Journal of Economics

Dynamic Relationship between the Housing Price and Selected Macroeconomic Variables in Kenya

Dr. Stephen Githae Njaramba PhD, Dr. Paul Gachanja, PhD & Dr. Charles Mugendi, PhD

ISSN: 2616-4965

Stratford Peer Reviewed Journals and Book Publishing
Journal of Economics
Volume 2||Issue 1||Page 35- 59|August||2018|
Email: info@stratfordjournals.org ISSN: 2616-4965

Dynamic Relationship between the Housing Prices and Selected Macroeconomic Variables in Kenya

***Stephen Githae Njaramba (Ph.D.)**
Department of Applied Economics
Kenyatta University
Kenya

Paul Gachanja (Ph.D.)
Department of Economics Theory
School of Economics
Kenyatta University
Kenya

Charles Mugendi (Ph.D.)
Department of Economics Theory
School of Economics
Kenyatta University
Kenya

***E-mail of corresponding author: sgnjaramba@gmail.com; Njaramba.stephen@ku.ac.ke**

***How to cite this article*: Njaramba, G. S., Gachanja, P. & Mugendi, C. (2018). Dynamic Relationship between the Housing Prices and Selected Macroeconomic Variables in Kenya,**
***Journal of Economics* Vol 2(1) pp. 35-59.**

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. Housing prices behavior have 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. This study examined the dynamic relationship between housing prices and selected macroeconomic variables in Kenya. In doing this, the study used time series data for the period 1960 to 2015 and VAR models. The VAR models were selected where Toda and Yamamoto (1995) methodology was used. This is a modified version of granger causality test based on augmented VAR modeling. The study findings 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 movements to avoid the cost that could result in case of instability in the housing market.

Key words: Housing Prices, Macroeconomic Stability, Housing Price Boom and Affordability

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 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

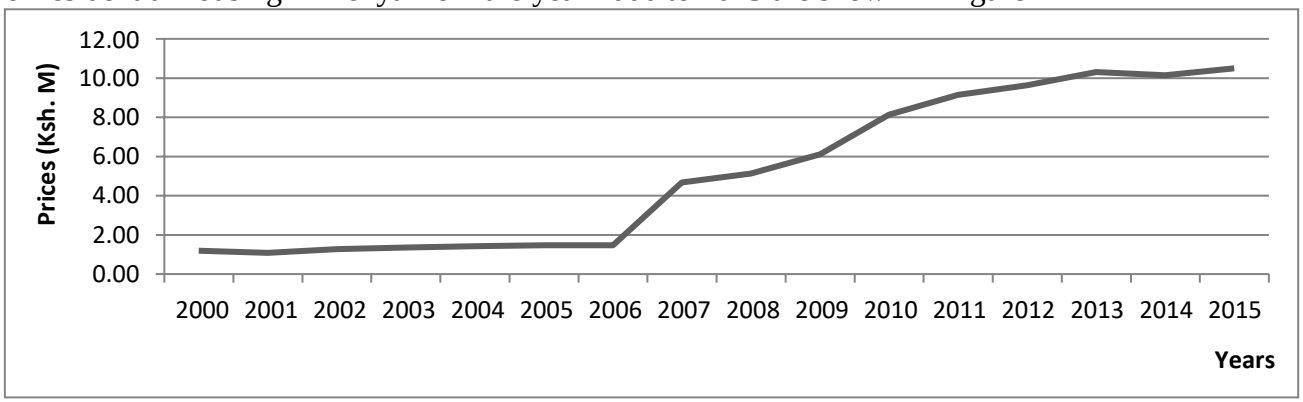

Figure 1: Average Housing Prices Growth in Kenya (2000-2015)
Source: Author's computation using data from KNBS

Figure 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 2 shows the relationship between the housing prices and some of the housing price fundamentals in Kenya.

