STUDY OF THE MACROECONOMIC DETERMINANTS OF THE PRICES OF RESIDENTIAL REAL ESTATE IN KENYA.

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DECLARATION

I declare that this work has not been previously submitted and approved for the award of a degree by this or any other University. To the best of my knowledge and belief, the Research Proposal contains no material previously published or written by another person except where due reference is made in the Research Proposal itself

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This Research Proposal has been submitted for examination with my approval as the Supervisor.

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CHAPTER ONE: INTRODUCTION

1. Introduction of the study.

According to Brueggeman and Fisher (2005) and Pagourtzi, Assimakopoulous, Hatzichristos and French (2003) real estate refers to land and anything fixed, immovable or permanently attached to it such as buildings and fences. Real estate markets are mainly characterized by the fact that they are heterogenous. There are no purchases in this market that are similar; every purchase, be it a parcel of land or developed property is unique and often, information on these transactions is not easily accessible or available to the public. The market is also characterized by large transaction costs and amounts in general. (Ridker, & Henning. 1969.) The buying process is not standardized because the pricing process is heavily based on negotiation.

Housing has a significant role in sustaining economy growth in a country. The level of housing provision is one of the key performance indicators (KPIs) of development (Ireri, 2010). In Kenya, specifically in major urban centres like Nairobi, supply of housing does not meet the increasing demand, as a result of poor planning among other factors (UN- HABITAT, 2008). The Ministry of Land, Housing and Urban Development in 2013 estimated the annual demand for housing in Nairobi County at over 250,000 units yet the annual supply was a mere 30,000 units mostly contributed by the private sector and not the government (Hassanali, 2012).

House prices are a significant indicator of the real estate market because prices are driven by the demand in the market. Demand on the other hand is determined by a number of macro and micro economic factors in an economy. Thus to fully understand the changes and developments in a real estate market, it is important to fully understand the forces behind price fluctuations. Higher property prices also tend to stimulate the economic activity through wealth effects, thereby encouraging investment and consumption spending.

Real estate markets are heterogenous, with a series of geographical and sectoral submarkets that lack a central trading market. Every property is usually unique and information on the market transactions is often not available. The pricing process is usually negotiated and the market is characterized by large transaction costs. The prices of an existing property should theoretically be equal to discounted present value of the expected stream of future income (rents), which depend on expected growth in income, anticipated real interest rates, taxes and other structural factors. The price should equilibrate demand and supply in a well-functioning market. The fundamental equilibrium price is the price at which the stock of existing real estate equals the replacement cost (Hilbers et al 2001). Therefore in theory a growth in prices

indicates growth in demand and hence a growth in the market. Several factors drive the demand of the real estate market.

In this study, we seek to determine which factors are driving the cost of housing in Kenya and measure the factors to determine their effect on the price.

2. Background of the Study

Studies to determine what drives house prices in urban areas have been conducted widely across the world such as the Hou (2010) and the Terrones & Otrok (2004). In Kenya, similar studies have been conducted in this sector with the most relative one to this study being by Julius (2012) that sought to establish the determinants of residential real estate prices in Nairobi. Generally, we can state that in Nairobi's real estate market, there are few concentrated studies that seek to explain what further lies behind the price points of the housing and this study seeks to fill in the research gap by determining not only the factors that affect housing but also the quantitative effect each of these factors have on the price.

Price theory says the interaction between the forces of demand and supply in a market determine the price of a house. A mismatch in the supply and demand can have extreme consequences. When there is a low demand for housing and an oversupply of properties, the prices of houses tend to fall. Decreasing housing prices have a negative effect on banks and financial institutions. Banks will lose money if people default from their mortgage payments (Tracy & Wright, 2012). These banks' losses lead to lower bank lending and lower investment which negatively affect the whole economy. When the demand for houses is higher than the supply (which is the case for houses in Nairobi), the prices rise and this leads to a shortage of affordable homes (Baranoff, 2016) and consequently an overpricing problem.

3. Statement of the Problem

Macroeconomic variables are systematic variables and a s such though their impact on the market as a whole have they have a direct influence on market risk (Radcliffe, 1998). These variables include economic output, unemployment level, level of money supply, inflation, savings and investment. The macroeconomic factors are real GDP, the inflation rate, the interest rate, the exchange rate, and the level of the stock market (Khalid et al., 2012). These factors give us insight on purchasing power, the question the paper seek to solve is what drives property prices in Kenya and intends to get the solution by determining if these factors affect property prices, and if they do, how each of these factors individually interact with prices.

4. Objective of Study

The general objective of this study was to investigate the effects of Macroeconomic variables on real estate prices in Kenya. The specific objectives of the study are:

i. To determine the effect of rate of interest on real estate prices in Kenya,

ii. To investigate the effect of inflation on real estate prices in Kenya

iii. To establish the effect of level of money supply on real estate prices in Kenya

5. Value of Study

The main expectation of this study is that individual homeowners and aspiring homeowners looking to sell or purchase apartments in the country will be able to determine the characteristics that cause influence house pricing and thus make well-informed decisions.

This study will expectedly add to the existing knowledge in the real estate field which will be beneficial to other researchers in this field as well as other academicians. It may also act as a foundation for continued research not only on this topic but on the industry in general.

Hence it makes a supplementary addition to similar studies conducted on the literature on determinants of residential real estate prices.

CHAPTER TWO: LITERATURE REVIEW

1. Introduction

This chapter brings up the relevant literature relating to residential real estate pricing. First, a recapitalization of the macroeconomic determinants of house prices, then a review of the theories that guide this study is made to give the research a firm theoretical base. Lastly, the empirical studies done in this area are also reviewed.

2. Macroeconomic Determinants of Residential Real Estate Prices

The prices of houses are a good indicator of the size of the real estate market. House prices are a good indicator of the size of a real estate market. Several factors affect residential real estate prices and according to (Mak, Choy, & Ho, 2012) the main ones are interest rates, GDP, level of money supply in the market, and the market inflation rate.

Interest Rates.

Interest rates have a major impact on real estate markets. Changes in interest rates can greatly influence a person's ability to purchase a house. When interest rates go down, mortgages are more affordable hence more people are able to purchase a house which drives the prices of houses up and the converse is true. When interest rates go up, mortgages become more expensive thus lowering demand and prices of real estate. The heavy influence of interest rates on an individual's purchasing power for residential properties is large and hence many people wrongly assume that mortgage rate is the only deciding factor in real estate valuation.

Gross Domestic Product (GDP).

This measure is a good indicator of the health of an economy. GDP is a monetary measure of all goods and services produced in a period of time, typically one year. When it is divided by the total population, one obtains the per capita measure which shows the people's standards of living. A low GDP indicates a lowered purchasing power and subsequently an overall low demand on real estate, which will lower the prices of houses in the market and the exact opposite is true. Therefore, we can generally state that the state of the economy and real estate prices are positively correlated. However, the cyclical nature of the economy may have differentiated effects on varied types of real estate. For example, an hotel investment would expectedly be more affected by downward economic movement than an investment in an office building. Hotels are more sensitive to current economic activity since they employ the short-term lease business model; customers will avoid paying their lease when the economy is doing

badly as opposed to offices which have longer term leases and thus current changes in the economy will not affect the lease. (Case et al, 2005).

