error term. For the null hypothesis, the test involved testing that, H_0: $\delta = 0$ against the alternative hypothesis that, H_A: $\delta < 0$, at 5 percent level of significance. The null hypothesis was not rejected if the values of computed statistic were more than those of critical values. This meant the series had a unit root and therefore not stationary. If the null hypothesis was rejected, then the series had no unit root and hence stationary.

To confirm the test results obtained from the ADF and PP tests, Kwiatkowski Phillips, Schmidt and Shin's test (KPSS) (1992) was employed as well so as to eliminate a possible low power against stationary near unit root processes which occurs in both ADF and PP tests.

KPSS has a null hypothesis of stationarity of the series around either mean or a linear trend; and the alternative hypothesis assumes that a series is non-stationary due to presence of a unit root. If the computed test statistics were found less than the critical value then the null hypothesis was not rejected.

The test was based on representation of P_t as in Equation (3.27) and Equation (3.28)

$$P_t = r_t + \text{ʒ}_t + \varepsilon_t \quad (3.27)$$

$$r_t = r_{t-1} + \mu_t \quad (3.28)$$

The behavior of the series depend on one parameter, which is variance of μ_t (δ_μ^2). If it is equals to 0, then r_t = constant and P_t is stationary, and if $\delta_\mu^2 > 0$ r_t is a random walk and P_t is not stationary.

3.9.2 Cointegration Analysis

If the variables in the study are integrated of the same order, then cointegration analysis using Johansen test is applicable. Cointegration is used to test whether non stationary series have a long-run equilibrium relationship between them (Gujarati, 2004). Two or more series of trending variables can be said to be co-integrated if they are integrated of the same order and at the same time they have a stationary linear combination between them. The cointegrated variables will then not move far apart as they are attracted to their long-run relationship. The analysis of integration of trending variables was used as a means of determining whether there was a non-spurious long-run equilibrium relationship that existed among the series used in the study. The confirmation of the integration order is the first step in cointegration analysis (Johansen, 1988). Johansen method was applied, using only the series integrated of order one, to test for

cointegration. This is because the test performs better in multivariate models by testing for the likelihood of multiple cointegrating relationships when there are more than two variables (Maddala, 2001).

Since all the variables used in the study were not integrated of the same order, ARDL bound test was also carried out to test for the presence of long-run relationships among all the variables. The test was based on Equation (3.29)

$$\Delta HP_t = \beta_0 + \sum_{i=1}^{K} \beta_{1i} \Delta(HP)_{t-i} + \sum_{i=0}^{K} \beta_{2i} \Delta(HCEXP)_{t-i} + \sum_{i=0}^{K} \beta_{3i} \Delta(PCGDP)_{t-i}$$

$$+ \sum_{i=0}^{K} \beta_{4i} \Delta(UPop)_{t-i} + \sum_{i=0}^{K} \beta_{5i} \Delta(PCI)_{t-i} + \sum_{i=0}^{K} \beta_{6i} \Delta(HStc)_{t-i} + \sum_{i=0}^{K} \beta_{7i} \Delta(CC)_{t-i} +$$

$$\sum_{i=0}^{K} \beta_{8i} \Delta(PT)_{t-i} + \sum_{i=0}^{K} \beta_{9i} \Delta(HHI)_{t-i} + \lambda_1 (HP)_{t-1} + \lambda_2 (HCEXP)_{t-1} + \lambda_3 (PCGDP)_{t-1} +$$

$$\lambda_4 (UPop)_{t-1} + \lambda_5 (PCI)_{t-1} + \lambda_6 (HStc)_{t-1} + \lambda_7 (CC)_{t-1} + \lambda_8 (PT)_{t-1} + \lambda_9 (HHI)_{t-1} + \varepsilon \quad (3.29)$$

The variables were as earlier defined. Δ denoted the first difference operator. The model was unrestricted intercept and no trend. $\lambda_1 \; to \; \lambda_9$ on the right hand side of Equation (3.29) corresponded to the long-run relationship. The other expressions represented with the summation signs ($\beta_{1i} \; to \; \beta_{9i}$) indicated the short-run dynamics of the model. K was the maximum number of lagged observations included in the model which was determined through use of Akaike Information Criterion (AIC) and Schwartz Information Criterion (SIC). In order to investigate the presence of long-run

relationships among the variables, bound testing was used. The bound testing procedure was based on the F test. The F test is a test of the hypothesis of no cointegration among the variables against the existence or presence of cointegration among the variables as denoted by Equations (3.30; 3.31)

H_o: $\boldsymbol{\lambda}_1 = \boldsymbol{\lambda}_2 = \boldsymbol{\lambda}_3 = \boldsymbol{\lambda}_4 = \boldsymbol{\lambda}_5 = \boldsymbol{\lambda}_6 = \boldsymbol{\lambda}_7 = \boldsymbol{\lambda}_8 = \boldsymbol{\lambda}_9 = 0$ (3.30)

(i.e., there is no cointegration among the variables)

H_o: $\boldsymbol{\lambda}_1 \neq \boldsymbol{\lambda}_2 \neq \boldsymbol{\lambda}_3 \neq \boldsymbol{\lambda}_4 \neq \boldsymbol{\lambda}_5 \neq \boldsymbol{\lambda}_6 \neq \boldsymbol{\lambda}_7 \neq \boldsymbol{\lambda}_8 \neq \boldsymbol{\lambda}_9 \neq 0$ (3.31)

(i.e., there was cointegration among the variables)

The ARDL bound test was based on the Wald test (F statistic). The asymptotic distribution of the Wald test was nonstandard under the null hypothesis of no cointegration among the variables. Two critical values are given by Pesaran et al. (2001) for the cointegration test. The lower critical bound assumes all the variables are integrated of order zero meaning that there is no cointegration relationship between the examined variables. The upper bound assumes that all the variables are integrated of order one meaning that there is cointegration among the variables. When the computed F-statistic was greater than the upper bound critical value, then the null hypothesis was rejected (the variables were cointegrated). If the F-statistic was below the lower bound critical value, then the null hypothesis could not be rejected (there was no cointegration among the variables). But when the computed F-statistics fell between the lower and upper bound, then the results were inconclusive.

3.10 Data Analysis

The first objective of the study was to analyze the sources of housing prices growth in Kenya. To achieve the objective, Equations (3.20) and (3.21b) were utilized. Equation (3.20) coefficients gave the long-run marginal effects while equation's (3.21b) coefficients gave the short-run marginal effects. The second, third and fourth objectives aimed at examining the dynamic relationship between housing prices and the selected macroeconomic variables. This was achieved by conducting Toda-Yamamoto Causality test and conducting impulse response using Equations 3.22, 3.23 and 3.24. Ordinary Least Square methods of estimation were utilized.

3.10.1 Diagnostic Tests

To ensure that estimates obtained from the estimated models were unbiased and consistent, diagnostic tests were undertaken. The tests for the ARDL model included: the normality test using Jarque-Bera statistics, Breuch-Godfrey Lagrange Multiplier test for serial autocorrelation, Lagrange Multiplier test for autoregressive conditional heteroskedasticity (ARCH), multicollinearity test using correlation matrix, Ramsey RESET test for specification error and CUSUM test for stability. For the VAR models, the tests included Serial Correlation test using VAR Residual Correlation LM test, Normality tests using VAR Residual Normality test and Stability test for parameter consistency using Inverse Roots of AR Characteristic Polynomial test.

CHAPTER FOUR

EMPIRICAL FINDINGS

4.1 Introduction

This chapter presents findings of the study. It starts by presenting descriptive statistics, results of time series property analysis and diagnostic tests on the estimated models. The chapter concludes by presenting the findings and discussion on the housing price growth and its dynamic relationship with selected macroeconomic variables.

4.2 Descriptive Statistics

The section presents a brief description and summary statistics for the variables used in the study. The statistics include mean, standard deviation and the range of values of the observations as presented in Table 4.1 The summaries are based on data collected from various sources as indicated in section 3.7 of chapter three for the period 1960 to 2015

Table 4.1: Summary Statistics of the variables

Variables	Mean	Median	Maximum	Minimum	Std. Dev.	No. of Obs
Housing Price (Ksh)	1.877943	0.760959	10.49638	0.157658	2.952711	56
Construction Cost (Ksh)	1.539846	0.708374	9.12684	0.02293	2.44541	56
Per capita GDP (Ksh)	0.064158	0.066325	0.08924	0.037359	0.011767	56
Private Capital Inflows (% of GDP)	0.935033	0.746117	2.737887	0.040833	0.703267	56
Household Indebtedness (% of GDP)	20.90773	19.89611	36.82999	11.80493	5.751805	56
Urban Population (% total population)	16.36123	16.332	25.35688	7.361994	5.226557	56
Property Taxes (% of GDP)	0.255874	0.205187	0.540003	0.085247	0.121776	56
Housing Stock (% of urban population)	1.482176	1.789981	2.928113	0.22623	0.682784	56
Household Consumption Expenditure (Ratio to GDP)	0.700298	0.685637	0.873729	0.590117	0.073365	56

Note: Variables measured in prices are in Ksh '000000'; % represents percentage; No. of Obs stands for number of observations; Std Dev. is standard deviation

On average, the real value of new housing in Kenya was Ksh. 1.88 million between the year 1960 and 2015. The minimum price was Ksh. 0.16 million while maximum was Ksh. 10.5 million. A standard deviation of Ksh. 2.95 million indicated a high variation from the mean during the period under the study. The descriptive statistics also indicated that the average real construction cost was Ksh. 1.54 million with a range from Ksh. 0.02 million to Ksh. 9.13 million and a standard deviation of Ksh. 2.45 million during the study period. The high increase in construction cost experienced during the period was attributed to the rise in the price of land that came about due to speculative activities. Speculative behavior was where individuals bought and held land not with aim of developing it, but with the hope that prices were to be higher in the future. On average therefore, investors in the housing sector earned a real net profit of Ksh. 0.34 million. The profit was achieved by getting the difference between the average real values of housing prices and construction costs.

The real per capita gross domestic product for Kenya was used to reveal its effect on the housing prices since it is the income of an individual that determined the affordability of a potential house purchase and construction. It was expected that changes in the levels of per capita income would have a mixed effect on the housing prices. The relationship between housing prices and real per capita GDP could be positive if more individuals purchased completed housing units already the market. This is as compared to those constructing their own housing units and thereby exerting pressure on the demand side of the housing market. The effect on the other side could be negative if more individuals, as their income increases, constructed their own houses rather than buying already completed and supplied housing units from the market. This would, on the other hand, exert pressure on the supply side of the housing market. The mean value of real per capita GDP was Ksh. 0.06 million, with a range from Ksh. 0.04 million to Ksh. 0.09 million and a standard deviation of Ksh. 0.01 million as given in Table 4.1. The per capita GDP standard deviation which shows the variation over the study period does not indicate a major variation during the period.

Private Capital Inflow's series was represented by net foreign direct investments into the economy. The net inflows were given as a percent of GDP. During the period 1960 to 2015, the private capital inflows ranged between 0.04 and 2.74 percent of GDP with a mean of 0.94 and a standard deviation of 0.7 as shown in Table 4.1. The figures supported the study claim that there had been a significant increase in private capital inflows relative to GDP rise during the study period.

Household indebtedness in the country ranged between 11.8 and 36.8 per cent of GDP, with a mean of 20.91 and a standard deviation of 5.75 during the period 1960 to 2015. The average change of household indebtedness as a percent of GDP was 3.8 per year during this period. This supported the study assertion of increase in the households' indebtedness during the study period.

Urban Population ranged between 7.36 to 25.36 percent of the total population. The mean was 16.36 and a standard deviation of 5.23. This indicated that, in average, 16 percent of the population lived in urban centers of the country during the study period. Given that 84 percent of the population lived in the rural areas of the country and that there had not been observed significant growth in housing prices in the rural areas, then the population effect on housing prices in the country was expected to be insignificant.

Table 4.1 also shows that the property taxes ranged between 0.09 and 0.5 percent of GDP with a mean of 0.26 and a standard deviation of 0.12 percent of GDP. The change in property taxes over the study period was also as a result of change in modes of collecting the property taxes in the country. Between the year 1960 and 1980, property taxes were collected by the national government and because of that, the percentage taxes were below the mean, thereafter, the rates collection was responsibility of local authority up to the year 2013 when the rates collection responsibility was taken over by the county government. It is observed that the changes on the mode of receiving the property taxes depicted structural changes on the property taxes series. The purpose of

inclusion of the variable was to establish whether these taxes and charges could explain the growth of housing prices.

Table 4.1 shows the housing stock to have ranged between 0.23 and 2.9 percent of the urban population during the period 1960 to 2015. The mean and the median were 1.48 and 1.79 percent of the urban population respectively. This meant that the supply of housing on average was 1.5 percent of urban population during the study period. The standard deviation was 0.68 percent. As the supply of the houses increases relative to population, the expectation was that the housing prices would decrease. Comparing the housing supply in relation to population over the study period, the statistics indicates an improvement of supply in relation to population during the study period.

Household Consumption Expenditure was captured since house prices fluctuation over time may affect households' consumption decisions and vice-versa. Rising housing prices may stimulate consumption by increasing households' perceived wealth and increased consumption may put upward pressure on housing prices. The series was given as a ratio to GDP. Between the periods 1960 to 2015, the values of household consumption expenditure ranged between 59 and 87 percent of GDP with a mean of 70 and a standard deviation of 7.3. This implied that over the period household consumption expenditure varied considerably relative to GDP.

4.3 Time Series Property Results

The study used time series data. This data exemplifies the problem of spurious regression (Gujarati, 2004). To check the time series properties of the data, several tests were carried out. These tests are discussed in sections 4.3.1 and 4.3.2

4.3.1 Unit Roots Tests

The study tested for non-stationarity of each variable determine their order of integration. For stationarity robust check, Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) were employed in testing for unit root. The KPSS was added as confirmatory test due to the fact that ADF and PP statistic have limitations of lower power and successive or persistent unit roots respectively (Gujarati, 2004). ADF and PP tend not to reject the null hypothesis in presence of close to unit roots. The tests results for all the variables are reported in Table A2.1 of Appendix 2. Where the results of ADF, PP and KPSS conflicted, KPSS was used to make the decision because of its high power of rejecting the null hypothesis when it is not true.

The unit root test results show that, other than the Private Capital Inflow series, all other series had unit root at levels. However, all the series were stationary at first difference. The unit root tests concluded that, Capital inflows series was stationary at level and therefore integrated of order zero (I(0)): Housing prices, Households' Consumption Expenditure, Households' Indebtedness, Construction Costs, Property Taxes, Housing

Stock and Urban Population series were stationary at first difference and hence integrated of order one (I(1)). Therefore, the series were subjected to cointegration tests.

4.3.2 Cointegration Analysis

Despite the fact that regression of non-stationary series on other non-stationary series may possibly produce spurious regression, there is a possibility that the regression can be meaningful if the variables were cointegrated (Yule, 1989; Ssekuma, 2011). In testing for cointegration, ARDL F-Bound tests ware utilized. This was because the variables were integrated of different order. However, for purpose of robust check, Johansen test for cointegration was analyzed where private capital inflows variable, whose integration was different from others, was excluded.

Johansen test was used to get the number of cointegrating equations since it performs better in a multivariate model. The test involves testing for the likelihood of multiple cointegrating relationships when there are more than two variables and integrated of the same order (Maddala, 2001). Both Trace and Eigen values were used to determine the number of cointegrating vectors. Only the variables integrated of order one were used for Johansen test.

Table A2.2 in Appendix 2 presents the Johansen cointegration test results. Both Trace statistic and Eigen values statistic indicate that there were two cointegrating relationship among the study variables. The test therefore rejected the null hypothesis of no cointegration and also the null hypothesis that there was one cointegrating vector in favor of two cointegrating vectors at 5 percent level of significance. The test however

could not reject the null hypothesis of at most two cointegrating vectors against the alternative hypothesis of three cointegrating vectors, for both the Trace and Eigen value test statistics. Consequently, it concluded that there were two cointegrating relationships among the study variables.

ARDL bounds test was carried out in order to determine whether the independent variables have a long-run relationship with the current value of housing price since all the study variables were not integrated of the same order. The study used automatic system generated maximum lag by use of Akaike's Information Criterion (AIC) for Equation (3.29). Following the procedure by Pesaran (1997), estimation of Equation (3.29) was done by use of least square methods. The results are presented in Table A2.3 of Appendix 2. The results were then tested for the joint significance of the parameters of the lagged variables using hypothesis (3.30) and (3.31) in Chapter 3. If the F-statistic is above the upper critical value (upper bound), the null hypothesis of no long-run relationship is rejected irrespective of the orders of integration for the time series. Conversely, if the test statistic fall below the lower critical value (lower bound), the null hypothesis is not rejected. But if the statistic fall between the lower and upper critical values, the test results for cointegration are inconclusive (Pesaran, 2001). The bounds test results are given in Table 4.2

Table 4.2: ARDL Bounds Test
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	85.46529	7
Critical Value Bounds		
Significance	I(0) Bound (lower Bounds)	I(1) Bound (upper bounds)
10%	2.03	3.13
5%	2.32	3.5
2.5%	2.6	3.84
1%	2.96	4.26

Source: Author's Calculations.

Table 4.2 shows that F-statistic is greater than upper bound values of 4.26 at 1 per cent level of significance. Therefore, it was concluded that there exists a long-run relationship between the dependent variable and the independent variables. Therefore, ARDL could be employed to derive the long-run and short-run effects.