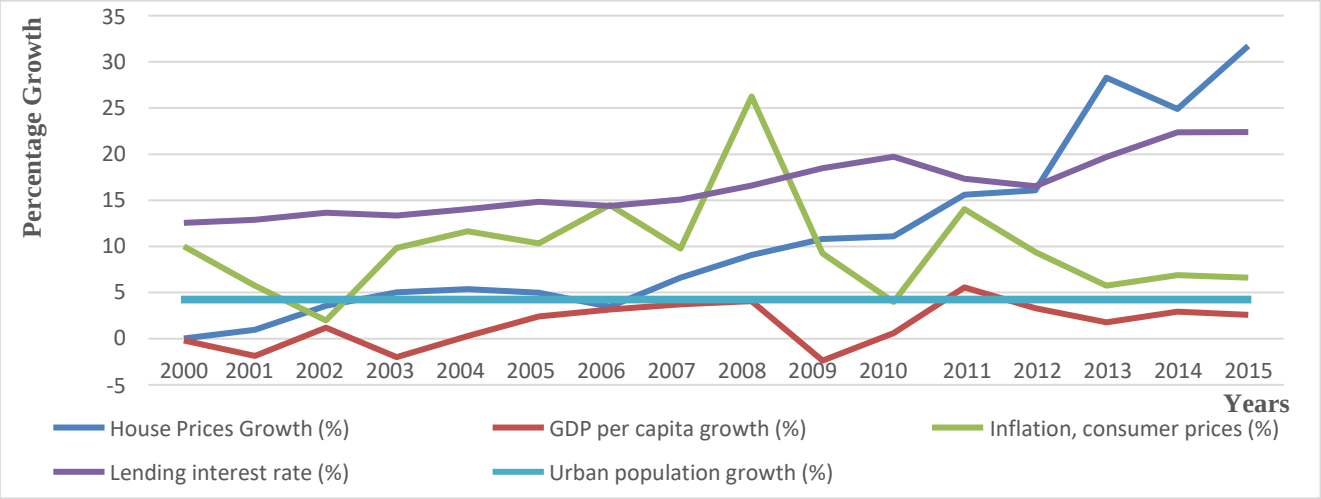

Figure 2: Growth in Average Housing Prices and its Fundamentals (2000-2015)
Source: Author's computation using data from KNBS

Figure 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 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 clear. 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).

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 & Gachanja, 2014; Hassconsult, 2015).

1.1 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 3 shows, the households' consumption expenditure increase is in similar direction with housing prices rise.

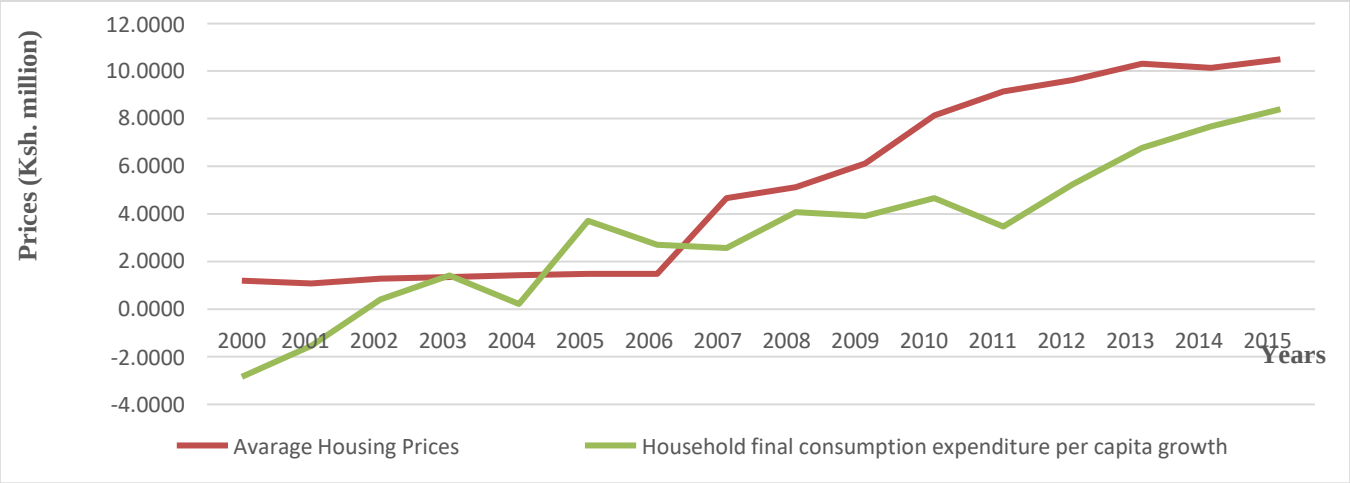

Figure 3: Households Consumption Expenditure and Average Housing Prices (2000-2015)
Source: Author's computation using data from KNBS

Figure 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 4 indicates. This is because housing is used as collateral for commercial bank loans by the households.

Figure 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 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 5

Figure 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 (Hassconsult, 2015). 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).