Level of money supply

Money supply may be defined as a measure of the circulation of money in the economy. Increase in money supply increases inflation risk and this has a negative effect on the real estate market. Abnormal growth in money supply leads to an inflated environment and affects investments because of increased discount rates (Liow, Ibrahim & Huang, 2005). In the period between the years 1980 and 1990, there was a bubble in the Japanese real estate market which was largely contributed to by the level of financial liberalization which caused a rapid, unmanageable expansion of credit. (Allen and Gale, 2000)

Inflation rate

Inflation may be described as a continued increase in prices of goods and services in an economy. Inflation rates affect the purchasing power of money and play a significant role in real estate investment decisions. Inflation can be measured by changes in the Consumer Price Index (CPI); the CPI measures retail prices of goods and services bought in households (Liow, Ibrahim and Huang, 2005). A study by Tsatsaronis and Zhu (2004) noted that most houses in developed nations are affected by inflation and that a higher inflation had a negative effect on house prices.

Other Factors: Microeconomic Factors

Comparable prices in the location.

According to a representative in Hass Consult, the prices of neighbouring house also play a large part when it comes to determining what the cost of a house will be in the area. The area where the house is located also plays a big role in determining its price. This may be driven by the cost of acquiring land in that area.

Amenities of individual houses.

Factors such as the availability of a swimming pool, a sauna or steam room, a gym, a generator, security, an elevator, and a borehole just to name a few will influence the price point of a house.

Other amenities to be taken into consideration will be the number of parking spaces, the size of the house in square footage, the number of bedrooms and bathrooms in the house, the age of house, the materials used for the finish of the house, the availability or lack thereof of interior furnishing, and lastly the general appearance of the home.

Timing of the purchase of the house.

The off-plan price of a house tends to be about 30% - 35% cheaper than the price of a house post-completion. [Property 24. (2018, June 29) The pros and cons of buying a property off-plan. Retrieved from: https://www.property24.com]. This is because at the beginning of the project, the developers need capital investors and thus an off-plan buyer will only be charged VAT whereas after the project is completed, the buyers of the home will have to pay an additional transfer duty.

Despite the fact that rental income from letting office spaces in Westlands did not do well last year seeing as the rent dropped by 2.5% [Muli F. (2017, September 25). Allure of living in Westlands crashes. Retrieved from: https://businesstoday.co.ke], the residential market in Westlands has maintained an upbeat performance. According to data collected during the third quarter of 2017, purchasing of an apartment remains the best investment alternative since the yield from the rent is 7.7% and the overall return is 27.7% gross.

The study also indicated that three-bedroomed apartments are the optimal investment to make given the heightened demand for them by the middle class. Hass Consult Pricing Index indicates that one to three-bedroomed apartments are highly associated with middle-class earners who account for approximately 56% of the total purchases made in the market. Also, apartments make up an average of 40% of all properties that are available for sale in the market. [Hass House Price Index. (2017. Quarter 4) Retrieved from: http://hassconsult.co.ke]

According to Cytonn, the rent for this area ranges between KES 40,000 to KES 150,000 for a typical apartment with average selling prices of KES 12 million-KES 25 million depending on the aforementioned factors that influence pricing. [Mbugua, W. (2018, June 29). Ideal areas to live in Nairobi; For different incomes. Retrieved from: https://www.cytonn.com/blog]

3. Review of Theories

User Cost Model

This model says that the cost of owning a house in a given period of time is known as the user cost which comprises the cost of not investing in any other asset or opportunity cost, all out of pocket expenses comprising maintenance as well as mortgage repayments and any valuation changes that may occur such as depreciation. If living in one own's house is cheaper than renting a house elsewhere, then homeowners will prefer to buy houses for subsistence rather than to make business renting their houses. (Rosen, 1979).

Efficient Market Hypothesis

According to Fama, efficiency of a market means that at any time, information signals sent out in a market will cause investment prices move to reflect the signals almost immediately and thus the market constantly regulates itself to mirror the current state of the economy. The real estate sector is considered generally safe and in this instance, under this theory, it means that investors believe that the prices of real estate in the economy actually reflect all the information available.

Agency Theory

In the Agency theory, there are two parties, one the principal, who engages an agent, to perform a task on their behalf. In this case, the principal is the prospective homeowner who hires a broker to find them a home. (Rottke, 2001). If there is any hidden information, hidden action and hidden intentions from any of the parties then there is an agency problem due to information asymmetry The problem may result in overpricing which may cause people to reach for legal aid as it is unfair.

Hedonic Model of Pricing

A Hedonic pricing model is used to identify price factors of a certain good, in this case, a house, and it does so under the assumption that the price is determined by internal characteristics of the good and the external factors affecting it. (Lancaster, 1966). The price of a house is determined by intrinsic characteristics of the property itself such as its size with regards to square footage and thus the number of bedrooms and bathrooms it has, its appearance and any other additional amenities it may come with such as a swimming pool or a tennis court. (Rosen, 1974). The price is also affected by extrinsic factors such as its location: primarily, the proximity of the house to amenities, both public and private, such as schools, hospitals, and shopping centres or malls. (Casetti, E. 2004. Applications of the Expansion Method.)

4. Empirical Studies

Mak, Choy, & Ho, (2012) studied the determinants of Real Estate Investments in China specific to regions. Their paper utilized a reduced – form equilibrium model to investigate the possible sources of real estate investments differentials among the region of study in the country. Specifically, empirical results suggested that demographics, economic and planning factors are the major determinants that cause real estate investments to vary among Chinese regions. The

relatively small coefficient estimate of real interest rates indicated that it has a significant but modest impact. Based on the coefficient estimates, the paper finally suggested that the Chinese government should focus on several policy parameters in order to achieve a more balanced state of real estate investments across Chinese regions.

Lieser & Groh, (2011), examined the determinants of commercial real estate investments for 47 countries from 2007 to 2009. They explored how different socio-economic, demographic and institutional characteristics affect commercial real estate investment activity through both cross- sectional and time series analysis, running augmented random effect panel regressions. Their results showed that economic growth, rapid urbanization, and compelling demographics attract real estate investments and also confirmed that lack of transparency in the legal framework, administrative burdens of doing real estate business, socio-cultural challenges and political instabilities of countries reduce real estate allocations.

Mikhed (2009) investigated whether rapidly decreasing U.S. house prices have been justified by fundamental factors such as personal income, population, house rent, stock market wealth, building costs, and mortgage rate. They first conducted the standard unit root and cointegration tests with aggregate data. Nationwide analysis potentially suffers from problems of the low power of stationarity tests and the ignorance of dependence among regional house markets. Therefore, they also employed panel data stationarity tests which are robust to cross-sectional dependence. Contrary to previous panel studies of the U.S. housing market, they considered several, not just one, fundamental factors. Their results confirmed that panel data unit root tests have greater power as compared with univariate tests. However, the overall conclusions are the same for both methodologies. The house price does not align with the fundamentals in sub-samples prior to 1996 and from 1997 to 2006. It appears that the real estate prices take long swings from their fundamental value and it can take decades before they revert to it. The most recent correction (a collapsed bubble) occurred around 2006.

Posedel & Vizek (2009) studied house price developments in six European countries: Croatia, Estonia, Poland, Ireland, Spain and the United Kingdom. The main goal was to explore the factors driving the rise of house prices in transition countries. Because house price increases in the last two decades were not peculiar to transition countries, the analysis was extended to three EU-15 countries that have recorded house price rises. The similarities and differences between the two groups of countries in terms of house price determinants can thus be explored. In the first part of the empirical analysis VAR was employed to detect how GDP, housing loans, interest rates and construction contribute to real house price variance. In the second part of the analysis multiple regression models were estimated. The results of both methods suggested that

the driving forces behind house price inflation in both groups of countries were very similar and encompass the combined influence of house price persistence, income and interest rates.

