IMPACT OF MACRO ECONOMIC VARIABLES ON CONSUMER PRICE INDEX: A STUDY OF SRILANKAN ECONOMY 1977-2016

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DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text and a list of references is given.

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Abstract

This study investigates impact of the macro economic variables on consumer price index SriLankan Economy. At many emerging economies including that of Sri Lanka are relatively limited and required to be repeated as the underlying economic settings of such economies have rapidly changed over the years. Hence, it is necessary to analyze the consumer price index over the years and various factors affecting its performance. This study examines the impact of economic variables on Consumer price index of Sri Lanka over the period 1977-2016. The study made use of secondary data gathered from the Central Bank report of Sri Lanka and data is analyzed by means of, unit root test, Granger Causality test, Correlation and ARDL Regression analysis using Eview10 and regression results suggests that Inflation and GDP variables have significant impact on Consumer price index. From that correlation analysis it is concluded that there is significant relationship between Inflation and Consumer price index.

Keywords: ARDL Analysis, Consumer price index, Gross Domestic Product, Granger Causality, Inflation,

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LIST OF ABBREVIATIONS

ADF	Augmented Dickey–Fuller
AIC	Akaike Information Criterion
AR	Autoregressive
ARDL	Auto Regressive Distributed Lag
CPI	Consumer Price index
CSE	Colombo Stock exchange
GDP	Gross Domestic Production
GNP	Gross National product
NISR	National Institute of statistics Rwanda
OLS	Ordinary Least Squares
ADF	Augmented Dickey–Fuller
PP	Phillips-Perron
SC	Schwartz Criterion
VAR	Vector Auto Regressive
FPE	Final prediction error
HQ	Hannan-Quinn information criterion
LR	LR test statistic

Chapter 1

Introduction

1.1 Background of the Contents

Every countries identifies that macro and micro economics is important to identify their performance in this context macroeconomics is essential to permanent and predictable changes in inflation are neutral in the long period in every country, they do not impact real activity. Therefore, evidence explains to level of inflation can have worse result for actual economic performance even in the time period. So researchers identified that different value of problem for personal in economic performance.

Inflation exists in different economies differently. So, inflation is existing but proper investigation. The impact of macroeconomic variables on consumer price index is be evaluated in this analysis. As researchers and any others are find out of different issue of unemployment and inflation relationship to this study.

Chinese Gross Domestic Product (GDP) very slowly growing and macro-economic variables in 2000.The vey essential practice in inflation and employment in this society so there is relationship between these two variables by (Qin Fei and Wang Qianyi 2013).

Danziger, S.H., and E Gottschalk (1986) examined that level of inflation increases the unemployment also increases. Always inflation rate is affected by the unemployment. So inflation is control in every country. So the changes of inflation rate are affected by in unemployment. So always control in inflation rate.

Inflation is badly affected in consumer buying power in the economy. It is affected different income people, and also affected by every country. Every people buying power depends on the inflation. Normally the development countries face this inflation problem.

CPI and GDP is very essential factor for every country this GDP is always affected by the inflation. Sometime very seriously affected by the GDP in the rate of inflation. But there is no relationship between CPI and GDP

Balami (2006) defined that inflation increase in the level of prices affected by no of things and facilities for a long duration of time. Inflation is always increasing the prices and it can be measured using the CPI, Gross National Product Implicit Price Deflator.

Economic growth of definition explained by researchers to general rises of service and goods value in some time of the period. Normally services and goods compare with one time to another time. It is valued by GNI or GDP.

Every country policy is evaluated the price of goods and services in the money value. Always maintain the policy of the country maintain the fixed prices in the services and goods. So that CPI is used in this analysis. Every Economic variable indicate the purchasing power but one of the variable in CPI is good indicator for analysis of the buying power. Purchasing basket is very essential factor so this CPI evaluated in the weighted average method.

Different purpose used by CPI. Level of prices fluctuations measured by CPI, economic factors are highly influenced in the CPI such as wages, income, salary and social benefits. Sometime not suitable method for evaluation of this CPI Index. This one also impact of countries policy and countries performance

Department of Census and Statistics in (DCS) in 1952 calculated the Colombo Consumer Price Index in Sri Lanka. This index is very essential for our country people purchasing power of services and goods. CPI meaning and evaluations are complicated index in every country.

1.2 Problem Statement

Macro-economic variables affected by CPI but Inflation is influence every country level of price. So they face price of goods and services by the purchasing problem of the money by Rashid and Kernal, (1997). Therefore, commodities purchasing power affected by inflation, so inflation identified the different value of commodities, and identifying the money value of goods. So macroeconomic has several variable but mostly power variable is one of the variable is inflation and other variables are GDP, GNP and exchange rate. These variable impacts on Consumer price index. This study evaluated the impact of macroeconomic variable on CPI.

There are several studies focused in developed countries. But some research is conducted in developing countries in some variable regarding the consumer price index evaluation. So that the problem identifying the association between macro-economic variables affected by policy and economist's findings around the world. Several findings evaluated by many researches, some argue that negative and positive association between the variables. So that, the aim of the research is find out impact of macroeconomic variables on consumer price index.

Developed countries have several studies has contact on in this macro-economic variables. But different variables analysis in Sri Lankan context regarding the economic variables, but there is no identification of these macro-economic variables in this CPI analysis. But several finding are identified the different countries, sometime the results are impact or no impact, so their relationship between the variables or no relationship between the variables. So in this analysis is effect of macroeconomic variables on consumer price index.

Identifying the international experience Sri Lanka has highly influence in inflation in people purchasing power. Therefore, this is very different in handling by the government policy. High price of commodities influence in buying power so Sri Lanka faces in these macro-economic variables are affected in this condition. Therefore, this study attempts to answer.

1.3 Research Questions

Is there any relationship between macro-economic variables on Consumer Price Index?

Do there any macro-economic variables impact on Consumer Price Index?

1.4 Aim of Study

The aim of the research is to investigate the impact of macroeconomic variables on Consumer Price Index in Sri Lankan economy.

1.5 Objectives:

- To understand the macro economic variables in Sri Lanka.
- To Study of exchange rate and GDP in Sri Lanka.
- To observe of Consumer Price index in Sri Lanka.
- To identify the relationship between macro-economic variables and Consumer Price Index

1.6 Significance of the Study

Every project affected by inflation in future. This leading to investment strategies is, so very low investment affected by growth of the economy. International wise reduce the inflation rate, but this one is building is very difficult. Decision making is very depending on smart tax system. Different nation has arrangement are different by the policies. Several theories are applied the economic variables with expansion of the policy.

Inflation growth relationship and impact on budgeted GDP and correct GDP (output gap) had an attitude on Fiji's price rises product, that inflation was negatively correlated to growth by Dewan & Hussein (2001).

Malik and Chowdhury (2001) said that positive relationship between GDP growth rate and inflation for four South Asian states by with co-integration and error correction models in long-run, identify the view, their outcome also propose to reasonable price increases is supportive to earlier monetary expansion and nourish support into price rises. So the authors suggest judicious inflation for the growth, Pakistan, Bangladesh, India and Sri Lanka.

Slesnic (1993) said that inflation is the incessant move up in the value stage of the nation that makes a payment considerably to the GDP. Cost and some factors identifying the unemployment rate. In addition, every country face employment and unemployment, inflation exchange rate problem touching circumstances anywhere it becomes hard designed for carry on with the working labor force. To recognize the type of troubles that face reduction of expenditure.

1.7 Organization of the report

The study is organized into five chapters. The chapters are structured as follows:

- The first chapter introduces the importance of economic variables. The chapter also highlights the research problem, research question, significant of the study, objectives of the study data collection and contents of the study.
- Chapter two reviews the theories and empirical framework of Macroeconomic variables on CPI. In this chapter, measures of Inflation rate, GDP, GNP and Exchange rate on Consumer Price Index are discussed. The chapter also includes the review of the previous empirical studies related to macro-economic variables on CPI.
- Chapter three will be the research approach utilized in conducting the study and sequence of the tasks performed in conducting the research work is introduced the research design, the analysis used in the study.
- Chapter four is the data presentation and analysis of the view.
- Chapter five is the conclusion of the empirical study, and recommendations for the Sri Lankan economy.

Chapter 2
Literature Review

2.0 Introduction

Generally, the important to the review of literature are summarize, analyze and review on the theoretical articles or empirical studies carried out by past researchers relating to the research title. At the same time, a deeper understanding can be developed by comparing different results found by the researchers.

This chapter will provide future researchers to identify and understanding of research done by past researchers follows some guidelines to improve the existing barriers in past studies. Moreover, it provides a clearer picture in identifying the impact of macroeconomic variables on Consumer Price Index (CPI). Moreover, in this methods can also be used to provide answers for the problem aroused.

In this chapter involves both theoretical view and empirical evidence related to the force of variables of macroeconomic on CPI. This conventional view to explain the macroeconomics that low inflation is an important condition for fostering economic growth.

2.1 Variable of Study

2.1.1 Inflation

Inflation is defined by Jhingan (2002) it is persistent to rear in the overall of prices. The majority usually identified catalog as CPI. The CPI is key procedures by typical put on the market prices that consumers pay.

Gunasekarage, Pisedtasalasai, & Power(2004) said thatColombo Consumers Price Index (CCPI) is generally applied to compute price rises in Sri Lanka. CPI measured by inflation rate. Macroeconomic health depends on inflation rate. Inflation rate and GDP not unconstructive, increasing the prices affected by the GDP.

Charges evaluated consumer price index which is reduction of the GDP. Therefore, inflation varied confident and adverse of the results. The adverse results are impact of amount of the value by (Blanchard, 1989)

Finally, the results are explained that dampen investment in the society, inflation increase very often in consumer purchasing power. Inconsistency of inflation mentioned the coming price points.

2.1.2 Gross Domestic product

GDP is complete service and goods of the price with in a country for the period of time. Small GDP evaluations are identified the performance in the economy. This is commonly used pointer of the monetary fitness as healthy as a device of a nation's normal of existing (Reddy, 2012.There are three approaches for calculating GDP namely product approach,expenditure approach and income approach.Under expenditure approach, GDP is calculated in final spending on goods and services. Based on the fair price of goods and facilities formed in a motherland, GDP is calculated under production approach. By income approach GDP is calculated based on the sums of the income received by all products in the country (Reddy, 2012)

Mwaniki (2014) said that GDP commonly identified the indicator of macro-economic variables. The levels of GDP will possible effect standard fair concert finished its effect on commercial success. An increase in GDP leads to economic growth and creates possibilities for increasing the stock market performance (Chandra, 2004).

2.1.3 Exchange rate

Exchang rate the worth of different moneys comparative to respectively add. The value of unique notes stated in meaning to other notes. The value of money is different currency in different countries. Daytime some exchange rate fluctuates and fixed by the agreement. When there are dissimilar fluctuations in the exchange rates, the exchange rates movement, there would be high movements of market return volatility. Some studies have concluded that here is a sturdy association among conversation rate movement and standard fair returns instability.

2.1.4 Gross National product (GNP)

Different results created by GNP in their country this value mentioned that purchasing value of product. All final products are evaluated in the several factors such as GDP, GNP. This variable not affected in the countries (Van den Bergh 2009)

2.1.5 Consumer Price Index (CPI)

International Labour Office (ILO) defined CPI as key figures are measured by the commodities values, so that families practice straight, or ramblingly, to gratify of requirements and wishes.

According to the National Institute of Statistic of Rwanda, The CPI is amount of the things and facilities of their life. Prices are changed by consumption sector of the Rwandan economy (NISR: March 2010)

CPI measured by rate of inflation as apparent by families, or fluctuations in their price of existing (that is, change in the amounts that the households to maintain their standard of living).

CPI is measured by weighted averages. Here some important variables are following up:

1. Underreporting of prices by stores, large rise in prices of essential goods not included in the index.

2. Disappearance of low grades of goods and deterioration in the quality of goods priced.

3. High retail-price increase in smaller cities not covered by the index

CPI used by basket of NISR is composed by the following division of commodities:

1. Nutrition and non-drinks beverages (rice and fish and meat)

2. Inebriating drinks and tobacco

3. Dress and footwear

4. Guard, liquid, power, air and additional oils

5. Providing, family tools and repetitive house conservation

6. Fitness

7. Carriage

8. Message

9. Regeneration and values

10. Teaching

11. Cafeterias and guesthouses

12. Various properties and rest area.

2.2 Fisher Hypothesis

In Fisher theory, the long-term relationship holds when interest rate is adjusted to expected inflation (Ling, Liew, & Wafa, 2010). It states that nominal interest rate can be calculated based on the following equation:

$n = i + r$

where;

i - the rate of inflation

n - nominal interest rate

r- actual interest rate.

There are three assumptions which need to be taken into considerations in Fisher theory. Firstly, the anticipated rate of inflation will be used instead of reported rate of inflation. Secondly, most countries will conduct the fisher hypothesis by using the rise in the expected price level (expected inflation) than the decline in the expected price level.

Thirdly, the nominal interest rate will be computed in which it is different to the actual amount of attention when the anticipated increase is eliminated. Real rate of interest refers to the market rate of interest (Kidwell, Peterson, 2008). Kumari (2011) stated that stocks are hedged against inflation rate when the nominal returns on an asset can be changed corresponding any change of mentioned inflation rate without affecting the actual rate of interest. Furthermore, the actual nominal interests can be determined by considering the anticipated and unanticipated nominal returns as well as the anticipated and unanticipated inflation based on the extension of Fisher Hypothesis (Li, Narayan, & Zheng, 2010).

2.3 Empirical Findings

A different economist explained the unscrupulous atmosphere to the overall community in the form of minor variations of value. The unemployment is control by inflation rate (Danziger, S.H.and E Gottschalk 1986).

Faria and Carneiro (2001) found that inflation and economic growth relationship between the Brazil economy. This was analyzed by the time series model of vector auto regression in between 1980 to 1995 for the annual data. Previous outcomes also provision the wonderful impartiality idea of currency in the extended path.

Sidrauski (1967) investigated that best resistor agenda if actual currency equilibriums is careful in the value purpose, value is unbiased and great impartial. Practical suggestion is in contradiction of the assessment that increase affects commercial development in the extended period.

Sweidan (2004) revealed that suggestion between inflation and economic growth has an organizational division effect or not for the Jordanian economy from 1970 to 2003. The result mentioned that this association tends to be identifying significant of inflation at two percentage of significant level. So Beyond this household inflation levels are impact of impact of economic growth adversely.

Slesnick (1993) mentioned that unemployment and inflation is positive association to (Blinder and Esaki, 1978; Blank, 1993; Mocan, 1995).It was explained both inflation and unemployment lead the GDP. The different solutions in this study were maintained as an important initiative for these economic issues. Unemployment in the different periods of economic cycles of polices are developed by the economist

Blinder and Esaki (1978) said that inflation is rises in the value of the economy that fund meaningfully to the GDP. The job loss level increases owed to remains growth the in the production cost, marketing costs, manufacturing and promotional costs, and others by Slesnic (1993)

Barro (1995) examined a significant association among economic growth and inflation. According to this study of the variables like fertility rate, education, etc. constant. Normally regression equations were used by different determinants growth. Therefore, in this outcome mentioned that there is association among inflation and economic growth.

Bruno and Easterly (1996) explained that inflation and growth that is association between each other these two variables are forty percent of household. This study also mentioned by Jamshaid, et al, (2010).

Blank (1993) mentioned that short revenue workers and said that their revenue fluctuated working hours and their places.

Catao and Terrones (2003) said that association between inflation and fiscal deficit. Soloman and Wet (2004) found that the impact inflation on budget deficit Tanzania and identified greater inflation influence by grater deficit.

Zafar and Zahid (1998) explained Inflation and Gross Domestic Production pakistan economy. They found badly impact of deficit of the budget in GDP. This was tested public and private.

Malik and Chowdhury (2001) found that association among GDP growth rate and inflation for four South Asian nations. So that authors identified reasonable inflation for the progress of the economies of Bangladesh, India, Pakistan and Sri Lanka.

Fiji economy is identified by inflation and growth relationship evaluated by Gokal and Hanif (2004). The authors output was there is association is negative.

Muhammad Umair and Raza Ullah (2013) examined the impact of inflation on GDP and unemployment rate in Pakistan in 2000-2010. The research is used by secondary data. As a result, increase in inflation and GDP insignificant at 10% level.

The linkages among money, credit, house prices and economic activity in developed nations addressed by McQuinn and O'Reilly (2008) a. Most evidence identify the significant of the study and also bidirectional association of macroeconomic factors and price of houses for G7 countries.

Inflation and employment level associated to each other and extra issues that affect the joblessness level, but inflation is highly influenced to other factors mention by (Cutler and Katz 1990)

Mocan (1995) explained inflation mechanism. As a result, is employment and unemployment affected by inflation rate? Unemployment and inflation also affected it is addressed by (Metin1998). This result helps to that analysis of multivariate co integration through the analysis.

House value is impact of the monetary policy. So that, the low in house values enhances the insignificant by consumer price inflation mention by (Hilde and Dag Henning 2010).

Volker (2005) examined that fiscal policy formulation and income in society. Unemployment is identified that economic downfall. Furthermore, the impact of unemployment is mentioned to be managed and controlled.

The factors influencing house prices in Iran. In this identified in macroeconomic variables of inflation, standard values, real production, exchange rate, and fluidness have effect of house prices address by (Chegeni, and Asgari 2007).

Aminu Umaru and Manu Donga (2013) explained that impact of unemployment and inflation on economic development in Nigeria analysis of the year 1986-2010. In this result variables are stationary based on unit root test and also Causality suggests that unemployment and inflation reason GDP and not GDP instigating unemployment and inflation.

Zaidi (2005) analyzed that unemployment problem due to increasing economic development of Pakistan. Therefore, in this research examined the programs by IMF. This output was the operational alteration.

Wiza Munyeka (2014) explained the association between growth of the economy and inflation is significant for the transmission of financial rule.