4.4 Diagnostic and Stability Tests

The estimation of the study models was carried out using OLS method. For this method of estimation to give unbiased, efficient and consistent estimates, certain assumption must be fulfilled. Therefore, before the estimated results could be adopted to address the research objectives, diagnostic tests were conducted to establish the models statistical appropriateness for ARDL and VAR. For the general ARDL model given by Equation (3.17), and whose estimated results are given in Appendix A2.4, its diagnostic tests are discussed in sections 4.4.1, 4.4.2, 4.4.3, 4.4.4 and 4.4.5 Also, in order to ascertain that the ARDL model reaches equilibrium values, stability test was conducted and the

results are discussed in section 4.4.6. For VAR diagnostics and stability tests, the results are discussed in sections 4.6.1, 4.6.2 and 4.6.3 respectively.

Before carrying out the diagnostics and stability tests for ARDL model, Equation (3.17) was estimated. This was for purpose of selecting appropriate model to be subjected to diagnostics and stability tests and for subsequent use in the ARDL analysis. The selection procedure entailed establishing the optimal lags and testing for goodness of fit. The estimation results are presented in Table A2.4 of Appendix 2. By employing automatic lags selection by use of Akaike's Information Criterion (AIC), the test adopted lags (3, 3, 3, 0, 3, 3, 2, 3) as expounded by Table A2.4 and Figure A3.1, as the optimal model out of the 20 models considered. The R-squared and Adjusted R-squared for the fitted model were approximately equals to one meaning that the study data set provided a perfect fit. The ability of the model was also confirmed by the standard error, which was 0.06, F-statistic of 5424.854 and its probability value equal to 0.0000 for the joint statistical significance of all the explanatory variables of the model. Therefore, the null hypothesis that the estimated parameters of the explanatory variables are jointly equal to zero was rejected at one percent level of significance. The model was hence used as the optimal model and was consequently subjected to diagnostics and stability tests as outlined in sections 4.4.1, 4.4.2, 4.4.3, 4.4.4, 4.4.5 and 4.4.6 respectively.

4.4.1 Multicollinearity Test

The study assessed potential for serious multicollinearity among the variables by developing correlation matrix. The pair-wise matrix was used to determine the degree of correlation among the study's variables to avoid serious multicollinearity problem that could undermine the reliability of the estimates of individual coefficients. The results are given in Table A2.5 of Appendix 2. Urban Population series was observed to be highly correlated (near perfect collinearity) with two other series. The series included household indebtedness and per-capita GDP (correlation coefficients of 0.94 and 0.9 respectively). Urban Population series was also not strongly correlated to housing prices (dependent variable) as compared to household indebtedness. The variable was therefore dropped from the ARDL analysis. In addition, the coefficients estimation from ARDL model improved their significance after dropping urban population variable without significantly affecting the values of adjusted R-squared thereby concluding that multicollinearity was a serious issue when urban population variable was included in the ARDL model.

4.4.2 Normality Tests

Residual based tests were carried out for the residual series of the general equation test. The first test was normality test by use of Jarque-Bera test. This tests whether or not the residual of the model estimated had the skewness and kurtosis that matches a normal distribution. From the histogram for normality tests given in Figure A3.2 of Appendix 3, the probability values (P-values) of the Jarque-Bera statistic were greater than 0.01 and the null hypothesis that the residuals were normally distributed could not be rejected at 1 percent level of significance. This ascertained that the data used is from a

normal distribution and that estimated coefficients were normally distributed and t and F tests could be used for hypothesis testing as they assumed normal distribution.

4.4.3 Serial Correlation Test

The second test on estimated residuals was Breusch-Godfrey LM serial correlation test. The test is to check for the violation of $Cov(u_t u_{t-s}) = E(u_t u_{t-s}) = 0$ for all $t \neq s$. The test is appropriate when there is a lagged dependent variable on the right hand side of the equation. The test results are presented in Table A2.6 of Appendix 2. The results showed no evidence of autocorrelation. The p-value of the LM test X^2 statistic was 0.9043 and therefore the null hypothesis of no serial correlation in the residuals could not be rejected at one percent level of significance.

4.4.4 Heteroscedasticity Test

In presence of heteroscedasticity, OLS estimator is no longer efficient. To test for heteroscedasticity, ARCH test was used. Results from ARCH test are presented on Table A2.7 of Appendix 2. The P-values for ARCH X^2 statistics was 0.2293. Therefore the null hypothesis of homoscedasticity could not be rejected at one percent level of significance. This implied that the standard errors of the estimates are not biased and t and f distributions can be used to draw inferences.

4.4.5 Test of specification error

The study also tested whether non-linear combinations of the independent variables used in the study ARDL model have any power in explaining the changes in housing

prices. Ramsey RESET test (see Wooldridge, 2012) was used in this regard. The tests results are given in Tables A2.8 of Appendix 2. From the results, calculated F-statistic was 0.5008. The null hypothesis of no specification error was not rejected. It was therefore concluded that there was no misspecification in the model. The linear functional form of the ARDL model was correctly specified and appropriate for estimation.

4.4.6 Model Stability Test

In order to test whether the dependent variable reaches its equilibrium value in the ARDL model, stability test was conducted for the model. The results given in Table A2.4 of Appendix 2 for the estimated general model showed that value of the sum of coefficients for the lagged dependent variable was minus (-) 0.841299. Because it was less than one, it was concluded that the model was stable.

The estimates by use of OLS from the ARDL model also needed to be tested for constancy. This is a test to establish whether or not the ARDL model's coefficients are stable. In testing for parameter constancy, CUSUM stability test was applied to the residuals. The results are shown by Figure A3.3 of Appendix 3. The estimates are within the acceptable region at 95 percent level of confidence. This means that the parameters are stable.

4. 5 Sources of Housing Prices Growth in Kenya

The first objective of the study was to analyze the sources of housing prices growth in Kenya. This was achieved through use of Autoregressive Distributed Lag (ARDL) model for long-run and short-run sources of housing prices growth. The estimation outputs are given in Table A2.10 of Appendix 2 where the table reports both short-run and long-run sources. The results extracted from Table A2.10 are discussed in sections 4.5.1 and 4.5.2 for short-run and long-run sources of housing prices growth respectively.

4.5.1 Short-run Sources of Housing Price Growth in Kenya

The short-run estimates were obtained in two stages. The first stage involved estimating the cointegrating ARDL Equation (3.21a). The residuals from estimation were then lagged once (ECT-1) and were then used in the second stage to estimate the ARDL model given by Equation (3.21b). The short-run results represent the coefficients of the differenced explanatory variables and they gave short-run marginal effect. The coefficients describe short-term effects of independent variables to the dependent variable. The results are presented in Table 4.3

Table 4.3: Short-Run effects of various variables on Housing Price

Dependent Variable	**Housing Prices**		
Regressors	**Coefficients**	**t-Statistics**	**Probability value**
Δ Housing Price lagged once	[0.888168]***	8.674888	0.0000
Δ Housing Price lagged twice	[0.599538]***	7.617652	0.0000
Δ Private Capital Inflows	[0.035841]	1.534910	0.1379
Δ Private Capital Inflows lagged once	[0.042064]*	2.035855	0.0529
Δ Private Capital Inflows lagged twice	[0.047532]**	2.174568	0.0397
Δ Construction Cost	[0.905366]***	17.327914	0.0000
Δ Construction Cost lagged once	[-0.207837]***	-3.972639	0.0006
Δ Construction Cost lagged twice	[-0.583704]***	-8.152418	0.0000
Δ Households' Consumption Expenditure	[0.770934]**	2.347299	0.0275
Δ Households' Indebtedness	[-0.012584]	-1.549067	0.1345
Δ Households' Indebtedness lagged once	[0.002070]	0.248750	0.8057
Δ Households' Indebtedness lagged twice	[0.019210]**	2.353542	0.0271
Δ Per capita GDP	[-11.577650]	-1.971973	0.0602
Δ Per capita GDP lagged once	[12.367415]**	2.092737	0.0471
Δ Property Taxes	[0.211859]	1.016860	0.3194
Δ Property Taxes lagged once	[-0.073867]	-0.280277	0.7817
Δ Property Taxes lagged twice	[-0.665732]***	-3.093739	0.0050
Δ Stock of housing	[0.514832]***	3.769943	0.0009
Δ Stock of housing lagged once	[1.635073]***	3.854093	0.0008
Δ Stock of housing lagged twice	[-0.790563]***	-3.195367	0.0039
Dummy Variable for the period after 2007	[2.160237]***	18.533548	0.0000
Error Correction Term (ECT)	[-1.841299]***	-16.611926	0.0000

Note: [***], [**] and [*] denote significant at levels 1%, 5% and 10% respectively.
Δ denotes the first difference operator
Source: Author's calculations.

From the Table 4.3, the coefficients of first and the second lags of real housing prices change are approximately 0.9 and 0.6 respectively. The values are positive and statistically significant at 1 percent level of significance. The change in housing price in the current period affects the housing prices in the second year and also in the third

year. The indication is that, past changes in housing prices have positive effect to the housing prices up to two years after. These results suggest that, in Kenya, current period's increase of housing prices, alongside other variables, is a significant driver of the housing prices increase in the future. This is because an increase in current housing prices increases the value of the housing as an investment component (q-value from Tobin's q model). With value of q greater than one, the returns from investment in housing market creates demand for housing as an investment tool in the current period and one period after, thereby pushing up the housing prices. This result and modeling approach has not been shown in the previous studies of the housing market.

Private capital inflows' coefficient is not statistically significant in the current period. However, the coefficient becomes significant after two years. In the short-run analysis, percentage private capital inflows affect the housing prices positively in the third year. This is because increase in the private capital inflows lowers the cost of financing housing and consequently increases the q-value of the housing (Tobin, 1972). This leads to an increased demand for housing as an investment vehicle pushing up the growth of housing prices in the consecutive periods. This finding conforms to those of Calvo et. al. (2003), Belke and Wiedmann (2006), Caballero and Krishnamurthy (2009) and Laibson and Mollerstrom (2010). These studies found that there was a significant growth of housing prices that was preceded by rising private capital inflows in the run-up to the sub-prime episode in the United States. Despite the private capital inflows depressing influence on interest rates, private capital inflows in Kenya increases the growth of housing prices significantly. Many alternative theories that accounted for a

positive correlation between housing prices and private capital inflows noticed that the rise in housing prices during the boom period could be attributed to an overall decline in risk premium and not to a fall in interest rates.

Construction cost coefficient is statistically significant at 1 percent level of significance. Its marginal effect to the housing prices is positive in the current period but negative in the following year and after two years. The construction costs included the cost of land, cost of building materials, cost of labor and cost of acquiring finances. It represented the replacement cost in the Tobin's model. The change in the direction of effect means that, a positive change in the cost of construction increases the housing prices in the current period. This positive change in the cost of construction however has a negative effect on q-value (Tobin, 1972). This affects negatively the demand for housing as an investment tool leading to decline in demand for investments in the following years. Reduced demand for investments in housing leads to reduction in housing prices in the consecutive periods. These findings were consistent with the Dipasquale and Wheaton (1994) on US housing market.

Households' consumption expenditure affects the housing prices positively and only in the current period. The coefficient is statistically significant at 5 percent level of significance. When the households' consumption expenditure increases, it raises the housing prices in the first year. The results further confirm the existence of positive effects of households' consumption expenditure on housing prices in Kenya. One percentage rise in households' consumption expenditure will trigger an immediate

increase in the demand for housing, pushing up the housing prices by Ksh. 0.77 million, if other variables remain unchanged. This finding is economically plausible both in terms of sign and magnitude according to Modigliani (1988) theory on consumption.

Household indebtedness does not have an immediate effect on housing prices in Kenya. The coefficients for the household indebtedness in the current year and the following year are insignificant at 5 percent level of significance. The coefficient however is significant and positive in two years after. A rise by 1 percent of household indebtedness in this year increases the housing prices by Ksh. 0.02 million in the third year after the rise. This suggests that an increase in commercial banks credit to households lead to an increase in the housing prices after two years. As was observed in the study by Gimeno and Martinez-Carrascal (2010) in Hong Kong and Hyun et al. (2013) in Korea, this is due to household indebtedness effect on demand side of the housing market where higher level of indebtedness indicates low capital constraint or financial liberalization and therefore increases demand for housing as an investment tool and also for owner occupation purposes. This effect is positive to the housing prices.

Per capita GDP's coefficient is insignificant at 5 percent in the current year. The coefficient however is positive and statistically significant in the following year. A short-run and positive income shock to households will have a positive shock to the housing prices in the following year. That is, when per capita GDP increases by Ksh. 1 million, the housing prices will increase by Ksh. 12.37 million in the second year of the

increase. This increase in the housing prices result from increased consumption on housing services. This finding was consistent with those of Reinhart and Rogoff (2008)

Property taxes' coefficient is not statistically significant in the current and following year. The coefficient however is statistically significant and negative in the third year at 1 percent level of significance. If the property taxes increase by 1 percentage point, housing prices reduces by Ksh. 0.67 million in the third year. The results mean that increased user cost of capital reduces demand for housing and hence the reduction in housing prices. The finding is consistent with Muellbauer and Murphy (2008) and Madsen (2011) findings that property taxes increases the effective user costs of housing and thus pushes demand for housing downward.

Housing stock coefficient is statistically significant in the current and in the previous periods at 1 percent level of significance. The effect of housing stock to the housing prices is positive in the first and second year but the effect becomes negative in the third year. This implies that when the housing stock rise, the housing prices increase in the current year and the following year before declining in the third year. This is inconsistent with economic theory where increased supply leads to reduction in prices. However the third year period effect conforms to the economic theories. The short-run effects of increased housing supply to the housing prices in the current period and the previous period could be through the effect on demand for housing as a tool for investment. When the return on housing market investment is positive (q-value is positive), the demand for housing as an investment tool increases pushing both the costs

and supply of housing upward (Madsen, 2011; Tobin, 1972). Due to the increased cost of housing supply, the growth in the housing prices increases. The prices however responded to the increased supply after the second year.

The Speed of Adjustment (ECT) indicates the amount of disequilibrium that is corrected in each period. The ECT coefficient in Table 4.3 represents the proportion by which the long-run disequilibrium in the housing prices is being corrected in each period. The coefficient is negative and statistically significant at 1 percent level of significance. This is a support to presence of long-run association between the housing prices and the variables used in the study. However, the coefficient of speed of adjustment is 1.84 which is greater than 1 in absolute term. This indicates an overshooting of economic equilibrium (Ssekuma, 2011). This implies that the housing prices adjust to above the long-run equilibrium early enough before the end of one year. This means that housing prices are above their fundamentally expected growth path every year. Disequilibrium or deviations below expected growth are quickly corrected. This supports the study proposition of continuous conformation to the expected growth in housing prices in Kenya over the study period.

4.5.2 Long-run Sources of Housing Price Growth in Kenya

Long-run sources of housing price growth in Kenya were extracted from Table A2.10 of Appendix 2. The coefficients showed how the housing prices reacted to permanent changes in the independent variables. The results were achieved through estimation of

equilibrium ARDL model given by Equation (3.20) in Chapter 3. The long-run results are given in table 4.4

Table 4.4: Long-run ARDL Results

Dependent Variable	**Housing Prices**		
Regressors	**Coefficients**	**t-Ratio**	**Probability**
Private Capital Inflows	[-0.041209]*	-2.032152	0.0533
Cost of Construction	[1.071151]***	94.415814	0.0000
Households' Consumption Expenditure	[0.418690]**	2.306418	0.0300
Households' Indebtedness	[0.001503]	0.289163	0.7749
Per Capita GDP	[-8.550959]***	3.905354	0.0007
Property Taxes	[0.390509]**	2.642665	0.0143
Housing Stock	[0.000159]	0.003253	0.9974
Dummy Variable for the period after 2007	[1.173213]***	11.693499	0.0000
Intercept	[0.226678]	1.364941	0.1849

Note: [***], [**] and [*] denote significant levels at 1%, 5% and 10% respectively.
Source: Authors calculation.

From the long-run ARDL results in the Table 4.4, the coefficients of construction cost, households' consumption expenditure and property taxes are positive and statistically significant at 5 percent level of significance indicating that the variables have a long-run positive effect on housing prices. The coefficient of dummy for period after the year 2007 is statistically significant indicating that there was a structural break. The coefficient for private capital inflows is negative but statistically significant at 10 percent level of significance. Per Capita GDP coefficient is also negative but statistically significant at 1 percent level of significance. Households' indebtedness and housing stock are not statistically significant in the long-run.

Private capital inflows coefficient is positive and statistically significant in the short-run but becomes negative and statistically significance at 10 percent level of significance in the long-run. When private capital inflows increase by 1 percent, the housing prices increase by Ksh. 0.04 million in the long-run but its effect is negative and insignificant at 5 percent level. Its effect is however positive and significant in the short-run. Therefore, in agreement with Favilukis et al. (2011), private inflows of foreign money into the domestic markets plays a small role in driving housing prices in the long-run despite its influence on interest rates.

Just as is in the case of short-run, the coefficient of households' consumption expenditure is positive and significant at 5 percent level of significance in the long-run. However, the marginal effect is smaller in the long-run. A one point increase in the ratio of households' consumption expenditure to GDP leads to Ksh. 0.419 million increase in housing prices in the long-run. The marginal effect of households' consumption expenditure is 0.77 in the short-run and 0.42 in the long-run. The long run marginal effect is therefore clearly less compared to the transitory shocks. The effect is through the wealth effect as found in the studies by Guglielmo and Ricardo, (2011), Muellbauer and Murphy, (2008) and Aron et al. (2007). From these studies, through the wealth channel, effects of households' consumption expenditure to housing prices are positive. However, the long-run effects are smaller due to the higher deposits requirements on housing purchases.

