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EFFECT OF SELECTED DEMOGRAPHIC AND MACRO-ECONOMIC VARIABLES ON HOUSE PRICES IN NAIROBI COUNTY, KENYA

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Abstract

House prices are not only a major point of economic and social debate in Kenya, but also in the whole world. They have been increasing in the country over the past decade and this is likely to continue in future. There are different factors that affect house prices, and their effect change over time. This study sought to determine the effect of selected macroeconomic and demographic factors on house prices in Nairobi County. The study adopted an explanatory research design and covered the period 2004Q1 to 2016Q4. The House Price Index was obtained from the Hass Property Consult limited while those of the other variables were obtained from the Kenya National Bureau of Statistics. The results revealed that the short run effect of exchange rate and inflation rate on house prices were negative and significant. However, the previous quarter mortgage rates and housing prices had a positive and significant effect on house prices in the current quarter in Kenya in the short run. The speed of adjustment from short to long-run equilibrium is quick with 11.96 per cent of the disequilibrium corrected each quarter. The long run results showed that, mortgage rate and new houses had a negative and highly significant effect on house prices while exchange rate had a positive and significant effect on the house prices in Kenya. The study recommends that the government should put in place measures to curb inflation, maintain a stable exchange rate and increase budgetary allocation to housing to increase supply of houses hence check price of new houses.

Key words: House Price Index, House Prices, Demographic Variables, Kenya

INTRODUCTION

Since the 2007/2008 global financial crisis, it is now widely acknowledged by empiricists and practioner's that the prices of houses play an important role in generation of business cycles and financial dynamics (Valadez, 2012; Shi & Jou, 2013). Davis and Heathcode (2003) asserts that house prices play a key role by leading the business cycle an assertion supported by Beltratti and Morana (2009) and Ghent and Owyang (2010). It also follows that house price fluctuations strengthen business cycles and that investment in houses leads the business cycle (IMF, 2009). The effect of house prices on business cycles is via aggregate expenditure and financial system (Tsatsaronis and Zhu 2004). Large cyclical variations in house prices have been witnessed in many industrialized nations, often having a price rise before a crash whereby investors lose out on their investments hence affecting their returns adversely (Nneji *et al.,* 2013).

According to Beltratti & Morana (2009), house price fluctuations affect economic growth strongly since housing is a major component of household wealth. House price changes affect the real side of the economy through affecting the financial system, a phenomenon associated with the US financial crisis of 2007-2008 (Kozicki, 2012). The volatility of house prices has similarly been documented in Africa. South Africa for instance, has witnessed a rapid appreciation in home values (Das *et al.,* 2011). Kenya in particular has registered significant house price changes within a short time. According to Hass consult report (2015), the average price for an apartment in Nairobi, the Kenya's capital city, increased from Ksh5.2M in December 2000 to Ksh11.58M in 2015. The report further asserts that no house in the formal market was below KSH 2M. However, exact statistics show that these houses traded at about KHS 14M in the first quarter of 2016.

The Kenyan housing market has attracted many investors, both individuals and institutional among them private developers who are seeking to diversify their portfolios (Hass consult, 2011). The revision of Kenya's National Housing Policy of 2004 led to increased attention to Nairobi County on addressing house supply shortfalls and slum upgrading initiatives. The real estate in Kenya has been experiencing a steady growth in the last decade and this is likely to continue in future (Knight Frank, 2014). Nevertheless, house demand outstrips supply by far. Although the country's Vision 2030 targets a supply of 200,000 housing units per year, only 35,000 are produced (CAHF, 2016)

Several demographic factors have been documented as major determinants of housing prices, among them housing permits, number of households and total population being significant in Cyprus (Sivitanides, 2014). Others include the number of housing loans approved, (Pillaiyan, 2015); new construction of housing (Berglund, 2007); private consumption (Beltratti & Morana, 2009) and household consumption (Gustafson *et al.,* 2016). The long-run demographic changes in developed countries have been known to affect house price developments. Major housing stock contributors are; self-contracted houses, government agencies, public private partnership and private developers (CAHF, 2016). A positive relationship is expected between house prices and the quantity of houses supplied. (Miregi & Obere, 2014). Housing needs on the other side to include; construction of new houses to supply new households, replacement of units already in stock through demolition and construction of additional units required to relieve current overcrowding (Schiller, 2007).