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 ignored the dynamic interconnection between housing prices and macroeconomic variables. To caution on uncertainty that would come in periods of housing prices instability, there is need for empirical framework to analyze 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 Objectives of the Study

The main objective of the study was to examine the dynamic relationship between housing prices upsurge and selected macroeconomic variables in Kenya. Specifically the study aimed at:

i. Examining the dynamic relationship between housing prices and households' indebtedness in Kenya.
ii. Examining the dynamic relationship between housing prices and private capital inflows in Kenya.
iii. Examining the dynamic relationship between housing prices and households' consumption expenditure in Kenya.

2.0 Methodology

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 the study objectives, Toda and Yamamoto Augmented Granger Causality tests based on Equations 1, 2 and 3 were employed.

Stratford Peer Reviewed Journals and Book Publishing
Journal of Economics
Volume 2||Issue 1||Page 35- 59|August||2018|
Email: info@stratfordjournals.org ISSN: 2616-4965

$$(HHI)_t=\lambda_0+\sum_{i=1}^{k+d}\lambda_{1i}(HP)_{t-i}+\sum_{i=0}^{k+d}\lambda_{2i}(HHI)_{t-i}+\epsilon_t$$

$$(HP)_t=\gamma_0+\sum_{i=0}^{k+d}\gamma_{1i}(HHI)_{t-i}+\sum_{i=1}^{k+d}\gamma_{2i}(HP)_{t-i}+\text{ʊ}_t \quad (1)$$

$$(PCI)_t=\delta_0+\sum_{i=0}^{k+d}\delta_{1i}(HP)_{t-i}+\sum_{i=1}^{k+d}\delta_{2i}(PCI)_{t-i}+\varphi_t$$

$$(HP)_t=\Phi_0+\sum_{i=0}^{k+d}\Phi_{1i}(PCI)_{t-j}+\sum_{i=1}^{k+d}\Phi_{2i}(HP)_{t-i}+\omega_t \quad (2)$$

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

$$(HP)_t=\alpha_0+\sum_{i=0}^{k+d}\alpha_{1j}(HCEXP)_{t-i}+\sum_{i=1}^{k+d}\alpha_{2i}(HP)_{t-i}+\upsilon_t \quad (3)$$

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. λ, γ, δ, Φ, β and α are the models parameters. The study used OLS to estimate Equation 1, Equation 2 and Equation 3

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.

3.0 Findings and Discussions

3.1 Dynamic relationship between Housing Prices and Selected Macroeconomic Variables.

The aim of the study 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). 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.

After selecting the lag length for Equations, 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 and shows 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.

3.1.1 Dynamic Relationship between Housing Prices and Households Indebtedness

To examine the dynamic relationship between housing prices and households' indebtedness, VAR model represented by Equation 1 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 were also used as control variables. The diagnostic tests for the model are given in Tables A2 and A3. The tests for autocorrelation and normality indicate absence of autocorrelation in the residuals and that residuals are normally distributed. Figure A1in the Appendix indicates stability for the VAR model. The VAR summary results are presented in Table 1

Table 1: 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. Therefore, households' indebtedness do not have significant effect on housing prices. As Table 1 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.

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 6

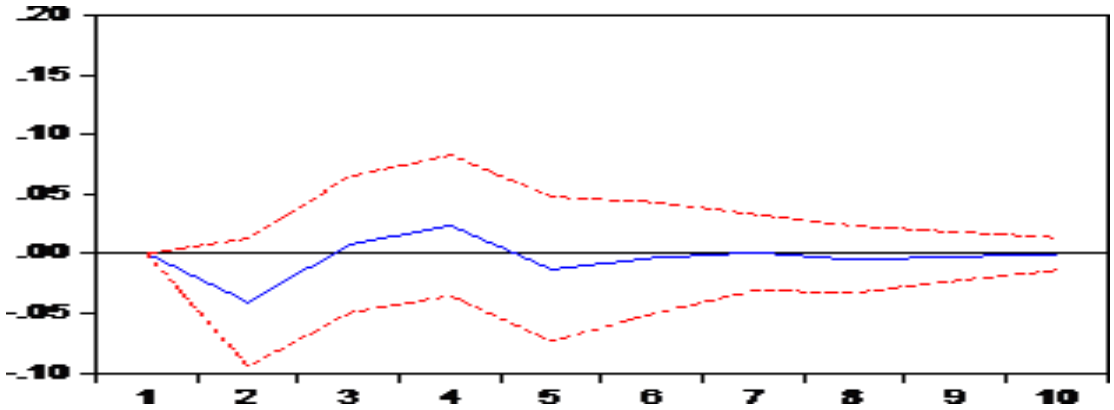

Figure 6: Impulse Response of Households' Indebtedness to House Price Shock
Source: Author's computation.