Housing stock does not have a long-run effect on the housing prices. This is due to the fact that increase in housing stock also leads to increase in cost of construction. Construction cost is perhaps the main variable noted to explain the movements of housing prices in the study findings. In the long-run Ksh. 1 million increases in construction cost results to Ksh. 1.07 million increase in the housing prices. The long-run effect, unlike the short-run, is positive and more than proportionate in its marginal effect. Therefore in support of Shiller (2005) for the positive sloping long-run housing supply theory, housing price tend to grow at a faster pace than the construction costs. Again, like the findings of this study, Featherstone and Baker, (1987) in their study for the US housing market found that housing prices overreact to construction costs shocks, and has a propensity to create bubbles in the housing prices. This study results as well shows that construction cost in Kenya housing market causes an overreaction to the housing prices in the long-run. This is explained by the cost of land in Kenya which has been increasing mainly due to speculation and high demand for land in the country. Like in the findings by Dipasquale and Wheaton, (1994) on US housing market, housing prices responds to changes in the cost of construction in both short-run and long-run but the long-run effect is clearly higher than in the short-run.

Unlike the case of short-run, per capita GDP coefficient is negative in the long-run and statistically significant at 1 percent level. An increase in per capita GDP by one percent, housing prices reduces by 8.56 percent in the long-run. Even though the result did not conform to economic theory, the outcome is consistent with expectations of this study. The negative effect of the per capita GDP on the housing prices means that more

individuals are building their own residential houses. This is against purchasing the ones completed and supplied in the market, as their level of per capita income increases. This scenario is explained by the growth of middle income population in Kenya. This group is increasingly building own residential housing. This has created high demand for land, especially agricultural land surrounding urban centers and creating an influx in the supply of new self-constructed housing in Kenya (AfDB, 2011). In the long-run, therefore, supply of new and modern housing in the market will continue as the per capita GDP rises. This will eventually put downward pressure in the housing prices. With housing being illiquid asset, an unexpected negative per capita GDP shock, households may as well need to sell their assets in distress to raise their income and maintain the consumption levels (Bernanke and Lown, 1991). These findings agree with Bernanke and Lown, (1991) for the Japan's housing market before the period of stagnation in 1990.

The property taxes have a positive long-run effect on the housing prices. Unlike the short-run effect that indicates a negative effect of property taxes on housing prices, in the long-run case, permanent property taxes have a positive effect. The property rates coefficient is significant at 5 percent level of confidence. In the long-run therefore, the increase in property taxes increases the cost of capital thereby reducing the q-value of housing investment. The findings support Tobin's (1975) theory on investment and Madsen (2011) theory on housing demand. According to these studies, while the taxes traditionally influenced housing prices through the channel of user costs, in the long-run they influence housing prices through the channel of acquisition costs. The taxes

therefore, have effects on housing prices that are quite different from those of user cost based in the short-run.

The housing price boom in Kenya therefore could be attributed to; rise in household consumption expenditure. Household consumption expenditure has both short-run and long-run effect on the housing price. It positively triggers an increase in the demand for housing pushing up the housing prices if the supply remains significantly unchanged; construction costs upswing that results from land speculation; property taxes that affects the housing price negatively in the short-run but positively in the long-run. The short-run effect is through the user cost of capital that lowers the demand for housing while in the long-run is through the acquisition cost; the other noted effect is the period after 2007. The effect that was captured by use of a dummy is significant at 1 percent level of confidence both in short-run and long-run. This indicates a structural change to the housing prices over the study period.

4.6 Dynamic relationship between Housing Prices and Selected Macroeconomic Variables.

In the second, third and fourth objective, the aim was to understand the dynamic relationship between housing prices and selected macroeconomic variables in Kenya. To achieve this, Vector Autoregressive (VAR) models were used to capture the dynamic interrelationships among variables by treating them as a priori endogenous (Sims, 1972). Testing for causality was conducted using a modified version of the Granger causality test proposed by Toda and Yamamoto (1995), which is valid regardless of whether a series is integrated of order zero, integrated of order one or

integrated of order two, non-cointegrated or cointegrated of any arbitrary order. Toda and Yamamoto method of testing for causality was used in order to avoid spurious causality or spurious absence of causality. Impulse response functions analyses were also utilized to addresses how the selected macroeconomic variables respond dynamically to exogenous shocks in housing prices. The impulse response analysis was to trace the response overtime of the current and future values of the variables to a unit increase in the current value of housing prices assuming that this increase returns to zero in subsequent periods and that all other variables are unchanged.

Though it was not necessary to determine the order of integration of the series used, it was important to determine the optimal lag length (k) for Equations (3.22), (3.23) and (3.24) in Chapter 3. This was because Toda and Yamamoto Granger causality test is very sensitive to the selection of the lag length. If the chosen lag length is less than the true lag length, the omission of relevant lags can cause bias. On the other hand, if the chosen lag length is more than required, the irrelevant lags in the equation cause the estimates to be inefficient (Clarke and Mirza, 2006). Following this, a combination of AIC, Schwarz's Bayesian Criterion (SBC) and likelihood ratio (LR) test ware used to select the number of lags required. Results are given in Table A2.11, A2.16 and A2.21 of appendix 2 for Models (3.22), (3.23) and (3.24) presented in Chapter 3.

After selecting the lag length for Equations (3.22), (3.23) and (3.24), the study tested whether the chosen orders of lags pass several diagnostic tests for the three models. If not, lag length were increased/decreased successively and also inclusion of other

variables as control variables until the results passed the diagnostic tests shown better results when tests for the reliability of the models, that is VAR Residual Serial Correlation LM Tests, VAR Residual Normality Tests and VAR stability tests.

4.6.1 Dynamic Relationship between Housing Prices and Households Indebtedness

To examine the dynamic relationship between housing prices and households' indebtedness, VAR model represented by equation (3.22) in Chapter 3 was estimated where both housing prices and households' indebtedness were endogenous. Lag order selection criteria, AIC and LR selected 8 lags as the optimal lags and also employed d_{max} = lag 9 as a control lag as suggested by Toda and Yamamoto (1995). Other variables given in equation (3.15) were also used as control variables. The diagnostic tests for the model are given in Tables A2.14 and A2.15. The tests for autocorrelation and normality indicate absence of autocorrelation in the residuals and that residuals are normally distributed. Figure A3.4 in Appendix 3 indicates stability for the VAR model. The VAR results are presented in Table A2.12 and Table A2.13 of appendix two. A summary for table A2.13 is presented in table 4.5.

Table 4.5: Toda and Yamamoto Augmented Causality Tests between Housing price and Households Indebtedness

Null Hypothesis	Chi-sq
Households Indebtedness does not granger causes Housing Price	[7.543895]
Housing Price does not granger causes Households' Indebtedness	[17.74561]**

Note: [**] denotes significant levels at 5%
Source: Author's computation.

Toda and Yamamoto Granger Causality test between housing prices and households' indebtedness shows one way causality. That is, housing prices ganger causes

households' indebtedness but households' indebtedness does not granger cause housing prices. This further confirms that, households' indebtedness do not have significant effect on housing prices, just as was given by the ARDL model. As Table 4.5 shows, the Toda and Yamamoto Granger causality test fails to reject the null hypotheses that households' indebtedness does not granger cause Housing Price at 5 percent level of significance. However the test rejected the null hypothesis that housing Prices do not granger cause households' indebtedness. This finding gave support for the existence of causality moving from housing prices to households' indebtedness at 5 percent level of significance. There is, therefore unidirectional causal relationship between housing prices and households' indebtedness. Households' indebtedness is caused by housing prices. This conforms to the findings in the studies by Hyun, Jong, and Myung (2013) for Korea, Gimeno and Martinez-Carrascal (2010) for Finland and Spain, Goodhart and Hofmann (2008) and Kohn (2007) for the industrialized countries.

The existence of a unidirectional relationship between housing prices and households indebtedness implies that a permanent and a negative shock resulting to a fall of housing prices in Kenya, has a high probability of driving defaults in loans repayments across the economy. Bario and Drehmann (2009) and Drehmann et al. (2010) also noted that if households' indebtedness and housing prices are positively related, then credit cycle causes housing prices cycle and housing prices cycle causes credit cycle. The findings suggest that, the household indebtedness in Kenya is related to housing prices increase. This results from the households using housing collateral values. These collateral values known to be credit risk (Drehmann et al., 2010).

To analyze the impact of housing prices to households' indebtedness in case of a one-off shock, the study used unrestricted VAR setup to calculate impulse response function. The results are presented in Figure 4.1

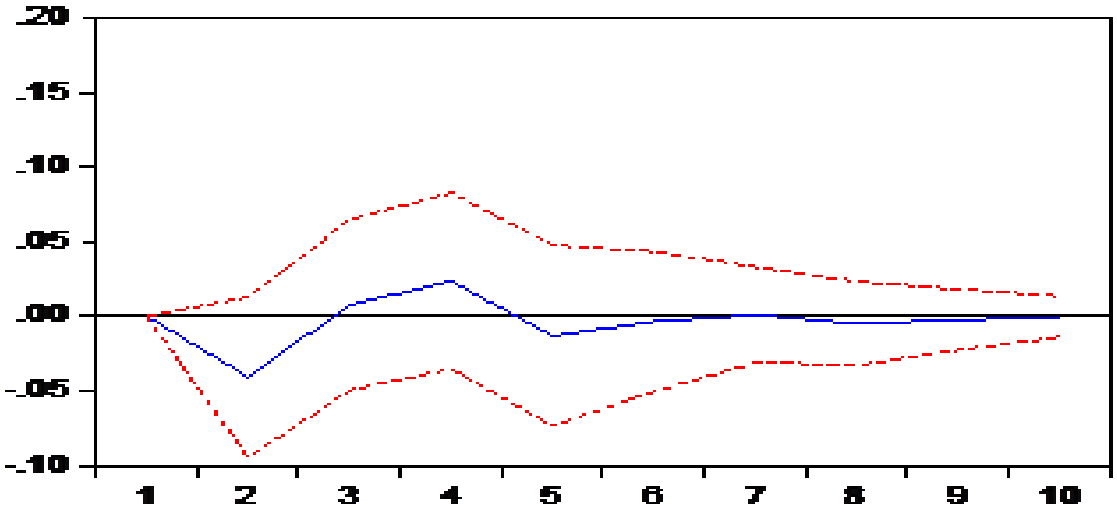


Figure 4.1: Impulse Response of Households' Indebtedness to House Price Shock
Source: Author's computation.

The figure shows the impact on households' indebtedness from a shock coming from housing prices. It exhibits a negative impact that gets positive in the third year of the shock. The impact wears off after seven years. This further confirms that housing is an important stock of wealth to the households in Kenya and is used for accessing funds. As long as housing prices are increasing, households' indebtedness will be fluctuating given the value of the collateral against which financial institutions extends credit. In case of a permanent and continuous decline in housing prices, financial institutions would have to reign on loans extended to households relative to a diminished capital base. That notwithstanding, decline in the value of housing could give an incentive to loans default.

The above analysis conforms to the description by Syricha (2013) findings which suggested that in the context of the sub-prime crisis, historical growth in housing prices fueled credit expansion and consequent property price booms in the US and UK. In the UK the housing boom was exacerbated by rising demand for housing coupled with inadequate physical supply and between the years 1997 – 2007, total household debts relative to GDP rose from 50 percent to 80 percent. Lending decisions were driven by the perception that high housing prices were defendable in the long-run. This was because continued housing prices growth would erode borrowers' debt burdens. In the US, lending patterns were similar but driven by the need to direct credit to previously excluded social classes and using housing as security.

4.6.2 Dynamic Relationship between Housing Price and Private Capital Inflows in Kenya

To analyze the dynamic relationship between housing price and private capital inflows in Kenya, causality test between housing prices and private capital inflows was carried out. This was through conducting Granger Causality test using Toda and Yamamoto (1995) method on Equation (3.23) given in Chapter 3. With regards to the lag length, Table A2.16 of Appendix 2 gave the Lag Order of 8 lags as the optimal number of lags. Other variables given in Equation (3.15) were used as control variables. Test on serial correlation and normality results are given in Tables A2.17 and A2.18 which indicate that the model did not have serial correlation and that the residuals were normally distributed. The tests for model stability are given by figure A3.5 which indicates that

the VAR model was stable. The Toda and Yamamoto Granger Causality tests results are shown on table A2.19 and A2.20. The summary of the results are presented in Table 4.6

Table 4.6: Toda and Yamamoto Augmented Causality Tests between Housing price and Private Capital Inflows

Null Hypothesis	Chi-sq
Capital Inflows does not granger cause Housing Price	[18.83888]**
Housing Price does not granger cause Capital Inflows	[31.61137]***

Note: [***] and [**] denote significant levels at 1% and 5%
Source: Author's computation.

The test rejects the null hypothesis that there is no causality moving from Private Capital Inflows to Housing Prices in favor of the alternative hypothesis at 5 percent level of confidence. The tests also indicate causality moving from housing price to private capital inflows at 1 per cent level of confidence. Therefore, housing prices granger causes private capital inflows and private capital inflows granger causes housing prices. The results implies that private capital inflows in Kenya are driven by foreign demand for country's housing as an investment vehicle and that higher housing prices attracts capital inflows. This finding agrees with the study by Reinhart and Reinhart (2008) on US 2007/2008 financial crisis that found out that capital inflows surge, which were connected to housing prices, preceded the crisis.

The study, using the unrestricted VAR setup, derived impulse response functions to establish the impact of Housing Prices Shock on Private Capital Inflows. The results are presented in Figure 4.2

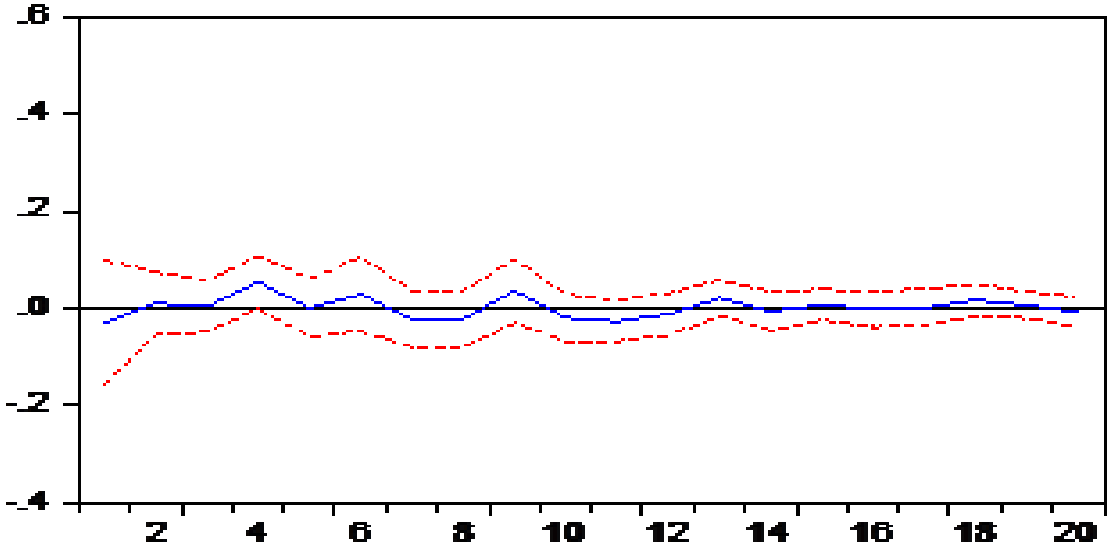


Figure 4.2: Impulse Response for Private Capital Inflows to Housing Price Shock
Source: Author's computation

The figure shows the impact on private capital inflows from a shock emanating from housing price. A unit increase in the housing prices from its mean value causes a rise in the private capital inflows from their equilibrium levels in the fourth year. The horizontal axis shows the number of years following the shock, while the vertical axis shows the change in the private capital inflows from the mean levels. The impact of the shock is positive but becomes negative in the seventh year. The effect therefore is a fluctuation that takes more than 10 years to wade off. Figure 4.2 implies that, an exogenous shock increasing housing prices in one period, private capital inflows fluctuates above and below their equilibrium levels and the memory persist for more than ten years if other variables remain constant. This could also imply that a slump in the housing prices could trigger private capital instability.

4.6.3 Dynamic Relationship between Housing prices and Households' Consumption Expenditure in Kenya

In examining the dynamic relationship between housing prices and households' consumption expenditure, a system of Equations given in (3.24) of Chapter 3, was used to conduct Granger causality test using Toda and Yamamoto method. The optimal number of lags selected was 14 lags and a control lag (d_{max}) equals to 15. Tests on normality and autocorrelation ascertain that the Unrestricted VAR model is free of autocorrelation and its residuals are normally distributed as shown in Tables A2.24 and Table A2.25 respectively**.** Test for Model stability is presented by Figures A3.6 which shows that the VAR model is stable. The Unrestricted VAR results are given in Table A2.22 and Table A2.23 of appendix 2 and the summary of the same in Table 4.7.

Table 4.7: Toda and Yamamoto Augmented Causality Tests between Housing price and Households' Consumption Expenditure

Null hypothesis	Chi-sq
Household Consumption Expenditure does not granger cause Housing Price	[26.81082]**
Housing Price does not granger cause household Consumption Expenditure	[32.23216]***

Note: [***] and [**] denote significant levels at 1% and 5%
Source: Author's calculation.