Low supply of houses can be attributed to high construction costs, rural-urban migration, population growth, lack of resources and borrowing constraints (Tipple, 1994; Matteo, 2005). Statistics show that 22 percent of Kenyans live in cities and that the urban population is growing at an annual rate of 4.2. With this level of growth, 150,000 new houses are required every year to meet the demand (KNBS, 2016; National Housing Survey, 2013). Coleman (2008) argues that future house prices appreciation expectations set by individuals is very vital as it has a huge effect on the demand of housing. It is for this reason that a speculative builder only constructs houses based on demand (Tipple, 1994) which could be attributed to supply not matching demand. Empirical studies (Nneji & Ward, 2013; Valadez, 2012; Zhang *et al.,* 2012; Beltratti & Morana., 2009; Wadud *et al.,* 2012), have shown the impact of various determinants on the house prices.

Given this background, the current study sought to find out the effect of selected demographic and macroeconomic variables on housing prices in Nairobi. Specifically, the effect of the following variables was examined: mortgage rate, exchange rate, the number of new houses and inflation.

RESEARCH METHODOLOGY

The study adopted an explanatory research design. This is because it aimed at explaining the relationship between the explanatory variables and the housing prices. The study analysed the effect of selected demographic and macroeconomic variables on house prices in Nairobi County. Data was collected for the following variables: house prices, exchange rate, inflation, mortgage rate and new houses. The study used secondary data which is appropriate for an explanatory research design. Various statistical tests were done on the data and the results to ensure robust results. These included unit root test and post estimation diagnostic tests.

Source of Data

Secondary data was collected for the entire period since January 2004 to December 2016. House price index data was obtained from the Hass Consult Limited while the other data were obtained from Kenya National Bureau of Statistics. This period was chosen on the basis of house price index data availability.

Data Analysis

The study adopted the vector autoregressive (VAR) model Sims (1980). In this model, all the variables are assumed to be simultaneous and are regressed on a given lags of themselves and all the other variables in the model. This specification is important in studying the joint behaviour of the variables. This is through giving empirical evidence of how various house price determinants respond to a shock in other variables. A VAR model is thus important in assessing the role of each variable in determining the house prices. According to Sims (1980), the models advantage is that it treats all the variables as simultaneous and allows for the modelling of both concurrent and long run associations between the variables. The relationship between the variables can thus be estimated using ordinary least squares. Sims (1980); Kim and Lee (2000) and Ochieng & Obere (2014) used a similar methodology. The model is specified as follows:

$$HPIt = \beta 0 + HPIt - i + \beta 1\, EXCRt - i + \beta 2\, INFLRt - i + \beta 3\, MGRt - i + \beta 4\, NEWHSEt - i + \varepsilon_t$$

$$HPIt = \beta 0 + HPIt - 1 + \beta 1\, EXCRt - 1 + \beta 2\, INFLRt - 1 + \beta 3\, MGRt - 1 + \beta 4\, NEWHSEt - 1 + \varepsilon_t$$

………………………………... (1.1)

Where, HPI_t is the house price index at time t while HPI_{t-i}, $EXCR_{t-i}$, $INFLR_{t-i}$, MGR_{t-i} and $NEWHSE_{t-i}$ represents the respective lagged house prices, exchange rate, inflation rate, mortgage rate and number of houses, i is the number of lags and the β's represents the coefficients whereas ε_t is a random error term.

The long and short-run relationship between the house prices and the explanatory variables was then modelled using VECM (Vector Error Correction Model). This model has two major advantages. First, it provides the explanation for short and long run house price behaviour (Wang *et al.,* 2008). Second, it treats all the variables in the model as simultaneous while linking every variable to its own and other variables lagged values (Tuluca *et al.,* 2000). VECM have been used by several other studies, including: Malpezzi (1999); Sing *et al.,* (2006); Gallin (2006) and Oikarinen (2009).