Eleftherios Thalassinos and Erginbay Uğurlu et.al (2012). Therefore, the GINI result has been used to amount the revenue dissimilarity. The output supports the hypothesis that inflation has a positive significant effect on income inequality.

Mahmoud A. Jaradat Saleh A. AI-Hhosban (2014) examined that Jordan economy from 1990 to 2012 that variables are interest rate and Inflation. There is positive association among the variables in this study.

Abdul and Marwan (2013) examined that the impact of, inflation rate, interest rate, and GDP on real economic growth in Jordan over the period 2000-2010 as a result there is constructive association among the variables.

2.4 Research Gap

Naik & Padhi (2012) explained that result of is repeated with different stage of periods and also in different frequency of the data. So that analysis on 'what is the impact of inflation and GDP on Consumer price index?' still remains an open empirical question.

Several empirical studies which are conducted in the context of developed countries. Studies conducted in Western countries cannot be generalized and not important have any application in context of emerging nations. As a result, the main reason for the research is to full fill the gap of required research area on the impact of MEV on Consumer price index in the Sri Lankan context

Chapter 3

Methodology

3.0 Introduction

This chapter consists to the formulations which remain necessary to understand the mathematical tend statistical and statistical simulations in time Series Analysis, Regression ARDL analysis, Granger Causality and co-integration. Since the study uses macroeconomic variables, it is more appropriate to interpret percentage changes (elasticity) of variables than absolute changes. Log-scale notifies on comparative vicissitudes, although linear-scale updates on total variations. In this study concentrated on impact of macroeconomic variable on consumer price index.

The primary stage of this route contains a test for stationary to find out the command of calculation of the variables. For this purpose, Augmented Dickey-Fuller (ADF) and Phillips-Peron tests for unit roots were employed. When the instruction of addition of each variable has been determined, examination of the co-integration, in this variables process in a rectilinear mixture. For this determination, multivariate co integration method is used by Johansen (1991). A finding of co integration implies the existence of a long-term relationship between the inflation, GDP on consumer price index. Co integrating relationships were found among the variables suggesting the extended run association among inflation, GDP and Consumer price index variables.

3.1 Data Collection

In analysis of the research is fully based on ancillary data. Data can be collected from annual report published by Sri Lanka central bank report of statistics are used. The data representing the period of 1977 to 2016 were extracted from the Central bank's annual reports for the analysis.

3.2 Unit root test

Unique method to regulate extra differencing is required, Unit Root Test are employed. There are arithmetical suggestion tests of stationary that are calculated for decisive is required. An amount of unit root examinations is existing, and they are based on dissimilar expectations. The Augmented Dickey Fuller (ADF) test is very famous and the results can be justified by Phillips –Perron (PP) test as well.

3.2.1 (ADF) and (PP) Test

This test of statistical analysis is test check by stationary or non-stationary in this data. Both tests are defined in valueless hypothesis of a unit root is current in a time series sample. The hypothesis is diverse contingent on which version of the test is castoff but is typically stationary or not stationary. Here the hypothesis is given below

Ho: Data are not stationary (Unit root exists)

H_1: Data are stationary (Unit root does not exist).

ADF test is higher automatically the H_0 can be rejected. Hence the H_1 is recognized the data are stationary Banumathy et.al (2015). Similar argument applies for Phillips-Perron Test.

3.3 Measures of dependence

Numerous events define the over-all conduct of a procedure as it changes ended period.

3.3.1 The Covariance

The covariance between x_t and its worth at additional period, say x_{t+k} is called the auto covariance at lag k, defined as follows;

$$\gamma_k = Cov(x_t, x_{t+k}) = E[(x_t - \mu)(x_{t+k} - \mu)]$$

The collection of the values of γ_k , k =0,1,2........ is called the auto covariance purpose? Note that the auto covariance at lag k = 0 is the alteration of the period series; that is, $\gamma_0 = \sigma_x^2$, which is variance of the series. The auto covariance events the direct requirement between two facts on the similar sequence experiential at diverse periods.

3.3.2 Coefficient of Autocorrelation

The autocorrelation coefficient at lag k for a stationary time series is defined as follows;

$$p(k) = \frac{E[(x_t - \mu)(x_{t+k} - \mu)]}{\sqrt{E[(x_t - \mu)^2 E[(x_{t+k} - \mu)^2]]}} = \frac{Cov(x_{t,} x_{t+k})}{Var(x_t)} = \frac{\gamma_k}{\gamma_0}$$

Here x_t is the current observation and x_{t+k} is the observation after k time period. The collection of the values of ρ_κ where k= 0,1,2............ is called the (ACF). While the ACF of non- stationary data decreases slowly. In other words, a strong and slowly dying ACF suggest deviations from stationary Montgomery et.al (2015). This test to measure the line association among time series comments detached by a gap of k period elements. Characteristics of ACF are; it is dimensionless amount, $p_k = p_{-k}$ that is the ACF is symmetric everywhere nil.

Sample autocorrelation is defined because it is necessary of estimating ACFs from a time series of finite length which is given below.

$$\hat{p} = \frac{\hat{\gamma}_k}{\gamma_o} \qquad k = 0, 1, 2, k$$

3.3.3 Partial Autocorrelation Function (PACF)

The PACF between x_t and x_{t+k} is autocorrelation between x_t besides x_{t-k} after adjusting for x_{t-1}, x_{t-2}, ... x_{t-k+1}, In general, partial autocorrelation is a conditional correlation of x_{t+k} with x_t.

3.4 Error Forecasting

Error for the time series can be written as follows;

Time series = Pattern + Error

3.4.1 Mean Absolute Percentage Error (MAPE)

MAPE events the scope of the fault in positions. It is measured as the average of the unsigned percentage error.

$$MAPE = \frac{1}{n}\sum_{i=1}^{n}\left|\frac{X_i - \hat{X}_i}{X_i}\right| \times 100$$

The above formula X_i the actual value and $\hat{X}_i$ is forecasted value and n is the number of observations. Generally, MAPE less than 10 % the fitted model is acceptable.

3.5 Model Selection Criteria

There are several models that can be used for forecasting a particular time series. Consequently, selecting an appropriate forecasting model is a considerable practical important. Thus, various criteria for model assumption have been introduced in the literature for model selection Montgomery et.al (2015).

3.5.1 Akaike's Information Criteria (AIC)

In this model evaluate the quality of the appropriate model by Akaike 1973, 1974 introduced an information criterion that is illustration of n comments, AIC is defined as follows.

$$AIC(\kappa) = -2\ln(\text{maximu m likelihood }) + 2\kappa\kappa\ln(n \approx n\ln\left(\hat{\sigma}_{\alpha}^{2}\right) + \kappa\ln\left(n\right)$$

Where $\hat{\sigma}_{\alpha}^{2}$ as is the maximum likelihood estimate σ_{α}^{2} where k is the number of limits projected in the classical counting continuous period. We favor the model with the minimum AIC.

3.5.2 Basian Information Criteria (BIC)

The BIC planned is however additional standards, which attempts to correct for AIC's tendency to over it. This criterion is given as following form;

$$BIC(\kappa) = -2\ln(\max imumlikelihood) + 2\kappa\ln(n) \approx n\ln\left(\hat{\sigma}_{\alpha}^{2}\right) + \kappa\ln\left(n\right)$$

Where $\hat{\sigma}_{\alpha}^{2}$ as is the maximum likelihood estimate σ_{α}^{2} where k is the number of parameters estimated in the model. As per completely the principles the chosen model is the one with a lowest BIC is the sample variance of the series.

3.5.3 Coefficient of determination

The coefficient of determination R^2 describes strengthen of the dependent variable describes by the independent variable/ In other words it used to measure of fit and to evaluate the goodness of fitted model. The best model gives that the largest of R^2 value.

3.6 Forecasting Accuracy

After forecasting by using fitted model it needs to check the accuracy of forecasting. There were different methods of measuring accuracy and comparing one forecasting method to another. Here we select the model has minimum Mean Absolute Percentage Error is showed the high accuracy, calculated by (MAPE) is employed to check the forecasting accuracy of the model.

3.7 Regression Analysis

Regression analysis is an arithmetical method to measure and identify an association among independent variable and explanatory variable. This is useful to have an idea about future behavior of the data and temperament of relationship of variables.

3.7.1 Auto Regressive Distributed Lag (ARDL) Model

Auto regressive distributed lag model degenerating a macroeconomic adaptable exclusively on its particular gaps like in an AR (p) model be a fairly limiting method. Eventually, it is suitable to undertake that here are further factors that energy a procedure. This model considers the lagged values of additional.Independent variables must be stationary.

This model equation is follow up:

$$y_t = \alpha_1 y_{t-1} + \beta_0 x_t + \beta_1 x_{t-1} + e_t$$

The above model is very important to compare to AR model

Here (1, 1) model α_1 and e_t are defined as above and β_0 and β_1 are the coefficients of the contemporaneous and lagged value of the exogenous variable, respectively.

3.7.2 Hypothesis Develop to check the model parameters

All the model parameters should be significance at 5% of significant level.

H_0: Model parameters are significant

H_1: Model parameters are not significant

3.8 Durbin- Watson statistic

The popular examination for sequential association is the statistical analysis given below;

$$d = DW = \frac{\sum_{t=2}^{T} \left(\hat{\in}_t - \hat{\in}_{t-1} \right)^2}{\sum_{t}^{T} \hat{\in}_t^2}$$

Where T is number of time periods, $\in_t$ is the mistake time in the model at time period t. Successive values of $\hat{\in}_t$ close to each other, the DW statistic will be low, indication the presence of positive correlation. The d lies between lower and upper bounds are as follows for hypothesis.

H_0: No auto correlation exists

H_1: Auto correlation exists

The decision rules are as follows:

1. If d is less than d_L, there probably is indication of optimistic autocorrelation.
2. If d is greater than, there probably is no indication of optimistic autocorrelation.
3. If d_L less than $d < d_U$, no definite conclusion about positive autocorrelation.
4. If d_U less than $d < 4 - d_U$, probably there is no evidence of positive or negative autocorrelation.
5. If $4 - d_U < d < 4 - d_L$, no definite conclusion about negative autocorrelation.
6. If $4 - d_L < d < 4$, there probably is evidence of negative autocorrelation.

d value always lies between 0 and 4.

The closer it is to zero, the greater is the indication of confident autocorrelation(ac), and the closer to 4, the greater is the evidence of negative. Normally d is about 2, there is no sign of optimistic or adverse (initial) command autocorrelation.

It has established upper (d_u) & lower (d_L) limits for the significance level of d.

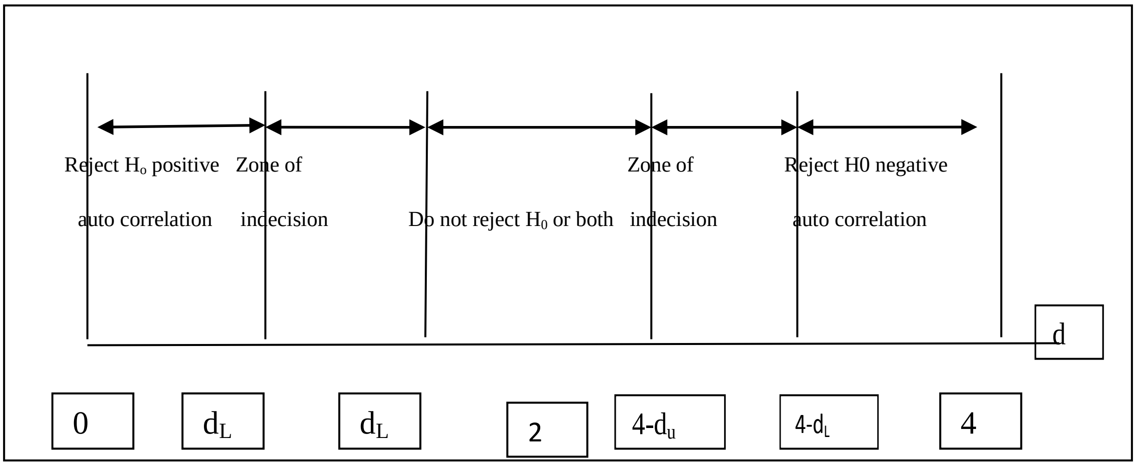


Figure: 3.1 Durbin- Watson statistics

3.9 Granger Causality

Granger Causality (1969) examination is arithmetical hypothesis test for assessing in one-time series is valuable in predicting extra, in other words the present worth of one mutable is produced by prior worth of additional variables. The indication of granger causality it is a decent pointer that a VAR, rather than a univariate model, is wanted. Even though the in the ordinary regression, the correlation and regression illustrate the relation between two variables but at on the same time they prepare not suggest action. Consider the following equations;

$$Y_t = \alpha_1 + \sum_{j=1}^{k_1} b_{2j} X_{i-j} + \sum_{i=1}^{m_1} C_{1i} Y_{t-i} + u_t$$

And

$$X_t = \alpha_2 + \sum_{j=1}^{k_2} b_{2j} X_{i-j} + \sum_{i=1}^{m_2} C_{2i} Y_{t-i} + v_t$$

Where k_1, k_2, m_1, m_2 are all positive integers and u_t, v_t are respectively the random disturbances of model 1 and 2.

3.10 Vector Auto regression (VAR) Models

Macro econometrician Christopher Sims (1980) developed in this model of Vector Auto Regression Models (VAR). The joint dynamics and casual relation among a set of macroeconomic variables. VAR models are helpful for forecasting. Consider an invariable autoregressive model for

VAR models are identifying two equations by two variables

Yt= $\alpha_0 + \alpha_1 X_{t-1} + \beta_1 Y_{t-1} + e_{1t}$

Xt= $\alpha_0 + \alpha_2 X_{t-1} + \beta_2 Y_{t-1} + e_{2t}$

Anywhere the β's is unidentified constants

Surprise movement is this error terms. Any variables are correlated in application of the model the error terms also correlated.

The amount of insulated standards to comprise in recognized of respectively calculation can be strong-minded by dissimilar approaches. The F-statistic method or the ICA can be castoff to control the amount of lags to be comprised in VAR model. The lag will be released after the perfect and earnings to test the next lag and linger until lag that is important will be found. The AIC approach is also applied to choose the lag length of the VAR model.

3.11 Testing for Co-integration

The basic idea had been given by Engle and Granger 1987.

- If ($y_{1,t}$, $y_{2,t}$ ....,$y_{m,t}$) are cointegrated, the true equilibrium error process Et must be *I*(0).
- If they are not co-integrated, then $\in_t$ must be *I*(1)
- Test the worthless suggestion of no co-integration against the alternative of co-integration by performing a unit root test on the equilibrium error process $\in_t$.

3. 12 Wald Test

Wald test is identified a certain predictor variable is significant or not. The null hypothesis was rejected the corresponding coefficient being zero.

H_0: The coefficients of variables = 0

H_1: At least one coefficient of variables $\neq 0$

$$W = \frac{\left(\hat{\theta} - \theta_0\right)^2}{Var\left(\hat{\theta}\right)} \sim \chi_1^2$$

But under H_0, the parameter of interest is usually 0 (i.e. $\theta_0 = 0$). Then the Wald statistic simplifies to

$$W = \frac{\left(\hat{\theta}\right)^2}{Var\left(\hat{\theta}\right)}$$

3.13 Model Diagnostics Test

Model is fitted the data. It is test is important to the evaluated outcome to lead number of diagnostics instructions. If the model fits well, the residuals must be basically behaving similar white sound that is regularized residuals are uncorrelated chance shock with zero mean and constant variance Montgomeryet.al (2015). Hence model diagnostic checking is accomplished through careful analysis of residual series. In our study work following diagnostic checking has been done to find the behavior of residuals.

To confirm and trust the results from the ARDL, it is necessary to kind of residuals are white noise. Therefore, following diagnostic checks are tested the fitted model.

3.13.1 Correlogram Q-Statistics of residuals

Correlogram Q-Statistics of residuals is explained the PACF and ACF of the equation errors up to the definite figure of pauses and calculates. Following hypothesis was tested in order to check whether the residuals are uncorrelated.

H_0: Residuals are uncorrelated

H_1: Residuals are correlated

3.13.2 Serial Correlation

This test is inspected by LM Test. Errors for ARDL output is verified in this test, spending the succeeding suggestion:

H_0: There is no Serial correlation in the errors

H_1: There is Serial correlation in the errors

3.13.3 Heteroscedasticity

In this analysis is very significant to check the heftiness of the ARDL yield since we cannot trust on them in the attendance of heteroscedasticity. The presence of heteroscedasticity is examined by Breusch-Pagan-Godfrey heteroscedasticity test.

H_0: There is no effect in the residuals

H_1: There is effect in the residuals

3.13.4 Normality Test

Error term are normally distributed in this analysis is very important to every fitted model. The usual distribution of the hypotheses remains given below:

H_0: Errors are usually spread

H_1: Errors are not usually spread

It is clear from the literature review, that most of the researches done on stock returns confirm that there is a tendency for the stock market returns to deviate from normality. But it should be tested in the study in order to gain correct estimates. The normality of the returns can be tested using the Jarque-Bera test for normality. This test will measure the skewness and kurtosis of the series compared to the usual distribution.

Jarque-Bera test measurement is given below.

$$L= \frac{N}{6}\left(S^2 + \frac{(K-3)^2}{4} \right)$$

Where:

S- Skewness

K –Kurtosis

N -amount of observations.

Under the null hypothesis, $L \sim \chi^2_{2,5\%}$. Therefore, if $L > \chi^2_{2,5\%}$, then H_0 will be rejected.

3.14 Hypotheses Development

A hypothesis is testable form and predicts a particular relationship between two or more variables. If a researcher thinks that a relationship exists, the study should first state it as a hypothesis and then test the hypothesis in the field (Bailey, 1978).

H_0: There is not significant impact of Macroeconomic variables on CPI.

H_1: There is a significant effect of Macroeconomic variables on CPI.

Chapter 4

Analysis and Discussion

4.0 Introduction

In this chapter includes the fitted time series models to forecast consumer price index. Preliminary analysis has been carried out to check the validity of the data series for the time series analysis and to understand the behaviour of the data series. Under Auto regressive distributed Lag Model building techniques was discussed.

