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MACROECONOMIC DETERMINANTS OF HOUSEHOLD EXPENDITURE IN SRI LANKA: A MULTIVARIATE CO-INTEGRATION APPROACH

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ABSTRACT

The policymakers and economists in macroeconomics long have been given much attention on the factors determining the consumption expenditures because the level of consumption per person is often viewed as key measure of an economy's productive success. This study is used to analyse the macroeconomic determinants of household consumption expenditure in Sri Lanka for the case of Sri Lanka in the post economic liberalization using multivariate co-integration approach. As macroeconomic variables, gross domestic product, gross domestic savings, gross national income were used to this study. The sample period consists of annual data from 1978 to 2016. Vector error correction model and Johansen co-integration approach were used to identify long run relationships among gross domestic product, gross national income, gross domestic savings and household final consumption expenditure in Sri Lanka. The Johansen co-integration test proved that the natural log value of household final consumption expenditure is co-integrated with natural log values of gross domestic product, gross domestic savings and gross national income. Vector error correction model indicated that the existence of long run causality among natural log values of household final consumption expenditure, gross national income and gross domestic savings. Wald test was used to determine short run causalities among gross domestic product, gross national *income, gross domestic savings and household final consumption expenditure in Sri Lanka. Wald test revealed that significant short run causalities among natural log values of household final consumption expenditure, gross domestic product, gross national income, and gross domestic savings.*

KEYWORDS - Co-integration, Household final consumption expenditure, Impulse Response Function, Variance Decomposition, Vector error correction model

INTRODUCTION

The policymakers and economists in macroeconomics long have been given much attention on the factors determining the relationship between consumption and savings. In past theoretical and empirical researches of those factors have focused as the concept of the consumption function. Lists of variables that influence on consumption and their magnitude with direction of their effects have been investigated. Income plays pivotal role on any such list and much of recent investigations have concerned the nature, reliability and measurement of the dependence of the consumption on income.

There is a principal reason of economists that have interested in the division of income between consumption and savings. That is the savings for accumulation of the wealth of nations help for growth in their capacity to produce goods and services. In other words, consumption uses productive resources in the present while savings enhance the resources available for production and consumption in the future.

Keynes, John M. (1936) stated the current consumption expenditure is a highly dependable and stable function of current income-that is “the amount of aggregate consumption mainly depends on the amount of aggregate income (both measured in terms of wage units)”. He termed it a “fundamental physiological rule of any modern community that, when its real income is increased, it will not increase its consumption by an equal absolute amount,” and stated somewhat less that “as a rule…. a greater proportion of income … (is) saved as real income increases” [1].

The life-cycle theory of consumption was developed by Franco Modigliani, Albert Ando and Richard E. Brumberg in the early 1960s [2]. It is commonly known as “life-cycle hypothesis”. The life-cycle hypothesis rejects the Keynesian consumption theory that current consumption depends on current income. The life-cycle hypothesis postulates that the individual sustains a constant or slightly increasing level of consumption over his life-cycle. It maintains that individuals stabilize their consumptions over a period of time as their consumption streams to the expected lifetime income stream.

The income starts from the year when the individual begins with full-time employment, reaches a maximum when he approaches his middle years and falls thereafter. If an individual decides not to make any assignment, then he will try at making the present value of his income stream equal to the present value of his consumption stream. Simply it implies that he would spend his entire income on consumption over the period of his life [2].

The permanent income hypothesis was developed by Milton Friedman in 1957. It is also known as Friedman's theory of consumption. Friedman's theory postulates that consumption is the function of permanent income. Permanent income is the mean of all the incomes anticipated by the households in the long run. The method of estimating permanent income is an approximation of incomes anticipated from all human wealth such as training, education, skill and intelligence and non-human wealth such as assets as money, stocks, bonds, real estates and consumer durables [3].

Wagner's law, also known as the explosion theory of government activities, was proposed by Adolf Wagner, a leading scholar of the German School of social policy. After investigating the industrialization of America, France, Germany, Japan and other countries during the British Industrial revolution, he offered an explanation on the increase of fiscal expenditures from the perspective of the expansion of government functions. It is unclear whether the increase of public expenditures mentioned in Wagner's law refers to an increase in the proportion of public expenditures in GDP or only to that of absolute amount.