The model is specified as follows:

$$\Delta HPI_t = \beta_o + \varphi ECT_{t-1} + \sum_{i=1}^{p} \beta_1 \Delta HPI_{t-1} + \sum_{i=1}^{p} \beta_2 \Delta \mathrm{EXCR}_{t-1} + \sum_{i=1}^{p} \beta_3 \Delta \mathrm{INFLR}_{t-1} + \sum_{i=1}^{p} \beta_4 \Delta MGR_{t-1} + \sum_{i=1}^{p} \beta_5 \Delta NEWHSE_{t-1} + \varepsilon_t$$

……………... (1.2)

ECT_{t-1} is the error correction term and it captures deviation from the long-run equilibrium path, φ is the correction coefficient and it shows how variables adjust towards their equilibrium.

EMPIRICAL RESULTS

Descriptive statistics

Descriptive statistics gives summaries about the sample and they form a fundamental basis for every quantitative data analysis. The most common measures include the mean, median, standard deviation, skewedness, kurtosis and the Jacque-Bera statistics. The summary of the statistical characteristics of all the variables are shown in Table 1.

Table 1: Descriptive Statistics results for the variables

	HPI	EXCR	INFLR	MGR	NEWHSE
Mean	268.5872	82.07542	10.40818	15.04825	4401.615
Median	271.0754	80.65367	7.466667	14.67334	4696.875
Maximum	439.3879	102.9673	29.13333	20.14041	10825.53
Minimum	139.9944	62.64600	3.333333	9.089416	1597.469
Std. Dev.	92.30754	10.45918	6.317467	2.492063	2398.545
Skewness	0.076222	0.386904	1.369709	0.023712	0.746476
Kurtosis	1.771411	2.491350	4.458412	2.829427	2.861341
Jarque-Bera	3.320784	1.857923	20.86798	0.067912	4.870949
Probability	0.190064	0.394964	0.000029	0.966614	0.087556
Sum	13966.53	4267.922	541.2252	782.5087	228884.0
Sum Sq. Dev.	434554.8	5579.121	2035.430	316.7292	2.93E+08
Observations	52	52	52	52	52

The data for all the variables is normally distributed because the mean and median are almost equal, skewness is close to zero and the *p* value of the Jarque-Bera test statistic is less than 0.05. However, inflation has a mean higher than median while new houses have a mean that is lower than the median.

Unit root tests

The study employed the Augmented Dickey- Fuller (ADF) as the standard test for unit root. This test is performed so as to avoid meaningless or nonsensical results (Gujarati, 2011). The unit root properties of the five variables was analysed at level and first difference using the ADF unit root test at both the intercept only and for intercept and trend and the results are as shown on the appendix, tables A.1 and A.2.

All the variables were non-stationary at level but stationary at first difference I (I) at five per cent significance level. As a result, this study used cointegration analysis. Since there was no cointegration, the study went ahead to use the VAR and VECM models for non-stationary data which analyse the data at first differences making them stationary and thus giving meaningful results.

Determination of Lag Length

Before a VAR model is estimated, appropriate lag intervals for the endogenous variables must first be determined. This is necessary so as to avoid the problem of over or under parameterization occasioned by inappropriate lag selection (Mahalik & Mallick, 2010 and Shahbaz, 2015). The lag length can be determined using Schwarz Information Criterion (SIC), Likelihood Ratio Test (LRT), Final Prediction Error (FPE), Akaike Information Criterion (AIC) and Hannan-Quinn Information Criterion (HQ). The lag length was selected based on the minimum of their values. The results of the lag length selection criteria are presented in table A.3.

From the findings on table A.3, LR, FPE, AIC and HQ selection criterion selects lag 2 while SC selects lag 1. The optimal lag length selected for this study was 2 based on the consensus between the LR, FPE, AIC and HQ lag length criterion. Besides, two lags were appropriate because they reduced the loss of degrees of freedom and minimised information criterion.

To confirm the stability of the VAR model with two lags a stability test using the AR roots table was carried out. The results are presented in figure A.1. From the results, the VAR is stable as all the roots lie inside the unit circle: The characteristic roots are less than one in absolute terms. A conclusion is made that VAR satisfies the stability condition.