4.1 Test for Stationary

An important for data examination is to see whether a series is stationary or not stationary. First co integration test was establishing long run relationship the proceeding then essentially to test the economic time series for stationary. Because economic variables are expected to be stationary before they can be used for meaningful statistical analysis. Any variable is not stationary, a large R^2 value can be obtained while around is no expressive relation among variables. However, practically, many economic time series are not stable and as such causes the conventional OLS-based statistical inferences to be spurious. To reject this problem, the variables were subjected to stationary test. Therefore, the first test is the fixed possessions of variables by employing the Unit Root Test.

The study used two different tests, such as Augmented Dickey Fuller (ADF) test and Phillips-Perron (PP) test for finding unit root in time series. Both analyses were performed on variables at level and also at first difference to test the following hypothesis.

H_0: Variable has unit root

H_1: Variable has not had a unit root

The results of Augmented Dickey fuller test for each of the logged values of the variables after collecting data, it is necessary to test for its suitability to carry on stationary time series analysis.

4.1.1 CPI

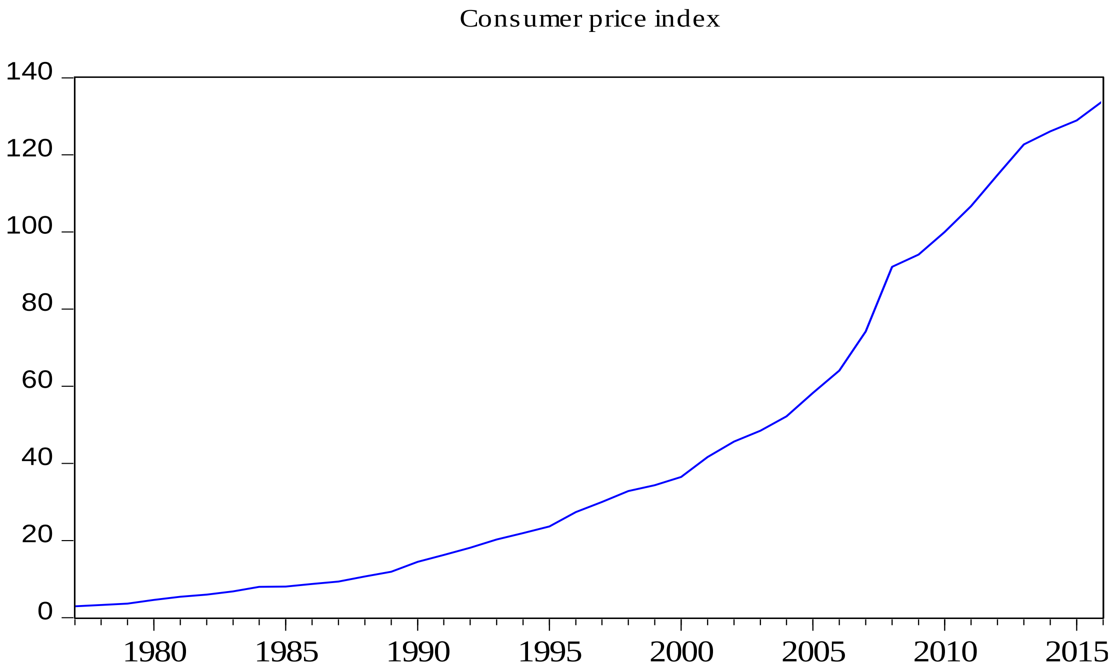


Figure 4.1: Time series plot of yearly consumer price index

Figure 4.1 shows the trend of CPI over the years from 1977 to 2016.It is shown that CPI shows an upward trend until 1985.In 1995, it declined slightly and then it shows an upward movement from1996 to 2016.

Table 4.1: ADF test results in CPI

Variable	ADF test statistic Null Hypothesis: Variable is Non- Stationary			
	Level		First Difference	
	Test Statistic	P-value	Test Statistic	P-value
Consumer Price Index	4.730506	1.000	-3.008470	0.0431

By looking at the results of Table 4.1 it is clear that ADF run at level appears that the p-values for Consumer price index is higher than the significance level of 5%. Therefore, the consumer price index is non-stationary at decided level. This implies that it is needed to take the first difference of that variable and check for stationary.

The results of ADF and PP that checked of first difference series show that the p-values for Consumer price index is less than the significant level of 5%. There ore null hypothesis can be disallowed and thus, can be concluded that all variables are stationary.

4.1.2 GDP

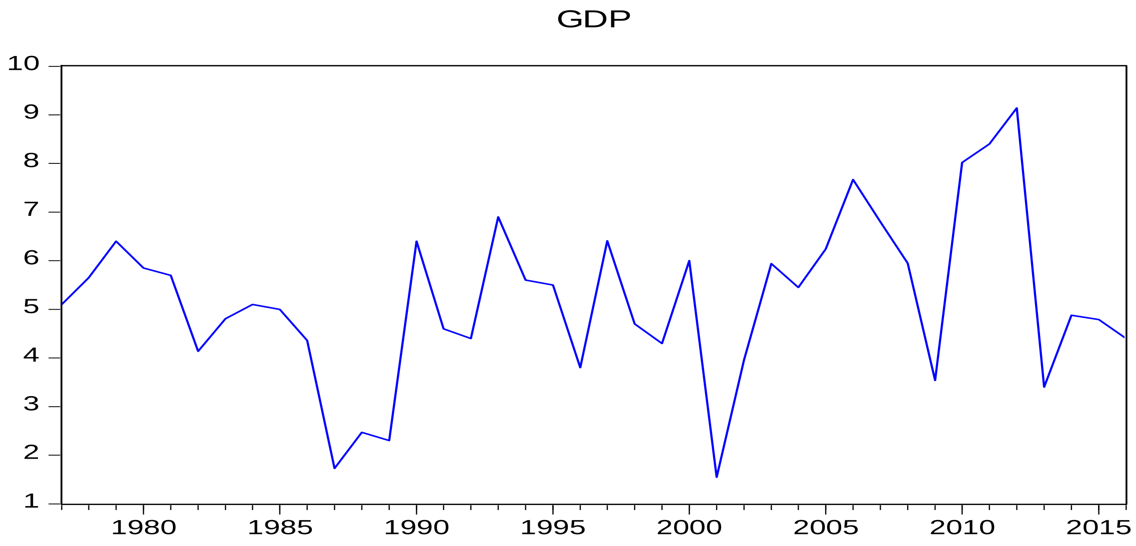


Figure 4.2: Time series plot of yearly GDP

Figure 4.2 shows how to GDP changes over the time period from 1977 to 2016. It shows a decreasing trend from 1987 and 2000. Then it improved slightly in 2001 and the changes in GDP remain almost same until 2003. Then there are wide fluctuations all years.

Table 4.2: ADF unit root test results in GDP

Variable	ADF test statistic	
	Level	
	Test Statistic	P value
GDP	-4.420953	0.0011

The above Table 4.2 it is clear that ADF run at level appears that the p-values for Consumer price index is less than the significance level at 5%. Therefore, the insignificant proposition is excluded and can be decided that GDP is stationary.

4.1.3 Inflation

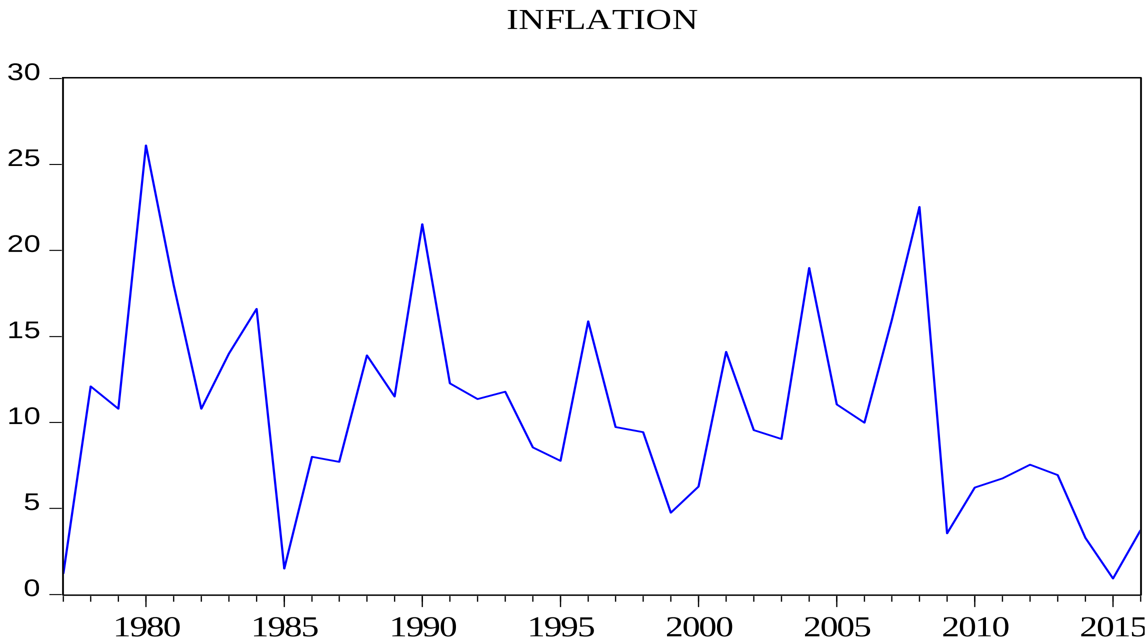


Figure 4.3: Time series plot of yearly Inflation

Figure 4.3 demonstrates the trend of INF during the period from 1977 to 2016. It shows the downward trend from 1983-1985 and then it improved sharply in 1990. In 1995, it dropped down. Inflation rate in Sri Lanka shows an upward trend and then it decreased until 2015.In 2016, inflation rate has improved.

Table 4.3: ADF unit root test results in inflation

Variables	ADF test	
	Level	
	Test Statistic	P-Value
Inflation	-4.761998	0.0004

The above Table 4.3 it is clear that ADF run at level appears that the p-values for inflation is less than the significance value at 5%. Therefore, the insignificant suggestion is rejected and can be settled that inflation is stationary.

All three variables are based on log value on pp test and ADF test are less than 5%. Therefore, the null hypothesis is rejected and alternative hypothesis was accepted.

4.1.4 GNP

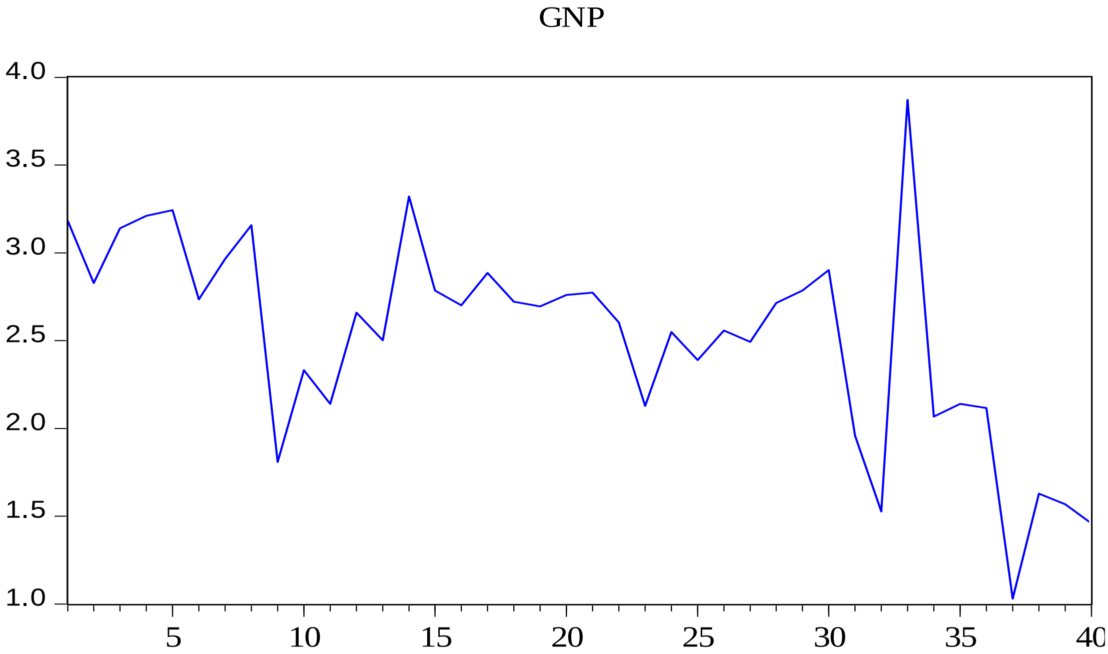


Figure 4.4: Time series plot of yearly GNP

Figure 4.4 demonstrates the trend of GNP during the period from 1977 to 2016. It shows the downward trend from 1984 and 1997 and then it improved sharply in 2010. In 1995, it dropped down. GNP rate in Sri Lanka shows an upward trend and then it decreased until 2013.In 2016, GNP has improved.

Table 4.4: ADF unit root test results in GNP

Variable	ADF test	
	Level	
	Test Statistic	P- value
GNP	-3.931520	0.0043

The above Table 4.4 it is clear that ADF run at level appears that the p-values for GNP is less than 5% of the critical value. Therefore, GNP is stationary and null hypothesis is rejected.

4.1.5 Exchange Rate

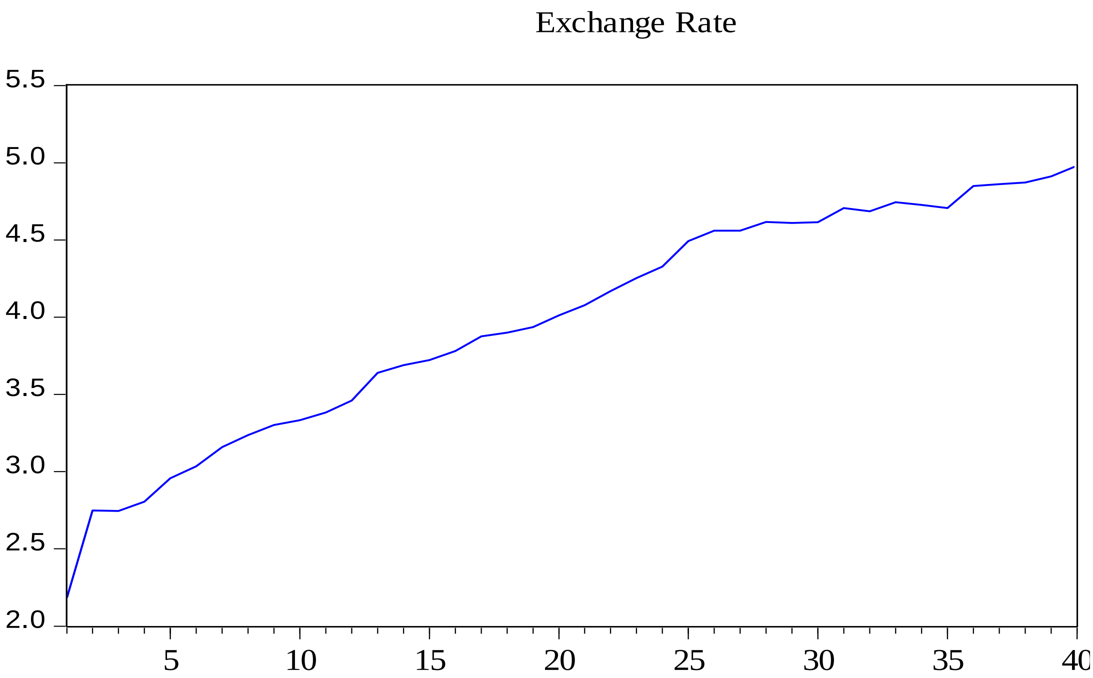


Figure 4.5: Time series plot of yearly Exchange rate

Figure 4.5 demonstrates the trend of exchange rate during the period from 1977 to 2016. It shows the downward trend from 1980 to 2000 improved. In 2011, it dropped down.

Table 4.5: ADF unit root test results in Exchange rate

Variable	ADF Test			
	Level		First Difference	
	Test Statistic	P-value	Test Statistic	P-value
Exchange Rate	-3.434456	0.1156	-12.47882	0.000

The above Table 4.5 it is clear that ADF run at level appears that critical value of 5% level. Therefore, exchange rate is higher than the significance level. Therefore, the exchange rate is non-stationary at decided level. This implies that it is needed to take the first difference of that variable and check for stationary.

The results of ADF and PP that checked of first difference series show that the p-values for exchange rate is less than the significant level of 5%. There ore null hypothesis can be disallowed and thus, can be concluded that all variables are stationary.

All five variables are based on log value on less than 5% in this ADF and PP test. Therefore, the alternative hypothesis was accepted and null hypothesis is rejected (Attached Annexure A).

There after identify the lag selection in this analysis multivariate cointegration analysis is more suitable for lag identification for the variables. For selection of appropriate lag length, five criteria were identified namely sequential modified Akaike information criterion (AIC) LR test statistic (LR), Final prediction error (FPE), and Hannan-Quinn information criterion (HQ). Schwarz information criterion (SC). Out of them, LR, FPE, AIC and HQ selected lag length of 1. The outcomes stay given in Stand 4. 6 below.

Table 4.6: VAR Lag Order Selection Criteria

VAR Lag Order Selection Criteria Endogenous variables: LNY LNX1 LNX2 LNX3 LNX4 Exogenous variables: C Sam: 1 40 Observe: 37						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-90.00059	NA	0.000117	5.135167	5.352859	5.211913
1	90.41005	302.3097*	2.67e-08*	-3.265408*	-1.959258*	-2.804929*
2	108.6194	25.59157	4.16e-08	-2.898358	-0.5033740	-2.054136
3	131.5525	26.03209	5.75e-08	-2.786620	0.696446	-1.558676

* Selection of lag

Each test at 5 % level in sequential modified LR test statistic- LR

FPE- Final prediction error

AIC - Akaike information criterion

SC- Schwarz information criterion

HQ- Hannan-Quinn information criterion

It is recommended the interval 1 is an optimum lag length to develop a VAR model as we decided to conduct a Granger Causality to test a causality effect among four variables. As the original data does not stationary we make them stationary taking their first difference series.