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.

Stratford Peer Reviewed Journals and Book Publishing
Journal of Economics
Volume 2||Issue 1||Page 35- 59|August||2018|
Email: info@stratfordjournals.org ISSN: 2616-4965

3.1.2 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 2. With regards to the lag length, Table A4 of Appendices gave the Lag Order of 8 lags as the optimal number of lags. Other variables were also used as control variables. Test on serial correlation and normality results are given in Tables A5 and A6 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 A2 which indicates that the VAR model was stable. The Toda and Yamamoto Granger Causality tests results are shown in Table 2

Table 2: 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.

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 7.

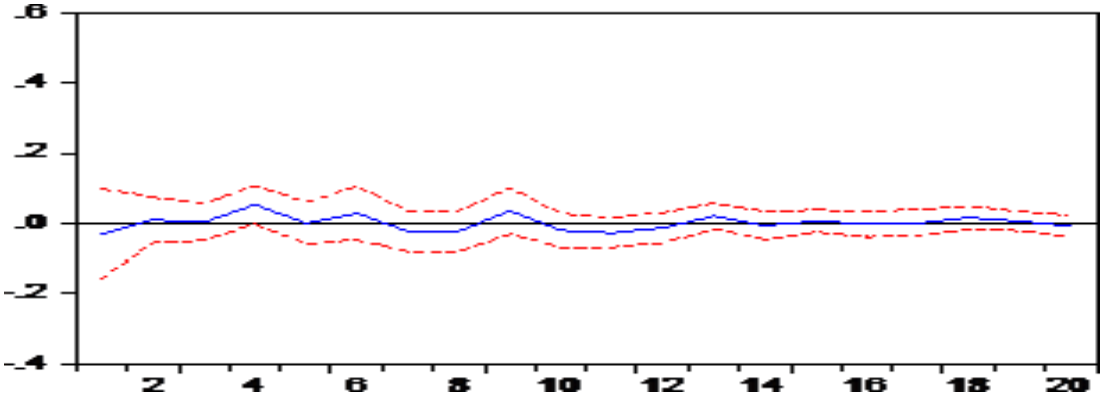

Figure 7: Impulse Response for Private Capital Inflows to Housing Price Shock
Source: Author's computation

Figure 7 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 7implies 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.

3.1.3 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 3 were 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 A8 and Table A9 respectively**.** Test for Model stability is presented by Figures A3 which shows that the VAR model is stable. The Unrestricted VAR results are given in Table 3

Table 3: 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 3 gives result 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 & Murphy, 2008)

Using the unrestricted VAR setup, impulse response function was developed and results are presented in Figure 8.

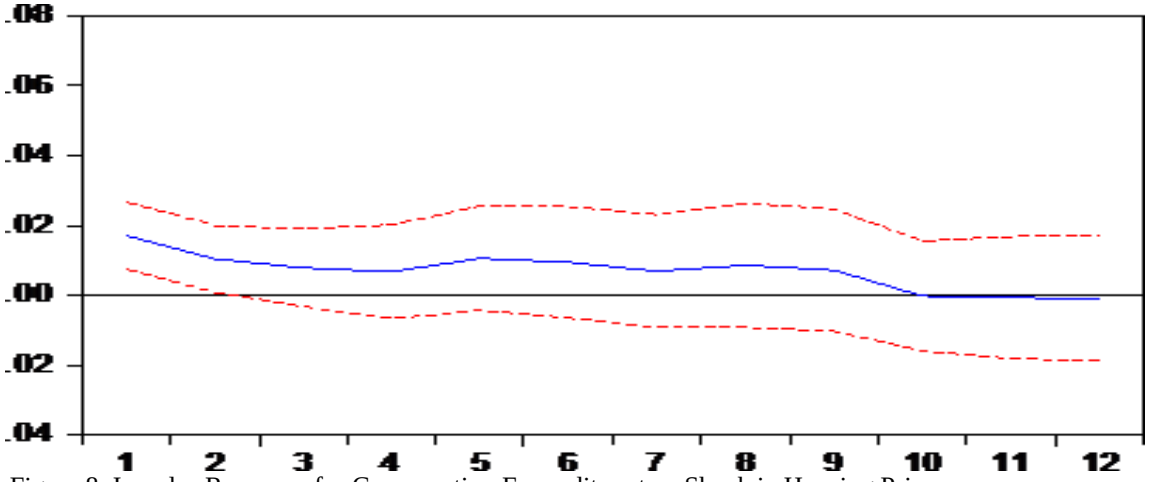

Figure 8: Impulse Response for Consumption Expenditure to a Shock in Housing Price
Source: Author's computation.