Cointegration Test Results

Since all the variables were stationary at first difference but non-stationary at level, this study adopted Johansen's cointegration test as opposed to Engel- Granger's test to test whether the variables were cointegrated. Johansen's test has two major advantages as compared to Granger's test. One is the ability to test for a number of co integration vectors when the number of variable is greater than two and the joint procedure of testing the maximum likelihood estimation of the vector error correction model and long run equilibrium relationship. We accept the null hypothesis if $p<0.05$. The results of trace test are indicated in table A.3 below. From the findings in table A.3, the null hypothesis that there was no cointegrating equation was rejected since the p value was less than 0.05. The results indicate that the study had one cointegrating equation. The study therefore concluded that we have a stable long-run cointegration relationship between independent variables and house prices in Nairobi County, Kenya.

Vector Error Correction Model (VECM)

When co- integration among the variables exists, the error correction model (ECM) is used to model the short run dynamics. VECM requires that the variables be integrated of order one (I (1)) and cointegrated. Since the variables in this study met this condition then the coefficients were estimated using VECM approach. This approach was used to model both the short and long run relationship in this study. The short run VECM results are presented in tables A.4 and A.5, respectively.

Before the interpretations were done, various diagnostic tests were carried out. This includes tests of autocorrelation, heteroscedasticity and normality. The results are presented in the appendix, Tables A.6 and A.7, and figure A.2, respectively. The results show that the residuals were normally distributed, were homoscedastic and had no serial correlation.

The VECM short run estimates are presented in table A.5 and can be summarized in the following equation:

$$\begin{aligned}(\Delta\, LNHPI_t) = {} & 0.0107 + 0.8262\ (\Delta \mathrm{LN}HPI_{t-1}) \\ & - 0.3877\ (\Delta \mathrm{LN}HPI_{t-2}) + 0.1770(\Delta \mathrm{LN}EXCR_{t-1}) + 0.0858(\Delta \mathrm{LN}EXCR_{t-2}) \\ & + 0.0117(\Delta \mathrm{LN}INFR_{t-1}) + 0.0030(\Delta \mathrm{LN}INFR_{t-2}) - 0.0378(\Delta LNMGR_{t-1}) \\ & + 0.1096(\Delta LNMGR_{t-2}) - 0.0180(\Delta LNNEWHSE_{t-1}) + 0.0140(\Delta LNNEWHSE_{t-2}) \\ & - 0.1196 ECM_{t-1}\end{aligned}$$

The findings in table A.5 indicate that the R^2 is 0.545 suggesting that the error correction model fits the data reasonably well with about 55% of the variations of the dependent variable (HPI) taken into account by explanatory variables (EXCR, INFR, MGR and NEWHSE). The error correction term (ECM), which indicates the speed of adjustment has a value of -0.1196. It is correctly signed and statistically significant at 5 percent. This implies that 11.96 per cent of the disequilibrium is corrected each quarter. The negative sign is a confirmation of existence of equilibrium in long term. In addition, it is noted that the absolute value is less than unity; hence a confirmation of error correction mechanism to correct departures of short run equilibrium as it follows the long-term path to attain an equilibrium.

The short run coefficients in the VECM model showed the effects of the previous quarter values on the current quarter house prices. The results showed that the first and second lags of first difference of house prices, first lag of first difference of exchange rate and second lag of first difference of mortgage rate significantly affect the current house prices. The results however showed that in the short run, no significant relationship existed between mortgage rate and new houses with house prices at five percent significance level since all their *p* values were above 0.05. The results further showed that the previous quarter house prices had a positive and significant effect on current house prices in Kenya in the short run. The results in the long run model in table A.4 and can be expressed in a summarized equation as:

$$LNHPI = -0.3440 + 0.0093LNINFRT - 0.6330LNMGR - 0.5640LNNEWHSE + 0.2627LNEXCHR \quad \text{(1.4)}$$

These results show that in the long-run mortgage rate and new houses had a negative and significant effect on the house prices in at one percent level of significance. Further, the findings of the study showed that the effect of Exchange rate on house prices was positive and significant in the long run at five per cent significance level however, inflation rate showed no significant effect on house prices.