4.2 Test of Causal Relationship among the Variables

A number of arguments have been made regarding how certain macro-economic variables effect on CPI. In the analysis empirically examines the degree to which the selected macro-economic variables effect on CPI in Sri Lanka. In this analysis was undertaken using Granger causality test.

Analysis of this study is explained to test goals at decisive whether previous principles of a variable assistance to forecast variations in additional variable. In this study, the Granger Connection test is showed the fundamental association between the GDP, Inflation, GNP and Exchange rate and CPI.

This Granger causality test has been carried out for lag 2 for first difference of each variable as they are showed stationary property.

Ho: X does not Granger Cause Y

H_1: X does Granger Cause Y

This Granger causality test with respect to CPI and GDP, inflation, GNP and Exchange rate are presented in Table 4.7.

Table 4.7: Pairwise Granger causality tests

Sample: 1 40 lags: 2			
Null Hypothesis:	Observation	F-Stic	Probability
LNX1 does not Granger Cause LNY	38	0.09219	0.9122
LNY does not Granger Cause LNX1		0.45049	0.6412

LNX2 does not Granger Cause LNY	38	0 .88448	0.4225
LNY does not Granger Cause LNX2		2.89638	0.0694
LNX3 does not Granger Cause LNY	38	0 .68930	0.5090
LNY does not Granger Cause LNX3		5.52836	0.0085
LNX4 does not Granger Cause LNY	38	1.14740	0.3298
LNY does not Granger Cause LNX4		0.26409	0.7695
LNX2 does not Granger Cause LNX1	38	1.49081	0.2400
LNX1 does not Granger Cause LNX2		0.09933	0.9057
LNX3 does not Granger Cause LNX1	38	1.51765	0.2341
LNX1 does not Granger Cause LNX3		1.46251	0.2463
LNX4 does not Granger Cause LNX1	38	0.62023	0.5440
LNX1 does not Granger Cause LNX4		0.33618	0.7169
LNX3 does not Granger Cause LNX2	38	3.96541	0.0286
LNX2 does not Granger Cause LNX3		3.12109	0.0574
LNX4 does not Granger Cause LNX2	38	1.39094	0.2630
LNX2 does not Granger Cause LNX4		0.29495	0.7465
LNX4 does not Granger Cause LNX3	38	2.49462	0.0980
LNX3 does not Granger Cause LNX4		0.98362	0.3847

According to the results presented in Table 4.7, it is clear that the worthless suggestion, which indicated that LNY has not Granger cause LNX1, LNX2, LNX3 and LNX4 fixes not Granger reason LNX2, LNX4 has not Granger cause LNX3 and LNY ensures not Granger root all variables are rejected. That indicates consumer price index does Granger cause inflation. However, the reverse is rejected and concludes that inflation does not Granger Cause Consumer price index. Therefore, in this analysis ideal connection exists after inflation to Consumer Price Index. Therefore, it can be inferred from the result that, inflation can be seen as a leading indicator that may influence or help in estimating the consumer price index.

All model is checked there is not significant the result of consumer price index.

4.3 Regression Model

The general linear regression model on one non-stationary time series y_t as a combination of other non-stationary time series x_{1t}, x_{2t}...., x_{kt} can be written as follows:

$$Yt = \beta_0+\beta_1 x_{1t} + \beta_2 x_{2t} + \ldots\ldots\ldots\ldots\ldots\ldots + \beta_k x_{1t} + e_t$$

Where $E_t \sim iid(0, \sigma^2)$ and β_i are parameters.

The behaviour of four variables carried out the regression analysis. Results of the regression analysis are given as follows;

Table 4.8: Autoregressive distributed Lag Analysis for Consumer Price Index, Inflation rate and GDP GNP and Exchange rate.

Dependent Variable: LNY
Method: ARDL
Sample (adjusted): 6 40
Included observation: after the adjustments 35
Max dependent lags: 4 (Auto selection)
Model selection method: AIC
Dynamic regressors (4 lags, automatic): LNX1(-1) LNX2(-1) LNX3(-1) LNX4(-1)
Fixed regressors: C
Number of models evalulated 12500
Selected Model: ARDL(4, 2, 4, 3, 4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNY(-1)	1.556857	.341057	4.564805	.0005
LNY(-2)	-.7110617	.514232	-1.381899	.1903
LNY(-3)	.639865	.478895	1.336128	.2044
LNY(-4)	-0.874897	0.357325	-2.448460	0.0293

LNX1(-1)	0.094660	0.033043	2.864728	0.0133
LNX1(-2)	0.050155	0.028148	1.781847	0.0981
LNX1(-3)	0.069583	0.024293	2.864270	0.0133
LNX2(-1)	-0.038030	0.025291	-1.503693	0.1566
LNX2(-2)	-0.028538	0.025617	-1.114030	0.2854
LNX2(-3)	-0.091846	0.035060	-2.619687	0.0212
LNX2(-4)	-0.008602	0.015232	-0.564744	0.5819
LNX2(-5)	-0.046417	0.015998	-2.901321	0.0124
LNX3(-1)	0.018214	0.017556	1.037475	0.3184
LNX3(-2)	0.012767	0.019242	0.663479	0.5186
LNX3(-3)	-0.027481	0.023679	-1.160568	0.2667
LNX3(-4)	-0.057532	0.028429	-2.023699	0.0641
LNX4(-1)	0.627222	0.214504	2.924061	0.0118
LNX4(-2)	-0.824926	0.213739	-3.859503	0.0020
LNX4(-3)	0.634008	0.213203	2.973726	0.0108
LNX4(-4)	-0.398010	0.186822	-2.130418	0.0528
LNX4(-5)	0.486919	0.100735	4.833669	0.0003
C	-.572069	.202935	-2.818983	.0145
R-squared	0.999636	Mean dependent variable		3.498936
Adjusted R-squared	0.999047	S.D. dependent variable		0.981805
S.E. of regression	0.030310	Akaike info criterion		-3.887942
Sum squared residual	0.011943	Schwarz criterion		-2.910295
Log likelihood	90.03899	Hannan-Quinn Criterian		-3.550459
F-statistic	1698.181	Durbin-Watson stat		2.243178
Pro(F-statistic)	0.000			

.

- P-values and any subsequent tests do not account for model selection.

Where

X1- GDP

X2- Inflation

X3- GNP

X4- Exchange Rate

Y- Consumer Price index

e-Error tem

Table 4.8 shows that 99.96 % of the variance in CPI and the estimated Standard of the error term is 0.0303 and indicated that p- value is 0.0000 which is less than 0.05. It mentions that there is an important impact X1, X2, X3 and X4 on CPI in different lag. The adjusted R^2 value is 0.9990 which means that all variables impact by 99.90% on consumer price index and remaining 0.10% are determined by other factors. A Durbin- Watson stat show a value of 2.24 which is closer to table value implies that around is no serial association. Even though the R^2 indicate the better the model fit it does indicate the model accuracy. Standard error of regression assesses how well the model describes the response. It denotes the standard deviation of in what way for the data principles fall from the fixed values. The minor values of standard error the healthier the model pronounces the response. Even though the regression model is fitted it does explain the relationship of factors well.

The above table presents the value of the estimated long run coefficients he dependent variable is CPI. Value of coefficient of the GDP is 0.0946, therefore in the long run; CPI is positively connected to the GDP in Sri Lanka. It explains further that increase in GDP (LNX1 (-1)) leads to a 9.46 % increase in consumer price index, and the connection is significant level. Coefficient of the rate of GDP (LNX1 (-2)) is 0.0515, It explains that growth in GDP indicate to a 5.15% rise in consumer price index, and the association is significant level and coefficient of the rate of GDP (LNX1 (-3)) is 0.06958, it clarifies further that rises in GDP leads to a 6.95% increase in CPI, and the liaison is significant level.

In this coefficient of the rate of inflation is -0.0380, It explains further that reduction in inflation (LNX2 (-1)) indicate to a 3.8 % diminution in consumer price index, and no affiliation is significant level, coefficient inflation is -0.0285, it explains further that decrease in inflation (LNX2 (-2)) point to a 2.85 % decrease in CPI. Then coefficient of the degree of rise is -0.0918, further that decline in inflation (LNX2 (-3)) leads to a 9.18 % reduction in consumer price index, and no relationship is significant level, the coefficient of the rate of inflation is -0.0086. It explains further that lessening in inflation(LNX2 (-4)) leads to a 0.08 % decrease in CPI, the coefficient of the degree of inflation is -0.0464, further that decline in inflation (LNX2(-2)) clues to a 4.64 % reduction in consumer price index, and no relationship is significant level.

The coefficient of the rate of GNP is 0.01821, which means that in the extended run, consumer price index is positively connected to the GNP in Sri Lanka. It explains further that increase in GNP (LNX3 (-1)) leads to a 1.82 % decrease in consumer price index, and no relationship is significant level. The coefficient of the rate of GNP is 0.01276, which means that in the elongated run, consumer price index is positively associated to the inflation in Sri Lanka. It explains further that increase in GNP (LNX3 (-2)) leads to a 1.27 % decrease in CPI. The coefficient of the proportion of GNP is -0.0274, which means that in the extended run, consumer price index is harmfully related to the inflation in Sri Lanka. It explains further that decrease in GNP (LNX3 (-3)) leads to a 2.74 % decrease in consumer price index, and no relationship is significant level, the coefficient of the rate of GNP is -0.05753, which means that in the long run, consumer price index is destructively related to the GNP in Sri Lanka .It explains further that a it decrease in GNP (LNX3 (-4)) leads to a 5.75 % decrease in consumer price index, and no relationship is significant level.

The constant of the rate of conversation amount is 0.62722, which means that in the extended run, consumer price index is positively related to the GNP in Sri Lanka. It explains further that rise in exchange rate (LNX4 (-1)) point to a 62.72 % decline in consumer price index, and relationship is significant level. The constant of the rate of conversation rate is -0.8249, which means that in the extended run, consumer price index is damagingly related to the exchange rate in Sri Lanka. It explains further that increase in exchange rate (LNX4 (-2)) leads to 8.24% decrease in CPI. The coefficient of the rate of exchange rate is 0.6340, which means that in the extended run, consumer price index is destructively related to the exchange rate in Sri Lanka. It explains further that increase in GNP (LNX4 (-3)) leads to a 6.34 % increase in consumer price index, and association is significant level, the coefficient of the rate of exchange rates -0.3980, which means that in the long run, consumer price index is damagingly related to the exchange rate in Sri Lanka.It explains further that decrease in GNP (LNX4 (-4)) leads to a 3.98 % decrease in consumer price index, and no relationship is significant level.

The coefficient of the rate of exchange rate is 0.4869, which means that in the long run, consumer price index is positively related to the exchange rate in Sri Lanka. It explains further that rise in exchange rate (LNX4 (-5)) indicate to a 48.69 % increase in consumer price index, and associations significant level.

4.4 Diagnostics of Residual

To settle and faith the outcomes from the table 4.8 ARDL model, it is necessary to style guaranteed that the residuals are white noise. Therefore, following analytic checks were supported out to justify the accuracy of the fixed model.

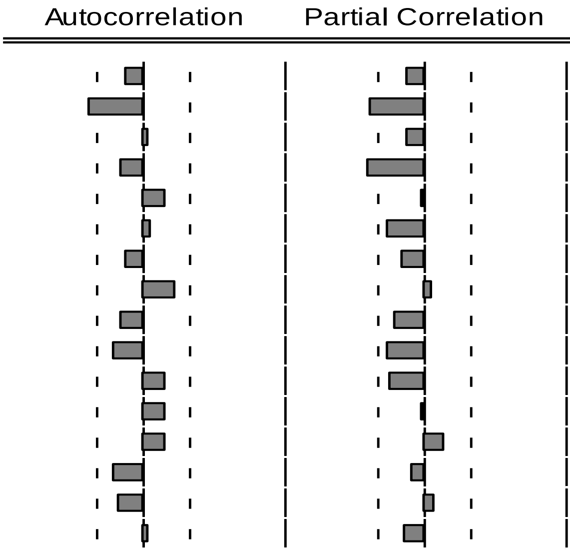
4.4.1 Correlogram Q-Statistics of residuals

Normally Auto correlation and Partial Auto Correlation of the equation errors up to the stated figure of lags and calculates the Ljung-Box Q-statistics (LBQ) for the corresponding lags. Following hypothesis was tested in order to check whether the residuals are uncorrelated.

H_0: Residuals are uncorrelated

H_1: Residuals are correlated

Sample: 1 40
Included observations: 35
Q-statistic probabilities adjusted for 4 dynamic regressors



	AC	PAC	Q-Stat	Prob*
1	-0.128	-0.128	0.6236	0.430
2	-0.386	-0.409	6.4597	0.040
3	0.025	-0.118	6.4845	0.090
4	-0.167	-0.423	7.6450	0.105
5	0.157	-0.017	8.7091	0.121
6	0.045	-0.263	8.8009	0.185
7	-0.124	-0.160	9.5148	0.218
8	0.228	0.065	12.008	0.151
9	-0.158	-0.224	13.257	0.151
10	-0.226	-0.279	15.913	0.102
11	0.169	-0.246	17.454	0.095
12	0.167	-0.018	19.026	0.088
13	0.164	0.146	20.606	0.081
14	-0.206	-0.088	23.216	0.057
15	-0.184	0.078	25.416	0.045
16	0.039	-0.153	25.520	0.061

*Probabilities may not be valid for this equation specification.

Figure 4.6: Correlogram of residuals

By looking at the figure 4.6 which is the error of correlogram, slightly shape in the ACF and PACF cannot be identified which safeguards the robustness of the results. Therefore, the p-values are larger than 0.05 up to 20^{th} lag, worthless hypothesis is not rejected and it is clear that the errors are uncorrelated at 5% significance level.

4.4.2 Serial Correlation

Breusch-Godfrey developed by this Serial Correlation LM Test.In this following hypothesis test for in this analysis.

H_0: There is no Serial correlation in the residuals

H_1: There is Serial correlation in the residuals

Table 4.9: Breusch -God serial LM test

Breusch -God Seri LM Test:			
F-statistic	2.384638	Prob. F(2,11)	0.1379
Obs*R-squared	10.58543	Prob. Chi-Square (2)	0.0650

Above table indicate that the probability value is 0.1379 which is less than 0.05 percent. So, the null hypothesis is not disallowed, and the absence of autocorrelation can be concluded.

4.4.3 Heteroscedasticity

Output of the robustness is check by in this test. The presence of heteroscedasticity is examined by Breusch-Pagan-Godfrey heteroscedasticity test.

H_0: There is no effect in the errors

H_1: There is effect in the errors

Table 4.10: Breusch-Pa-God hetero test

Heteroscedasticity test Breusch-Pagan-Godfrey			
F-statistic	0.291136	Prob. F(21,13)	.9941
Obs*R-squared	11.19529	Prob. Chi-Sq(21)	.9588
Scaled explained SS	2.733518	Prob. Chi-Squ (21)	1.0000

In this table 4.10 specify that the probability value is 0. 9941. It is larger than significant value 0.05. Therefore, hypothesis of null hypothesis cannot be excluded and can be concluded that there is no effect in the residuals.

4.4.4 Test of Normality

In this test identify the error term indicate the normal distribution and following hypothesis are formulated as below:

H_0: Errors are usually spread

H_1: Errors are not usually spread

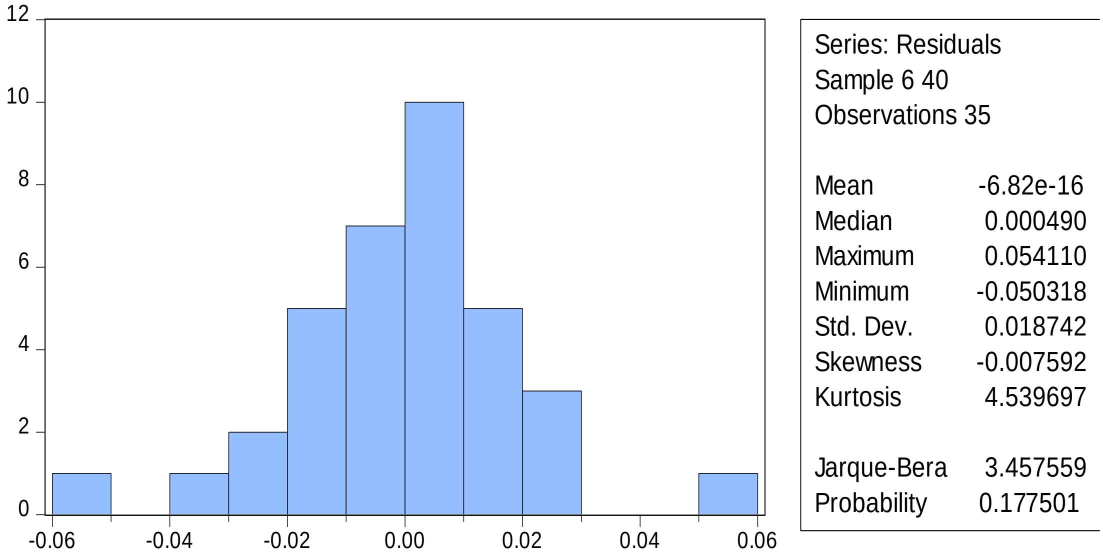


Figure 4.7**:** Histogram of residuals

By looking at the Figure 4.8, the histogram shows that residuals are usually spread. The familiarity of errors is also established by the Jarque-Bera test since then p-value (1775) is larger than the acute value at 5 percent level. So, the worthless hypothesis cannot be excluded and can be decided that the residuals are generally circulated.

4.5 Test of Short Run Relationship between the Variables

Wald test was used to identify any significant short run association between Macro economic variables and CPI. Analysis is to the outcomes are presented as follows.