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. The findings supports 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.

4.0 Conclusions

From the study findings, 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.

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, 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

5.0 Recommendations and Implications

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 policy makers charged with maintaining price and financial stability. 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 this period 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.

6.0 References

African Development Bank. (2011). *The Middle of the Pyramid: Dynamics of the Middle Class in Africa*. Nairobi: Market Brief.

Antipa, P., & Lecat, R. (2009). The Housing Bubble and Financial Factors: *Insights from a Structural Model of the French and Spanish Residential Markets* (pp. 267-620). France: Banque de France conference.

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

Arnott, R. (1997). Urban Spatial Structure. *Journal of Economic Literature*, 36 (3), 1426-1464.

Balchin, N. (2009). *The impact of the global financial crisis in Africa*. Cape Town: University of Cape Town.

Borio, C., & McGuire P. (2004). Twin peaks in equity and housing prices. *BIS Quarterly Review,* 7 (4), 79–96.

Borio, C., Drehmann, M., Gambacorta, L., Jimenez, G., & Trucharte, C. (2010). Countercyclical capital buffers: Exploring options. *BIS Working Paper,* 317 (12), 154-267.

Caporale, G. & Pittis, N. (1999). Efficient Estimation of Cointegrating Vectors and Testing for Causality in Vector Auto Regressions. *Journal of Economic Surveys*, 13(4), 3–35.

Centre for Affordable Housing in Africa (CAHF), (2012). *Housing Finance in Africa: a Review of Some of African's Housing Finance Markets*. Retrieved March 17, 2016, from http://www.housingfinanceafrica.org/Citymark/.

Clarke, A. & Mirza, S. (2006). A Comparison of Some Common Methods for Detecting Granger Non-causality. Journal of Statistical Computation and Simulation, 76(3), 207-231.

Collyns, C., & Senhadji, A. (2002). Lending Booms, Real Estate Bubbles and the Asian Crisis. *IMF Working Paper (*pp 02-20). Washington: International Monetary Fund.

Demary, M. (2009*). The Link between Output, Inflation, Monetary Policy and Housing Price Dynamics*. Research Center for Real Estate Economics. Germany: Institut der deutschen Wirtschaft K¨oln .

Drehmann, M., Borio, C., Gambacorta, L., Jiménez, G. & Trucharte, C. (2010). Countercyclical Capital Buffers: Exploring Options. *BIS Working Papers No 317*, Retrieved on March, 20, 2016 from http://www.bis.org.

Egebo T., Richardson P., & Lienert, I. (1987). A Model of Housing Investment for the Major OECD Economies. *OECD Economic Outlook.* 14(86), 7-57.

Favilukis, J., Kohn, D., Ludvigson, C., & Van, N. (2011*).* International Capital Flows and House Prices: Theory and Evidence**.** *Journal of Economic Perspectives,* 19 (4), 67-92.

Filipa, S., Towbin, P., & Wieladek, T. (2011). *Low interest rates and housing booms: the role of capital inflows, monetary policy and financial innovation*. Retrieved February 20, 2016, from http: www.bankofengland.co.uk/publications/workingpapers/index.htm.

Giussani, B., & Hadjmatheou, G. (1991). Modeling Regional House Prices in the United Kingdom. Reginal Science Association, 70 (2),201-219.

Green, F., & Hendershott, G. (1990). Regional Differences in Personal Savings. *Applied Economics*, 22 (7), 933-945.

Guglielmo C., & Ricardo M. (2011). *Consumption, Wealth, Stock and Housing Returns*: *Evidence from Emerging Markets*. London: London School of Economics.

Hassconsult limited (2015). The Property Market in Kenya. Hass Property Index. Nairobi: Annual Report.

Hendershott, P. (1980). Real User Costs and the Demand for Single-Family Housing. *Brookings Papers on Economic Activity*, 2 (1), 23-58.