DISCUSSION

Effect of House Prices on House prices

The Vector Error Correction Model short run coefficient for house prices was significant for both the previous two periods at five percent level of significant with coefficients of 0.8262 and -0.3877. This implied that in the short run a one percent increase in house prices in the previous quarter would lead to a 0.826 percent increase in current quarter house prices and a one percent increase in the house prices two periods behind would lead to a 0.3877 percent decrease in the current house prices. The interpretation of these results is traceable to the rational expectation hypothesis which portends that expectation of future house prices and other variables affect house prices in the short run (Muth, 1961).

Effect of Mortgage Rate on House Prices

Long run coefficient for mortgage rate was -0.633 with a *p* value of 0.004 which indicated a negative and highly significant relationship existed between mortgage rate and house prices. This implies that in the long run a one percent increase in mortgage rate would lead to decrease in house prices by approximately 0.6330 percent. The short run coefficients of the first and second lag of first difference of mortgage rate was -0.0378 and 0.1096 respectively and not statistically significant in influencing house prices in the short-run however in the long-run there was a negative and highly significant relationship. The study findings are consistent with those of (Brissimis and Vlassopoulous, 2007; Gimeno & Carrascal, 2010; Tsatsaronis & Zhu, 2004; Shi &Jou, 2013) who found a negative relationship between mortgage rate house prices in the long run.

Effect of Exchange Rate on House prices

The long run coefficient for exchange rate is 0.2627 which was significant at five per cent level of significance. This implied that a one percent increase in exchange rate in the long run would lead to 0.2627 percent increase in house prices. Short run dynamics indicate a coefficient of 0.1769 with a p value of 0.0640 for exchange rate variable in the previous quarter, which indicated a statistical significant effect at 10 percent level. This implied that in the short run a one percent increase in exchange rate in the previous quarter would lead to a 0.17 percent increase in the current quarter house prices. This therefore implied that in the short run exchange rate had a statistically positive relationship with house prices in the short run. These results are consistent with past studies that found a similar relationship, Liu & Hu, 2012 and Zhang *et al.,* 2012)

Effect of Number of New Houses on House Prices

The coefficient of new houses in the long run model was -0.563 with a p value of 0.0007 which was statistically significant at five percent level. This implied that in the long run a one percent increase in new houses would lead to a 0.563 percent decrease in house price in the long run. This led to the rejection of the null hypothesis and the study concluded that there is a negative and significant relationship between new houses and house prices. The coefficient of new houses in the short run, was insignificant in explaining house prices in the first and second lagged periods. This meant that in the long run the number of new houses had a negative and significant effect on house prices with no effect in the short run. These results are consistent with those of Marsden, 2015; Leonhard, 2013 and Halket *et al.,* (2015) who found a negative relationship between number of houses and house prices. Marsden (2015) found a negative coefficient which was statistically significant and concluded that in the long-run, the inelastic supply of housing contributes to house price volatility.

Effect of Inflation on House Prices

The long run results for inflation indicate a coefficient of 0.0093 and is not statistically significant in influencing house prices. This study therefore concluded that there was no significant relationship between inflation and house prices in the long-run. This led to the acceptance of null hypothesis and concluded that inflation had no significant effect on house prices. In the short run, the coefficients of first and second lag of inflation were 0.0117 and 0.0030 which were not statistically significant. These findings therefore indicated that there was no significant relationship between inflation and house prices in the short run.

CONCLUSION AND THE IMPLICATIONS

The study empirically examined determinants of house prices in Nairobi County, Kenya over the period 2004Q1-2016Q4 using a VAR and VECM models. The specific determinants examined were exchange rate, inflation, mortgage rate and new houses. This approach was chosen because of its ability to simultaneously study the effects of several variables affecting the housing prices.

The results revealed that the short run effects of exchange rate and inflation rate on house prices were negative and significant. However, the previous quarter mortgage rate and housing prices had a positive and significant effect on house prices in the current quarter in Kenya in the short run. The speed of adjustment coefficient was 0.1196, which means 11.96% is corrected in each quarter to eliminate disequilibrium. The long run results showed that inflation rate, mortgage rate, new houses, and exchange rate had a positive and significant effect the house prices in Kenya.