Table 4.7 give results from the Toda and Yamamoto augmented causality test between housing price and households' consumption expenditure. The results reject the null hypothesis that housing prices do not cause households' consumption expenditure at 1 percent level of confidence. They also reject the second null hypothesis that households' consumption expenditure does not cause housing prices and accepts the alternative hypothesis that households' consumption expenditure causes housing prices

at 5 percent level of confidence. This means that there exists bidirectional causality between housing prices and households' consumption expenditure. Positive relationship between households' consumption expenditure and housing prices implies that falling housing prices could cause reduction in aggregate demand across the economy. Also, changes in households' net value as a result of housing prices growth could influence adverse selection and moral hazard even in lending on the side of financial institutions. Implication of this is that housing prices exerts liquidity effect on the households balance sheets which impacts on households desire to consume. From a theoretical point of view, housing prices affect aggregate demand via two channels, effects on housing expenditure and affecting household wealth. Rising house prices stimulate consumption by increasing households' perceived wealth and by relaxing borrowing constraints (Muellbauer and Murphy, 2008)

Using the unrestricted VAR setup, impulse response function was developed and results are presented in Figure 4.3.

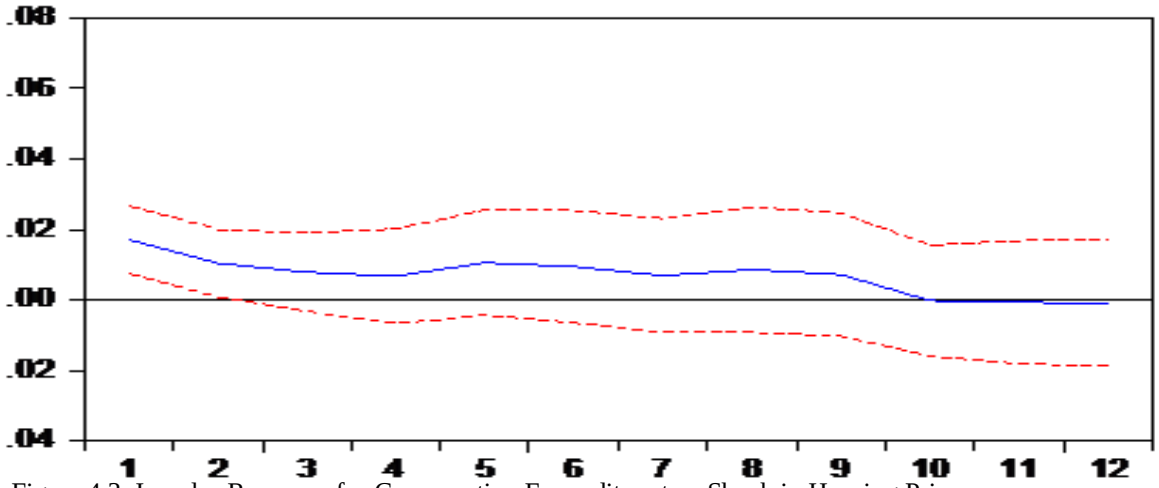


Figure 4.3: Impulse Response for Consumption Expenditure to a Shock in Housing Price
Source: Author's computation.

The figure shows the impact on households' consumption expenditure from housing prices shock. The impact is positive for a period of ten years after which the impact fades out. If an exogenous shock increases housing prices in one period, households' consumption expenditure rapidly grows. This finding concurred with Demary (2009) who noted that households' consumption expenditures are responsive to housing prices change. Demary (2009) finding was that, in the year 2002, US experienced rising housing prices and strong households' consumption expenditure which fueled the financial crisis due to reduction in aggregate demand emanating from reducing households' wealth out of reducing housing prices.

The findings also supported Muellbauer and Murphy (2008) results that, households translate positive equity into loans and consequently housing prices appreciation are associated with higher households' consumption expenditure. In a deep mortgage market, greater competitiveness means borrowers benefits from higher loan to value ratios and thus needs to save less to finance new housing purchases. Moreover, existing homeowners could release equity easily due to the depth of credit markets. These effects lead to an increase in household consumption expenditure when housing prices grow.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND POLICY IMPLICATIONS

5.1 Introduction

This chapter presents a summary of the study, conclusions, the suggested policy implications of the findings, contribution to knowledge and areas for further research.

5.2 Summary

Since the year 2000, housing prices in Kenya have increased by over 300 percent in real terms especially in the urban centers and continues to grow rapidly (Hassconsult, 2015; Republic of Kenya, 2015). As a result, decent housing is way above the majority of buyers and renters capacity to pay. Consequently, over 60 per cent of the country's urban population lives in slums with no permanent houses, no water supply, no electricity connection, no social amenities nor security (World Bank, 2011; Wanyama, 2012).The agricultural lands surrounding urban centers are also being converted to residential centers so as to tap from high returns coming from housing investments thereby affecting agricultural production (AfDB, 2011; Njaramba, 2011). The often cited causes of the increase in housing prices are long period of historically low nominal interest rates, low supply and increased population (Tsatsaronis & Zhu, 2004). However, in Kenya, the real interest rates remain high and the ratio of the stock of housing to population has relatively been stable over the study period (Republic of Kenya, 2016). The growth in housing prices also outpaced the increase in consumer prices in Kenya during the study period (Republic of Kenya, 2000; 2004; 2009; 2010; 2013; 2015 & Hassconsult, 2015).

The policies and macroeconomic reforms that started after independence together with infrastructural development that aimed at ensuring accessible and adequate housing in Kenya have not managed to calm down the housing prices (CAHF, 2012 & Republic of Kenya, 2010; 2013; 2014; 2015). In the developed and developing economies where housing prices recorded similar strong upward movements in the housing prices, they were followed by long lasting phases of stagnation or decline in the housing prices. This resulted to financial crisis in these countries (Tsatsaronis & Zhu, 2004 & Demary, 2009). Housing prices boom-burst therefore gives a concern when it comes to housing market in Kenya. The boom-burst of housing prices was the motivation behind the current study. That the expected downward correction associated with the end of the housing prices boom might occur and hamper the economic outlook of the country.

As the housing prices were rapidly growing in Kenya, there were also increases in capital inflows, household's consumption expenditure and households' indebtedness in the country. These variables had earlier influenced (source or transmission) boom-burst episodes in developed and developing economies (Demary, 2009). This raised the questions of whether the observed increases in these macroeconomic variables in Kenya were related to the housing prices increase, and if there were links, what direction of causation existed and the impact of the housing prices on these macroeconomic variables.

In analyzing the sources of housing prices growth in Kenya, the study adopted the ARDL model. The model was suitable because housing prices needed to be analyzed

based on the previous values of the housing prices together with other past values of exogenous variables. With the ARDL it was therefore possible to use differing optimal number of lags among the variables. ARDL has also the advantage of being applied to a small sample size, give estimates for short-run and long-run dynamics and also is relieved of the burden of establishing the order of integration amongst the variables. Furthermore, it could distinguish dependent and explanatory variables and allow testing for the existence of relationship between the variables without the usual endogeneity problem.

In establishing the dynamic relationship between the housing prices and the selected macroeconomic variables, the study used VAR models and a modified version of Granger Causality tests as proposed by Toda and Yamamoto (1995). The method was valid regardless whether a series is integrated of order zero, integrated of order one or integrated of order two, non-cointegrated or cointegrated of any arbitrary order. The advantage of the Toda and Yamamoto procedure over others is that it does not require pre-testing for the cointegration properties of the system and thus avoids the potential bias associated with unit root and cointegration tests (Rambaldi & Doran, 1996). This is because pre-tests for unit root and cointegration might suffer from size distortions, which often imply the use of an inaccurate model for the non-causality test. The method also takes care of any intervening variable, a common problem found in the traditional method of granger causality test.

The study, through the use of a Tobin's q modeling approach to housing prices, has shown that, the housing prices growth in Kenya is attributed to; first, rise in household consumption expenditure, Household consumption expenditure positively triggers changes in the housing demand. It plays a bigger role in the short-run than in the long-run. Its effect is therefore quicker and long lasting. Second, the effect of construction cost on housing prices is positive both in the short-run and in the long-run. The long-run effects however show an overreaction to the housing prices; third, property taxes which affect the housing prices negatively in the short-run but positively in the long-run. The short-run effect is through the user cost of capital that lowers demand for housing while the long-run is through acquisition cost of capital that affects the housing supply negatively; fourth, the study included a dummy variable to capture the structural break coming in the data series after the year 2007. The effect is positive and significant both in short-run and in long-run; Fifth, the roles of private capital inflows into the domestic market and change in the stock of housing is small in driving housing prices and are negative in the long-run; Sixth, households' indebtedness has a temporal positive shocks to the housing prices. Finally, per capita GDP has negative effect to the housing prices. This is an indication that increase in per capita income makes it possible for household to construct their housing resulting to less demand for the housing supplied for sale.

For the dynamic relationship between housing prices and selected macroeconomic variables, the study findings were that; First, there is a unidirectional relationship between housing prices and households indebtedness. That is, housing prices granger

cause households' indebtedness but households indebtedness does not granger cause housing prices. Secondly, a shock in housing prices will create fluctuations in households' indebtedness around its mean value. The impact wears off after seven years. This means that, an exogenous shock increasing housing prices in one period, household's indebtedness decreases in that period but increases after three years. This effect remains significant for a period of seven years. This implies that housing is an important stock of wealth to the households in Kenya. As long as housing prices are growing, household indebtedness will be fluctuating given the value of the collateral against which financial institutions extend credits. Households in Kenya therefore are able to translate housing equity into loans and consequently housing prices appreciation is associated with fluctuations in the households' indebtedness.

For the third objective, the study finds a bidirectional relationship between housing prices and private capital inflows in Kenya. That is, private capital inflows in the country are driven by foreign demand for country's housing as an investment vehicle and that higher housing prices attract capital inflows. The impact of the housing prices shock on private capital inflows is positive but becomes negative in the seventh year. The impact takes more than ten years to wade off. This implies that, if an exogenous shock increases housing prices in one period, private capital inflows fluctuates above and below their equilibrium levels and that the memory persists for more than ten years if other variables remain constant. Therefore, as external private capitals come in search for more attractive returns, the easiest place in Kenya is the housing market. Thus, the surge in the demand for housing by foreign investors result into growth in housing

prices in the short-run and then the high housing prices attract more private capital inflows. However, the increased inflows of capital have the capacity to calm down the housing prices growth in the long-run. Previous studies had showed that there were instances in which the housing boom gave rise to unrealistic expectations on the part of investors, and the boom continued beyond what could be explained by realistic asset return differentials.

In line with the fourth objective, the study found that there exist a bidirectional relationship between households consumption spending and housing prices. When housing prices increase, the households' wealth grows thereby raising consumer aggregate spending since they have a more secure financial position and a lower estimate of the likelihood of suffering financial distress. The study also investigated the role of transitory shocks in the housing prices on households' consumption expenditure. A positive shock on housing prices has a positive impact on households' consumption expenditure. Since housing prices fluctuate considerably over time, these fluctuations therefore affect households' consumption decisions. Rising housing prices stimulates consumption by increasing households' perceived wealth, or by relaxing borrowing constraints.

5.3 Conclusions

The purpose of this study was to analyze the sources of housing prices growth and also examine the dynamic relationship between housing prices and the selected macroeconomic variables in Kenya. In regard to the sources of housing prices growth, the study found that the sources include; previous growth in housing prices propagate

the growth, household consumption expenditure both in the short-run and in the long-run, construction cost affects housing price in the short-run and in the long-run, property taxes has a positive long-run effect, while the transitory sources of housing prices growth include; private capital inflows, households' indebtedness and per capita income. However, private capital inflows and per capita income affect housing prices negatively in the long-run. The speed of adjustment is greater than one implying that housing prices adjusts to their long-run growth path pretty fast.

Based on the findings of the first objective, it is interesting to note that: housing prices growth reinforces themselves such that, the current increases in housing prices have positive transitory shocks to the housing prices in the consecutive periods as well as permanent positive shocks; household consumption expenditure increases have quicker and lasting effects to the housing prices; housing prices are overreacting to the construction costs increase in the long-run; It is also worth noting that housing stock are increasing at a faster rate in relation to urban population. It is not surprising that the housing supply has mixed transitory effects on housing prices and no permanent effect. This is in contrast to the popular view that low supply of housing is the reason for high housing prices in Kenya; another observation from the first objective is that, with increase in per capita income, households construct own residential houses rather than buying the ones in supply. This makes the effect of per capita income on housing prices to be negative in the long-run.

Also observed from the study's first objective is that, per capita income and private capital inflows influence housing prices positively in the short-run but negatively in the long-run. The magnitudes of effects in the short-run were higher than those of long-run. This means that higher per capita income and capital inflows have possibilities of creating a bubble in the housing prices which is reversible in the long-run. Observed from the findings as well is that, property taxes effect on housing prices growth is negative in the short-run but it is positive in the long-run.

Therefore, the growth in housing prices in Kenya can be attributed to: expectations of future increase in housing prices growth, increase in households' consumption expenditure, housing prices overreaction to construction costs and finally the property taxes.

From the second objective, the study found that housing prices and household's indebtedness have a unidirectional relationship. With a positive shock in the housing prices, households' indebtedness becomes negative but gets positive in the third year of the shock. The impact wears off after seven years. From the findings, the households' indebtedness does not granger cause housing prices but housing prices granger causes households' indebtedness. Therefore, the study notes that the two variables do not have contemporaneous impact on each other rather, households' indebtedness reacts to the housing prices, and that changes in the housing prices create fluctuations in the households' indebtedness. Clearly, households translate increase in housing prices into loans and for this reason; housing prices appreciation is associated with fluctuation in

households' indebtedness. Borrowers are benefiting from higher loans to the value of housing. This means that households are sensitive to changes in the value of housing as collateral.

From the third objective of this study; there is a bidirectional relationship between housing prices and private capital inflows in Kenya. The impact of the housing prices shock on private capital inflows is positive but becomes negative in the seventh year. The impact takes more than ten years to wade off. Therefore, private capital inflows in Kenya granger cause housing prices and that housing prices granger cause private capital inflows in Kenya. An exogenous shock that increases housing prices in one period causes a fluctuation in private capital inflows and the memory persist for more than ten years if other variables remain unchanged.

Finally, from the findings of fourth objective of the study, there exists a bidirectional relationship between household consumption spending and housing prices. With a positive shock in housing prices, household consumption spending increases. Therefore, housing prices exerts liquidity effect on the households' balance sheets which is shown through a positive impact on households' consumption expenditure, rising housing prices stimulates consumption by increasing households' perceived wealth. The increased household consumption expenditure in return exerts pressure on the housing prices. When the housing market experiences instability, the households' consumption expenditure gets affected. If the effect on households demand is major, the aggregate economy demand is then affected. It is interesting to note that; despite the

low home ownership in Kenya, the growth in housing prices still have an effect on households consumption expenditure

5.4 Policy Implications

In Kenya, put against average earnings the housing prices are considered high, and can only be afforded by the top income earners. Because of lack of affordable housing, people live in areas with reduced access to clean water, sanitation, unreliable and unhealthy energy sources, increased exposure to diseases and low levels of financial security.

One of Kenya's government objectives is to guarantee affordable housing as noted by the country's constitution (Republic of Kenya, 2010) and its long term blue print plan, Vision 2030 (Republic of Kenya, 2015). In the struggle to achieve this, encouragement of homeownership has also been a key government policy. However this has not been quite successful as large number of slums and a low home ownership index still exist. The success can be achieved if the growth in the housing prices is managed through the following means: foremost, controlling the high cost of construction brought about by high cost of land, construction materials and land development charges. This can be done through research on cheaper alternative building materials and proper land use planning that discourages destabilizing speculation in land. Also there is need for substituting buildings for land by erecting taller apartment buildings.

The Kenya National Housing Corporation needs to make public and encourage the use of readily available alternative building material besides the conventional material while not compromising on quality to address the overreaction of housing prices.

Another method of taming growth in housing prices is reducing or doing away with taxation on development and developed land. In lowering or doing away with property taxes, the housing prices will be lowered and thereby making housing affordable.

The behavior of housing prices not only affects business cycle dynamics, by affecting the aggregate demand, but also the performance of commercial banks, through the effect on the collateral values. Understanding this behavior is thus of key interest to central banks that is charged with maintaining price and financial stability. In this regard, the central bank of Kenya should consider the following policies:

Because housing prices impact on households' indebtedness, there is need for regulation on the high incidence of commercial banks allowing increased access to credit associated with housing prices boom. That is, there is need for central bank increased supervision to commercial banks during the periods of housing boom. This is because, during housing prices boom, it is also the period when access to housing for use as collaterals is relatively favorable. The supervision is to ensure that banks' are sufficiently liquid and that the risks of nonperforming loans are reduced. Dynamic interrelationship between housing prices and households' indebtedness is a risk to the

stability of the financial sector because borrowers are benefitting from higher loan to value ratio resulting from booming housing prices.

Secondly, commercial banks should beware of rapid growth of households' indebtedness during the housing prices boom. When the bubble bursts, these households are not in a position to repay their bank loans, leading to insolvencies in the financial sector and, possibly, bank failures. Therefore, the financial institutions should treat housing prices boom as if is temporary and constitute a proper loan to stable housing valuation.