Hyun, K., Jong, S., & Myung-Soo, Y. (2013). The House Price Dynamics with Household Debt: *The Korean Case, Economic Research Institute, the Bank of Korea*, 39 (1), 100-794.

Kigige, A., & Omboi M. (2011). Factors Influencing Real Estate Property Price: A Survey of Real Estates in Meru Municipality, *Kenya. Journal of Economics and Sustainable Development, 2 (4), 201-5.*

Matindi, N. (2003). Affordable Housing for Low and Middle Income Earners in Nairobi–Kenya. Retrieved on March, 20, 2016 from http://www. hdm.lth.se/fileadmin/hdm/alumni/papers/SDD_2008_242b/Nora_Matindi_Kenya.pdf.

Mishkin, F. (2007). *Housing and the Transmission Mechanism*. Washington, D.C: Federal Reserve Bank of Kansas City.

Modigliani, F., & Ando, A. (1957). Tests of the Life-Cycle Hypothesis of Savings. *Bulletin of the Oxford University Institute of Economics and Statistics*, 19 (1), 99–124.

Muellbauer J., & Murphy, A. (2008). The Assessment of Housing Markets and the Economy. *Oxford Review of Economic Policy*, 24 (1), 1-33.

Muellbauer, J., & Murphy, A. (1997). Booms and Busts in the UK Housing Market. *Economic Journal: Royal Economic Society, 107(3), 456-869.*

Muriuki, H. (2003). Milk and Dairy Products, Post-harvest Losses and Food Safety in Sub-Saharan Africa and the Near East: *FAO Prevention of Food Losses Programme.* Nairobi: FAO, Retrieved

on March, 20, 2016 from http://www.fao.org/fileadmin/templates/ags/docs/dairy/P1assessmentkenya.pdf .

Njaramba, S. (2011). *Supply Response of Kenyan Coffee in the International Market*. Unpublished Masters Project: Kenyatta University, Nairobi.

Njiru, M., & Moronge, M. (2013). Factors affecting growth of mortgage industries in Kenya: A case study of National Housing Corporation. *International Journal of Social Sciences and Entrepreneurship,* 1 (7), 26-35.

Oikarinen, R. (2009). Global Housing Markets: Crises and Institutions. *Journal of International Finance,* 67 (9), 207-218.

Organization for Economic Co-operation and Development, (2004). *Housing markets, wealth and the business cycle.* Economic Outlook, OECD.

Rarnbaldi, A. & Doran, H. (1996). *Testing for Granger Non-Causality in Cointegrated Systems Made Easy*. Australia: University of New England.

Republic of Kenya. (2015). *Economic Survey.* Nairobi: Government Printer.

Sims, A. (1972). The Role of Approximate Prior Restrictions in Distributed Lag Estimation. *Econometricia,* 67(18), 169-75.

Stiglitz, J. (1990). *Peer Monitoring and Credit Markets*. New York: Oxford University Press.

Syricha, M. (2013). *House price Dynamics in the USA*. London: University of Essex.

Toda, H. & Yamamoto, T. (1995). Statistical Inference in Vector Auto Regressions with Possibly Integrated Processes. *Journal of Econometrics,* 66, (1), 225-250.

Tsatsaronis, K., & Zhu, H. (2004). What drives housing price dynamics: Cross-Country Evidence. *BIS Quarterly Review*, 279 (5), 27–2.

Verbeek, B. (2004). *Decision Making Within International Organization*. New York: Routledge.

Vuluku, G., & Gachanja, J. (2014). *Supply Side Aspects of Residential Housing for Low Income Earners in Kenya*. Nairobi: Kenya Institute for Public Policy Research and Analysis.

Wanyama, J. (2012). Effect of land-use/cover change on land degradation in the Lake Victoria basin: case of upper Rwizi catchment, southwestern Uganda. PhD dissertation, Katholieke Universiteit, Leuven, Belgium.

Wardrip, K., Williams, L., & Hague, S. (2011). The Role of Affordable Housing in Creating Jobs and Stimulating Local Economic Development. *Journal of Planning Literature,* 21(4), 371-385.

World Bank (2011). *World Development Report on Conflict, Security, and Development*. Washington, DC: World Bank.