In a nutshell, mortgage rate, exchange rate, number of new houses and inflation play a key role in determining house prices in Nairobi County. The coefficient of mortgage rate was expected to be negative and highly significant in determining house prices in the short run, contrary to our expectations. This can be associated with the less developed mortgage market in Kenya. The findings of this study are consistent with rational expectations hypothesis which argues expected future prices and other demographic and macroeconomic variables affect current house prices.

RECOMMENDATIONS

The findings of this study will help the Kenyan government, through its selective credit control policy by the Central Bank of Kenya, to stimulate the growth of the housing market by channelling funds to the market. Based on expectation hypothesis, this growth in funds towards the housing market will increase mortgage uptake, increase supply of houses and in the end check the growth of house prices. The government can also provide appropriate housing finance products. It therefore follows that the mortgage finance markets should be restructured to capture the desire and expectations of house buyers of having affordable houses.

Kenya has had a steady currency depreciation making imported goods expensive which in turn is pushed forward to the final consumer in form of house prices via the building materials. In effect, higher housing material costs leads to reduced housing supply. To solve this problem, the Kenya government should come up with and enact a remittance policy that targets specific groups and give them incentives to use the monies received build affordable houses. This can be achieved by creating policies that increase remittances inflows and directing them into national financial institutions that are geared towards promoting the housing market.

The Kenya government should develop policies that endeavour to increase supply of houses. For instance, the government should partner with key organizations like Shelter Afrique under the framework of public private partnership so as to ensure provision of houses in a bid to increase supply. The government has adopted the provider- based approach through the National Housing Corporation often acting as a social welfare agency to build houses for those sections of urban population who need or deserve special treatment like the civil servants and low-income groups as well the slum upgrading projects. This makes supply responses to be based on the fact that people need housing instead on the ability of housing investment to improve the economy. The government should also focus on housing as an investment and partner with international organization like World Bank and International Monetary Fund to provide housing as an investment channel. This can be coupled with tax incentives for those who construct the highest number of house units to increase supply.

LIMITATIONS OF THE STUDY

This study had two major limitations. First, the study relied on Hass Consult Ltd House price Index developed with the year 2000 as the base year. This limited the scope of analysis and the size sample in developing trends and hence meaningful relationships. There is need to harmonize the development of house price index given that other institutions among them Kenya Bankers Association, are also developing the same. Second, the study used exchange rate, inflation, mortgage rate and new houses yet there are other variables that affect house prices, for instance construction cost, broad money, credit regulation, house purchase loans, housing permits, population, number of households and private consumption among others.

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APPENDICES

Table A.1: ADF Unit Root Test Results (At levels)

Variable	Level		Remarks
	Intercept Only	Intercept and trend	
LnHPI	-1.090 (0.7127)	-1.0445 (0.9278)	Non-stationary
LnEXCR	-0.3941 (0.9023)	-2.7171 (0.2345)	Non-stationary
LnINFLR	-2.102 (0.2447)	-3.0144 (0.0701)	Non-stationary
LnMGR	-3.594 (0.0093)	-3.2703 (0.0831)	Non-stationary
LnNEWHSE	0.502 (0.9852)	-2.6778 (0.2499)	Non-stationary

Source: Researcher 2017

Table A.2: ADF Unit Root Test Result (at first difference)

Variable	First Difference		Remarks
	Intercept Only	Intercept and trend	
LnHPI	-5.1163 (0.0001)***	-5.1102 (0.0007)***	Stationary
LnEXCR	-5.8471 (0.000)***	-5.944 (0.0000)***	Stationary
LnINFLR	-5.9816 (0.000)***	-5.9066 (0.0001)***	Stationary
LnMGR	-5.180 (0.0001)***	-5.5359 (0.0002)***	Stationary
LnNEWHSE	-3.6750 (0.0075)***	-3.7741 (0.0263)**	Stationary

Source: Researcher 2017

*Note: The values are t-statistic values while the values in brackets () are their corresponding p values. '***', '**' represent significance at 1 percent and 5 percent respectively.*