Julius, (2012) studied the determinants of Residential Real Estate Prices in Nairobi. Her objective was to evaluate factors that have been affecting the real estate market since there was little empirical study prior to this. In particular she evaluated how interest rates, level of money supply, rate of inflation, employment rate and population growth affected house prices. Using secondary data collected from the Central Bank of Kenya, Kenya National Bureau of Statistics and the Hass Consulting Ltd., a multivariate regression was done using SPSS to establish the relationships. The study found out that employment growth and the level of money supply information can give economists and financial analysts a better understanding of the real estate market and its influence on real estate prices. An increase in interest rates reduces residential real estate prices.

5. Summary of Literature Review

In conclusion, there is wide literature to support residential real estate pricing. The hedonic model though widely used suffers a few setbacks due to the ideal assumptions on which it operates and the likelihood of misspecifications. The prospect, agency and game theories each try to explain real estate pricing from different aspects and provide a good basis for empirical study. Empirical studies have also been undertaken on the determinants of house prices globally. Locally no comprehensive research has been done to cover the whole nation. There is evidence that the real estate market is enlarging not only in Nairobi but also in other parts of the country. Hence there is need to extend the research.

CHAPTER THREE: RESEARCH METHODOLOGY

1. Introduction

This chapter describes the methodology used to conduct the research and analyze the data collected.

2. Research Design

The study takes the form of a descriptive design as it seeks to establish a relationship between certain existing phenomena from the information collected on the variables under study.

Population

The target population for the study are the regions in which Hass Consult has carried out residential real estate projects in; these areas represent the scope of interest.

Sample Design

The Housing Property Index (HPI) is a composite index assimilated by Hass Consult Limited and represented the data scope for this study

Data Collection

The data used in the study was collected from The Central Bank of Kenya (interest rates), The Kenya National Bureau of Statistics (housing and population trends), and Hass Consult Limited (residential real estate prices).

Data Analysis

A simple vector autoregressive (VAR) model was run to analyze the way real estate prices react to each of the independent macroeconomic variables as listed in its simple form below:

$$y_t = A_1 y_{t-1} + \varepsilon_t$$

Such that y_t represents the Housing Price Index (HPI) and $A_1 y_{t-1}$ is a combination of the vectors of the 'x' variables and ε_t is the error term. The explanatory variables in this regression were:

1. Central Bank Rate (CBR)
2. Foreign Exchange Rate (FOREX)
3. Annual change in the national Gross Domestic Product (GDP)
4. Level of Money Supply (M1)

5. Level of Inflation (INF)

NB: The USD is not only the world's major reserve currency but Kenya's reserve currency as well. This is why when considering the foreign exchange rate, we use the historical data of the Kenyan shilling versus the US Dollar rate.

This simple VAR is then further expounded as follows:

$$\begin{pmatrix} y_{1t} \\ y_{2t} \end{pmatrix} = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{pmatrix} y_{1t-1} \\ y_{2t-1} \end{pmatrix} + \begin{pmatrix} \epsilon_{1t} \\ \epsilon_{2t} \end{pmatrix}$$

These equations prove that all the variables are related to each other and thus can further be generally specified as:

$$Y_{1t} = a_{11}y_{1t-1} + a_{12}y_{2t-1} + \varepsilon_{1t}$$

$$Y_{2t} = a_{21}y_{1t-1} + a_{22}y_{2t-1} + \varepsilon_{2t}$$

The regression in the study applied a vector autoregressive model of order 1, denoted VAR(1), as follows:

$$X_{t,1} = \alpha_1 + \Phi_{11}X_{t-1,1} + \Phi_{12}X_{t-1,2} + \Phi_{13}X_{t-1,3} + \Phi_{14}X_{t-1,4} + \varepsilon_{t,1}$$

$$X_{t,2} = \alpha_2 + \Phi_{21}X_{t-1,1} + \Phi_{22}X_{t-1,2} + \Phi_{23}X_{t-1,3} + \Phi_{24}X_{t-1,4} + \varepsilon_{t,2}$$

$$X_{t,3} = \alpha_3 + \Phi_{31}X_{t-1,1} + \Phi_{32}X_{t-1,2} + \Phi_{33}X_{t-1,3} + \Phi_{34}X_{t-1,4} + \varepsilon_{t,3}$$

$$X_{t,4} = \alpha_4 + \Phi_{41}X_{t-1,1} + \Phi_{42}X_{t-1,2} + \Phi_{43}X_{t-1,3} + \Phi_{44}X_{t-1,4} + \varepsilon_{t,4}$$

$$X_{t,5} = \alpha_5 + \Phi_{51}X_{t-1,1} + \Phi_{52}X_{t-1,2} + \Phi_{53}X_{t-1,3} + \Phi_{54}X_{t-1,4} + \varepsilon_{t,5}$$

Where the variables were specified as follows:

1. $X_{t,1}$ – DCBR
2. $X_{t,2}$ – DLOGFOREX
3. $X_{t,3}$ – DLOGGDP
4. $X_{t,4}$ – DLOGM1
5. $X_{t,5}$ - DINFLATION

Unit Root Test

Throughout this study, unit root test is conducted to test whether the series in the group (or it is first or second difference) are stationarity, for the purpose to prevent obtaining any spurious and invalid results.

Hypothesis statements:

H0: There is a unit root test (Non-stationary).

H1: There is no unit root test (Stationary).

Decision rule: Reject null hypothesis if p-value is less than the significance level. Otherwise, do not reject null hypothesis.

Unit root test is employed to examine whether there are stationary or non- stationary trend of time series data for all variables

Both Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests under the category of unit root test will be run to determine whether there is stationary or non-stationary in this study.

Therefore, following test results above, the 'D' used as the prefix of the variable titles is to signify that each of the variables have been differenced to ensure that they were stationary for estimation of VAR purposes. Other variables were logged in order to get their percentage forms and enable comparisons to be drawn.

Unit Test Results

Before Differencing

Variable	ADF P-Value	PP Test Stat	Stationarity
CBR	.1027	.1027	Non-Stationary
INFLATION	.1124	.1415	Non-Stationary
LOG FOREX	.4140	.5417	Non-Stationary
LOG GDP	.1408	.4194	Non-Stationary
LOG M1	.2471	.3566	Non-Stationary

After Differencing

Variable	ADF P-Value	PP Test Stat	Stationarity
DCBR	.0000	. 0000	Stationarity at I(1)
DINFLATION	. 0000	. 0000	Stationarity at I(1)
DLOGFOREX	. 0000	. 0000	Stationarity at I(1)
DLOGGDP	.0483	. 0010	Stationarity at I(I)
DLOGM1	. 0000	. 0000	Stationarity at I(I)

CHAPTER FOUR: DATA ANALYSIS, RESULTS AND DISCUSSION

1. Introduction

The data in this chapter was analyzed using E-Views 10.0 and was used to interpret how inflation rates, GDP, money supply, interest and location of real estate affect real estate prices, using multivariate regression and descriptive models. The first part, the descriptive statistics, enable us to make statistical conclusions about the data trends and the latter, the inferential statistics help us to determine the relationship between the dependent and independent variables.