Wagner's law tells that when the domestic income increases, the public expenditure will increase faster. The proportion of government expenditures in GDP increases with income per capita, which is called the relative increase of fiscal expenditures.

The objective of this study is investigate the existence of long run relationship and short run relationship among gross domestic product, gross domestic savings, and gross national income to household final consumption expenditure in Sri Lanka [4].

MATERIALS AND METHODS

Data Descriptions

This study examines the effect of variables gross domestic product, gross domestic savings, gross domestic income on household final consumption expenditure in Sri Lanka from the period 1978 to 2016 using error correction mechanism. Annual data of household final consumption expenditure, gross domestic product, gross domestic savings and gross national income during period 1978 to 2016 were taken to study. Annual data of household final consumption expenditure [5], gross domestic product [6], gross domestic savings [7] and gross domestic income [8] were taken from statistical bulletin of the World Bank website. The description of variables used in this research study as follows:

LNHFCE - Log of Household Final Consumption Expenditure

LNGDP - Log of Gross Domestic Product

LNGDS - Log of Gross Domestic Savings

LNGNI - Log of Gross National Income

Box-Cox Transformation

Box-cox transformation is a commonly used method to normalize data. Box-cox transformation will manipulate non normal data and suggest the appropriate factor to be used to change the data into normal data [9]. It helps to identify an appropriate exponent that can transform data into "normal shape".

Unit Root Test

Stationary of a series is important phenomenon because it can influence its behaviour. In a time series analysis, the ordinary least squares (OLS) regression results might provide a spurious regression if the data series are non-stationary.

Time series stationary is the statistical characteristics of a series such as its mean and variance over time. If both are constant over time, then the series said to be stationary process (i.e. is not a random walk/has unit root). Differencing operations produces other set of observations such as the first-differenced values, second differenced values so on.

If a series is stationary without any differencing it is called as I (0), or integrated of order 0. On the other hand, a series that has stationary first differences is called I (1), or integrated of order one. Augmented Dickey-Fuller test and Phillips-Perron (PP) test were used to test stationary of variables.

Co-integration Test

Co-integration is an econometric technique for testing the relationship between non-stationary time series variables. If two or more series each have a unit root, but a linear combination of them is stationary, then the series are said to be co-integrated [10].

The Johansen test and estimation strategy–maximum likelihood–makes it possible to estimate all co-integrating vectors when there are more than two variables. If there are three variables each with unit roots, there are at most two co-integrating vectors. More generally, if there are n variables which all have unit roots, there are at most $n-1$ co-integrating vectors. The Johansen test provides estimates of all co-integrating vectors.

The Johansen tests are likelihood-ratio tests. There are two tests:

1. The maximum eigenvalue test - examines whether the largest eigenvalue is zero relative to that the next largest eigenvalue is zero. The first test is a test whether the rank of the matrix Π is zero. The null hypothesis is that the rank Π = 0 and the alternative hypothesis is that rank Π = 1. For further tests, the null hypothesis is that rank Π = 1, 2, 3… and alternative hypothesis is that rank Π = 2, 3….

   The maximum eigenvalue test statistic is:

   $$LR_{max}\,(r,r+1) = -T * \ln\left(1-\hat{\lambda}_{r+1}\right)$$

   Where $LR_{max}\,(r,r+1)$ is the likelihood ratio test statistic for testing whether rank Π = r versus the alternative hypothesis that rank Π = r + 1. λ is the maximum eigenvalue and T is the sample size [11].

2. The trace test - tests whether the rank of the matrix Π is r. the null hypothesis is that rank Π = r. The alternative hypothesis is that r < rank $\Pi \leq$ n, where n is the maximum number of possible co-integrating vectors. For the succeeding test if

this null hypothesis is rejected, the next null hypothesis is that rank Π = r +1 and the alternative hypothesis is that r +1 < rank Π ≤ n.