Table A.3: Lag Length Selection Criteria for VAR

Lag	LogL	LR	FPE	AIC	SC	HQ
0	123.4265	NA	4.95e-09	-4.934438	-4.739521	-4.860778
1	388.8203	464.4391	2.23e-13	-14.95084	-13.78134*	-14.50889
2	429.9993	38.12588*	1.04e-13*	-16.01942*	-13.48089	-14.81472*
3	455.5764	34.10274	1.26e-13	-15.64902	-12.53035	-14.47047
4	489.4661	63.48438	1.17e-13	-15.62497	-11.92617	-14.47257

* indicates lag order selected by the criterion

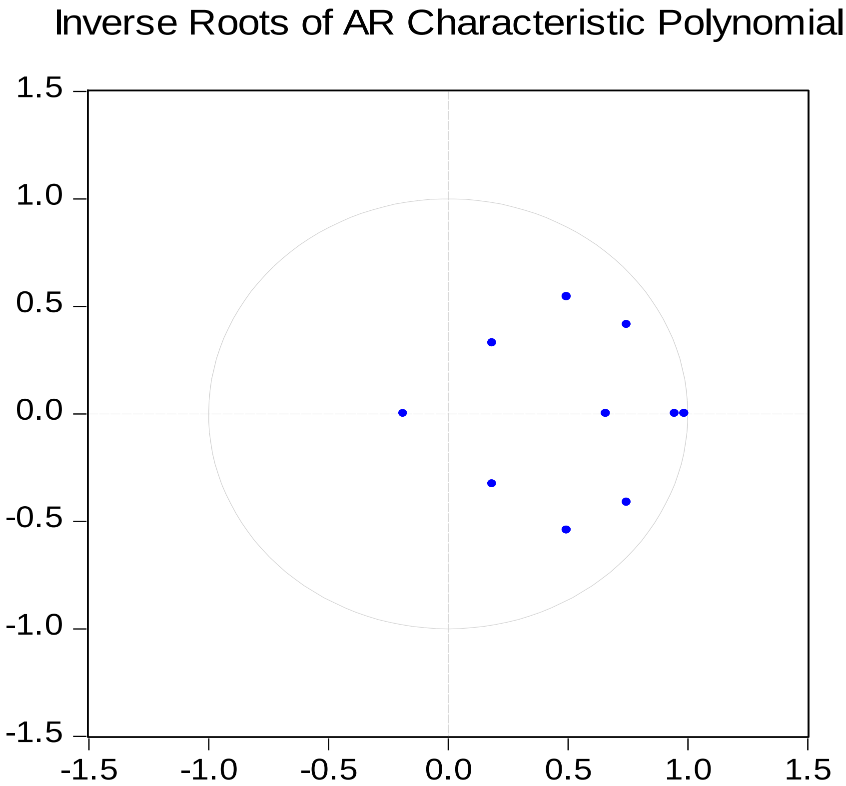
LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error AIC: Akaike information criterion

SC: Schwarz information criterion HQ: Hannan-Quinn information criterion

Source: Researcher 2017

Figure A.1: Inverse Roots of AR Characteristic Polynomial



Source: Researcher 2017

Table A.3: Cointegration Results using trace test

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.501071	77.78538	69.81889	0.0101
At most 1	0.390389	43.71606	47.85613	0.1161
At most 2	0.217104	19.46432	29.79707	0.4599
At most 3	0.125694	7.471316	15.49471	0.5235
At most 4	0.017987	0.889393	3.841466	0.3456

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

* denotes rejection of the hypothesis at the 0.05 level

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

Source: Researcher 2017

Table A.4: Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LnINFLR	0.009276	0.02000	0.46391	0.6743
LnMGR	-0.633007***	0.08136	-7.78059	0.0044
LnNEWHSE	-0.56397***	0.03842	-14.6806	0.0007
LnEXCR	0.262742**	0.10764	2.44089	0.0424
C	-0.343987	0.00445	2.54122	0.0148