2. Descriptive Statistics

The research finding on the descriptive statistic in the data collected.

Table 4.2.1: Descriptive Statistics

Date: 01/11/19 Time: 01:16
Sample: 1 120

	CBR	INFLATION	LOGFOREX	LOGGDP	LOGM1
Mean	9.322333	10.17198	4.329199	5.889573	6.104321
Median	8.500000	10.68716	4.330272	5.875610	6.115085
Maximum	21.65000	19.71573	4.603469	6.094377	6.646852
Minimum	5.750000	2.001324	4.127618	5.651127	5.312565
Std. Dev.	3.179816	5.008021	0.093431	0.118660	0.409847
Skewness	1.875912	-0.017212	0.231027	-0.132020	-0.383744
Kurtosis	6.144437	1.612583	3.205499	1.972287	1.875412
Jarque-Bera	119.8183	9.630552	1.278619	5.629561	9.268691
Probability	0.000000	0.008105	0.527657	0.059918	0.009712
Sum	1118.680	1220.638	519.5039	706.7488	732.5185

Findings show that there was mean of 9.32 for CBR, 5.88 for LOGGDP, 6.104 for LOGM1 and 10.17 for INFLATION. On standard deviation CBR had 3.179, LOGGDP had 0.118, LOGM1 had 0.4098 while INFLATION had 5.008. The Consumer Price Index which was used to calculate inflation had the highest standard deviation hence the highest variation from the mean.

3. Correlation

Table 4.3.1.Correlation Tests before Differencing

	CBR	INFLATION	LOGFOREX	LOGGDP	LOGM1
CBR	1	0.219655854	0.188603532	0.273049906	0.247565754
INFLATION	0.219655854	1	0.150749087	0.313070181	0.339088318
LOGFOREX	0.188603532	0.150749087	1	0.338242387	0.378453598
LOGGDP	0.273049906	0.313070181	0.338242387	1	0.982995184
LOGM1	0.247565754	0.339088318	0.378453598	0.982995184	1

The table above shows correlation tests before the data was differenced (when the data was non-stationary). We are able to observe that the Level of Money Supply and the GDP growth are highly positively correlated, almost at 1 (.9829).

Table 4.3.2. Correlation Tests after Differencing

	DCBR	DINFLATION	DLOGFOREX	DLOGGDP	DLOGM1
DCBR	1	-0.022926996	-0.089957329	-0.332985838	-0.030933789
DINFLATION	-0.022926996	1	-0.055224201	-0.057512937	-0.022552037
DLOGFOREX	-0.089957329	-0.055224201	1	-0.033904052	0.092089712
DLOGGDP	-0.332985838	-0.057512937	-0.033904052	1	0.036786648
DLOGM1	-0.030933789	-0.022552037	0.092089712	0.036786648	1

The table above shows correlation tests after the data was differenced; here the data was all stationary. All the data here is weakly correlated with each other as opposed to the previous case.

We are able to see the data shifted to become negatively correlated in the second table as compared to the first one.

4. Diagnostic Checks

Autocorrelation

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.095013	Prob. F(2,43)	0.9096
Obs*R-squared	0.246388	Prob. Chi-Square(2)	0.8841

Do not reject H0 since the p-value for the Breusch-Godfrey Serial Correlation LM test is 0.8841 which is greater than α=0.05. Therefore, there is no autocorrelation problem.

Normality

Series: Residuals Sample 2002Q1 2015Q4	
Mean	1.23e-15
Median	0.000326
Maximum	0.019096
Minimum	-0.019505
Std. Dev.	0.008213
Skewness	
Jarque-Bera	0.360028

Do not reject H0 since the p-value for the JB statistic is 0.835259 which is greater than α=0.05. Therefore, the error term is normally distributed in this model.

Heteroskedasticity

Heteroskedasticity Test: ARCH

F-statistic	0.323724	Prob. F(1,53)	0.5718
Obs*R-squared	0.333901	Prob. Chi-Square(1)	0.5634

Do not reject H0 since the p-value for the ARCH test is 0.5634 which is greater than α=0.05. Therefore, there is no heteroscedasticity problem.

5. VAR and Variance Decomposition

Before estimating the VAR and subsequently running the Variance Decomposition, we must first determine the order of the VAR. Ordering means placing the variables in the decreasing order of exogeneity.

VAR Granger Causality Test Results

VAR Granger Causality/Block Exogeneity Wald Tests
Date: 01/17/19 Time: 14:13
Sample: 1 120
Included observations: 117

Dependent variable: DCBR

Excluded	Chi-sq	df	Prob.
DINFLATION	0.945120	2	0.6234
DLOGFOREX	0.441593	2	0.8019
DLOGGDP	0.543652	2	0.7620
DLOGM1	0.094723	2	0.9537
All	2.254146	8	0.9722

Dependent variable: DINFLATION

Excluded	Chi-sq	df	Prob.
DCBR	0.612215	2	0.7363
DLOGFOREX	0.266195	2	0.8754
DLOGGDP	0.607964	2	0.7379
DLOGM1	5.511467	2	0.0636
All	7.653373	8	0.4680

Dependent variable: DLOGFOREX

Excluded	Chi-sq	df	Prob.
DCBR	3.214694	2	0.2004
DINFLATION	0.287635	2	0.8660
DLOGGDP	0.929621	2	0.6283
DLOGM1	2.078071	2	0.3538
All	5.931854	8	0.6549

Dependent variable: DLOGGDP

Excluded	Chi-sq	df	Prob.
DCBR	2.976471	2	0.2258
DINFLATION	1.819018	2	0.4027
DLOGFOREX	5.655858	2	0.0591
DLOGM1	1.577529	2	0.4544
All	10.21709	8	0.2501

Dependent variable: DLOGM1

Excluded	Chi-sq	df	Prob.
DCBR	3.652163	2	0.1610
DINFLATION	0.805910	2	0.6683
DLOGFOREX	2.894428	2	0.2352
DLOGGDP	2.309406	2	0.3152
All	7.530195	8	0.4807

For every test result; the variable that is not listed as dependent is considered to be independent, i.e. the excluded variables. The above test included two lags.

The test:

NULL: The independent variable (lag 1 & lag 2) cannot cause the dependent variable

ALT: They cause the dependent variable

The decision rule:

IF P VALUE > 5PC WE CANNOT REJECT NULL: WE ACCEPT NULL

IF P VALUE <5PC WE REJECT NULL AND ACCEPT ALT

Thus for all test results, none of the independent variables cause the dependent variable: this implies exogeneity.