4.5.1 Short run relationship Consumer price index

$H_0: C(1) = C(2) = C(3) = C(4) = 0$

$H_1: at\ least\ one\ C(i) \neq 0\ for\ i = 1,2,3,4$

Table 4.11: Wald test for the Consumer Price Index

Wald Test: System: %system			
Test Statistic	Value	Df	Probability
F-statistic	40.08210	(4,13)	.0000
Chi-square	160.3284	4	.0000

Null Hypothesis: C(1) =C(2)= C(3)=C(4)=0 Null Hypothesis Summary		
Nor Restriction (= 0)	Value	Std. Error.
C(1)	1.556857	.341057
C(2)	-.710617	.514232
C(3)	.639865	.478895
C(4)	-.874897	.357325

Results in Table 11 indicate that the probability-value of Chi-square statistic test is 0.0000 less than 0.05. Therefore, H_0 is disallowed at 5% level of implication and container be decided that here is a short run relationship of LNY (consumer price index).

4.5.2 Short run relationship between GDP

$H0: C(5) = C(6) = C(7) = 0$

$H1: at\ least\ one\ C(i) \neq 0\ for\ i = 5,6,7$

Table 4.12: Wald test for the relationship between GDP

Wald Test: System: %system			
Test Statistic	Value	Df	Probability
F-statistic	3.517175	(3,13)	.0460
Chi-square	10.55153	3	.0144

Null Hypothesis : C(5)=C(6)= C(7)=0 Null Hypothesis Summary:		
Normalized Restriction (= 0)	Value	Std. Error.
C(5)	.094660	.033043
C(6)	.050155	.028148
C(7)	.069583	.024293

Restrictions are linear in coefficients.

The above table indicates that the P-value of Chi-square test statistic is 0.0014 less than 0.05.Therefore, 5% significance H_0 is disallowed and can be explained that around is a short run association from LNX1 (Gross domestic product). Inflame lag values.

4.5.3 Short run relationship between Inflation

$H_0: C(8) = C(9) = C(10) = C(11) = C(12) = 0$
$H_1: at\ least\ one\ C(i) \neq 0\ for\ i = 8,9,10,11,12$

Table 4.13: Wald test for the relationship between inflation

Wald Test:			
System: %system			
Test Statistic	Value	Df	Probability
F-statistic	2.638400	(5,13)	.0737
Chi-square	13.19200	5	.0216
Null Hypothesis: C(8)=C(9)= C(10)= C(11)= C(12)=0			
Null Hypothesis Summary:			

Normalized Restriction (= 0)	Value	Std. Error.
C(8)	-.038030	.025291
C(9)	-.028538	.025617
C(10)	-.091846	.035060
C(11)	-.008602	.015232
C(12)	-.046417	.015998

In this table indicates that the probability-value of Chi-square test statistic is 0.000 less than 0.05. Therefore, 5% significance level H_0 is rejected and can be mentioned that there is a short run relationship from LNX3 (inflation).

4.5.4 Short run relationship between GNP

$H_0: C(13) = C(14) = C(15) = C(16) = 0$
$H_1: at\ least\ one\ C(i) \neq 0\ for\ i = 13,14,15,16$

Table 4.14: Wald test for the relationship between GNP

Wald Test: System: %system			
Test Statistic	Value	Df	Probability
F-statistic	2.078739	(4,13)	.1421
Chi-square	8.314956	4	.0807
Null Hypothesis: C(13)=C(14)= C(15)= C(16)=0 Null Hypothesis summary:			

Normalized Restriction (= 0)	Value	Sd. Error.
C(13)	-.018214	.017556
C(14)	-.012767	.019242
C(15)	-.027481	.023679
C(16)	-.057532	.028429

As a result, that the probability - value of Chi-square test statistic is 0.000 less than 0.05.Therefore, 5% significance level H_0 is not rejected and can be mentioned that there is a no short run relationship (causality) from LNX3 (GNP).

4.5.5 Short run relationship between Exchange rate

H_0: $C(17) = C(18) = C(19) = C(20) = (21) = 0$
H_1: $at\ least\ one\ C(i) \neq 0\ for\ i = 17,18,19,20,21$

Table 4.15: Wald test for the relationship between Exchange rate

Wald Test: System: %system			
Test statistic	Value	Df	Probability
F-statistic	7.634411	(5,13)	.0015
Chi-square	38.17205	5	.0000
Null Hypothesis: C (17) =C(18)= C(19)= C(20)=C(21)=0 Null Hypothesis Summary:			

Normalized Restriction (= 0)	Value	Std. Error.
C(17)	.627222	.214504
C(18)	-.824926	.213739
C(19)	.634008	.213203
C(20)	-.398010	.186822
C(21)	.486919	.100735

The above table illustrated that the probability-value of Chi-square test statistic is 0.000 less than 0.05. Therefore, 5% significance H_0 is precluded and can be mentioned that there is a short run connection from LNX4 (Exchange rate).

In above analysis of short run no association the variables of GNP. So Again ARDL model will be check in this analysis.

Table 4.16: Autoregressive distributed Lag Analysis for Consumer Price Index, Inflation rate and GDP and Exchange rate.

Dependent Variable: LNY
Method: ARDL
Sample (adjusted): 6 40
Included observation: after the adjustments 35
Max dependent lags: 4 (Auto selection)
Model selection method: AIC
Dynamic regressors (4 lags, automatic): LNX1(-1) LNX2(-1) LNX4(-1)
Fixed regressors: C
Number of models evaluated 12500
Selected Model: ARDL (4, 4, 4, 4)

Var	Coef	St. Err	t-Sta	Pro.*
LNY(-1)	0.868140	0.187946	4.619098	0.0030
LNY(-2)	-0.179282	0.287817	-0.622901	0.5427
LNY(-3)	-0.084738	0.299590	-0.282846	0.7812
LNY(-4)	0.359728	0.200229	1.796583	0.0926
LNX1(-1)	0.000497	0.015420	0.032216	0.9747
LNX1(-2)	0.021991	0.115156	1.450965	0.1674
LNX1(-3)	0.042837	0.013818	3.100031	0.0073
LNX1(-4)	0.010010	0.011858	0.844133	0.4119
LNX1(-5)	0.019669	0.011228	1.751744	0.1002
LNX2	0.061616	0.007209	8.546951	0.0000
LNX2(-1)	0.020539	0.014244	1.441908	0.1699
LNX2(-2)	0.031211	0.017252	1.809111	0.0905
LNX2(-3)	0.042177	0.018423	2.289401	0.0370

LNX2(-4)	0.023486	0.009200	2.552721	0.0221
LNX4(-1)	-0.013593	0.010135	-1.341171	0.1998
LNX4(-2)	-0.019851	0.011901	-1.668015	0.1160
LNX4(-3)	-0.035068	0.013519	-2.593994	0.0203
LNX4(-4)	-0.034813	0.013814	-2.520162	0.0235
LNX4(-5)	-0.037988	0.012698	-2.991714	0.0091
C	0107015	0.077440	1.381920	0.1872
R-squared	.999786	Mean dependent var		3.498936
Adjusted R-squared	.999516	S.D. dependent var		.981805
S.E. of regression	.021609	Akaike info criterion		-4.535830
Sum squared resid	.007004	Schwarz criterion		-3.647059
Log likelihood	99.37702	Hannan-Quinn Criter		-4.229026
F-statistic	3693.203	Durbin-Watson stat		2.078779
Pro(F-statistic)	0.0000			

Table 4.16 shows that 99.97 % of the variance in consumer price index and the evaluated error term is 0.007 and indicated that p- worth is 0.000 which is less than 0.05. It indicates that there is an important impact X1, X2 and X4 and on consumer price index in different lag. The adjusted R^2 value is 0.9995 which means that all variables impact by 99.95% on consumer price index and remaining 0.05% are determined by other factors. Durbin- Watson stat shows a value of 2.07 which is closer to table value implies that there is no serial correlation. Even though the R^2 indicate the better the model fit it does indicate the model accuracy. Standard error of regression assesses how well the model describes the response. It mentioned that how for the data standards fall from the tailored values in the standard deviation. The lower values of standard error the improved the classical defines the reply. Even though the regression model is fitted it does explain the relationship of factors well.

The above table presents the value of the estimated long run coefficients he dependent variable is CPI. The coefficient of the rate of GDP is 0.00049, which means that in the extended run, consumer price index is positively connected to the GDP in Sri Lanka. It explains further that increase in GDP (LNX1 (-1)) leads to a

0.004 % increase in consumer price index, and the no relationship is significant level. The coefficient of the rate of GDP (LNX1 (-2)) is 0.0219, which means that in the extensive run, consumer price index is positively connected to the GDP in Sri Lanka. It explains further that upsurge in GDP point to 2.19% reduction in consumer price index, and the no relationship is significant level. The coefficient of the rate of GDP (LNX1 (-3)) is 0.0428, which means that in the extended route, consumer price index is positively connected to the GDP in Sri Lanka. It explains further that increase in GDP indicates to a 4.28% growth in consumer price index, and the relationship is significant level. There is another GDP (LNX1(-4)) and GDP (LNX1(-5)) are 0.0100 and 0.0196, which means that in the long run, consumer price index is positively connected to the GDP in Sri Lanka. It explains further that upsurge in GDP indicate to 1.00% and 1.96% increase in consumer price index, and the no relationship is significant level.

The coefficient of the rate of inflation is 0.0616, which means that in the extended run, consumer price index is positively connected to the inflation in Sri Lanka. It explains further that decrease in inflation LNX2 leads to a 6.16 % increase in consumer price index, and relationship is significant level, the coefficient of the rate of inflation is 0.0205, which means that in the extensive run, consumer price index is positively related to the inflation in Sri Lanka. It explains further that growth in inflation (LNX2 (-1)) leads to a 2.05 % diminution in consumer price index, and no relationship is significant level. The coefficient of the rate of inflation is 0.0312, which means that in the elongated run, consumer price index is positively related to the inflation in Sri Lanka. It explains further that increase in inflation (LNX2 (-2)) indicate to a 3.12 % increase in consumer price index. The coefficient of the rate of inflation is 0.0421, which means that in the long run, consumer price index is positively related to the inflation in Sri Lanka. It explains further that increase in inflation (LNX2(-3)) leads to a 4.21 % increase in consumer price index, and no relationship is significant level, the coefficient of the rate of inflation is 0.0234, which means that in the extended run, consumer price index is positively associated to the inflation in Sri Lanka. It explains further that increase in inflation (LNX2 (-4)) leads to a 2.34 % increase in CPI.

The coefficient of the degree of exchange rate is -0.0135, which means that in the long run, consumer price index is destructively associated to the exchange rate in Sri Lanka. It explains further that increase in exchange rate (LNX4 (-1)) leads to a 1.35 % decrease in consumer price index, and no relationship is significant level. The coefficient of the rate of exchange rate is -0.0198, which means that in the extended run, CPI index is negatively related to the inflation in Sri Lanka. It explains further that upsurge in exchange rate (LNX4 (-2)) leads to a 1.98 % reduction in consumer price index. The coefficient of the rate of exchange rate is -0.0350, which means that in the long run, consumer price index is damagingly related to the inflation in Sri Lanka. It explains further that decrease in exchange rate (LNX4 (-3)) leads to a 3.5 % decrease in consumer price index, and relationship is significant level, the coefficient of the rate of exchange rate is -0.0348, which means that in the long run, consumer price index is negatively related to the exchange rate in Sri Lanka. It explains further that decrease in exchange rate (LNX4 (-4)) leads to a 3.48 % decrease in consumer price index, and no relationship is significant level. The coefficient of the rate of exchange rate is -0.0379, which means that in the lengthy run, consumer price index is undesirably related to the exchange rate in Sri Lanka. It explains further that decrease in exchange rate (LNX4 (-5)) leads to a 3.79 % decrease in consumer price index, and relationship is significant level.

To confirm and trust the results from the table 4.16 ARDL model, it is necessary to variety guaranteed that the errors are snowy sound. Therefore, following diagnostic checks were carried out to justify the accuracy of the fitted model.

4.6 Residual Diagnostic Test

4.6.1 Correlogram Q-Statistics of residuals

Normally ACF and PACF of the equation residuals higher the potentially amount of gaps and calculates the Ljung-Box Q-statistics for the corresponding lags. Following hypothesis was tested in order to check whether the residuals are uncorrelated.

H_0: Residuals are uncorrelated

H_1: Residuals are correlated

Date: 03/09/19 Time: 09:56
Sample: 1 40
Included observations: 35
Q-statistic probabilities adjusted for 4 dynamic regressors

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
		1	-0.091	-0.091	0.3136	0.575
		2	-0.012	-0.020	0.3192	0.852
		3	-0.128	-0.132	0.9803	0.806
		4	-0.221	-0.252	3.0267	0.553
		5	0.065	0.007	3.2105	0.668
		6	0.073	0.055	3.4471	0.751
		7	0.255	0.227	6.4489	0.488
		8	-0.281	-0.302	10.223	0.250
		9	0.063	0.065	10.420	0.318
		10	-0.115	-0.038	11.100	0.350
		11	-0.080	-0.054	11.447	0.407
		12	0.016	-0.186	11.461	0.490
		13	-0.042	-0.060	11.566	0.564
		14	-0.133	-0.271	12.652	0.554
		15	-0.079	-0.051	13.059	0.598
		16	0.142	-0.045	14.433	0.567

*Probabilities may not be valid for this equation specification.

Figure 4.8: Correlogram of residuals

By looking at the figure 4.6 which is the residuals of the correlogram, any pattern in the ACF or PACF cannot be identified which guarantees the fitness of the outcomes. Since the probability value-values are higher than 0.05 up to 20^{th} lag, so that 5% significance level residuals are uncorrelated therefore null hypothesis also not rejected.

4.6.2 Serial Correlation

Breusch-Godfrey Serial Correlation LM Test used their analysis. Error for regression output are tested for serial correlation, the following hypothesis are formulated:

H_0: There is no Serial correlation in the errors

H_1: There is Serial correlation in the errors

Table 4.17: Breusch - God serial correlation LM test

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	.293655	Prob. F(2,13)	.7504
Obse*R-sq	1.512871	Prob. Chi-Sq (2)	.0650

The results of Table 4.17 indicate that the p-value is 0.0650 which is higher than critical value 0.05. Therefore, the absence of autocorrelation mentioned the null hypothesis is not rejected.

4.6.3 Heteroscedasticity

In this test is essential to identify the robustness of the outcome since we cannot rely on them in the attendance of heteroscedasticity. The presence of heteroscedasticity is examined by Breush -Pagan-Godfrey heteroscedasticity test.

H_0: There is no effect in the errors

H_1: There is effect in the errors

Table 4.18: Breush -Pagan-Godfrey heteroscedasticity test

Heteroscedasticity test: Breush -Pagan-Godfrey			
F-statistic	.278127	Prob. F(19,15)	.9951
Obs*R-squared	9.118047	Prob. Chi-Square (19)	.9715
Scaled explained SS	1.888963	Prob. Chi-Square (19)	1.0000

Results in Table 4.18 indicate that the p-value is .9715. It is higher than 0.05 percent. Therefore, no effect is in the errors so the null hypothesis cannot be rejected.

4.6.4 Test of Normality

In this test is essential to identify whether the residuals are follows distributed by normal and the following hypotheses are formulated as given below:

H_0: errors are usually spread

H_1: errors are not usually spread

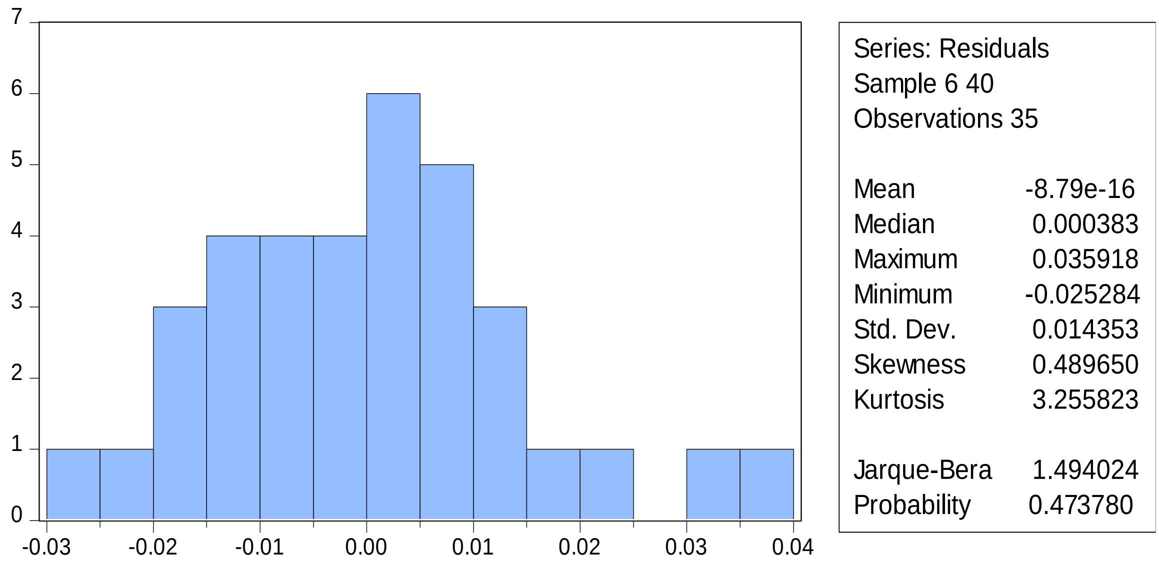


Figure 4.9**:** Histogram of residuals

By looking at the Figure 4.10, the histogram clearly mentions that errors are usually spread. The regularity of errors is also mentioned by the Jarque-Bera test since then prob-value (0.4737) is advanced than the 5% level.Therefore, the residuals are usually spread and, the null hypothesis cannot be rejected.

4.7 Test of Short Run Relationship between the Variables

Wald test was used to identify any significant short run association between Macro economic variables and CPI. Analysis is to the outcomes are presented as follows.