Thirdly, the government, through the central bank, should also mark the short-run increases in real housing prices fueled by private capital inflows and also private capital inflows fueled by growth in housing prices, as these can reflect housing bubble. This is by making sure that the housing prices correspond to the real market fundamentals and the expectations of future prices are derived on real values.

Lastly, loan to proper valuation of the housing should be constituted by the central bank of Kenya. That is, shadow housing prices should be constituted for use in determining loans to ratio of housing value. In this regard, housing market in general and house prices in particular need to be monitored in macro prudential surveillance. In addition, more resources must be devoted to collecting and disseminating data on housing prices and related variables such as loan to value ratios since accurate housing prices

information will be important for purpose of efficient resources allocation and avoiding housing bubble.

5.5 Contribution to Knowledge

Housing investment is one of the most volatile components of national product, and understanding its sources of variability illuminates the sources of volatility in the national product. This has been achieved through establishing the sources of housing prices growth in Kenya and by extension, the sources of its volatility. In this study, it has been established that increase in housing stock has no effect on the housing prices and that growth in per capita income forces the housing prices downward in the long-run. This is against popular views.

Though the housing prices booms and busts episode have been part of recent financial instability in emerging and developed economies, housing prices surveillance in Kenya has not formed part of macroeconomic analysis. The current study findings have brought this possibility to limelight by showing that housing market dynamically relate with the selected macroeconomic variables. Understanding the relationships means understanding the risk the housing prices have on aggregate expenditure and financial system stabilities.

Under the results, the study realizes that, despite the low home ownership in the country, changes in housing prices is part and parcel in the households' consumption decision making. In this case, housing prices is directly related to aggregate spending.

The study has also established that housing prices is used to determine the amount of credit to the households. This is despite the fact that the financial market in the country is still developing.

5.6 Areas for Further Research

This study concentrated in identifying the various sources of housing prices growth. Further, the study examined the dynamic relationship with the selected macroeconomic variables in Kenya. To achieve this, an ARDL bounds test approach to cointegration and VAR models were utilized. To enrich on the finding of this study, future studies on housing market should consider: Effects of location, transport and culture to the housing prices. It also important to develop a model that is able to predict the trend and behavior of the housing prices and therefore be able to test for a bubble in the housing prices. Finally, developing a model that analyzes the impact of speculative behavior in the housing market in Kenya will be useful information.

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Appendix 1

Table A1.1 Study Data (1960-2015)

Period	HP	PCI	HCEXP	HHI	PT	HStc	CC	UPop	PCGDP
1960	0.38620689655172	0.741430535231254	0.718979502533167	13.468394973271	0.2335498458359	0.2262304269672	0.0625377643505	7.3619939201327	0.04178761099953
1961	0.22732240437159	0.572763684913218	0.711935057892406	12.305794219402	0.1906780165991	0.2465512924929	0.0338797814208	7.5649989559217	0.03735883632273
1962	0.29044585987261	0.679667335818755	0.719342696880540	11.804931823132	0.1741711252593	0.2823854370216	0.0229299363057	7.7739958161881	0.03962418802330
1963	0.30967741935484	1.081863445134900	0.725194583423611	13.175194734515	0.1571353500447	0.3098686799816	0.0505376344086	8.0379977380962	0.04175043316860
1964	0.33333333333333	1.137494667993740	0.689094548539339	13.694985424793	0.2186712104675	0.3416966917786	0.0529411764706	8.3179984517657	0.04243350773976
1965	0.29354838709677	1.549872689029120	0.700617340240556	13.762630124195	0.2020202587038	0.3736455966560	0.2193548387097	8.6050041337435	0.04189909146021
1966	0.38016528925620	2.461973478939160	0.661216318680414	12.611203100360	0.1683096695949	0.3823321322982	0.2925619834711	8.9019959776045	0.04651493508021
1967	0.33781512605042	2.334774266626600	0.666061108587006	14.584279872785	0.1817355747388	0.3882974717471	0.2235294117647	9.2090010634706	0.04650656693803
1968	0.25487179487180	1.375496234000000	0.646403935280973	12.890010758918	0.1634527849044	0.4169476333876	0.2194871794872	9.5249970244471	0.04855613887500
1969	0.25481171548117	0.922377647000000	0.627531822981665	12.729192665835	0.1747144091389	0.4714823476296	0.2280334728033	9.8499988544052	0.05065798749636
1970	0.34736842105263	0.860645654356612	0.601840446338141	15.118918730137	0.1746236859568	0.5386808254874	0.3122807017544	10.2949966700633	0.04664815067204
1971	0.34857142857143	0.416106401607860	0.646534543565198	17.432534559310	0.2015303712567	0.6154370787828	0.3164625850340	10.7779992569577	0.05501180660930
1972	0.31050228310502	0.298963712421605	0.621711400478342	16.486048365666	0.1780494286474	0.7118642329253	0.2687214611872	11.2820026872099	0.06214004571650
1973	0.22000000000000	0.689808849228798	0.590117272002733	17.893316634407	0.1525674598657	0.8208148215705	0.1768674698795	11.8049994373418	0.06345848861236
1974	0.20189573459716	0.787674535586111	0.644291505609503	17.976430658999	0.2083529744508	0.9106507351915	0.1853080568720	12.3490020771002	0.06366246047397
1975	0.15765819041987	0.526447731260968	0.632209409208657	17.333166207069	0.4733851424751	0.9921884005285	0.1437019515080	12.9139987932887	0.06189636098747

Period	HP	PCI	HCEXP	HHI	PT	HStc	CC	UPop	PCGDP
1976	0.31630847029077	1.334617501375890	0.646056686846450	16.827084479912	0.4559713813979	1.1830979571326	0.2814159292035	13.5029973619557	0.06092676676879
1977	0.34159509202454	1.258132157642890	0.656481531265122	17.508602613044	0.3837303080811	1.2331342475012	0.2598773006135	14.1120025508035	0.06424814118521
1978	0.24046052631579	0.648865948198056	0.644957726139540	21.712030364975	0.3393617695989	1.2787563707895	0.2097039473684	14.7450024858109	0.06616421932212
1979	0.24936207655081	1.347523817698050	0.645051926873230	20.973264097502	0.3252939661832	1.3660710157377	0.2197096348438	15.4009976366119	0.06856670902768
1980	0.22282768777614	1.086996806269830	0.620255959181749	21.811778081552	0.2924503694138	1.5667414447213	0.1932253313697	15.5830012787141	0.06970172704465
1981	0.39525423728814	0.206398348813209	0.647356811145511	21.003079850361	0.4507223942208	1.7956406769751	0.2821307506053	15.6809988603755	0.06962172669472
1982	0.46569343065693	0.202141561728623	0.655030278528296	20.437024362329	0.4352022412090	1.9313418076709	0.3740354535975	15.7800001799567	0.06801999287235
1983	0.29284685549688	0.397023828968166	0.611442829825033	19.323011551383	0.5400026635776	2.0359781192074	0.2712433989438	15.8790002768987	0.06633570102971
1984	0.57822222222222	0.173683868466405	0.642248432923290	18.986403354452	0.5058122466176	2.1426586391492	0.4924444444444	15.9790005584767	0.06500113889335
1985	1.03460207612457	0.470183986763428	0.682423451269497	19.334084569633	0.4660177995389	2.0856825398864	0.9193771626298	16.0789997799164	0.06532026168634
1986	0.46103896103896	0.452068019635588	0.599222715438932	19.311988230907	0.3863436295869	2.0405001194888	0.4044526901670	16.1800022399048	0.06749234053084
1987	0.70076775431862	0.494068886011905	0.622532895990875	18.416417726094	0.4176711971564	2.0368279336402	0.6428023032630	16.2809980764741	0.06897426593437
1988	0.62646657571624	0.504720678148344	0.615419973782702	18.926142832345	0.4216239969065	2.0261898786119	0.5557980900409	16.3830007976618	0.07071512455544
1989	0.87929342492640	0.750803531135696	0.688850796430368	19.224478753739	0.3758125538059	2.0447167760132	0.7925417075564	16.4849998486870	0.07151967897990
1990	1.25313588850174	0.665873828821861	0.623896733863416	18.656532352076	0.3342605168230	2.0228084973174	1.1501742160279	16.7479981535623	0.07204517569115
1991	1.07563291139241	0.231013007896898	0.635143758571723	19.958072590222	0.3884403205685	2.0070481137698	1.0050632911392	17.0429981537988	0.07070553408924

Period	HP	PCI	HCEXP	HHI	PT	HStc	CC	UPop	PCGDP
1992	0.85157152020526	0.077512888536204	0.673042508765810	22.152450240505	0.3899847607499	1.9958053012200	0.8053880692752	17.3420002449884	0.06791057007192
1993	0.82114942528736	2.532351133572150	0.631259664158778	18.496196443499	0.3534652533842	1.9999435504863	0.7739463601533	17.6450012886869	0.06605250316596
1994	1.06326923076923	0.103976796940169	0.624163872464492	19.834155886069	0.3007054619023	1.9839839516733	0.9996153846154	17.9519994840667	0.06579571313070
1995	1.06935608999224	0.467474289317279	0.692617361554331	25.814117780877	0.1557439758183	1.9500132161803	1.0273079906905	18.2629986042834	0.06677512171376
1996	1.05299860529986	0.902160125818836	0.760695525277690	21.681626109378	0.2514542193437	1.9282445483120	1.0218967921897	18.5790012223277	0.06770640948310
1997	1.13402346445825	0.473451364916979	0.771795361106459	24.355177830311	0.2601280258804	1.9119629879893	1.0912353347136	18.8979984047705	0.06631507489795
1998	1.09903181189488	0.188365603434476	0.776940090610316	23.963416784182	0.1878825333371	1.8935792953280	1.0580912863071	19.2219996513399	0.06682335692595
1999	1.18975741239892	0.402864463850226	0.785800295884689	26.569441930003	0.1900416243797	1.8725602652946	1.1455525606469	19.5499986139181	0.06670196224643
2000	1.20109221128021	0.872895972152775	0.782907715662389	25.758382768056	0.1898449979585	1.8502458141136	1.0889973142346	19.8920002755440	0.06545048297132
2001	1.08410118406889	0.040833358287158	0.795703087860375	25.222686695123	0.1884444644837	1.8299553589872	1.0495156081808	20.2389992492926	0.06622446710445
2002	1.28392857142857	0.210062252852969	0.786144703406405	25.854601834827	0.1936703004618	1.8006468562577	1.1076349206349	20.5910012180357	0.06489873596827
2003	1.35647985989492	0.548412532071826	0.771191801954793	25.155675222790	0.1873037387059	1.7843222453407	1.2488528896673	20.9479999138031	0.06509136647438
2004	1.42781103286385	0.886194263505208	0.755246878945704	27.287516032728	0.1307448861322	1.7620424015462	1.3467723004695	21.3100007956452	0.06665293100885
2005	1.48056198347107	1.113202069608830	0.753993890056332	26.276875470049	0.1182623744018	1.7601175752862	1.4173002754821	21.6749988118489	0.06876952689521
2006	1.48073042564372	1.196219536813600	0.762317800735859	22.888310996039	0.0852473173255	1.7597954236471	1.4181082501314	22.0449999813978	0.07132993248225
2007	4.66774468085106	2.281243173734840	0.788546609592400	23.044964281586	0.1099440397630	1.7600992237239	2.5098297872340	22.4199998174523	0.07424308479823
2008	5.13252811328613	1.266291327300950	0.793275598073021	25.380611749054	0.1161410647677	1.7727439697972	2.6231153685964	22.8000005857060	0.07248161706739

Period	HP	PCI	HCEXP	HHI	PT	HStc	CC	UPop	PCGDP
2009	6.11526567332021	0.514027176505012	0.792512885481938	25.021610000875	0.1133904950539	1.7838167960490	4.6506887826820	23.1829991901194	0.07292306786547
2010	8.13843054082715	0.945165309313035	0.791555936151221	27.228415110518	0.1081724329750	1.8272323115477	7.7850265111347	23.5710008499488	0.07697577133960
2011	9.15163696643183	1.333374599223930	0.798034787668435	30.572643263177	0.1168077236268	1.8993785934039	7.7178408619975	23.9669990942047	0.07952751468531
2012	9.63179939894816	2.737887210000000	0.799995778605358	29.537674878993	0.1352653308930	1.9667873220238	7.5551277235162	24.3700006144375	0.08095498157181
2013	10.31070921985820	2.030505417000000	0.808875494868628	31.808839462226	0.2119338775823	2.0402626908861	8.0990425531915	24.7800002018635	0.08330734702525
2014	10.13674905595610	2.232266356000000	0.806909605515231	34.420288172774	0.2146454654186	2.1139160410781	8.7005149330587	25.1969999810314	0.08545630428136
2015	10.49637503823800	2.343655701000000	0.873728586563800	36.829993020000	0.2480670049807	2.9281126590000	9.1268401650000	25.3568753229300	0.08924000000000

Appendix 2

Table A2.1: Unit Root Tests

Variable	Type of Test	Form of Test	Test Statistic	Critical Value at 5 %	Conclusion
Housing Price	ADF	Intercept	2.671158	2.91552	Not Stationary
		Trend & Intercept	0.626872	3.493692	Not Stationary
	PP	Trend and Intercept	0.161219	3.493692	Not Stationary
	KPSS	Trend and Intercept	0.194557	0.146000	Not Stationary
1st Difference of Housing Prices	ADF	Intercept	2.059356	2.918778	Not Stationary
		Trend & Intercept	6.336601	3.495295	Stationary
		None	1.806631	1.947248	Not Stationary
	PP	Trend & Intercept	6.519419	3.495295	Stationary
	KPSS	Trend & Intercept	0.106868	0.146000	Stationary
Households Consumption Expenditure	ADF	Intercept	0.707365	2.915522	Not Stationary
		Trend & Intercept	2.376743	3.493692	Not Stationary
		None	0.590131	1.946878	Not Stationary
	PP	Trend & Intercept	2.376743	3.493692	Not Stationary
	KPSS	Trend & Intercept	0.215597	0.146000	Not Stationary
1st Difference of households Consumption Expenditure	ADF	Intercept	8.975940	2.916566	Stationary
		Trend & Intercept	9.308586	3.495295	Stationary
		None	8.974854	1.946996	Stationary
	PP	Trend & Intercept	9.649883	3.495295	Stationary
	KPSS	Intercept	0.048058	0.463000	Stationary

Variable	Type of Test	Form of Test	Test Statistic	Critical Value at 5 %	Conclusion
Private Capital Inflows	ADF	Intercept	3.756632	2.915522	Stationary
		Trend & Intercept	3.808828	3.493692	Stationary
		None	0.400706	1.947119	Not Stationary
	PP	Trend & Intercept	3.837518	3.493692	Stationary
	KPSS	Intercept	0.211566	0.463000	Stationary
Household Indebtedness	ADF	Intercept	0.093504	2.915522	Not stationary
		Trend & Intercept	2.562691	3.493692	Not stationary
		None	1.657209	1.946878	Not Stationary
	PP	Trend & Intercept	2.571134	3.493692	Not stationary
	KPSS	Intercept	0.980826	0.463000	Not stationary
1st Difference of Household Indebtedness	ADF	Intercept	9.197272	2.916566	Stationary
		Trend & Intercept	9.296013	3.495295	Stationary
		None	8.654192	1.946996	Stationary
	PP	Trend & Intercept	9.577596	3.495295	Stationary
	KPSS	Trend & Intercept	0.067549	0.146000	Stationary
Urban Population	ADF	Intercept	1.211971	2.916566	Not stationary
		Trend & Intercept	3.483507	3.495295	Not Stationary
		None	0.652954	1.946996	Not stationary
	PP	Trend & Intercept	1.716961	3.493692	Not Stationary

Variable	Type of Test	Form of Test	Test Statistic	Critical Value at 5 %	Conclusion
	KPSS	Intercept	0.896175	0.463000	Not Stationary
1st Difference of Urban Population	ADF	Intercept	1.998015	2.916566	Not Stationary
		Trend & Intercept	1.960164	3.495295	Not Stationary
		None	0.853356	1.946996	Not Stationary
	PP		2.181590	3.495295	Not Stationary
		Intercept	0.088168	0.463000	Stationary
	KPSS	Trend & Intercept	0.088111	0.146000	Stationary
Construction Cost	ADF	Intercept	2.417369	2.915522	Not Stationary
		Trend & Intercept	0.619591	3.493692	Not Stationary
		None	3.329273	1.946878	Stationary
	PP	Trend & Intercept	0.336999	3.493692	Not Stationary
	KPSS	Intercept	0.186653	0.146000	Not Stationary
1st Difference of Construction Cost	ADF	Intercept	5.031495	2.916566	Stationary
		Trend & Intercept	5.580515	3.495295	Stationary
		None	4.723261	1.946996	Stationary
	PP	Trend & Intercept	5.612071	3.495295	Stationary
	KPSS	Intercept	0.129847	0.146000	Stationary
Housing Stock	ADF	Intercept	0.454619	2.916566	Not Stationary
		Trend & Intercept	1.380909	3.495295	Not Stationary
		None	1.134101	1.946996	Not Stationary