Also the order of the variables will be as follows:

1. Dcbr – 97.22%
2. Dlogforex – 65.49%
3. Dlogm1 – 48.07%
4. Dinflation – 46.80%
5. Dloggdp – 25.01%

VAR Test Results

Vector Autoregression Estimates
Date: 01/17/19 Time: 14:42
Sample (adjusted): 4 120
Included observations: 117 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	DCBR	DLOGFOREX	DLOGM1	DINFLATION	DLOGGDP
DCBR(-1)	0.035976	-0.003082	-0.003650	0.042548	0.000536
	(0.10557)	(0.00173)	(0.00198)	(0.10590)	(0.00042)
	[0.34080]	[-1.77802]	[-1.84228]	[0.40178]	[1.27638]
DCBR(-2)	-0.112578	-0.000215	-0.000787	-0.073491	0.000454
	(0.10553)	(0.00173)	(0.00198)	(0.10586)	(0.00042)
	[-1.06680]	[-0.12429]	[-0.39712]	[-0.69422]	[1.08239]
DLOGFOREX(-1)	-0.204605	0.279182	-0.153905	2.884853	0.054322
	(5.77068)	(0.09475)	(0.10832)	(5.78890)	(0.02296)
	[-0.03546]	[2.94641]	[-1.42087]	[0.49834]	[2.36631]
DLOGFOREX(-2)	3.820352	-0.240976	0.138800	0.029028	-0.008420
	(5.86473)	(0.09630)	(0.11008)	(5.88325)	(0.02333)
	[0.65141]	[-2.50240]	[1.26087]	[0.00493]	[-0.36088]
DLOGM1(-1)	-1.549405	-0.098182	-0.318757	8.366079	0.005916
	(5.10428)	(0.08381)	(0.09581)	(5.12040)	(0.02031)
	[-0.30355]	[-1.17146]	[-3.32700]	[1.63387]	[0.29135]
DLOGM1(-2)	-0.732686	0.035917	-0.061208	-5.556652	0.025383
	(5.09889)	(0.08372)	(0.09571)	(5.11498)	(0.02028)
	[-0.14370]	[0.42899]	[-0.63953]	[-1.08635]	[1.25137]
DINFLATION(-1)	0.074232	-0.000829	-3.10E-05	0.381865	-0.000508
	(0.09628)	(0.00158)	(0.00181)	(0.09658)	(0.00038)
	[0.77101]	[-0.52443]	[-0.01717]	[3.95377]	[-1.32657]
DINFLATION(-2)	0.025675	0.000136	-0.001481	0.000993	9.76E-05
	(0.09517)	(0.00156)	(0.00179)	(0.09547)	(0.00038)
	[0.26979]	[0.08692]	[-0.82933]	[0.01040]	[0.25775]
DLOGGDP(-1)	-5.844390	-0.396015	-0.706165	10.50556	0.763971
	(26.5247)	(0.43553)	(0.49788)	(26.6085)	(0.10552)
	[-0.22034]	[-0.90927]	[-1.41835]	[0.39482]	[7.24015]
DLOGGDP(-2)	-10.53232	0.349439	0.640205	-20.00859	-0.197261
	(25.8773)	(0.42490)	(0.48573)	(25.9590)	(0.10294)
	[-0.40701]	[0.82240]	[1.31804]	[-0.77078]	[-1.91622]
C	0.087326	-0.000103	0.015766	0.008393	0.001012
	(0.18447)	(0.00303)	(0.00346)	(0.18506)	(0.00073)
	[0.47338]	[-0.03411]	[4.55305]	[0.04535]	[1.37904]
R-squared	0.031377	0.161186	0.162882	0.184539	0.425003
Adj. R-squared	-0.060002	0.082053	0.083909	0.107609	0.370758
Sum sq. resids	247.3891	0.066699	0.087161	248.9536	0.003915
S.E. equation	1.527698	0.025085	0.028675	1.532520	0.006077
F-statistic	0.343374	2.036891	2.062492	2.398781	7.834888
Log likelihood	-209.8199	270.9641	255.3109	-210.1887	436.8326
Akaike AIC	3.774700	-4.443831	-4.176255	3.781004	-7.279190
Schwarz SC	4.034391	-4.184140	-3.916564	4.040695	-7.019498
Mean dependent	0.004017	-0.001002	0.011265	0.012037	0.003214
S.D. dependent	1.483830	0.026182	0.029960	1.622290	0.007661

Determinant resid covariance (dof adj.)	8.46E-11
Determinant resid covariance	5.16E-11
Log likelihood	555.6065
Akaike information criterion	-8.557376
Schwarz criterion	-7.258918
Number of coefficients	55

VAR estimates are interpreted similar to OLS estimates and thus must be considered while applying the ceteris paribus effect. Judging by the t-statistics (values in square brackets on the third rows), they exhibit that most of the variables, be it in the first or second lags, weakly influence their own selves and thus are weakly endogenous. This is to mean, none of the differenced variables have a strong influence on the other values that are being regressed against them in the vector autoregression.

Next, we interpret the values in the first row, with a specific focus on the first realizations (-1). Ensuring ceteris paribus holds, the first realization of the differenced value of the CBR (DCBR) is associated with 3.5976% increase in the differenced value of CBR. Holding the same line of reasoning constant: DLOGFOREX(-1) causes a 27.9182% increase in DLOGFOREX,

DLOGM1(-1) causes a 31.8757% decrease in DLOGM1 given that the sign is negative, DINFLATION(-1) causes a 38.1865% increase in DINFLATION, DLOGGDP(-1) causes a 76.3971% increase in DLOGGDP.

Variance Decomposition Results

Variance Decomposition of DCBR:

Period	S.E.	DCBR	DLOGFOR	DLOGM1	DINFLATION	DLOGGDP
1	1.527698	100.0000	0.000000	0.000000	0.000000	0.000000
2	1.534283	99.31142	0.004208	0.077214	0.562855	0.044300
3	1.548970	98.29836	0.425613	0.076272	0.932808	0.266950
4	1.551297	98.02598	0.435744	0.091479	0.985012	0.461786
5	1.552105	97.92448	0.496401	0.095674	0.991395	0.492055
6	1.552279	97.90275	0.515404	0.095916	0.993605	0.492323
7	1.552287	97.90183	0.515711	0.095977	0.994106	0.492377
8	1.552301	97.90002	0.517390	0.096042	0.994146	0.492404
9	1.552303	97.89985	0.517433	0.096048	0.994157	0.492509
10	1.552304	97.89970	0.517553	0.096048	0.994162	0.492533

Variance Decomposition of DLOGFOREX:

Period	S.E.	DCBR	DLOGFOR	DLOGM1	DINFLATION	DLOGGDP
1	0.025085	0.631030	99.36897	0.000000	0.000000	0.000000
2	0.026664	2.964153	94.75400	1.425791	0.182592	0.673462
3	0.027049	3.122200	94.46584	1.517626	0.238982	0.655348
4	0.027333	3.117407	94.26920	1.540807	0.236792	0.835795
5	0.027361	3.157082	94.07958	1.546331	0.239946	0.977061
6	0.027390	3.150524	94.08048	1.543929	0.242336	0.982734
7	0.027394	3.152233	94.07675	1.543534	0.243082	0.984398
8	0.027395	3.152184	94.07584	1.543505	0.243082	0.985387
9	0.027395	3.152148	94.07591	1.543501	0.243073	0.985369
10	0.027395	3.152206	94.07570	1.543498	0.243072	0.985527

Variance Decomposition of DLOGM1:

Period	S.E.	DCBR	DLOGFOR	DLOGM1	DINFLATION	DLOGGDP
1	0.028675	0.152826	0.657736	99.18944	0.000000	0.000000
2	0.030982	1.231957	2.485957	94.69271	0.003245	1.586129
3	0.031309	1.240624	3.181194	93.06941	0.437688	2.071082
4	0.031348	1.243684	3.197549	92.94210	0.494851	2.121814
5	0.031370	1.244068	3.193168	92.87386	0.517506	2.171398
6	0.031372	1.244530	3.200176	92.85869	0.519328	2.177276
7	0.031373	1.244806	3.200581	92.85469	0.520139	2.179789
8	0.031374	1.244789	3.201568	92.85350	0.520298	2.179845
9	0.031374	1.244795	3.201685	92.85333	0.520351	2.179841
10	0.031374	1.244795	3.201725	92.85328	0.520357	2.179840