4.7.1 Short run relationship Consumer price index

$H_0: C(1) = C(2) = C(3) = C(4) = 0$
$H_1: at\ least\ one\ C(i) \neq 0\ for\ i = 1,2,3,4$

Table 4.19: Wald test for the Consumer Price Index

Wald Test: System: %system			
Test Statistic	Value	Df	Probability
F-statistic	38.1342	(4,13)	.0000
Chi-square	158.1235	4	.0000
Null Hypothesis: C(1) =C(2)= C(3)=C(4)=0 Null Hypothesis Summary			

Nor Restriction (= 0)	Value	Std. Error.
C(1)	0.868140	0.187946
C(2)	-0.179282	0.287817
C(3)	-0.084738	0.299590
C(4)	0.359728	0.200229

Results in Table 19 indicate that the probability-value of Chi-square statistic test is 0.0000 less than 0.05. Therefore, H_0 is rejected at 5% level of implication and container be decided that here is a short run relationship of LNY (consumer price index).

4.7.2 Short run relationship between GDP

$H0: C(5) = C(6) = C(7) = C(8) = C(9) = 0$

$H1: at\ least\ one\ C(i) \neq 0\ for\ i = 5,6,7,8,9$

Table 4.20: Wald test for the relationship between GDP

Wald Test: System: %system			
Test Statistic	Value	Df	Probability
F-statistic	3.43561	(5,13)	.0432
Chi-square	10.55153	5	.0231
Null Hypothesis : Co(5)=Co(6)= Co(7)=0 Null Hypothesis Summary:			

Normalized Restriction (= 0)	Value	Std. Error.
C(5)	0.000497	0.015420
C(6)	0.021991	0.115156
C(7)	0.042837	0.013818
C(8)	0.010010	0.11858
C(9)	0.019669	0.011228

Restrictions are linear in coefficients.

The above table indicates that the probability-value of Chi-square test statistic is 0.000 less than 0.05.Therefore, 5% significance H_0 is disallowed and can be explained that around is a short run association from LNX1 (Gross domestic product). Inflame lag values.

4.7.3 Short run relationship between Inflation

H_0: $C(10) = C(11) = C(12) = C(13) = C(14) = 0$
H_1: $at\ least\ one\ C(i) \neq 0\ for\ i = 10,11,12,13,14$

Table 4.21: Wald test for the relationship between inflation

Wald Test: System: %system			
Test Statistic	Value	Df	Probability
F-statistic	3.43210	(5,13)	.0537
Chi-square	12.11234	5	.0116
Null Hypothesis: C(10)=C(11)= C(12)= C(13)= C(14)=0 Null Hypothesis Summary:			

Normalized Restriction (= 0)	Value	Std. Error.
C(10)	0.061616	0.007209
C(11)	0.020539	0.014244
C(12)	0.031211	0.017252
C(13)	0.042177	0.018423
C(14)	0.023486	0.009200

In this table indicates that the probability-value of Chi-square test statistic is 0.000 less than 0.05. Therefore, 5% significance level H_0 is rejected and can be mentioned that there is a short run relationship from LNX3 (inflation).

4.7.4 Short run relationship between Exchange rate

$H_0: C(15) = C(16) = C(17) = C(18) = C(19) = 0$
$H_1: at\ least\ one\ C(i) \neq 0\ for\ i = 15,16,17,18,19$

Table 4.22: Wald test for the relationship between Exchange rate

Wald Test: System: %system			
Test Statistic	Value	Df	Probability
F-statistic	3.23456	(5,13)	.0673
Chi-square	8.314956	5	.0407
Null Hypothesis: C(15)=C(16)= C(17)= C(18)= C(19)=0 Null Hypothesis summary:			

Normalized Restriction (= 0)	Value	Sd. Error.
C(15)	-0.013593	0.010135
C(16)	-0.019851	0.011901
C(17)	-0.035068	0.013519
C(18)	-0.034813	0.013814
C(19)	-0.037988	0.012698

As a result, that the probability - value of Chi-square test statistic is 0.000 less than 0.05. Therefore, 5% significance level H_0 is rejected and can be mentioned that there is a short run relationship (causality) from LNX4 (exchange rate).

4.8 Hypothesis Testing

H_1- There is a significant impact of inflation rate, GNP, GDP and Exchange rate on Consumer price index.

ARDL regression model shows table 4.16 that the pro-value is 0.0000 which is lower than 0.05. It is implying that significant impact macro economic variables on consumer price index.

4.9 Chapter Summary

This report mentioned that the evaluate and get the results any changes in the identified macro economic variables on consumer price index. The variables were tested using Augmented Dickey Fuller test (ADF) and Phillips-Perron (PP) test with respect to their stationary. Since all the variables were found to be integrated of same order. Therefore, there is long run equilibrium association among these variables.

The study further established that in the short run, consumer price index and inflation, GNP has a significant negative relationship. This finding is not surprising because inflation reduces the real disposable income of individuals and consumer price index.

Inflation rate is negatively related to consumer price index in both the short run and long run at significance of 5% level. In addition, the study found out that, inflation does not Granger cause GNP and consumer price index. However, the reverse is invalid. But the results of Granger causality test indicate that only inflation granger causes consumer price index. Generally, two variables around obligation be granger cause in at slightest one way in cointegration test. Normally granger causality test included many parameters.

It is difficult to discard the worthless hypothesis by the scare sample information. This test has some problem. Each of the line shows that there is no conflict in the results. So it is clearly show there is association between in different process of the sample.

The ARDL model analyses all variables are significant impact of consumer price index different lag. The results mentioned that the consumer price index was associated in less exogenous in relation to the GNP and inflation. Also, the results implied that inflation prove to be the most significant factors that explain the movement consumer price index.

Chapter 5

Discussion

5.1 Summary

Throughout the time, consumer price index goes up, even though Sri Lanka major consuming country of commodity we would able to liberate its impacts. Therefore, forecasting consumer price index is an important component in many economic decisions making. It can be done in numerous ways. This analysis work to examination is to add to a determining model for yearly consumer price index in which this was done through ADF, PP, ARDL (Autoregressive Distributed Lag) model and regression model would be used for forecasting is provided that it is one of the most sophisticated techniques of time series forecasting Khan (2016). The failure of stationary of original data set, since it was proved by ADF test and PP test thus decided to move to first difference of consumer price index. Basically, first difference of the consumer price index that is satisfied stationary conditions which were justified by ADF test and PP test. Depending on the statistical analysis was done in chapter 4, regression model it was selected as the best model to forecast in Sri Lanka

Consumer price index is always influenced by multiple issues such as exchange rate, inflation rate, GDP, GNP and etc. Among these factors in our study four factors were considered; inflation rate, GDP, GNP and Exchange rate. Three different analyses have been carried on determining the relationship with consumer price index and four factors. First ordinary regression analysis checked for time series data then analyzed of regression model analysis. Thus, to understand the relationship between four variables co-integration has been carried out. And also effect on the granger causality has been tested. Then study work carried to identify ARDL effect between consumer price index and other variables.

5.2 Conclusion and Recommendations

Finally, in this study work depending on the statistical results we came to following conclusions.

- For the first phase of the study we fitted a time series model to forecast the yearly consumer price index in Sri Lanka. We have developed a systematic and iterative methodology of ARDL models used but it is significant and analysis is fitted model. It is the best fitted model to consumer price index depending on the residual analysis and forecasting accuracy.
- The work carried on the Autoregressive distributed lag analysis and non-stationary analysis we made following conclusions.
- Consumer price and inflation rate value shows negative correlation which can be understood form the ordinary regression analysis.
- The co-integration study carried under model indicates there is only long –run equilibrium from macro economic variables to Consumer price index
- Granger causality test based have been improved with additional variables of GDP, GNP, exchange rate and Inflation with consumer price index. The tested data ranges can be changed into different frequencies like monthly and quarterly. Further extended lags should be considered to find detailed and accurate causality on consumer price index form other variables.

5.3 Limitation of the Study

Only consider some variables of (inflation rate, GDP, GNP, and Exchange rate) and Consumer Price Index for this research.

Time of the period considered was limited 1977 to 2015.

Consumer price Index affected several factors.

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Annexure A

Variables

y- Consumer price index
X1- GDP
X2- Inflation
X3- GNP
X4- Exchange rate

Unit Root test

Null Hypothesis: CONSUMER_PRICE_INDEX has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		4.730506	1.0000
Test critical values:	1% level	-3.610453	
	5% level	-2.938987	
	10% level	-2.607932	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CONSUMER_PRICE_INDEX)
Method: Least Squares
Date: 09/27/18 Time: 23:33
Sample (adjusted): 2 40
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CONSUMER_PRICE_INDEX(-1)	0.050255	0.010624	4.730506	0.0000
C	1.256990	0.611899	2.054245	0.0471

R-squared	0.376870	Mean dependent var	3.362308
Adjusted R-squared	0.360029	S.D. dependent var	3.278228
S.E. of regression	2.622523	Akaike info criterion	4.816071
Sum squared resid	254.4723	Schwarz criterion	4.901382
Log likelihood	-91.91339	Hannan-Quinn criter.	4.846680
F-statistic	22.37769	Durbin-Watson stat	1.298578
Prob(F-statistic)	0.000032		

Null Hypothesis: GDP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.420953	0.0011
Test critical values:	1% level	-3.610453	
	5% level	-2.938987	

	10% level	-2.607932	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GDP)
Method: Least Squares
Date: 09/27/18 Time: 23:34
Sample (adjusted): 2 40
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP(-1)	-0.694156	0.157015	-4.420953	0.0001
C	3.594334	0.858109	4.188668	0.0002

R-squared	0.345652	Mean dependent var	-0.017949
Adjusted R-squared	0.327967	S.D. dependent var	1.997113
S.E. of regression	1.637186	Akaike info criterion	3.873755
Sum squared resid	99.17394	Schwarz criterion	3.959066
Log likelihood	-73.53822	Hannan-Quinn criter.	3.904364
F-statistic	19.54482	Durbin-Watson stat	2.006174
Prob(F-statistic)	0.000083		

Null Hypothesis: INFLATION has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.761998	0.0004
Test critical values:	1% level	-3.610453	
	5% level	-2.938987	
	10% level	-2.607932	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INFLATION)
Method: Least Squares
Date: 09/27/18 Time: 23:35
Sample (adjusted): 2 40
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INFLATION(-1)	-0.743026	0.156032	-4.761998	0.0000
C	8.028141	1.894866	4.236785	0.0001

R-squared	0.379992	Mean dependent var	0.065385
Adjusted R-squared	0.363235	S.D. dependent var	6.975489
S.E. of regression	5.566271	Akaike info criterion	6.321248
Sum squared resid	1146.385	Schwarz criterion	6.406559
Log likelihood	-121.2643	Hannan-Quinn criter.	6.351857
F-statistic	22.67663	Durbin-Watson stat	1.916740

Prob(F-statistic)	0.000029

Null Hypothesis: GNP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.463146	0.0001
Test critical values:	1% level	-3.610453	
	5% level	-2.938987	
	10% level	-2.607932	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GNP)
Method: Least Squares
Date: 09/27/18 Time: 23:36
Sample (adjusted): 2 40
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GNP(-1)	-0.896110	0.164028	-5.463146	0.0000
C	12.81677	2.784509	4.602884	0.0000

R-squared	0.446489	Mean dependent var	-0.507692
Adjusted R-squared	0.431529	S.D. dependent var	11.12769
S.E. of regression	8.389947	Akaike info criterion	7.141866
Sum squared resid	2604.475	Schwarz criterion	7.227177
Log likelihood	-137.2664	Hannan-Quinn criter.	7.172475
F-statistic	29.84596	Durbin-Watson stat	1.997405
Prob(F-statistic)	0.000003		

Null Hypothesis: D(CONSUMER_PRICE_INDEX) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.008470	0.0431
Test critical values:	1% level	-3.615588	
	5% level	-2.941145	
	10% level	-2.609066	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CONSUMER_PRICE_INDEX,2)
Method: Least Squares

Date: 09/27/18 Time: 23:33
Sample (adjusted): 3 40
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CONSUMER_PRICE_INDEX(-1))	-0.394172	0.131021	-3.008470	0.0048
C	1.432939	0.609692	2.350269	0.0244

R-squared	0.200904	Mean dependent var	0.126053
Adjusted R-squared	0.178707	S.D. dependent var	2.909981
S.E. of regression	2.637177	Akaike info criterion	4.828491
Sum squared resid	250.3693	Schwarz criterion	4.914680
Log likelihood	-89.74133	Hannan-Quinn criter.	4.859156
F-statistic	9.050891	Durbin-Watson stat	2.188198
Prob(F-statistic)	0.004770		

Null Hypothesis: EXCHANGE_RATE has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		1.024581	0.9961
Test critical values:	1% level	-3.610453	
	5% level	-2.938987	
	10% level	-2.607932	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EXCHANGE_RATE)
Method: Least Squares
Date: 09/27/18 Time: 23:36
Sample (adjusted): 2 40
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXCHANGE_RATE(-1)	0.016835	0.016431	1.024581	0.3122
C	2.399435	1.259610	1.904903	0.0646

R-squared	0.027589	Mean dependent var	3.505897
Adjusted R-squared	0.001308	S.D. dependent var	4.051781
S.E. of regression	4.049131	Akaike info criterion	5.684802
Sum squared resid	606.6319	Schwarz criterion	5.770113
Log likelihood	-108.8536	Hannan-Quinn criter.	5.715411
F-statistic	1.049767	Durbin-Watson stat	2.321440
Prob(F-statistic)	0.312213		

Null Hypothesis: D(EXCHANGE_RATE) has a unit root
Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.882754	0.0000
Test critical values:	1% level	-3.615588	
	5% level	-2.941145	
	10% level	-2.609066	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EXCHANGE_RATE,2)
Method: Least Squares
Date: 09/27/18 Time: 23:37
Sample (adjusted): 3 40
Included observations: 38 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EXCHANGE_RATE(-1))	-1.159963	0.168532	-6.882754	0.0000
C	3.955699	0.868815	4.552984	0.0001

R-squared	0.568202	Mean dependent var	0.076842
Adjusted R-squared	0.556208	S.D. dependent var	6.118716
S.E. of regression	4.076151	Akaike info criterion	5.699379
Sum squared resid	598.1402	Schwarz criterion	5.785568
Log likelihood	-106.2882	Hannan-Quinn criter.	5.730045
F-statistic	47.37230	Durbin-Watson stat	1.925316
Prob(F-statistic)	0.000000		

Least Sqare

Dependent Variable: CONSUMER_PRICE_INDEX
Method: Least Squares
Date: 09/27/18 Time: 23:40
Sample: 1 40
Included observations: 40

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CONSUMER_PRICE_INDEX	1.000000	1.88E-16	5.31E+15	0.0000
GDP	6.13E-17	1.26E-15	0.048798	0.9614
INFLATION	-1.88E-15	4.22E-16	-4.447221	0.0001
GNP	1.32E-15	2.77E-16	4.760509	0.0000
EXCHANGE_RATE	0.000000	1.66E-16	0.000000	1.0000
M2	0.000000	4.36E-16	0.000000	1.0000

R-squared	1.000000	Mean dependent var	44.19625
Adjusted R-squared	1.000000	S.D. dependent var	42.12879
S.E. of regression	1.44E-14	Sum squared resid	7.01E-27
Durbin-Watson stat	2.339083		

VAR Lag Order Selection Criteria
Endogenous variables: LNX1 LNX2 LNX3 LNY LNX4
Exogenous variables: C
Date: 10/17/18 Time: 15:34
Sample: 1 40
Included observations: 37

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-90.00059	NA	0.000117	5.135167	5.352859	5.211913
1	90.41005	302.3097*	2.67e-08*	-3.265408*	-1.959258*	-2.804929*
2	108.6194	25.59157	4.16e-08	-2.898348	-0.503740	-2.054136
3	131.5525	26.03209	5.75e-08	-2.786620	0.696446	-1.558676

* 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

Vector Autoregression Estimates
Date: 10/23/18 Time: 14:34
Sample (adjusted): 2 40
Included observations: 39 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	LNY	LNX1	LNX2	LNX3	LNX4
LNY(-1)	0.941238	0.382322	-1.381452	-0.314903	0.252447
	(0.04859)	(0.40752)	(0.65726)	(0.52191)	(0.07506)
	[19.3696]	[0.93817]	[-2.10183]	[-0.60337]	[3.36321]
LNX1(-1)	0.011244	0.156656	0.214572	-0.103081	-0.039755
	(0.02056)	(0.17244)	(0.27811)	(0.22084)	(0.03176)
	[0.54682]	[0.90849]	[0.77153]	[-0.46677]	[-1.25167]
LNX2(-1)	0.009391	0.001489	0.037185	0.257310	-0.024572
	(0.01143)	(0.09582)	(0.15455)	(0.12272)	(0.01765)
	[0.82188]	[0.01554]	[0.24061]	[2.09674]	[-1.39220]
LNX3(-1)	0.007488	0.260759	0.216460	0.029390	0.028201
	(0.01590)	(0.13331)	(0.21501)	(0.17073)	(0.02455)
	[0.47105]	[1.95601]	[1.00674]	[0.17214]	[1.14851]
LNX4(-1)	0.064557	-0.417318	1.858032	0.124935	0.561152
	(0.07342)	(0.61572)	(0.99306)	(0.78856)	(0.11341)
	[0.87927]	[-0.67777]	[1.87101]	[0.15844]	[4.94795]
C	-0.027253	1.096545	-1.717945	2.548127	1.047173
	(0.14670)	(1.23027)	(1.98423)	(1.57560)	(0.22661)
	[-0.18578]	[0.89131]	[-0.86580]	[1.61724]	[4.62113]
R-squared	0.998645	0.195768	0.325482	0.418354	0.991582
Adj. R-squared	0.998440	0.073915	0.223282	0.330226	0.990307
Sum sq. resids	0.065655	4.617408	12.01105	7.573430	0.156653
S.E. equation	0.044604	0.374061	0.603300	0.479059	0.068899
F-statistic	4864.820	1.606588	3.184759	4.747113	777.4420
Log likelihood	69.20612	-13.73091	-32.37278	-23.37975	52.24843
Akaike AIC	-3.241339	1.011841	1.967835	1.506654	-2.371714
Schwarz SC	-2.985407	1.267774	2.223767	1.762586	-2.115782
Mean dependent	3.285592	1.582074	2.201089	2.508920	4.026839
S.D. dependent	1.129267	0.388702	0.684545	0.585363	0.699802