The likelihood ratio test statistic is:

$$LR_{tr}\ (r,n) = -T * \sum_{i=r+1}^{n} \ln\left(1-\hat{\lambda}_i\right)$$

Where, $LR_{tr}\ (r,n)$ is the likelihood ratio statistic for testing whether rank Π = r versus the alternative hypothesis that rank Π ≤ n. λ is the largest eigenvalue and T is the sample size [11].

Vector Error Correction Model

Engle and Granger showed that once a number of variables are co-integrated, there always exists a corresponding error-correction representation that implies that changes in the dependent variable are a function of the level of disequilibrium in the co-integrating relationship as well as changes in other explanatory variables. In other words, if co-integration has been detected between variables that indicate there exists a long term equilibrium relationship between variables. The regression equation form of vector error correction model as follows:

$$\Delta Y_t = \alpha_y + \sum_{i=0}^{n} \beta_{y,i}\,\Delta Y_{t-i} + \sum_{i=0}^{n} \delta_{y,i}\,\Delta X_{t-i} + \sum_{i=0}^{n} \gamma_{y,i}\,\Delta Z_{t-i} + \sum_{i=0}^{n} \tau_{y,i}\,\Delta M_{t-i} + \sum_{i=0}^{n} \epsilon_{y,i}\,ECT_{t-i} + \mu_{y,t}$$

Where △ is first difference notation. Y (natural logarithms of household final consumption expenditure), X (natural logarithms of gross domestic product), Z (natural logarithms gross domestic savings), M (natural logarithms of gross national income) are variables in time series model. ECT refers error correction terms derived from long run co-integrating relationship via the Johenson maximum likelihood procedure, μ_t (for t = 1, 2, 3…) are serially uncorrelated random error terms with mean zero. i refers the number of lags [12].

Wald Test

Wald test is used to testing the significance of particular explanatory variables in a statistical model. The Wald test, described by Polit (1996) and Agresti (1990), is one of a number of ways of testing whether the parameters associated with a group of explanatory variables are zero.

If the Wald test is significant, then would conclude that the parameters associates with these variables are not zero, so that the variables should be included in the model. If the Wald test is not significant, then these explanatory variables can be omitted from the model [13].

Innovation Accounting

Innovation accounting can be used to evaluate the influence of exogenous shocks on the variables of a VEC model. There are several tools to evaluate the influence of exogenous shocks on the variables of a VECM.

1. Impulse response functions (IRF)
2. Variance Decomposition (VD)

Though the result of VECM indicates the exogeneity or endogeneity of a variable in the system and the direction of Granger-Causality within the sample period, it does not provide the dynamic properties of the system. The analysis of the dynamic interactions among the variables in the post-sample period is conducted through Impulse response functions (IRFs) and variance decompositions (VDs).

Breusch-Godfrey LM test for Serial Correlation

Serial correlation is the common concept used to describe the relationship between observations on the same variable over periods of time. If the serial correlation of observation is zero, observations are said to be independent. However, if serial correlation has statistically significant, it means observations do not come from in a random process, but rather observations are related to their prior observation values. In this case, observations may exhibit positive or negative serial correlation [14].

Breusch – Godfrey Lagrange Multiplier (LM) test that can be examined the higher order of serial correlation when lagged dependent variable is used. The null hypothesis of the Breusch-Godfrey LM test is that there is no serial correlation among residuals up to the specified number of lags [15].

Breusch-Pagan-Godfrey test for Heteroskedasticity

Heteroskedasticity is the violation of assumption which is the observations of the error terms are drawn from a distribution that has a constant variance. The assumption of constant variances for observations of the error term (homoscedasticity) is not always realistic. In general, heteroskedasticity is more likely to take place in cross-sectional models than in time series models.

The Breusch-Pagan test is used to test heteroskedasticity in a linear regression. The null hypothesis is there is no heteroscedasticity in the residuals [16].

Jarque-Bera Test for Normality

There are numerous formal tests for normality. One of most popular tests for the normality is the Jarque-Bera test. The Jarque-Bera test involves a statistic that is a function of skewness and excess kurtosis of the sample.

$$JB = \left(\frac{n}{6}\right)[S^2 + \left(\frac{(K-3)^2}{4}\right)]$$

Where JB is the Jarque-Bera test statistic, n is the number of observations, S is the skewness of the sample, and K is the excess kurtosis of the sample. The test statistics follows chi-squired distribution under the null hypothesis normality with 2 degree of freedom [17].