Variance Decomposition of DINFLATION:

Period	S.E.	DCBR	DLOGFOR	DLOGM1	DINFLATION	DLOGGDP
1	1.532520	0.488508	0.103172	0.297020	99.11130	0.000000
2	1.664440	0.423042	0.256564	3.062808	96.13596	0.121630
3	1.691914	0.851906	0.258683	3.770505	94.75251	0.366399
4	1.694930	0.866118	0.302500	3.760964	94.59532	0.475093
5	1.696782	0.864593	0.339548	3.774829	94.44300	0.578031
6	1.697215	0.864774	0.358926	3.772939	94.40820	0.595157
7	1.697304	0.864684	0.359782	3.774235	94.40248	0.598815
8	1.697323	0.864694	0.360343	3.774346	94.40107	0.599548
9	1.697329	0.864728	0.360383	3.774428	94.40059	0.599876
10	1.697330	0.864731	0.360439	3.774424	94.40047	0.599941

Variance Decomposition of DLOGGDP:

Period	S.E.	DCBR	DLOGFOR	DLOGM1	DINFLATION	DLOGGDP
1	0.006077	14.93561	0.464370	1.665839	0.271961	82.66222
2	0.007652	11.25322	2.287474	1.950263	1.938939	82.57010
3	0.008049	10.20338	3.813601	2.603836	2.892524	80.48666
4	0.008096	10.14164	3.877853	2.763692	3.157511	80.05930
5	0.008102	10.13693	3.877657	2.800194	3.202554	79.98266
6	0.008102	10.13660	3.878934	2.802318	3.209356	79.97280
7	0.008103	10.13634	3.879881	2.802257	3.210902	79.97062
8	0.008103	10.13621	3.880709	2.802222	3.211286	79.96957
9	0.008103	10.13621	3.880712	2.802223	3.211376	79.96948
10	0.008103	10.13620	3.880753	2.802228	3.211391	79.96943

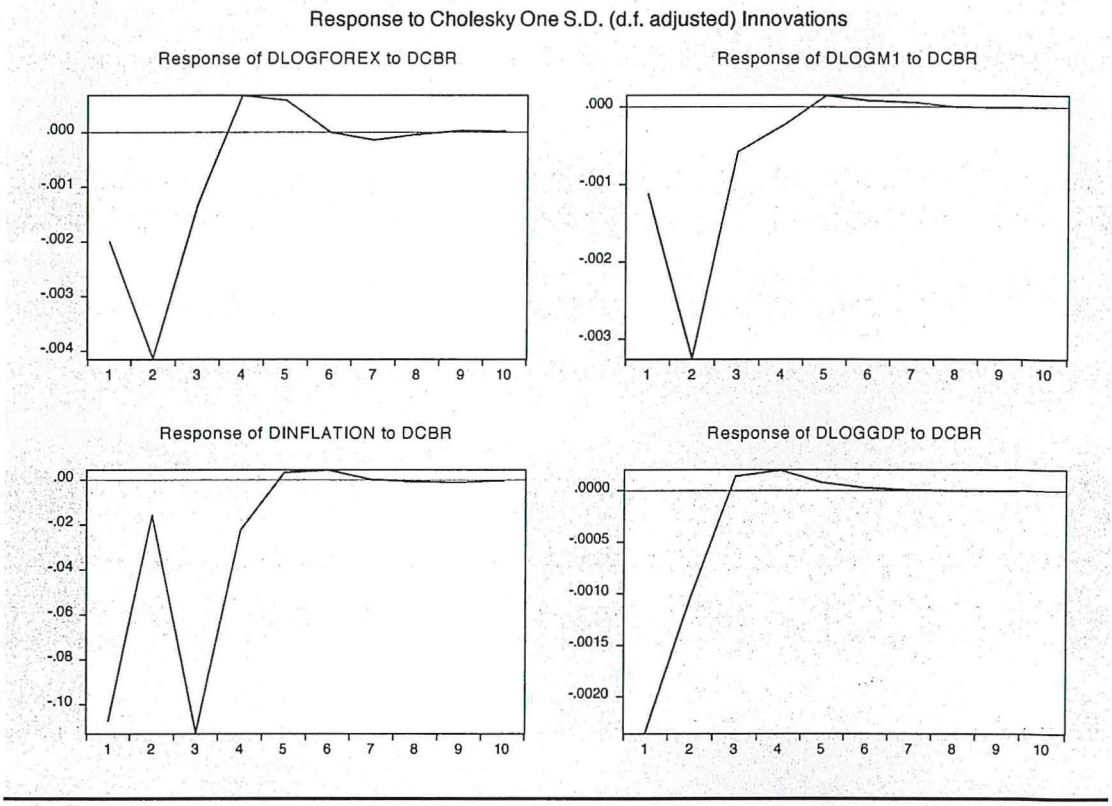
Cholesky Ordering: DCBR DLOGFOREX DLOGM1 DINFLATION DLOGGDP

The rows indicate the percentage of the Forecast Error Variance of the variable in the title for every variance decomposition. We may further divide the time periods into short run (period 1- period 5) and long run (period 6 – period 10).

For example, in the short run, looking at Year 1, 100% of forecast error variance in DCBR is explained by the variable itself therefore other variables in the model do not have a strong influence on DCBR (they have strong exogenous impact). This is seen to continue with time

even into the long run where the impact of the other variables on DCBR is negligible as it is less than zero.