Determinant resid covariance (dof adj.)	2.40E-08
Determinant resid covariance	1.04E-08
Log likelihood	81.75806
Akaike information criterion	-2.654259
Schwarz criterion	-1.374597
Number of coefficients	30

Vector Autoregression Estimates
Date: 10/17/18 Time: 15:34
Sample (adjusted): 2 40
Included observations: 39 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	LNX1	LNX2	LNX3	LNY	LNX4
LNX1(-1)	0.156656	0.214572	-0.103081	0.011244	-0.039755
	(0.17244)	(0.27811)	(0.22084)	(0.02056)	(0.03176)
	[0.90849]	[0.77153]	[-0.46677]	[0.54682]	[-1.25167]
LNX2(-1)	0.001489	0.037185	0.257310	0.009391	-0.024572
	(0.09582)	(0.15455)	(0.12272)	(0.01143)	(0.01765)
	[0.01554]	[0.24061]	[2.09674]	[0.82188]	[-1.39220]
LNX3(-1)	0.260759	0.216460	0.029390	0.007488	0.028201
	(0.13331)	(0.21501)	(0.17073)	(0.01590)	(0.02455)
	[1.95601]	[1.00674]	[0.17214]	[0.47105]	[1.14851]
LNY(-1)	0.382322	-1.381452	-0.314903	0.941238	0.252447
	(0.40752)	(0.65726)	(0.52191)	(0.04859)	(0.07506)
	[0.93817]	[-2.10183]	[-0.60337]	[19.3696]	[3.36321]
LNX4(-1)	-0.417318	1.858032	0.124935	0.064557	0.561152
	(0.61572)	(0.99306)	(0.78856)	(0.07342)	(0.11341)
	[-0.67777]	[1.87101]	[0.15844]	[0.87927]	[4.94795]
C	1.096545	-1.717945	2.548127	-0.027253	1.047173
	(1.23027)	(1.98423)	(1.57560)	(0.14670)	(0.22661)
	[0.89131]	[-0.86580]	[1.61724]	[-0.18578]	[4.62113]
R-squared	0.195768	0.325482	0.418354	0.998645	0.991582
Adj. R-squared	0.073915	0.223282	0.330226	0.998440	0.990307
Sum sq. resids	4.617408	12.01105	7.573430	0.065655	0.156653
S.E. equation	0.374061	0.603300	0.479059	0.044604	0.068899
F-statistic	1.606588	3.184759	4.747113	4864.820	777.4420
Log likelihood	-13.73091	-32.37278	-23.37975	69.20612	52.24843
Akaike AIC	1.011841	1.967835	1.506654	-3.241339	-2.371714
Schwarz SC	1.267774	2.223767	1.762586	-2.985407	-2.115782
Mean dependent	1.582074	2.201089	2.508920	3.285592	4.026839
S.D. dependent	0.388702	0.684545	0.585363	1.129267	0.699802

Determinant resid covariance (dof adj.)	2.40E-08
Determinant resid covariance	1.04E-08
Log likelihood	81.75806
Akaike information criterion	-2.654259
Schwarz criterion	-1.374597
Number of coefficients	30

System: UNTITLED
Estimation Method: Least Squares
Date: 10/17/18 Time: 15:36
Sample: 2 40
Included observations: 39
Total system (balanced) observations 195

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.156656	0.172437	0.908485	0.3649
C(2)	0.001489	0.095822	0.015544	0.9876
C(3)	0.260759	0.133312	1.956010	0.0522
C(4)	0.382322	0.407517	0.938174	0.3495
C(5)	-0.417318	0.615723	-0.677770	0.4989
C(6)	1.096545	1.230269	0.891306	0.3741
C(7)	0.214572	0.278113	0.771528	0.4415
C(8)	0.037185	0.154546	0.240611	0.8102
C(9)	0.216460	0.215011	1.006741	0.3155
C(10)	-1.381452	0.657260	-2.101833	0.0371
C(11)	1.858032	0.993062	1.871013	0.0631
C(12)	-1.717945	1.984227	-0.865801	0.3879
C(13)	-0.103081	0.220840	-0.466770	0.6413
C(14)	0.257310	0.122719	2.096738	0.0375
C(15)	0.029390	0.170732	0.172141	0.8635
C(16)	-0.314903	0.521907	-0.603370	0.5471
C(17)	0.124935	0.788556	0.158435	0.8743
C(18)	2.548127	1.575604	1.617238	0.1077
C(19)	0.011244	0.020562	0.546817	0.5852
C(20)	0.009391	0.011426	0.821882	0.4123
C(21)	0.007488	0.015897	0.471054	0.6382
C(22)	0.941238	0.048594	19.36957	0.0000
C(23)	0.064557	0.073421	0.879274	0.3805
C(24)	-0.027253	0.146701	-0.185775	0.8528
C(25)	-0.039755	0.031761	-1.251668	0.2125
C(26)	-0.024572	0.017650	-1.392204	0.1657
C(27)	0.028201	0.024555	1.148506	0.2524
C(28)	0.252447	0.075061	3.363211	0.0010
C(29)	0.561152	0.113411	4.947950	0.0000
C(30)	1.047173	0.226605	4.621132	0.0000

Determinant residual covariance		1.04E-08	

Equation: LNX1 = C(1)*LNX1(-1) + C(2)*LNX2(-1) + C(3)*LNX3(-1) + C(4)
*LNY(-1) + C(5)*LNX4(-1) + C(6)
Observations: 39

R-squared	0.195768	Mean dependent var	1.582074
Adjusted R-squared	0.073915	S.D. dependent var	0.388702
S.E. of regression	0.374061	Sum squared resid	4.617408
Durbin-Watson stat	2.357948		

Equation: LNX2 = C(7)*LNX1(-1) + C(8)*LNX2(-1) + C(9)*LNX3(-1) + C(10)
*LNY(-1) + C(11)*LNX4(-1) + C(12)
Observations: 39

R-squared	0.325482	Mean dependent var	2.201089
Adjusted R-squared	0.223282	S.D. dependent var	0.684545
S.E. of regression	0.603300	Sum squared resid	12.01105
Durbin-Watson stat	1.983841		

Equation: LNX3 = C(13)*LNX1(-1) + C(14)*LNX2(-1) + C(15)*LNX3(-1) +
C(16)*LNY(-1) + C(17)*LNX4(-1) + C(18)
Observations: 39

Vector Autoregression Estimates
Date: 10/17/18 Time: 15:30
Sample (adjusted): 3 40
Included observations: 38 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	LNY	LNX1	LNX2	LNX3	LNX4
LNY(-1)	0.921780	-0.196285	-2.012738	0.599300	0.215479
	(0.33372)	(2.40436)	(4.25085)	(3.48069)	(0.34817)
	[2.76212]	[-0.08164]	[-0.47349]	[0.17218]	[0.61889]
LNY(-2)	-0.017367	1.074869	0.007833	-1.356419	-0.185023
	(0.35297)	(2.54307)	(4.49607)	(3.68148)	(0.36826)
	[-0.04920]	[0.42267]	[0.00174]	[-0.36844]	[-0.50243]
LNX1(-1)	0.006639	0.026502	0.058786	-0.025195	-0.016366
	(0.02476)	(0.17835)	(0.31532)	(0.25819)	(0.02583)
	[0.26821]	[0.14859]	[0.18643]	[-0.09758]	[-0.63367]
LNX1(-2)	0.014008	-0.072010	0.198520	-0.101250	-0.001982
	(0.02344)	(0.16886)	(0.29854)	(0.24445)	(0.02445)
	[0.59769]	[-0.42645]	[0.66497]	[-0.41419]	[-0.08105]
LNX2(-1)	0.009340	0.010449	0.082323	0.220440	-0.003178
	(0.02601)	(0.18739)	(0.33130)	(0.27127)	(0.02714)
	[0.35911]	[0.05576]	[0.24849]	[0.81261]	[-0.11713]
LNX2(-2)	-0.003060	0.148556	-0.129844	0.136559	-0.009663
	(0.01574)	(0.11340)	(0.20049)	(0.16416)	(0.01642)
	[-0.19439]	[1.31002]	[-0.64764]	[0.83185]	[-0.58842]
LNX3(-1)	0.007232	0.216964	0.223823	-0.094657	0.003743
	(0.01947)	(0.14026)	(0.24797)	(0.20305)	(0.02031)
	[0.37149]	[1.54688]	[0.90261]	[-0.46618]	[0.18430]
LNX3(-2)	0.006853	0.350956	0.307510	0.007224	-0.015619
	(0.01913)	(0.13781)	(0.24364)	(0.19950)	(0.01996)
	[0.35829]	[2.54668]	[1.26213]	[0.03621]	[-0.78267]
LNX4(-1)	0.041040	0.089886	1.638012	0.545329	0.733458
	(0.13861)	(0.99862)	(1.76554)	(1.44566)	(0.14461)
	[0.29609]	[0.09001]	[0.92777]	[0.37722]	[5.07202]
LNX4(-2)	0.081857	-1.120767	1.329033	0.295533	0.185116
	(0.10727)	(0.77282)	(1.36632)	(1.11877)	(0.11191)
	[0.76312]	[-1.45024]	[0.97271]	[0.26416]	[1.65415]
C	-0.162641	1.142804	-4.743791	1.104173	0.369180
	(0.23159)	(1.66855)	(2.94995)	(2.41549)	(0.24162)
	[-0.70227]	[0.68491]	[-1.60809]	[0.45712]	[1.52794]
R-squared	0.998580	0.433652	0.428699	0.474541	0.995989
Adj. R-squared	0.998054	0.223894	0.217107	0.279926	0.994503
Sum sq. resids	0.062392	3.238616	10.12303	6.787173	0.067912
S.E. equation	0.048071	0.346336	0.612313	0.501375	0.050152
F-statistic	1898.349	2.067391	2.026059	2.438363	670.4226
Log likelihood	67.90650	-7.133303	-28.78698	-21.19118	66.29578
Akaike AIC	-2.995079	0.954384	2.094051	1.694273	-2.910304
Schwarz SC	-2.521041	1.428422	2.568089	2.168311	-2.436266
Mean dependent	3.340876	1.578138	2.193401	2.500541	4.060495
S.D. dependent	1.089629	0.393131	0.692025	0.590846	0.676453

Determinant resid covariance (dof adj.)	1.39E-08
Determinant resid covariance	2.52E-09
Log likelihood	106.5622
Akaike information criterion	-2.713799
Schwarz criterion	-0.343608
Number of coefficients	55

Dependent Variable: LNY
Method: Least Squares
Date: 10/17/18 Time: 15:37
Sample: 1 40
Included observations: 40

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNX1	0.023203	0.127287	0.182291	0.8564
LNX2	-0.140593	0.069126	-2.033858	0.0494
LNX3	-0.437331	0.075139	-5.820290	0.0000
LNX4	1.161674	0.045829	25.34783	0.0000

R-squared	0.937534	Mean dependent var	3.230242
Adjusted R-squared	0.932328	S.D. dependent var	1.168371
S.E. of regression	0.303938	Akaike info criterion	0.550655
Sum squared resid	3.325625	Schwarz criterion	0.719543
Log likelihood	-7.013106	Hannan-Quinn criter.	0.611720
Durbin-Watson stat	1.148075		

Dependent Variable: LNY
Method: ARDL
Date: 10/17/18 Time: 15:38
Sample (adjusted): 6 40
Included observations: 35 after adjustments
Maximum dependent lags: 4 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (4 lags, automatic): LNX1(-1) LNX2(-1) LNX3(-1)
LNX4(-1)
Fixed regressors: C
Number of models evalulated: 2500
Selected Model: ARDL(4, 2, 4, 3, 4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNY(-1)	1.556857	0.341057	4.564805	0.0005
LNY(-2)	-0.710617	0.514232	-1.381899	0.1903
LNY(-3)	0.639865	0.478895	1.336128	0.2044
LNY(-4)	-0.874897	0.357325	-2.448460	0.0293
LNX1(-1)	0.094660	0.033043	2.864728	0.0133
LNX1(-2)	0.050155	0.028148	1.781847	0.0981
LNX1(-3)	0.069583	0.024293	2.864270	0.0133
LNX2(-1)	-0.038030	0.025291	-1.503693	0.1566
LNX2(-2)	-0.028538	0.025617	-1.114030	0.2854
LNX2(-3)	-0.091846	0.035060	-2.619687	0.0212
LNX2(-4)	-0.008602	0.015232	-0.564744	0.5819
LNX2(-5)	-0.046417	0.015998	-2.901321	0.0124
LNX3(-1)	0.018214	0.017556	1.037475	0.3184
LNX3(-2)	0.012767	0.019242	0.663479	0.5186
LNX3(-3)	-0.027481	0.023679	-1.160568	0.2667
LNX3(-4)	-0.057532	0.028429	-2.023699	0.0641
LNX4(-1)	0.627222	0.214504	2.924061	0.0118
LNX4(-2)	-0.824926	0.213739	-3.859503	0.0020
LNX4(-3)	0.634008	0.213203	2.973726	0.0108
LNX4(-4)	-0.398010	0.186822	-2.130418	0.0528
LNX4(-5)	0.486919	0.100735	4.833669	0.0003
C	-0.572069	0.202935	-2.818983	0.0145

R-squared	0.999636	Mean dependent var	3.498936
Adjusted R-squared	0.999047	S.D. dependent var	0.981805
S.E. of regression	0.030310	Akaike info criterion	-3.887942
Sum squared resid	0.011943	Schwarz criterion	-2.910295
Log likelihood	90.03899	Hannan-Quinn criter.	-3.550459
F-statistic	1698.181	Durbin-Watson stat	2.243178
Prob(F-statistic)	0.000000		

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

Date: 10/17/18 Time: 15:38
Sample: 1 40
Included observations: 35
Q-statistic probabilities adjusted for 4 dynamic regressors

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
		1	-0.128	-0.128	0.6236	0.430
		2	-0.386	-0.409	6.4597	0.040
		3	0.025	-0.118	6.4845	0.090
		4	-0.167	-0.423	7.6450	0.105
		5	0.157	-0.017	8.7091	0.121
		6	0.045	-0.263	8.8009	0.185
		7	-0.124	-0.160	9.5148	0.218
		8	0.228	0.065	12.008	0.151
		9	-0.158	-0.224	13.257	0.151
		10	-0.226	-0.279	15.913	0.102
		11	0.169	-0.246	17.454	0.095
		12	0.167	-0.018	19.026	0.088
		13	0.164	0.146	20.606	0.081
		14	-0.206	-0.088	23.216	0.057
		15	-0.184	0.078	25.416	0.045
		16	0.039	-0.153	25.520	0.061

*Probabilities may not be valid for this equation specification.

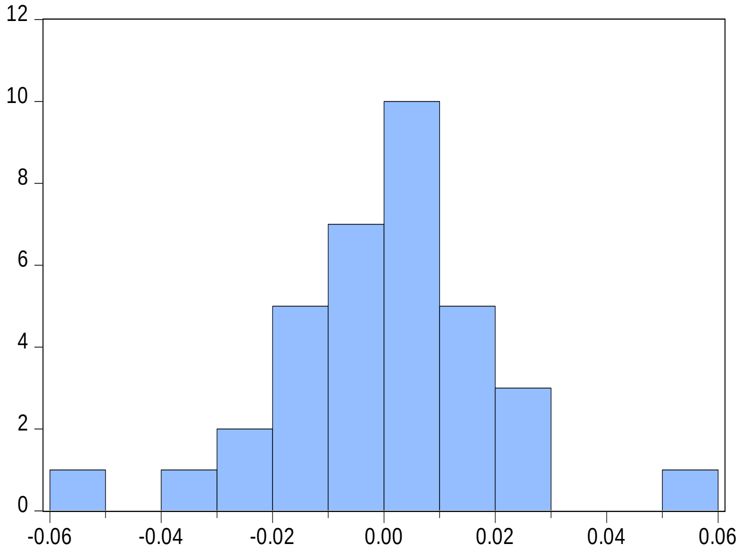
Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	2.384638	Prob. F(2,11)	0.1379
Obs*R-squared	10.58543	Prob. Chi-Square(2)	0.0050

Test Equation:
Dependent Variable: RESID
Method: ARDL
Date: 10/17/18 Time: 15:39
Sample: 6 40
Included observations: 35
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNY(-1)	0.018181	0.322386	0.056394	0.9560
LNY(-2)	0.136253	0.493863	0.275892	0.7877
LNY(-3)	-0.242275	0.460575	-0.526026	0.6093
LNY(-4)	0.119149	0.331618	0.359295	0.7262
LNX1(-1)	-0.006907	0.030229	-0.228488	0.8235
LNX1(-2)	-0.008289	0.026151	-0.316974	0.7572
LNX1(-3)	-0.005981	0.022500	-0.265800	0.7953
LNX2(-1)	0.002932	0.023022	0.127369	0.9009
LNX2(-2)	0.001345	0.023359	0.057579	0.9551
LNX2(-3)	0.011838	0.032336	0.366099	0.7212
LNX2(-4)	0.007568	0.014268	0.530391	0.6064
LNX2(-5)	0.009066	0.015109	0.600016	0.5607
LNX3(-1)	-0.004319	0.016079	-0.268596	0.7932
LNX3(-2)	0.000161	0.017476	0.009200	0.9928
LNX3(-3)	-0.001222	0.021749	-0.056164	0.9562
LNX3(-4)	-0.002864	0.026210	-0.109262	0.9150
LNX4(-1)	0.054579	0.204631	0.266720	0.7946
LNX4(-2)	0.003987	0.210713	0.018920	0.9852
LNX4(-3)	-0.079648	0.210932	-0.377600	0.7129
LNX4(-4)	0.016357	0.180352	0.090695	0.9294
LNX4(-5)	-0.031588	0.092747	-0.340587	0.7398
C	0.008367	0.184298	0.045401	0.9646
RESID(-1)	-0.307728	0.343510	-0.895835	0.3895
RESID(-2)	-0.682150	0.329200	-2.072145	0.0625