Variable	Type of Test	Form of Test	Test Statistic	Critical Value at 5 %	Conclusion
	PP	Trend & Intercept	1.415556	3.493692	Not Stationary
	KPSS	Intercept	0.190702	0.146000	Not Stationary
1st Difference of Housing Stock	ADF	Intercept	0.368053	2.916566	Not Stationary
		Trend & Intercept	0.125562	3.495295	Not Stationary
		None	0.163295	1.946996	Not Stationary
	PP	Trend & Intercept	0.502075	3.495295	Not Stationary
	KPSS	Intercept	0.153844	0.146000	Not Stationary
		Trend & Intercept	0.144275	0.463000	Stationary
Property Taxes	ADF	Intercept	1.853162	2.915522	Not Stationary
		Trend & Intercept	1.915559	3.493692	Not Stationary
		None	0.753329	1.946878	Not Stationary
	PP	Trend & Intercept	1.797076	3.493692	Not Stationary
	KPSS	Intercept	0.206903	0.146000	Not Stationary
1st Difference of the Property Taxes	ADF	Intercept	7.225524	2.916566	Stationary
		Trend & Intercept	7.167091	3.495295	Stationary
		None	7.294402	1.946996	Stationary
	PP	Trend & Intercept	7.275633	3.495295	Stationary
	KPSS	Intercept	0.100249	0.146000	Stationary
Per capita GDP	ADF	Intercept	1.288702	2.916566	Not Stationary

Variable	Type of Test	Form of Test	Test Statistic	Critical Value at 5 %	Conclusion
		Trend & Intercept	2.040242	3.495295	Not Stationary
	PP	Trend & Intercept	1.458727	3.493692	Not Stationary
	KPSS	Trend &Intercept	0.162870	0.146000	Not Stationary
Ist Difference of Per Capita GDP	ADF	Intercept	4.825359	2.917650	Stationary
		Trend & Intercept	4.765973	3.496960	Stationary
	PP	Trend & Intercept	6.097778	3.495295	Stationary
	KPSS	Intercept	0.149355	0.463000	Stationary

Table A2.2: Johansen Tests for Co-integration

Sample (adjusted): 1962 2015
Included observations: 54 after adjustments
Trend assumption: Linear deterministic trend
Series: HP PCI CC HCEXP HHI HStc PCGDP PT
Lags interval (in first differences): 1 to 1
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.856594	247.2303	159.5297	0.0000
At most 1 *	0.629569	142.3582	125.6154	0.0032
At most 2	0.429124	88.73143	95.75366	0.1380
At most 3	0.348309	58.45998	69.81889	0.2857
At most 4	0.303917	35.33803	47.85613	0.4303
At most 5	0.158758	15.77455	29.79707	0.7280
At most 6	0.080213	6.439256	15.49471	0.6436
At most 7	0.035005	1.924154	3.841466	0.1654

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.856594	104.8721	52.36261	0.0000
At most 1 *	0.629569	53.62680	46.23142	0.0069
At most 2	0.429124	30.27145	40.07757	0.4062
At most 3	0.348309	23.12195	33.87687	0.5212
At most 4	0.303917	19.56347	27.58434	0.3721
At most 5	0.158758	9.335297	21.13162	0.8045
At most 6	0.080213	4.515102	14.26460	0.8014
At most 7	0.035005	1.924154	3.841466	0.1654

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table A2.3: ARDL Bounds Test Equation:

Dependent Variable: D(HP)
Method: Least Squares
Sample: 1963 2015
Included observations: 53

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(HP(-1))	0.883487	0.108179	8.166902	0.0000
D(HP(-2))	0.590101	0.083091	7.101863	0.0000
D(PCI)	0.040659	0.024632	1.650651	0.1118
D(PCI(-1))	0.089225	0.024142	3.695769	0.0011
D(PCI (-2))	0.044089	0.023225	1.898350	0.0697
D(HHI)	-0.004919	0.007794	-0.631055	0.5340
D(HHI(-1))	-0.010628	0.011141	-0.953992	0.3496
D(HHI(-2))	0.021210	0.008678	2.444065	0.0222
D(CC)	0.919633	0.054554	16.85741	0.0000
D(CC(-1))	-0.805920	0.075646	-10.65377	0.0000
D(CC(-2))	-0.568207	0.075851	-7.491113	0.0000
D(HStc)	0.560959	0.143649	3.905064	0.0007
D(HStc(-1))	0.997214	0.284879	3.500479	0.0018
D(HStc(-2))	-0.887186	0.256447	-3.459538	0.0020
D(PCGDP)	-9.599649	6.636282	-1.446540	0.1610
D(PCGDP(-1))	13.24547	6.211238	2.132501	0.0434
D(PT)	0.292479	0.216707	1.349653	0.1897
D(PT(-1))	-0.554116	0.291905	-1.898274	0.0697
D(PT(-2))	-0.646895	0.228115	-2.835834	0.0091
DUMMY	2.157756	0.124911	17.27435	0.0000
C	0.540500	0.348743	1.549851	0.1343
PCI(-1)	-0.060713	0.040314	-1.505999	0.1451
HHI(-1)	-0.003866	0.011819	-0.327121	0.7464
HCEXP(-1)	0.652507	0.401382	1.625651	0.1171
CC(-1)	1.975524	0.142094	13.90289	0.0000
HStc(-1)	0.069304	0.092477	0.749416	0.4609
PCGDP(-1)	-17.27167	4.514232	-3.826049	0.0008
PT(-1)	0.572036	0.300734	1.902136	0.0692
HP(-1)	-1.848875	0.116550	-15.86335	0.0000

R-squared	0.995027	Mean dependent var	0.192565
Adjusted R-squared	0.989225	S.D. dependent var	0.564917
S.E. of regression	0.058639	Akaike info criterion	-2.532739
Sum squared resid	0.082524	Schwarz criterion	-1.454655
Log likelihood	96.11758	Hannan-Quinn criter.	-2.118160
F-statistic	171.5059	Durbin-Watson stat	2.343961
Prob(F-statistic)	0.000000		

Table A2.4: General ARDL Model Results

Dependent Variable: Housing Price
Method: ARDL
Sample (adjusted): 1963 2015
Included observations: 53 after adjustments
Maximum dependent lags: 3 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (3 lags, automatic): PCI HHI HCEXP CC HStc PCGDP PT
Fixed regressors: DUMMY C
Number of models evalulated: 49152
Selected Model: ARDL(3, 3, 3, 0, 3, 3, 2, 3)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Housing Price lagged once	0.046869	0.040595	1.154552	0.2596
Housing Price lagged twice	-0.288630	0.057040	-5.060118	0.0000
Housing Price lagged thrice	-0.599538	0.078704	-7.617652	0.0000
Private Capital Inflows	0.035841	0.023351	1.534910	0.1379
Private Capital Inflows lagged once	-0.022123	0.022083	-1.001832	0.3264
Private Capital Inflows lagged twice	-0.042064	0.020662	-2.035855	0.0529
Private Capital Inflows lagged thrice	-0.047532	0.021858	-2.174568	0.0397
Household Indebtedness	-0.012584	0.008124	-1.549067	0.1345
Household Indebtedness lagged once	-0.007324	0.010000	-0.732404	0.4710
Household Indebtedness lagged twice	0.002070	0.008322	0.248750	0.8057
Household Indebtedness lagged thrice	0.019210	0.008162	2.353542	0.0271
Household Consumption Expenditure	0.770934	0.328434	2.347299	0.0275
Construction Cost	0.905366	0.052249	17.32791	0.0000
Construction Cost lagged once	0.275403	0.059241	4.648889	0.0001
Construction Cost lagged twice	0.207837	0.052317	3.972639	0.0006
Construction Cost lagged thrice	0.583704	0.071599	8.152418	0.0000
House Stock	0.514832	0.136562	3.769943	0.0009
House Stock lagged once	0.329972	0.341019	0.967604	0.3429
House Stock lagged twice	-1.635073	0.424243	-3.854093	0.0008
House Stock lagged thrice	0.790563	0.247409	3.195367	0.0039
Per Capita GDP	-11.57765	5.871100	-1.971973	0.0602
Per Capita GDP lagged once	8.200188	7.071877	1.159549	0.2576
Per Capita GDP lagged twice	-12.36742	5.909685	-2.092737	0.0471
Property Taxes	0.211859	0.208346	1.016860	0.3194
Property Taxes lagged once	-0.232413	0.219401	-1.059308	0.3000
Property Taxes lagged twice	0.073867	0.263549	0.280277	0.7817
Property Taxes lagged thrice	0.665732	0.215187	3.093739	0.0050
DUMMY	2.160237	0.116558	18.53355	0.0000
C	0.417381	0.309667	1.347838	0.1903

R-squared	0.999842	Mean dependent var	1.967185
Adjusted R-squared	0.999658	S.D. dependent var	3.011598
S.E. of regression	0.055717	Akaike info criterion	-2.634945
Sum squared resid	0.074506	Schwarz criterion	-1.556861
Log likelihood	98.82605	Hannan-Quinn criter.	-2.220366
F-statistic	5424.854	Durbin-Watson stat	2.103313
Prob(F-statistic)	0.000000		

Table A2.5: Correlation Matrix

	UPop	PT	PCGDP	HStc	HP	HHI	HCEXP	CC	PCI
UPop	1.00	-0.15	0.90	0.86	0.71	0.94	0.66	0.72	0.15
PT	-0.15	1.00	0.11	0.29	-0.34	-0.21	-0.56	-0.32	0.33
PCGDP	0.90	0.11	1.00	0.89	0.65	0.86	0.37	0.66	0.11
HStc	0.86	0.29	0.89	1.00	0.44	0.77	0.33	0.47	0.08
HP	0.71	-0.34	0.65	0.44	1.00	0.76	0.69	0.99	0.51
HHI	0.94	-0.21	0.86	0.77	0.76	1.00	0.71	0.78	0.18
HCEXP	0.66	-0.56	0.37	0.33	0.69	0.71	1.00	0.67	0.29
CC	0.72	-0.32	0.66	0.47	0.99	0.78	0.67	1.00	0.48
PCI	0.15	-0.33	0.11	-0.08	0.51	0.18	0.29	0.48	1.00

Table A2.6 Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.075462	Prob. F(3,21)	0.9725
Obs*R-squared	0.565259	Prob. Chi-Square(3)	0.9043

Test Equation:
Dependent Variable: RESID
Method: ARDL
Sample: 1963 2015
Included observations: 53
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
HP(-1)	0.005675	0.045201	0.125558	0.9013
HP(-2)	-0.006823	0.062352	-0.109426	0.9139
HP(-3)	-0.001338	0.087021	-0.015380	0.9879
PCI	0.000351	0.028174	0.012457	0.9902
PCI(-1)	-0.003836	0.024988	-0.153503	0.8795
PCI(-2)	0.001613	0.024254	0.066522	0.9476
PCI(-3)	-0.000644	0.023695	-0.027197	0.9786
HHI	-0.000452	0.008734	-0.051760	0.9592
HHI(-1)	0.000632	0.010754	0.058790	0.9537
HHI(-2)	0.000741	0.009035	0.082011	0.9354
HHI(-3)	8.37E-05	0.008876	0.009434	0.9926
HCEXP	-0.021600	0.369007	-0.058536	0.9539
CC	0.003048	0.057626	0.052892	0.9583
CC(-1)	-0.003384	0.063431	-0.053347	0.9580
CC(-2)	0.002377	0.056710	0.041911	0.9670
CC(-3)	0.002216	0.078442	0.028249	0.9777
HStc	0.006122	0.152036	0.040269	0.9683
HStc(-1)	-0.029227	0.386363	-0.075646	0.9404
HStc(-2)	-0.002240	0.455024	-0.004922	0.9961
HStc(-3)	0.017545	0.272841	0.064304	0.9493
PCGDP	-0.636833	6.561378	-0.097058	0.9236
PCGDP(-1)	1.045938	7.840367	0.133404	0.8951
PCGDP(-2)	-0.489475	6.476844	-0.075573	0.9405
PT	0.003123	0.223989	0.013945	0.9890
PT(-1)	0.001025	0.242316	0.004229	0.9967
PT(-2)	0.026199	0.289314	0.090555	0.9287
PT(-3)	-0.006836	0.234201	-0.029189	0.9770
DUMMY	-0.005232	0.126624	-0.041318	0.9674
C	0.010108	0.357883	0.028243	0.9777
RESID(-1)	-0.068337	0.270959	-0.252205	0.8033
RESID(-2)	0.099285	0.266681	0.372300	0.7134
RESID(-3)	0.006695	0.287772	0.023266	0.9817

R-squared	0.010665	Mean dependent var	1.52E-17
Adjusted R-squared	-1.449781	S.D. dependent var	0.037853
S.E. of regression	0.059246	Akaike info criterion	-2.532460
Sum squared resid	0.073712	Schwarz criterion	-1.342850
Log likelihood	99.11019	Hannan-Quinn criter.	-2.074993
F-statistic	0.007303	Durbin-Watson stat	1.993869
Prob(F-statistic)	1.000000		

Table A2.7: Heteroskedasticity Test: ARCH

F-statistic	1.429595	Prob. F(1,50)	0.2375
Obs*R-squared	1.445451	Prob. Chi-Square(1)	0.2293

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 05/03/17 Time: 20:21
Sample (adjusted): 1964 2015
Included observations: 52 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.001671	0.000342	4.889883	0.0000
RESID^2(-1)	-0.166710	0.139430	-1.195657	0.2375

R-squared	0.027797	Mean dependent var	0.001432
Adjusted R-squared	0.008353	S.D. dependent var	0.002008
S.E. of regression	0.002000	Akaike info criterion	-9.553829
Sum squared resid	0.000200	Schwarz criterion	-9.478782
Log likelihood	250.3996	Hannan-Quinn criter.	-9.525058
F-statistic	1.429595	Durbin-Watson stat	1.838781
Prob(F-statistic)	0.237470		

Table A2.8: Ramsey RESET Test
Specification: HP HP(-1) HP(-2) HP(-3) PCI PCI(-1) PCI(-2) PCI(-3) HHI HHI(-1) HHI(-2) HHI(-3) HCEXP CC CC(-1) CC(-2) CC(-3) HStc HStc(-1) HStc(-2) HStc(-3) PCGDP PCGDP(-1) PCGDP(-2) PT PT(-1) PT(-2) PT(-3) DUMMY C
Omitted Variables: Powers of fitted values from 2 to 4

	Value	df	Probability
F-statistic	0.813336	(3, 21)	0.5008

F-test summary:

	Sum of Sq.	df	Mean Squares
Test SSR	0.007756	3	0.002585
Restricted SSR	0.074506	24	0.003104
Unrestricted SSR	0.066751	21	0.003179

Table A2.9: Unrestricted Ramsey RESET Test Equation:
Dependent Variable: HP
Method: ARDL
Sample: 1963 2015
Included observations: 53
Maximum dependent lags: 3 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (3 lags, automatic):
Fixed regressors: C

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
HP(-1)	0.018060	0.074014	0.244007	0.8096
HP(-2)	-0.225569	0.079014	-2.854788	0.0095
HP(-3)	-0.272222	0.237112	-1.148073	0.2638
PCI	0.016718	0.027054	0.617934	0.5433
PCI(-1)	-0.010463	0.024944	-0.419446	0.6792
PCI(-2)	-0.027249	0.023772	-1.146282	0.2646
PCI(-3)	-0.024545	0.027811	-0.882570	0.3875
HHI	-0.005491	0.009583	-0.573044	0.5727
HHI(-1)	-0.002026	0.010780	-0.187953	0.8527
HHI(-2)	0.004423	0.009400	0.470583	0.6428
HHI(-3)	0.011237	0.009957	1.128524	0.2718
HCEXP	0.280450	0.458777	0.611299	0.5476
CC	0.592528	0.275599	2.149965	0.0434
CC(-1)	0.134642	0.118271	1.138414	0.2678
CC(-2)	0.189452	0.060029	3.155976	0.0048
CC(-3)	0.211418	0.253584	0.833720	0.4138
HS	-0.057883	0.396984	-0.145806	0.8855
HStc(-1)	0.838175	0.485558	1.726211	0.0990
HStc(-2)	-1.418156	0.517944	-2.738047	0.0123
HStc(-3)	0.721274	0.298279	2.418122	0.0248
PCGDP	-7.549240	6.737768	-1.120436	0.2752
PCGDP(-1)	4.640756	7.547427	0.614879	0.5452
PCGDP(-2)	-7.778873	6.696703	-1.161597	0.2584
PT	0.084558	0.241898	0.349561	0.7301
PT(-1)	-0.025298	0.264328	-0.095706	0.9247
PT(-2)	-0.129590	0.301095	-0.430396	0.6713
PT(-3)	0.331672	0.341587	0.970973	0.3426
DUMMY	0.648405	1.382712	0.468937	0.6439
C	0.522250	0.320473	1.629625	0.1181
FITTED^2	0.256825	0.205137	1.251967	0.2243
FITTED^3	-0.041709	0.030805	-1.353976	0.1901
FITTED^4	0.002062	0.001418	1.454271	0.1607

R-squared	0.999858	Mean dependent var	1.967185
Adjusted R-squared	0.999650	S.D. dependent var	3.011598
S.E. of regression	0.056379	Akaike info criterion	-2.631659
Sum squared resid	0.066751	Schwarz criterion	-1.442049
Log likelihood	101.7390	Hannan-Quinn criter.	-2.174193
F-statistic	4785.618	Durbin-Watson stat	1.953618
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not aCCount for model selection.