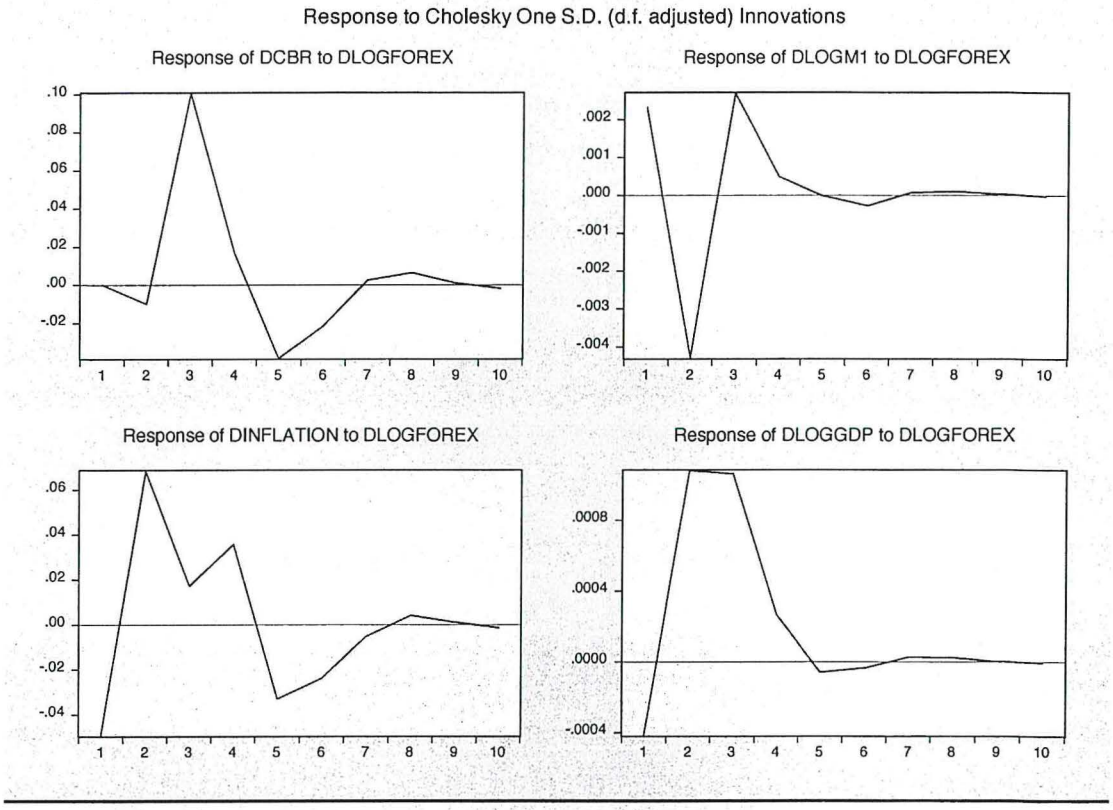
6. Impulse Response Functions



Graph 4.6.1. This shows the response of other variables to a 1 standard deviation shock to DCBR

Generally, we are able to observe that a shock to DCBR seems to cause sharp declines in all the other variables which then seem to gradually increase with time and stabilize around the zero-line. Shocks to DCBR render all other variables with negative values in the short run.

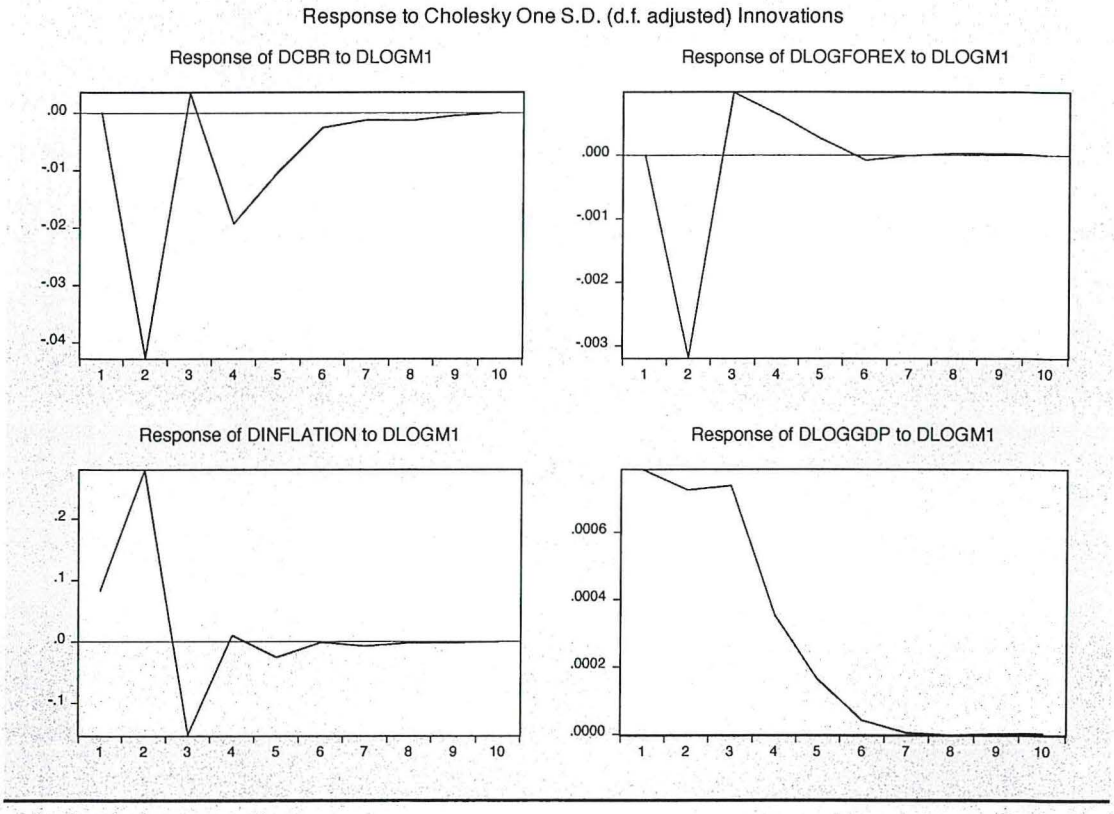
The variable that is affected the most seems to be DLOGGDP followed by DINFLATION given the distance of the graph from the origin.



Graph 4.6.2. This shows the response of other variables to a 1 standard deviation shock to DLOGFOREX

A shock to DLOGFOREX causes a sharp increase to DCBR, DINFLATION and DLOGGDP in the short-run which gradually corrects and tends towards zero in the long-run. It however causes the exact opposite effect on DLOGM1 as it decreases sharply at first then increase as time progresses.

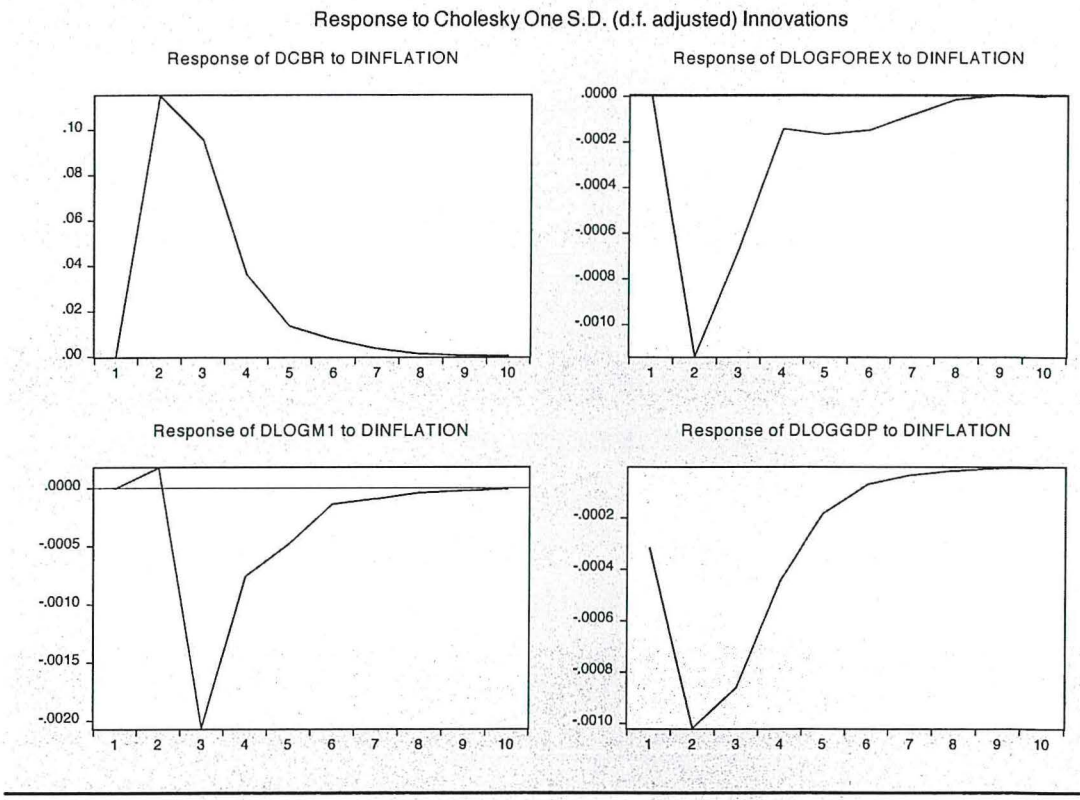
The greatest impact of the shock to DLOGFOREX is experienced by DCBR and DINFLATION whilst DLOGGDP experiences the least significant change.