R-squared	0.302441	Mean dependent var	-6.82E-16
Adjusted R-squared	-1.156091	S.D. dependent var	0.018742
S.E. of regression	0.027520	Akaike info criterion	-4.133825
Sum squared resid	0.008331	Schwarz criterion	-3.067300
Log likelihood	96.34193	Hannan-Quinn criter.	-3.765661
F-statistic	0.207360	Durbin-Watson stat	2.034135
Prob(F-statistic)	0.999277		



Series: Residuals
Sample 6 40
Observations 35

Mean	-6.82e-16
Median	0.000490
Maximum	0.054110
Minimum	-0.050318
Std. Dev.	0.018742
Skewness	-0.007592
Kurtosis	4.539697
Jarque-Bera	3.457559
Probability	0.177501

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	0.291136	Prob. F(21,13)	0.9941
Obs*R-squared	11.19529	Prob. Chi-Square(21)	0.9588
Scaled explained SS	2.733518	Prob. Chi-Square(21)	1.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 10/17/18 Time: 15:39
Sample: 6 40
Included observations: 35

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.003065	0.005816	-0.526904	0.6071
LNY(-1)	-0.002997	0.009775	-0.306539	0.7640
LNY(-2)	-0.002516	0.014739	-0.170730	0.8671
LNY(-3)	0.007957	0.013726	0.579705	0.5720
LNY(-4)	-0.003574	0.010242	-0.348952	0.7327
LNX1(-1)	0.000517	0.000947	0.545927	0.5944
LNX1(-2)	0.000434	0.000807	0.537794	0.5998
LNX1(-3)	-2.56E-05	0.000696	-0.036721	0.9713
LNX2(-1)	-3.43E-05	0.000725	-0.047347	0.9630
LNX2(-2)	8.57E-05	0.000734	0.116779	0.9088
LNX2(-3)	-7.61E-06	0.001005	-0.007573	0.9941
LNX2(-4)	1.81E-05	0.000437	0.041426	0.9676
LNX2(-5)	8.99E-05	0.000459	0.196110	0.8476
LNX3(-1)	3.42E-05	0.000503	0.068004	0.9468
LNX3(-2)	-0.000327	0.000552	-0.593732	0.5629
LNX3(-3)	-2.23E-06	0.000679	-0.003292	0.9974
LNX3(-4)	-0.000276	0.000815	-0.339149	0.7399
LNX4(-1)	0.007492	0.006148	1.218671	0.2446
LNX4(-2)	-0.003579	0.006126	-0.584158	0.5691
LNX4(-3)	-0.000918	0.006111	-0.150169	0.8829
LNX4(-4)	-0.001754	0.005355	-0.327607	0.7484
LNX4(-5)	0.000374	0.002887	0.129430	0.8990

R-squared	0.319865	Mean dependent var	0.000341
Adjusted R-squared	-0.778814	S.D. dependent var	0.000651
S.E. of regression	0.000869	Akaike info criterion	-10.99233
Sum squared resid	9.81E-06	Schwarz criterion	-10.01468
Log likelihood	214.3657	Hannan-Quinn criter.	-10.65484
F-statistic	0.291136	Durbin-Watson stat	2.492255
Prob(F-statistic)	0.994106		

Heteroskedasticity Test: White
Null hypothesis: Homoskedasticity

F-statistic	0.568131	Prob. F(21,13)	0.8796
Obs*R-squared	16.74945	Prob. Chi-Square(21)	0.7262
Scaled explained SS	4.089660	Prob. Chi-Square(21)	1.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 10/17/18 Time: 15:40
Sample: 6 40
Included observations: 35

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-8.96E-05	0.001863	-0.048108	0.9624
LNY(-1)^2	0.000704	0.001341	0.525149	0.6083
LNY(-2)^2	-0.002576	0.002222	-1.159304	0.2672
LNY(-3)^2	0.003624	0.002186	1.657919	0.1213
LNY(-4)^2	-0.001965	0.001228	-1.600060	0.1336
LNX1(-1)^2	0.000300	0.000251	1.196323	0.2529
LNX1(-2)^2	0.000267	0.000214	1.248595	0.2338
LNX1(-3)^2	3.14E-05	0.000175	0.179852	0.8600
LNX2(-1)^2	-0.000167	0.000171	-0.977175	0.3463
LNX2(-2)^2	0.000129	0.000159	0.814795	0.4299
LNX2(-3)^2	-8.84E-05	0.000150	-0.589897	0.5654
LNX2(-4)^2	4.71E-06	8.79E-05	0.053623	0.9581
LNX2(-5)^2	-6.31E-06	8.20E-05	-0.076976	0.9398
LNX3(-1)^2	2.17E-05	9.05E-05	0.239862	0.8142
LNX3(-2)^2	-0.000161	0.000102	-1.572348	0.1399
LNX3(-3)^2	-1.76E-05	0.000110	-0.159171	0.8760
LNX3(-4)^2	-8.85E-05	0.000125	-0.710770	0.4898
LNX4(-1)^2	0.000950	0.000532	1.784577	0.0977
LNX4(-2)^2	-0.000506	0.000607	-0.834244	0.4192
LNX4(-3)^2	3.98E-05	0.000591	0.067386	0.9473
LNX4(-4)^2	-0.000556	0.000541	-1.027712	0.3228
LNX4(-5)^2	0.000224	0.000330	0.678424	0.5094

R-squared	0.478556	Mean dependent var	0.000341
Adjusted R-squared	-0.363778	S.D. dependent var	0.000651
S.E. of regression	0.000761	Akaike info criterion	-11.25802
Sum squared resid	7.52E-06	Schwarz criterion	-10.28037
Log likelihood	219.0153	Hannan-Quinn criter.	-10.92053
F-statistic	0.568131	Durbin-Watson stat	2.838302
Prob(F-statistic)	0.879635		

Wald test lny

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	40.08210	(4, 13)	0.0000
Chi-square	160.3284	4	0.0000

Null Hypothesis: C(1)=C(2)=C(3)=C(4)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(1)	1.556857	0.341057
C(2)	-0.710617	0.514232
C(3)	0.639865	0.478895
C(4)	-0.874897	0.357325

Restrictions are linear in coefficients.

Wald test x1

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	3.517175	(3, 13)	0.0460
Chi-square	10.55153	3	0.0144

Null Hypothesis: C(5)=C(6)=C(7)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(5)	0.094660	0.033043
C(6)	0.050155	0.028148
C(7)	0.069583	0.024293

Restrictions are linear in coefficients.

Wald test x2

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	2.638400	(5, 13)	0.0737
Chi-square	13.19200	5	0.0216

Null Hypothesis: C(8)=C(9)=C(10)=C(11)=C(12)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(8)	-0.038030	0.025291
C(9)	-0.028538	0.025617
C(10)	-0.091846	0.035060
C(11)	-0.008602	0.015232
C(12)	-0.046417	0.015998

Restrictions are linear in coefficients.

Wald test x3

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	2.078739	(4, 13)	0.1421
Chi-square	8.314956	4	0.0807

Null Hypothesis: C(13)=C(14)=C(15)=C(16)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(13)	0.018214	0.017556
C(14)	0.012767	0.019242
C(15)	-0.027481	0.023679
C(16)	-0.057532	0.028429

Restrictions are linear in coefficients.

Wald test x4

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	7.634411	(5, 13)	0.0015
Chi-square	38.17205	5	0.0000

Null Hypothesis: C(17)=C(18)=C(19)=C(20)=C(21)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(17)	0.627222	0.214504
C(18)	-0.824926	0.213739
C(19)	0.634008	0.213203
C(20)	-0.398010	0.186822
C(21)	0.486919	0.100735

Restrictions are linear in coefficients.

Dependent Variable: LNY
Method: ARDL
Date: 03/09/19 Time: 09:54
Sample (adjusted): 6 40
Included observations: 35 after adjustments
Maximum dependent lags: 4 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (4 lags, automatic): LNX1(-1) LNX2(-) LNX3(-1)
Fixed regressors: C
Number of models evalulated: 500
Selected Model: ARDL(4, 4, 4, 4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNY(-1)	0.868140	0.187946	4.619098	0.0003
LNY(-2)	-0.179282	0.287817	-0.622901	0.5427
LNY(-3)	-0.084738	0.299590	-0.282846	0.7812
LNY(-4)	0.359728	0.200229	1.796583	0.0926
LNX1(-1)	0.000497	0.015420	0.032216	0.9747
LNX1(-2)	0.021991	0.015156	1.450965	0.1674
LNX1(-3)	0.042837	0.013818	3.100031	0.0073
LNX1(-4)	0.010010	0.011858	0.844133	0.4119
LNX1(-5)	0.019669	0.011228	1.751744	0.1002
LNX2	0.061616	0.007209	8.546951	0.0000
LNX2(-1)	0.020539	0.014244	1.441908	0.1699
LNX2(-2)	0.031211	0.017252	1.809111	0.0905
LNX2(-3)	0.042177	0.018423	2.289401	0.0370
LNX2(-4)	0.023486	0.009200	2.552721	0.0221
LNX3(-1)	-0.013593	0.010135	-1.341171	0.1998
LNX3(-2)	-0.019851	0.011901	-1.668015	0.1160
LNX3(-3)	-0.035068	0.013519	-2.593994	0.0203
LNX3(-4)	-0.034813	0.013814	-2.520162	0.0235
LNX3(-5)	-0.037988	0.012698	-2.991714	0.0091
C	0.107015	0.077440	1.381920	0.1872

R-squared	0.999786	Mean dependent var	3.498936
Adjusted R-squared	0.999516	S.D. dependent var	0.981805
S.E. of regression	0.021609	Akaike info criterion	-4.535830
Sum squared resid	0.007004	Schwarz criterion	-3.647059
Log likelihood	99.37702	Hannan-Quinn criter.	-4.229026
F-statistic	3693.203	Durbin-Watson stat	2.078779
Prob(F-statistic)	0.000000		

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

Date: 03/09/19 Time: 09:56
Sample: 1 40
Included observations: 35
Q-statistic probabilities adjusted for 4 dynamic regressors

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
		1	-0.091	-0.091	0.3136	0.575
		2	-0.012	-0.020	0.3192	0.852
		3	-0.128	-0.132	0.9803	0.806
		4	-0.221	-0.252	3.0267	0.553
		5	0.065	0.007	3.2105	0.668
		6	0.073	0.055	3.4471	0.751
		7	0.255	0.227	6.4489	0.488
		8	-0.281	-0.302	10.223	0.250
		9	0.063	0.065	10.420	0.318
		10	-0.115	-0.038	11.100	0.350
		11	-0.080	-0.054	11.447	0.407
		12	0.016	-0.186	11.461	0.490
		13	-0.042	-0.060	11.566	0.564
		14	-0.133	-0.271	12.652	0.554
		15	-0.079	-0.051	13.059	0.598
		16	0.142	-0.045	14.433	0.567

*Probabilities may not be valid for this equation specification.

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	0.293655	Prob. F(2,13)	0.7504
Obs*R-squared	1.512871	Prob. Chi-Square(2)	0.4693

Test Equation:
Dependent Variable: RESID
Method: ARDL
Date: 03/09/19 Time: 09:57
Sample: 6 40
Included observations: 35
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNY(-1)	0.183574	0.315313	0.582196	0.5704
LNY(-2)	-0.023426	0.451941	-0.051835	0.9594
LNY(-3)	-0.144821	0.425810	-0.340106	0.7392
LNY(-4)	-0.007035	0.218206	-0.032241	0.9748
LNX1(-1)	-0.010083	0.020885	-0.482806	0.6373
LNX1(-2)	-0.009023	0.022436	-0.402140	0.6941
LNX1(-3)	-0.005036	0.016458	-0.306007	0.7644
LNX1(-4)	-0.007311	0.016217	-0.450812	0.6596
LNX1(-5)	-0.003678	0.014811	-0.248345	0.8077
LNX2	-0.003399	0.008855	-0.383868	0.7073
LNX2(-1)	-0.012317	0.021973	-0.560533	0.5846
LNX2(-2)	-0.013180	0.030999	-0.425178	0.6777
LNX2(-3)	-0.000967	0.021352	-0.045287	0.9646
LNX2(-4)	0.000585	0.009763	0.059909	0.9531
LNX3(-1)	-0.002853	0.011905	-0.239670	0.8143
LNX3(-2)	0.003260	0.013925	0.234124	0.8185
LNX3(-3)	0.008848	0.018960	0.466685	0.6484
LNX3(-4)	0.007805	0.018645	0.418593	0.6823
LNX3(-5)	0.002349	0.014770	0.159005	0.8761
C	0.008711	0.083290	0.104587	0.9183
RESID(-1)	-0.446748	0.588148	-0.759585	0.4611
RESID(-2)	-0.224899	0.661683	-0.339889	0.7394

R-squared	0.043225	Mean dependent var	-8.79E-16
Adjusted R-squared	-1.502335	S.D. dependent var	0.014353
S.E. of regression	0.022705	Akaike info criterion	-4.465731
Sum squared resid	0.006702	Schwarz criterion	-3.488084
Log likelihood	100.1503	Hannan-Quinn criter.	-4.128247
F-statistic	0.027967	Durbin-Watson stat	1.922594
Prob(F-statistic)	1.000000		

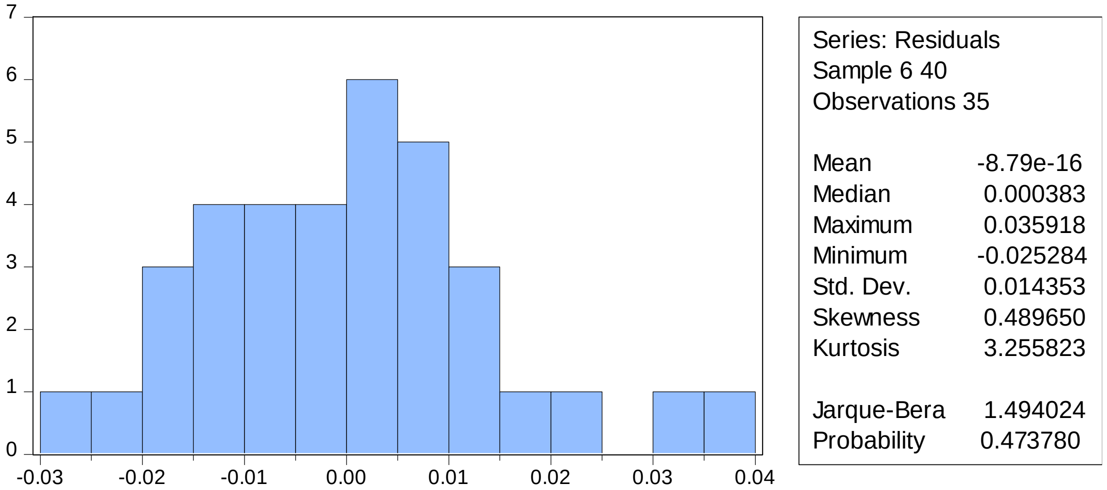
Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	0.278127	Prob. F(19,15)	0.9951
Obs*R-squared	9.118047	Prob. Chi-Square(19)	0.9715
Scaled explained SS	1.888963	Prob. Chi-Square(19)	1.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 03/09/19 Time: 09:57
Sample: 6 40
Included observations: 35

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000679	0.001415	-0.480066	0.6381
LNY(-1)	0.000447	0.003434	0.130122	0.8982
LNY(-2)	-0.000209	0.005259	-0.039780	0.9688
LNY(-3)	-0.001864	0.005474	-0.340446	0.7382
LNY(-4)	0.001635	0.003658	0.446998	0.6613
LNX1(-1)	0.000210	0.000282	0.744904	0.4678
LNX1(-2)	-6.65E-05	0.000277	-0.240089	0.8135
LNX1(-3)	-0.000147	0.000252	-0.582154	0.5691
LNX1(-4)	0.000142	0.000217	0.657426	0.5209
LNX1(-5)	-1.90E-05	0.000205	-0.092727	0.9273
LNX2	0.000152	0.000132	1.153716	0.2667
LNX2(-1)	0.000111	0.000260	0.427433	0.6751
LNX2(-2)	3.22E-05	0.000315	0.102068	0.9201
LNX2(-3)	0.000170	0.000337	0.506186	0.6201
LNX2(-4)	0.000133	0.000168	0.790360	0.4416
LNX3(-1)	-0.000190	0.000185	-1.027904	0.3203
LNX3(-2)	-0.000152	0.000217	-0.699152	0.4952
LNX3(-3)	-7.57E-05	0.000247	-0.306545	0.7634
LNX3(-4)	9.91E-05	0.000252	0.392676	0.7001
LNX3(-5)	8.01E-05	0.000232	0.345200	0.7347

R-squared	0.260516	Mean dependent var	0.000200
Adjusted R-squared	-0.676165	S.D. dependent var	0.000305
S.E. of regression	0.000395	Akaike info criterion	-12.54068
Sum squared resid	2.34E-06	Schwarz criterion	-11.65191
Log likelihood	239.4619	Hannan-Quinn criter.	-12.23388
F-statistic	0.278127	Durbin-Watson stat	2.217225
Prob(F-statistic)	0.995069		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Series: Residuals
Sample 6 40
Observations 35
Mean -8.79e-16
Median 0.000383
Maximum 0.035918
Minimum -0.025284
Std. Dev. 0.014353
Skewness 0.489650
Kurtosis 3.255823
Jarque-Bera 1.494024
Probability 0.473780