7.0 Appendix

Table A1: VAR Lag Order Selection Criteria

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: VAR Residual Serial Correlation LM Tests

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 A3: VAR Residual Normality Tests

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 A4:VAR Lag Order Selection Criteria
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 5: VAR Residual Normality Tests
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 6: VAR Residual Serial Correlation LM Tests

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 A7: VAR Lag Order Selection Criteria

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

Lag	LogL	LR	FPE
0	-44.73304	NA	0.037660
1	45.16044	165.9572	0.000460
2	46.58019	2.475451	0.000527
3	47.81572	2.027537	0.000610
4	53.53055	8.792050	0.000564
5	57.45026	5.628304	0.000574
6	60.32354	3.831042	0.000622
7	61.79308	1.808667	0.000730
8	65.17886	3.819853	0.000785
9	67.43244	2.311360	0.000908
10	75.02320	7.006859	0.000813
11	92.27729	14.15720*	0.000453
12	97.08562	3.452137	0.000493
13	104.0342	4.276047	0.000500
14	112.3032	4.240535	0.000500*
15	117.2419	2.026101	0.000643
16	135.5085	5.620494	0.000474
17	162.9994	5.639177	0.000275

* 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 A8:VAR Residual Serial Correlation LM Tests

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 A9: VAR Residual Normality Tests

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

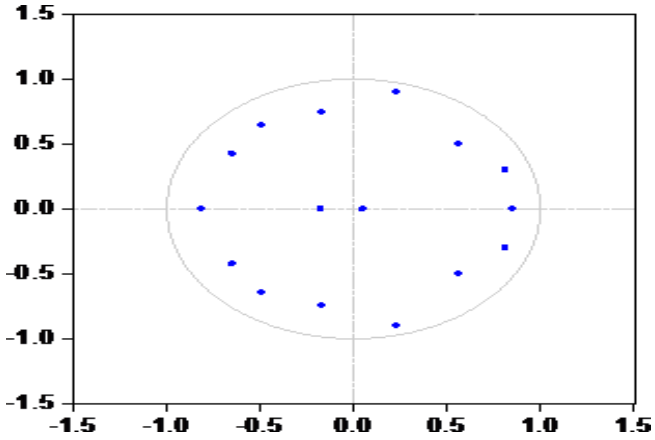

Figure A1: Inverse Roots of AR Characteristic Polynomial (Housing Prices and Households Indebtedness)

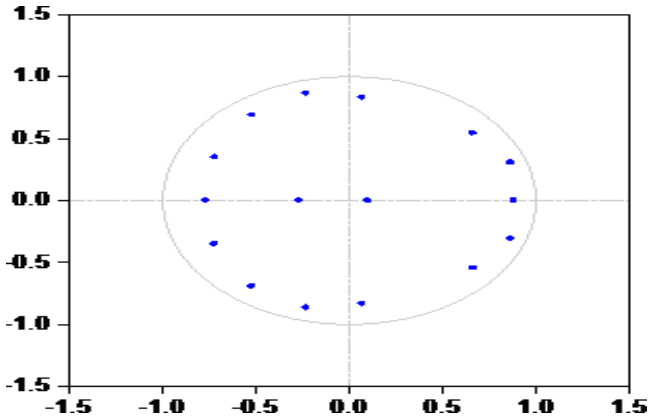

Figure A2: Inverse Roots of AR Characteristic Polynomial (Housing Prices and Private Capital Inflows)

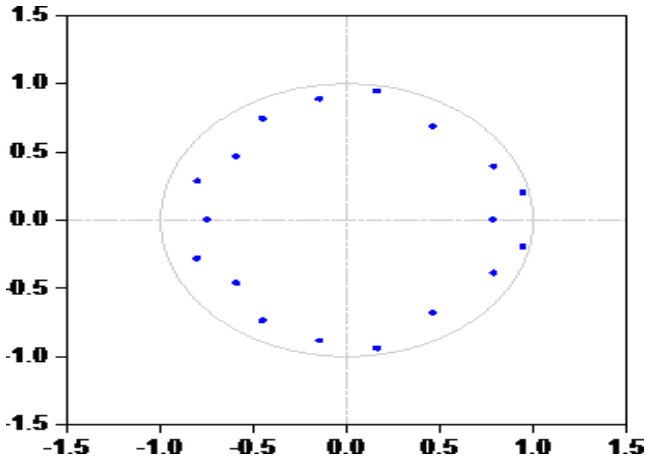

Figure A3.6: Inverse Roots of AR Characteristic Polynomial (Housing Prices and Households Consumption Expenditure)