Table A2.10: ARDL Short-run And Long-run Form
Dependent Variable: HP
Selected Model: ARDL(3, 3, 3, 0, 3, 3, 2, 3)
Sample: 1960 2015
Included observations: 53

Short-run Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(HP(-1))	0.888168	0.102384	8.674888	0.0000
D(HP(-2))	0.599538	0.078704	7.617652	0.0000
D(PCI)	0.035841	0.023351	1.534910	0.1379
D(PCI(-1))	0.042064	0.020662	2.035855	0.0529
D(PCI(-2))	0.047532	0.021858	2.174568	0.0397
D(HHI)	-0.012584	0.008124	-1.549067	0.1345
D(HHI(-1))	0.002070	0.008322	0.248750	0.8057
D(HHI(-2))	0.019210	0.008162	2.353542	0.0271
D(HCEXP)	0.770934	0.328434	2.347299	0.0275
D(CC)	0.905366	0.052249	17.327914	0.0000
D(CC(-1))	-0.207837	0.052317	-3.972639	0.0006
D(CC(-2))	-0.583704	0.071599	-8.152418	0.0000
D(HStc)	0.514832	0.136562	3.769943	0.0009
D(HStc(-1))	1.635073	0.424243	3.854093	0.0008
D(HStc(-2))	-0.790563	0.247409	-3.195367	0.0039
D(PCGDP)	-11.577650	5.871100	-1.971973	0.0602
D(PCGDP(-1))	12.367415	5.909685	2.092737	0.0471
D(PT)	0.211859	0.208346	1.016860	0.3194
D(PT(-1))	-0.073867	0.263549	-0.280277	0.7817
D(PT(-2))	-0.665732	0.215187	-3.093739	0.0050
DUMMY	2.160237	0.116558	18.533548	0.0000
ECT(-1)	-1.841299	0.110842	-16.611926	0.0000

ECT = HP - (-0.0412*PCI -0.0015*HHI + 0.4187*HCEXP + 1.0712*CC + 0.0002*HStc -8.5510*PCGDP + 0.3905*PT + 1.1732*DUMMY + 0.2267)

Long-run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PCI	-0.041209	0.020278	-2.032152	0.0533
HHI	0.001503	0.005198	0.289163	0.7749
HCEXP	0.418690	0.181533	2.306418	0.0300
CC	1.071151	0.011345	94.415814	0.0000
HStc	0.000159	0.048986	0.003253	0.9974
PCGDP	-8.550959	2.189548	-3.905354	0.0007
PT	0.390509	0.147771	2.642665	0.0143
DUMMY	1.173213	0.100330	11.693499	0.0000
C	0.226678	0.166071	1.364941	0.1849

Table A2.11: VAR Lag Order Selection Criteria for Model 3.22

Endogenous variables: HP HHI
Exogenous variables: C DUMMY CC PCI HStc HCEXP HP(-9) HHI(-9)
Sample: 1960 2015
Included observations: 41

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-205.0964	NA	83.64045	10.10226	10.18585	10.13270
1	-117.3827	162.5912	1.409788	6.018669	6.269436*	6.109985*
2	-112.7085	8.208304	1.366795*	5.985783	6.403727	6.137975
3	-109.2283	5.772188	1.407950	6.011135	6.596257	6.224204
4	-105.0094	6.585478	1.403868	6.000460	6.752760	6.274406
5	-101.0542	3.066372	2.199499	6.392888	7.646721	6.849465
6	-96.40937	5.437856	2.207632	6.361433	7.782444	6.878886
7	-85.51383	9.779632	2.134978	6.220187	7.975553	6.859394
8	-60.53925	6.324592*	1.550040	5.401515 *	7.844180	6.409119
9	-57.12953	1.995936	1.893126	5.616074	8.040152	6.498790
10	-48.73106	4.096813	1.914646	5.587281	7.992770	6.345107

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

Table A2.12: Vector Autoregression Estimates for Model 3.22

Sample (adjusted): 1969 2015
Included observations: 47 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	HSE_P	HH_IND
HP(-1)	0.153212	1.017507
	(0.05775)	(0.88114)
	[2.65291]	[1.15476]
HP(-2)	-0.054283	-0.935384
	(0.07070)	(1.07864)
	[-0.76783]	[-0.86719]
HP(-3)	-0.000617	-0.004452
	(0.09819)	(1.49813)
	[-0.00628]	[-0.00297]
HP(-4)	0.176004	0.189399
	(0.06986)	(1.06583)
	[2.51947]	[0.17770]
HP(-5)	0.174397	0.210006
	(0.07250)	(1.10612)
	[2.40553]	[0.18986]
HP(-6)	0.025323	0.229436
	(0.07518)	(1.14707)
	[0.33682]	[0.20002]
HP(-7)	-0.335235	0.316358
	(0.06809)	(1.03890)
	[-4.92325]	[0.30451]
HP(-8)	-0.055957	0.060124
	(0.07155)	(1.09172)
	[-0.78203]	[0.05507]
HHI(-1)	-0.009606	0.374834
	(0.01539)	(0.23477)
	[-0.62431]	[1.59662]
HHI(-2)	0.004696	0.117017
	(0.01531)	(0.23361)
	[0.30668]	[0.50090]
HHI(-3)	0.010008	0.205287
	(0.01451)	(0.22138)
	[0.68974]	[0.92730]
HHI(-4)	-0.018782	-0.160990
	(0.01481)	(0.22588)
	[-1.26865]	[-0.71271]
HHI(-5)	0.003252	0.012779
	(0.01569)	(0.23936)
	[0.20726]	[0.05339]
HHI(-6)	0.006221	-0.083511
	(0.01480)	(0.22588)
	[0.42017]	[-0.36971]
HHI(-7)	0.019680	0.164599
	(0.01406)	(0.21451)
	[1.39975]	[0.76733]
HHI(-8)	-0.004783	-0.004276
	(0.01511)	(0.23050)
	[-0.31662]	[-0.01855]
DUMMY	2.362388	-1.716288
	(0.20179)	(3.07870)
	[11.7074]	[-0.55747]
CC	0.607211	0.352735
	(0.08003)	(1.22108)
	[7.58699]	[0.28887]
PCI	-0.000149	-0.781782
	(0.05100)	(0.77817)
	[-0.00293]	[-1.00464]
HStc	0.029421	0.212358
	(0.08614)	(1.31424)
	[0.34156]	[0.16158]
HCEXP	-0.089012	13.52910
	(0.34042)	(5.19387)
	[-0.26148]	[2.60482]
HP(-9)	0.254415	-0.316973
	(0.11788)	(1.79856)
	[2.15820]	[-0.17624]
HHI(-9)	-0.003209	-0.090099
	(0.01359)	(0.20730)
	[-0.23616]	[-0.43462]

R-squared	0.999243	0.931615
Adj. R-squared	0.998549	0.868929
Sum sq. resids	0.342990	79.84199
S.E. equation	0.119546	1.823938
F-statistic	1440.413	14.86155
Log likelihood	48.93463	-79.14281
Akaike AIC	-1.103601	4.346502
Schwarz SC	-0.198210	5.251894
Mean dependent	2.177690	22.39437
S.D. dependent	3.138884	5.037979

Determinant resid covariance (dof adj.)	0.046456
Determinant resid covariance	0.012113
Log likelihood	-29.66442
Akaike information criterion	3.219763
Schwarz criterion	5.030545

Table A2.13: VAR Granger Causality/Block Exogeneity Wald Tests for Model 3.22

Sample: 1960 2015
Included observations: 46

Dependent variable: HP

Excluded	Chi-sq	df	Prob.
HHI	7.543895	8	0.5807
All	7.543895	8	0.5807

Dependent variable: HHI

Excluded	Chi-sq	df	Prob.
HP	17.74561	8	0.0382
All	17.74561	8	0.0382

Table A2.14: VAR Residual Serial Correlation LM Tests for Model 3.22

Null Hypothesis: no serial correlation at lag order h
Date: 05/04/17 Time: 13:33
Sample: 1960 2015
Included observations: 47

Lags	LM-Stat	Prob
1	3.749709	0.4409
2	4.865688	0.3014
3	5.510562	0.2388
4	3.660722	0.4539
5	4.067087	0.3970
6	5.103082	0.2769
7	6.187113	0.1856
8	4.929774	0.2946

Probs from chi-square with 4 df.

Table A2.15: VAR Residual Normality Tests for Model 3.22

Orthogonalization: Cholesky (Lutkepohl)
Null Hypothesis: residuals are multivariate normal
Sample: 1960 2015
Included observations: 47

Component	Skewness	Chi-sq	df	Prob.
1	-0.080154	0.050326	1	0.8225
2	0.908778	6.469379	1	0.0110
Joint		6.519705	2	0.0384

Component	Kurtosis	Chi-sq	df	Prob.
1	3.442292	0.383093	1	0.5360
2	3.925985	1.679170	1	0.1950
Joint		2.062263	2	0.3566

Component	Jarque-Bera	df	Prob.
1	0.433419	2	0.8052
2	8.148548	2	0.0170
Joint	8.581968	4	0.0724

Table A2.16:VAR Lag Order Selection Criteria for Model 3.23

Endogenous variables: HP PCI
Exogenous variables: C CC HCEXP DUMMY HHI HStc PCGDP PT
Sample: 1960 2015
Included observations: 46

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-27.87233	NA	0.023258	1.907492	2.543542	2.145760
1	-9.530945	28.70825	0.012554	1.283954	2.079016	1.581789
2	-4.518818	7.409230	0.012142	1.239949	2.194022	1.597350
3	5.679985	14.18964	0.009415	0.970435	2.083522	1.387404
4	6.053822	0.487614	0.011253	1.128095	2.400193	1.604630
5	9.834031	4.601993	0.011679	1.137651	2.568761	1.673753
6	18.22267	9.482808	0.010002	0.946840	2.536963	1.542510
7	42.33971	25.16561	0.004367	0.072186	1.821322	0.727423
8	55.68238	12.76255*	0.003083*	-0.334017*	1.574131*	0.380787*
9	59.14940	3.014798	0.003394	-0.310844	1.756316	0.463527
10	62.06820	2.284274	0.003899	-0.263835	1.962338	0.570103

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

Table 2.17: VAR Residual Normality Tests for Model 3.23

Orthogonalization: Cholesky (Lutkepohl)
Null Hypothesis: residuals are multivariate normal
Sample: 1960 2015
Included observations: 47

Component	Skewness	Chi-sq	df	Prob.
1	-0.457076	1.636527	1	0.2008
2	0.437426	1.498843	1	0.2208
Joint		3.135371	2	0.2085

Component	Kurtosis	Chi-sq	df	Prob.
1	2.633850	0.262545	1	0.6084
2	3.254458	0.126800	1	0.7218
Joint		0.389345	2	0.8231

Component	Jarque-Bera	df	Prob.
1	1.899072	2	0.3869
2	1.625644	2	0.4436
Joint	3.524716	4	0.4741

Table 2.18: VAR Residual Serial Correlation LM Tests for Model 3.23

Null Hypothesis: no serial correlation at lag order h
Sample: 1960 2015
Included observations: 47

Lags	LM-Stat	Prob
1	2.340508	0.6734
2	1.465779	0.8327
3	2.956759	0.5651
4	11.03369	0.0262
5	4.457232	0.3476
6	3.556191	0.4694
7	12.25718	0.0155
8	3.149686	0.5331
9	0.389479	0.9833

Probs from chi-square with 4 df.

Table A2.19: VAR Granger Causality/Block Exogeneity Wald Tests for Model 3.23

Sample: 1960 2015
Included observations: 47

Dependent variable: HP			
Excluded	Chi-sq	df	Prob.
PCI	18.83888	8	0.0157
All	18.83888	8	0.0157
Dependent variable: PCI			
Excluded	Chi-sq	df	Prob.
HP	31.61137	8	0.0001
All	31.61137	8	0.0001

TableA2.20:Vector Autoregression Estimates for Model 3.23
Sample (adjusted): 1969 2015
Included observations: 47 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	HP	PCI		HP	PCI
HP(-1)	0.913314	-0.047797	PCI(-1)	0.149126	0.060054
	(0.18481)	(0.17932)		(0.21748)	(0.21102)
	[4.94192]	[-0.26655]		[0.68571]	[0.28460]
HP(-2)	0.194652	-0.120845	PCI(-2)	0.249380	0.165738
	(0.25954)	(0.25183)		(0.18492)	(0.17942)
	[0.74999]	[-0.47987]		[1.34861]	[0.92373]
HP(-3)	0.390095	0.323245	PCI(-3)	0.059642	0.213425
	(0.26117)	(0.25341)		(0.17089)	(0.16581)
	[1.49366]	[1.27559]		[0.34901]	[1.28714]
HP(-4)	-0.325944	0.198484	PCI(-4)	-0.045455	-0.006071
	(0.26901)	(0.26101)		(0.19954)	(0.19362)
	[-1.21166]	[0.76043]		[-0.22780]	[-0.03135]
HP(-5)	-0.289040	0.291979	PCI(-5)	-0.134157	-0.291283
	(0.29112)	(0.28247)		(0.17895)	(0.17363)
	[-0.99287]	[1.03367]		[-0.74968]	[-1.67756]
HP(-6)	-0.306929	-0.489263	PCI(-6)	-0.138865	-0.196313
	(0.30280)	(0.29380)		(0.19580)	(0.18998)
	[-1.01365]	[-1.66530]		[-0.70921]	[-1.03332]
HP(-7)	-0.233980	-0.598705	PCI(-7)	0.156688	0.236405
	(0.32274)	(0.31316)		(0.18324)	(0.17780)
	[-0.72497]	[-1.91185]		[0.85508]	[1.32962]
HP(-8)	0.547739	0.253302	PCI(-8)	0.023800	-0.004780
	(0.34424)	(0.33401)		(0.18897)	(0.18335)
	[1.59117]	[0.75837]		[0.12595]	[-0.02607]
C	-0.247250	0.416163			
	(0.35948)	(0.34880)			
	[-0.68780]	[1.19314]			
HP(-9)	0.495636	0.395049			
	(0.48000)	(0.46574)			
	[1.03258]	[0.84822]			
PCI(-9)	-0.064464	0.044758			
	(0.18568)	(0.18016)			
	[-0.34719]	[0.24843]			

R-squared	0.980386	0.615740
Adj. R-squared	0.967778	0.368716
Sum sq. resids	8.889227	8.368873
S.E. equation	0.563447	0.546707
F-statistic	77.75482	2.492633
Log likelihood	-27.55539	-26.13785
Akaike AIC	1.981080	1.920759
Schwarz SC	2.729012	2.668691
Mean dependent	2.177690	0.860139
S.D. dependent	3.138884	0.688085

Determinant resid covariance (dof adj.)	0.091137
Determinant resid covariance	0.032346
Log likelihood	-52.74515
Akaike information criterion	3.861496
Schwarz criterion	5.357360

Table A2.21: VAR Lag Order Selection Criteria for Model 3.24

Endogenous variables: HP HCEXP
Exogenous variables: C
Sample: 1960
2015
Included observations: 39

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-44.73304	NA	0.037660	2.396566	2.481877	2.427175
1	45.16044	165.9572	0.000460	-2.008228	-1.752295	-1.916401
2	46.58019	2.475451	0.000527	-1.875907	-1.449353	-1.722863
3	47.81572	2.027537	0.000610	-1.734139	-1.136963	-1.519878
4	53.53055	8.792050	0.000564	-1.822079	-1.054282	-1.546600
5	57.45026	5.628304	0.000574	-1.817962	-0.879543	-1.481265
6	60.32354	3.831042	0.000622	-1.760182	-0.651141	-1.362267
7	61.79308	1.808667	0.000730	-1.630415	-0.350752	-1.171283
8	65.17886	3.819853	0.000785	-1.598916	-0.148632	-1.078566
9	67.43244	2.311360	0.000908	-1.509356	0.111550	-0.927789
10	75.02320	7.006859	0.000813	-1.693498	0.098030	-1.050713
11	92.27729	14.15720*	0.000453	-2.373194	-0.411044	-1.669192
12	97.08562	3.452137	0.000493	-2.414647	-0.281876	-1.649427
13	104.0342	4.276047	0.000500	-2.565856	-0.262463	-1.739419
14	112.3032	4.240535	0.000500*	-2.784781*	-0.310767*	-1.897126*
15	117.2419	2.026101	0.000643	-2.832916	-0.188279	-1.884043
16	135.5085	5.620494	0.000474	-3.564536	-0.749278	-2.554446
17	162.9994	5.639177	0.000275	-4.769203	-1.783323	-3.697895

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

Table A2.22: VAR Granger Causality/Block Exogeneity Wald Tests for Model 3.24

Sample: 1960 - 2015
Included observations: 41

Dependent variable: HP			
Excluded	Chi-sq	df	Prob.
HCEXP	26.8108214		0.0204
All	26.8108214		0.0204

Dependent variable: HCEXP			
Excluded	Chi-sq	df	Prob.
HP	32.23216	14	0.0037
All	32.23216	14	0.0037