Source: Researcher 2017

*Note: ***,**,* represent significance at 1 %, 5% and 10 % significance level*

Table A.5: Vector Error Correction Estimates

	Coefficient	Std. Error	t-Statistic	Prob.
ECT(-1)	-0.119625	0.071806	-4.665942	0.0042
LnHPI (-1)	0.826249	0.140560	5.878277	0.0000
LnHPI(-2)	-0.387707	0.168561	-2.300101	0.0272
LnEXCR(-1)	0.176996	0.092692	1.909504	0.0640
LnEXCR(-2)	0.085787	0.081448	1.053280	0.2990
LnINFLR(-1)	0.011720	0.009028	1.298199	0.2023
LnINFLR(-2)	0.003030	0.008449	0.358672	0.7219
LnMGR(-1)	-0.037802	0.047566	-0.794729	0.4318
LnMGR(-2)	0.109600	0.057306	1.912536	0.0636
LnNEWHSE(-1)	-0.017972	0.084487	-0.212717	0.8327
LnNEWHSE(-2)	0.014005	0.076468	0.183155	0.8557
C	0.010748	0.004703	2.285282	0.0281
R-squared	0.544916	Mean dependent var		0.022850
Adjusted R-squared	0.409621	S.D. dependent var		0.020887
S.E. of regression	0.016049	Akaike info criterion		-5.217446
Sum squared resid	0.009530	Schwarz criterion		-4.754143
Log likelihood	139.8274	Hannan-Quinn criter.		-5.041670
F-statistic	4.027604	Durbin-Watson stat		1.854774
Prob(F-statistic)	0.000670			

Source: Researcher 2017

Table A.6: Breusch Godfrey Serial Correlation LM test results

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	2.143085	Prob. F(2,35)	0.0072
Obs*R-squared	5.397388	Prob. Chi-Square(2)	0.0198

Source: Researcher 2017

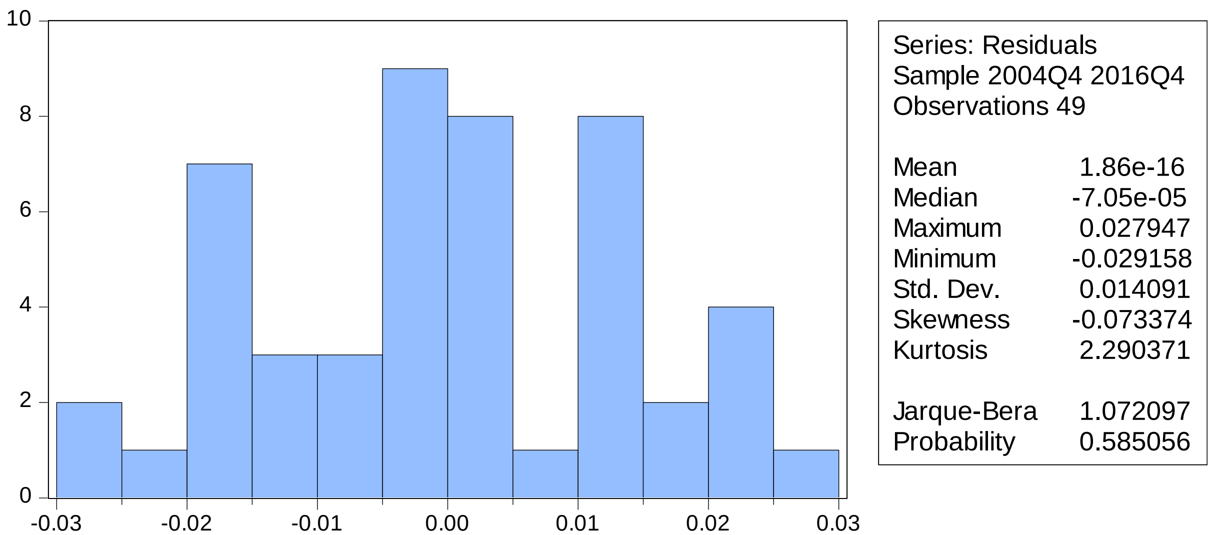
Table A.7: Heteroskedasticity Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.582897	Prob. F(15,33)	0.8669
Obs*R-squared	10.26339	Prob. Chi-Square(15)	0.8029
Scaled explained SS	3.775606	Prob. Chi-Square(15)	0.9984

Source: Researcher 2017

Figure A.2: VEC Residual Normality Tests



Source: Researcher 2017