Graph 4.6.3. This shows the response of other variables to a 1 standard deviation shock to DLOGM1

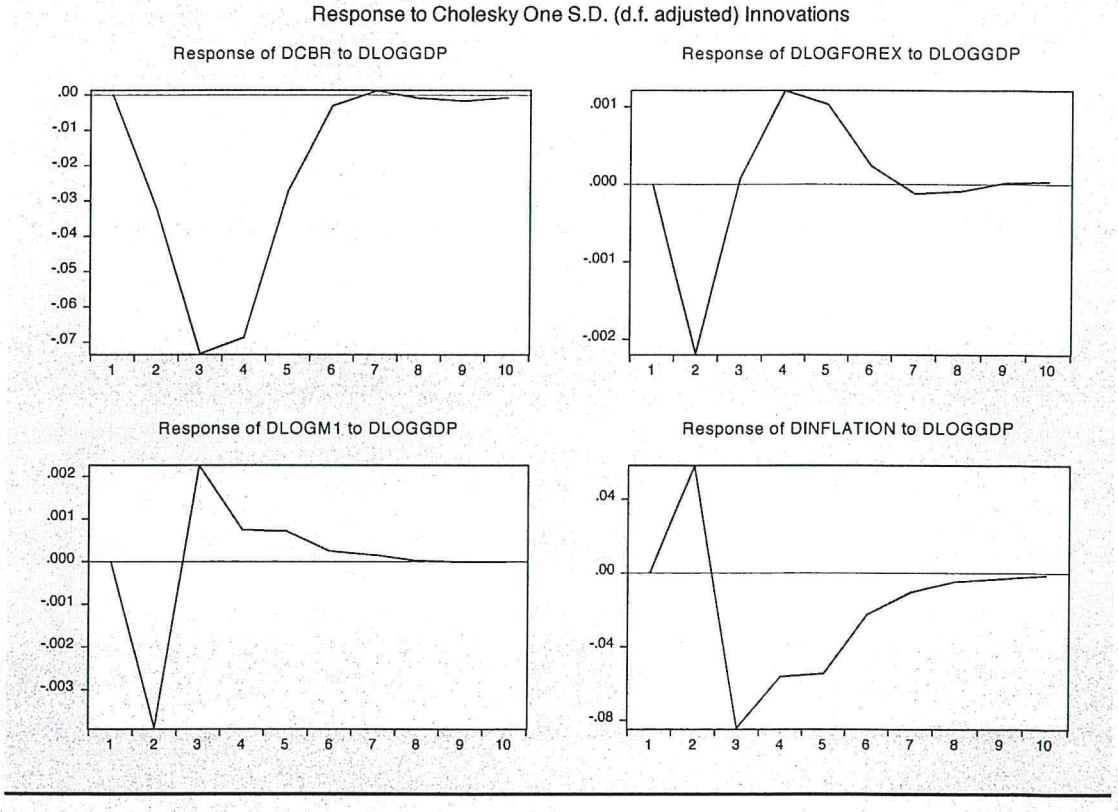
A shock to DLOGM1 causes a sharp decrease in the short-run to DCBR and DLOGFOREX with a relatively smaller impact as compared to the impact the shock has on DINFLATION with regards to magnitude.

The impact of the shock is experienced in its least form by DLOGGDP but has a gradual reducing effect.



Graph 4.6.4. This shows the response of other variables to a 1 standard deviation shock to DINFLATION

A shock to DINFLATION seems to only have a great impact to DCBR, i.e. a sharp increase as the other graphs show a thousand times less impact and appear to be reducing in the short term.



Graph 4.6.5. This shows the response of other variables to a 1 standard deviation shock to DLOGGDP.

A shock to DLOGGDP, similarly to shocks to inflation seem to majorly affect DCBR by causing a sharp decrease. Overall this decreasing effect is the same for DLOGFOREX and DLOGM1 whereas as for DINFLATION, the effect shows a slight increase, the opposite.

7. Conclusion

In a nutshell, this study has analyzed the dynamics data with a series of time series econometrics test. In the beginning, the descriptive statistics of each variable is being reviewed. Besides that, Unit Root Test which consists of ADF and PP test, VAR test, diagnostic checking and variance decomposition have been conducted in this chapter. Overall, all the empirical results from the methodologies used in this study have been interpreted and showed in figure, diagram and table form. The clear and precise interpretation of the results have been showed on the below of each of the test in this chapter.

CHAPTER FIVE: SUMMARY AND RECOMMENDATIONS

1. Summary

Chapter One gave a brief introduction to the topic and set the context for the study by briefly introducing concepts that would be used throughout the paper. Chapter 2 explains the relationship between HPI and macroeconomic variables has been explained based on literature from previous researchers; theoretical models such as supply and demand theory and purchasing power parity theory are discussed as part of the literature published to determine between housing price index determinants in Kenya.

Next, this chapter 3 discusses all the methodologies and statistical test that will be implementing in this study. It has clearly defined and elaborated the ideas for each of the methodology. Firstly, Unit Root Test that consists of ADF and PP tests is carried out to test whether there are stationary or non-stationary trend of time series data for all variables. It is necessary to check the order of integration of the level variables for an appropriate econometrics method in order to avoid obtaining any spurious and invalid results. Diagnostic testing has been conducted in order to ensure no econometric problems in the model.

In the chapter 4, a series of test have been conducted and the results we obtain are clearly explained. Initially, this study has overviews the descriptive statistics of all the measured variable and controlled variables. The results from both ADF and PP tests reveal that all variables in the dataset are non-stationary at level. After the first difference of both ADF test and PP test, all the variables are stationary at the first difference. After running the VAR test, it was seen that none of the differenced variables had a strong influence on the other values that are being regressed against them. The variance decomposition test showed that the variables in the model do not have a strong influence (small percentage) on each other when it comes to predictability of values in future time periods. Lastly, the impulse response functions showed for how long a shock on each of the variables affects the other variables and clearly showed us the impact in both the short and long run.

2. Policy Recommendations

It is vital for investors to understand which macroeconomic variables are bringing the utmost effect to house price. The research aimed to delineate how macroeconomic variables affect real estate prices in Kenya. From the results, we may postulate that Ministry of Transport, Infrastructure, Housing and Urban Development should avail lower-price, good quality homes to Kenyans in need. This is already underway, through partnership with the United Nations for

Project Services (UNOPS) and will see one million Kenyans are housed in the National Housing Project in the first phase.

The Central Bank of Kenya should apply controls to regulate the money supply levels so as to reduce extreme price fluctuations thus ensuring stability of not only prices, but exchange and interest rates as well. This is in turn will ensure the purchasing power of the shilling does not depreciate and thus foreign direct investment will be encouraged which will boost economic growth.

3. Limitations of the Study

The data collected was secondary from sources including previous literature documented from the study of the aforementioned topic, the Central Bank of Kenya data, the Kenya National Bureau of Statistics website and lastly, Hass Consult Limited. The data represented in the study was true and obtained from reliable sources but may have been prone to unreliability, say because it was intended for other uses.

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