Table A2.23: Vector Autoregression Estimates for Model 3.24

Sample (adjusted): 1975 -2015
Included observations: 41 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	HP	HCEXP		HP	HCEXP
HP(-1)	0.318899	-0.004376	HH CONSEXP(-1)	-6.024804	-0.104232
	(0.30958)	(0.01630)		(5.93557)	(0.31255)
	[1.03011]	[-0.26844]		[-1.01503]	[-0.33349]
HP(-2)	0.586789	-0.006361	HCEXP(-2)	-9.145724	0.010786
	(0.28039)	(0.01476)		(5.85214)	(0.30816)
	[2.09280]	[-0.43082]		[-1.56280]	[0.03500]
HP(-3)	0.584489	-0.006224	HCEXP(-3)	-6.727656	-0.100238
	(0.33310)	(0.01754)		(5.83419)	(0.30721)
	[1.75468]	[-0.35483]		[-1.15314]	[-0.32628]
HP(-4)	-0.341852	0.017981	HCEXP(-4)	-1.807554	-0.180262
	(0.41549)	(0.02188)		(5.57694)	(0.29366)
	[-0.82276]	[0.82185]		[-0.32411]	[-0.61384]
HP(-5)	-0.590067	0.011526	HCEXP(-5)	5.023011	-0.365521
	(0.35218)	(0.01854)		(4.86597)	(0.25623)
	[-1.67548]	[0.62153]		[1.03227]	[-1.42655]
HP(-6)	-0.049011	0.008723	HCEXP(-6)	-1.373830	-0.756502
	(0.39135)	(0.02061)		(5.78546)	(0.30464)
	[-0.12524]	[0.42328]		[-0.23746]	[-2.48323]
HP(-7)	0.382204	-0.010758	HCEXP(-7)	-11.47635	-0.188544
	(0.41039)	(0.02161)		(7.32253)	(0.38558)
	[0.93133]	[-0.49783]		[-1.56727]	[-0.48899]
HP(-8)	0.570377	-0.006036	HCEXP(-8)	-12.25481	0.025645
	(0.38471)	(0.02026)		(6.71668)	(0.35368)
	[1.48260]	[-0.29794]		[-1.82453]	[0.07251]
HP(-9)	-0.478261	-0.083900	HCEXP(-9)	0.104607	-0.002813
	(0.96320)	(0.05072)		(5.89946)	(0.31065)

	[-0.49654]	[-1.65422]		[0.01773]	[-0.00905]
HP(-10)	-0.647753	0.013385	HCEXP(-10)	10.29239	0.245433
	(1.13559)	(0.05980)		(5.83461)	(0.30723)
	[-0.57041]	[0.22384]		[1.76402]	[0.79885]
HP(-11)	-0.823953	0.112978	HCEXP(-11)	15.12642	0.062180
	(0.98832)	(0.05204)		(6.00007)	(0.31594)
	[-0.83369]	[2.17089]		[2.52104]	[0.19681]
HP(-12)	0.726418	0.134154	HCEXP(-12)	3.079771	-0.169373
	(1.28940)	(0.06790)		(5.58482)	(0.29408)
	[0.56338]	[1.97588]		[0.55145]	[-0.57594]
HP(-13)	2.829539	0.155933	HCEXP(-13)	-8.941781	-0.181349
	(1.51855)	(0.07996)		(4.74800)	(0.25001)
	[1.86332]	[1.95008]		[-1.88327]	[-0.72535]
HP(-14)	3.606980	0.114745	HCEXP(-14)	-10.38852	-0.068439
	(1.60514)	(0.08452)		(4.41167)	(0.23230)
	[2.24715]	[1.35758]		[-2.35478]	[-0.29461]
C	20.36770	1.793367			
	(12.1021)	(0.63726)			
	[1.68298]	[2.81418]			
HP(-15)	1.759646	0.062074			
	(1.58639)	(0.08353)			
	[1.10921]	[0.74310]			
HCEXP(-15)	-0.437583	-0.256676			
	(5.24573)	(0.27622)			
	[-0.08342]	[-0.92923]			

R-squared	0.994011	0.970669
Adj. R-squared	0.976045	0.882677
Sum sq. resids	2.565870	0.007115
S.E. equation	0.506544	0.026673
F-statistic	55.32592	11.03131
Log likelihood	-1.365353	119.3369
Akaike AIC	1.578798	-4.309118
Schwarz SC	2.874425	-3.013491
Mean dependent	2.455324	0.713313
S.D. dependent	3.272779	0.077872

Determinant resid covariance (dof adj.)	0.000139
Determinant resid covariance	8.28E-06
Log likelihood	123.5211
Akaike information criterion	-3.001029
Schwarz criterion	-0.409774

Table A2.24:VAR Residual Serial Correlation LM Tests for model 3.24

Null Hypothesis: no serial correlation at lag order h
Sample: 1960 2015
Included observations: 41

Lags	LM-Stat	Prob
1	5.023352	0.2849
2	3.421039	0.4900
3	5.862331	0.2097
4	3.213431	0.5228
5	11.56594	0.0209
6	4.295964	0.3674
7	2.558234	0.6342
8	7.324901	0.1197
9	5.453169	0.2439
10	3.968225	0.4103
11	0.925395	0.9209
12	3.894917	0.4204
13	4.748972	0.3140

Probs from chi-square with 4 df.

Table A2.25: VAR Residual Normality Tests for model 3.24

Orthogonalization: Cholesky (Lutkepohl)
Null Hypothesis: residuals are multivariate normal
Sample: 1960 2015
Included observations: 41

Component	Skewness	Chi-sq	df	Prob.
1	-0.131610	0.118362	1	0.7308
2	0.160360	0.175722	1	0.6751
Joint		0.294083	2	0.8633

Component	Kurtosis	Chi-sq	df	Prob.
1	4.111325	2.109866	1	0.1464
2	3.038631	0.002549	1	0.9597
Joint		2.112415	2	0.3478

Component	Jarque-Bera	df	Prob.
1	2.228227	2	0.3282
2	0.178271	2	0.9147
Joint	2.406499	4	0.6615

Appendix 3

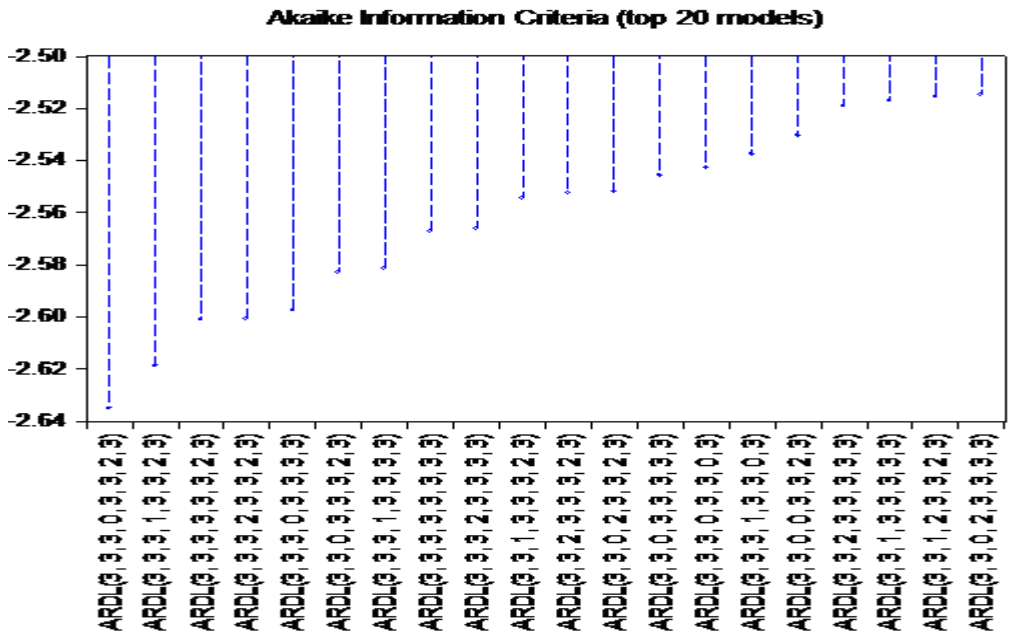

Figure A3.1: AIC Test for ARDL Model

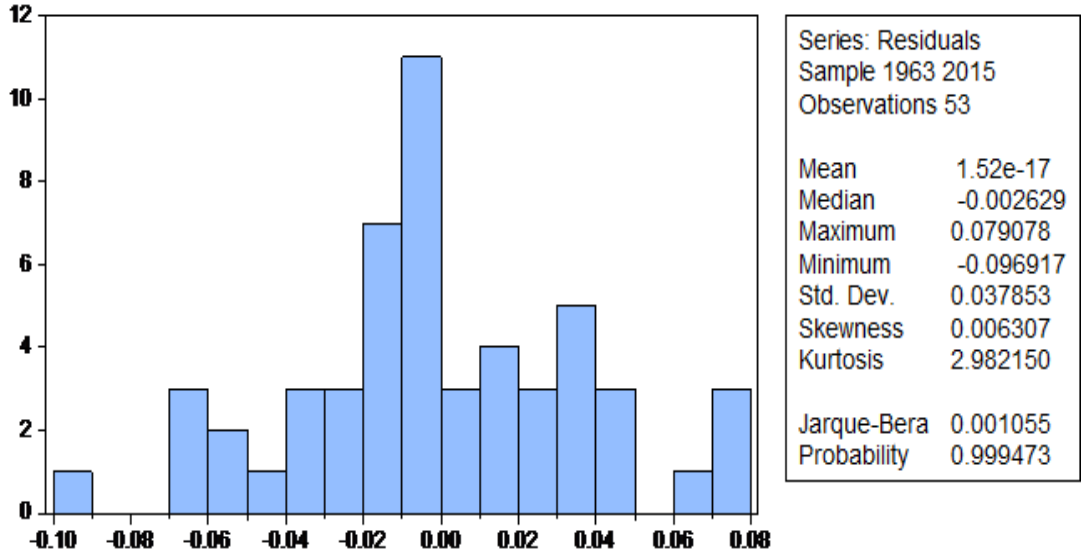

Figure A3.2: Jarque-Bera Histogram Normality Test for ARDL Model

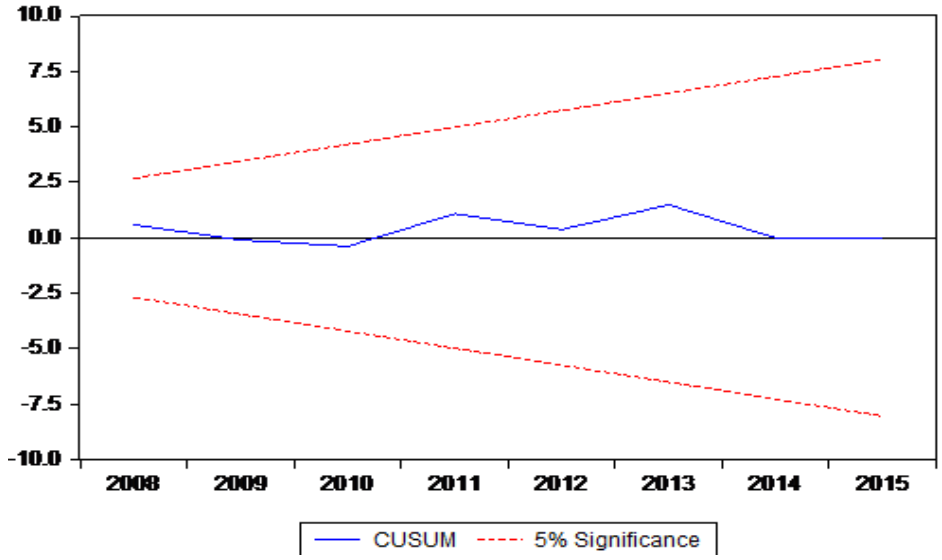

Figure A3.3: CUSUM Stability Test for ARDL Model

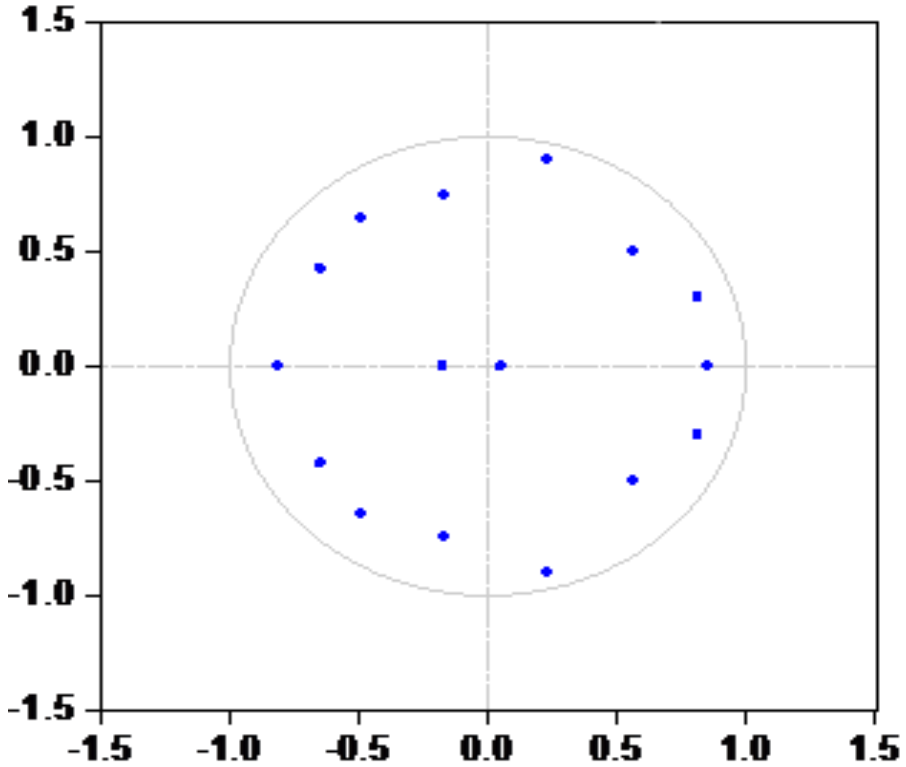

Figure A3.4: Inverse Roots of AR Characteristic Polynomial for Model 3.22 (Housing Prices and Households Indebtedness)

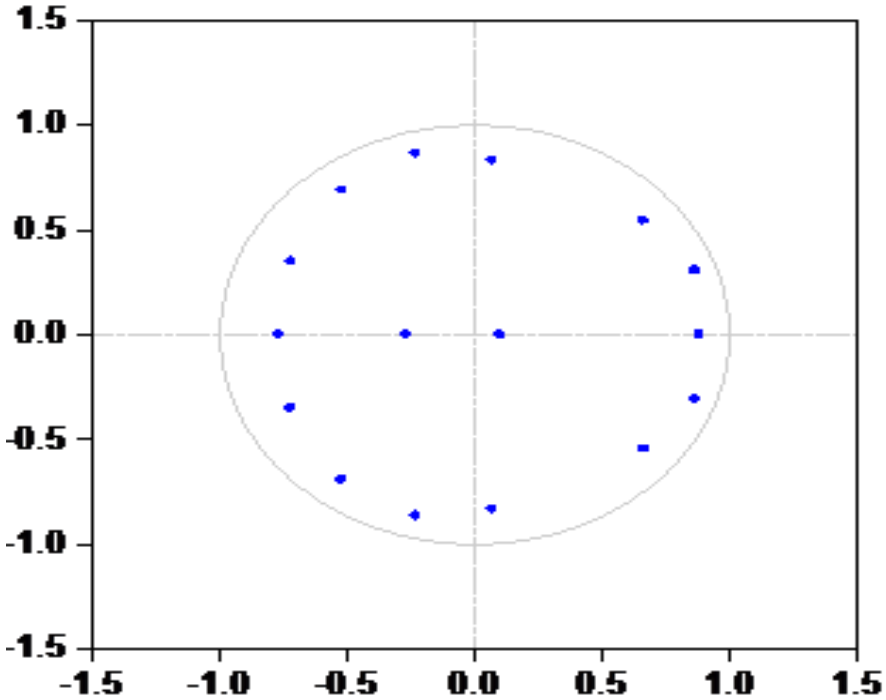

Figure A3.5: Inverse Roots of AR Characteristic Polynomial for Model 3.23 (Housing Prices and Private Capital Inflows)

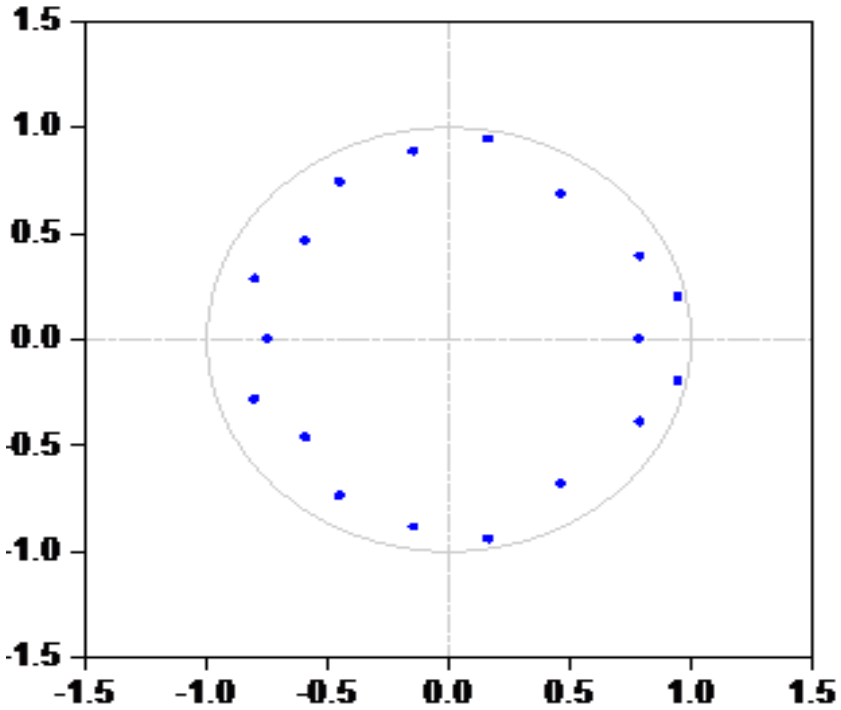

Figure A3.6: Inverse Roots of AR Characteristic Polynomial for Model 3.24 (Housing Prices and Households Consumption Expenditure)