CUSUM Test

The standard CUSUM test is one of the tests on structural change with unknown break point. This test based on recursive residuals which are independently distributed under the null hypothesis. The CUSUM test takes the cumulative sum of recursive residuals then plots its value against the upper and lower bounds of the 95% confidence interval at each pint. The CUSUM of squares statistic is a cumulative sum of squares residuals, expressed as a fraction of sum of squared residuals summed over all observations. The test is plotted with 5% confidence bounds. The test parameter is considered as instability when the cumulative sum of squares goes outside the area between the two critical lines [18].

RESULTS AND DISCUSSION

This section describes the results of this research study. Data analysis and outputs of statistical tests which are used to analyze the data are discussed under this section.

Box-Cox Transformations

Box-Cox transformation is used to identify appropriate exponent of data series to transform into normal data series by reducing variability of data. The λ value indicates the power to which all data should be raised.

Table 1: Box- Cox transformations results

Variable	λ value
HFCE	0.00
GDP	0.00
GNI	0.00
GDS	0.00

The λ values of household final consumption expenditure (HFCE), gross domestic product (GDP), gross domestic savings (GDS) and gross national income (GNI) show that appropriate exponents of data series to transform into normal data series by reducing variability of data are 0.00. Therefore, natural log transformation of series can be used to decrease variability of series and make series more close to the normal.

Test for Stationarity - Unit Root Test

Two standard procedures of unit root test namely the Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) test were performed to check the stationary nature of the series. Both tests were performed to examine variables at level and also at first difference of series.

Table 2: ADF and PP unit root test results

Variable	Augmented Dickey-Fuller test statistic				Philips-Perron test statistic			
	H_o: Variable is non-stationary				H_o: Variable is non-stationary			
	Level		First Difference		Level		First Difference	
	Test Statistic	P-value	Test Statistic	P-value	Test Statistic	P-value	Test Statistic	P-value
LNHFCE	0.481721	0.9609	-7.053813	0.0000	0.481721	0.9839	-7.051849	0.0000
LNGDP	0.730092	0.9913	-6.795404	0.0000	0.774708	0.9923	-7.051849	0.0000
LNGNI	0.441699	0.9823	-7.083770	0.0000	0.493788	0.9844	-7.051811	0.0000
LNGDS	0.479846	0.9838	-8.047335	0.0000	0.613928	0.9884	-7.938711	0.0000

The Augmented Dickey-Fuller and Phillips-Perron test results prove that all log transformed series are non-stationary at levels, but stationary at first difference. Hence, the two tests proved that all log transformed series are integrated into same order. Therefore, Johansen test of co-integration can be applied.

Johansen Co-integration Test

Table 3: Results of Co-integration Tests

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.835816	107.1288	47.85613	0.0000
At most 1 *	0.470642	36.66486	29.79707	0.0069
At most 2	0.246634	11.85730	15.49471	0.1639
At most 3	0.020613	0.812326	3.841466	0.3674
Trace test indicates 2 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.835816	70.46390	27.58434	0.0000
At most 1 *	0.470642	24.80755	21.13162	0.0145
At most 2	0.246634	11.04498	14.26460	0.1520
At most 3	0.020613	0.812326	3.841466	0.3674
Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				

According to Table 3, the Trace test and Maximum eigenvalue test indicates 2 co-integrating equations at the 5% significance level. Both trace test and Maximum eigenvalue are proven that there are at least two co-integrated vectors among log transformed macroeconomic variables.

Long Run Relationship

After normalization co-integrated vectors on LNHFCE and normalized co-integrating coefficients were estimated as reported in table 4.

Table 4: Results of Co-integration Tests

Cointegrating Eq	CointEq1	CointEq2
LNHFCE(-1)	1.000000	0.000000
LNGDP(-1)	0.000000	1.000000
LNGDS(-1)	-1.320151 (0.24512) [-5.38567]	0.360878 (0.07106) [5.07820]
LNGNI(-1)	0.685355 (0.29917) [2.29082]	-1.453895 (0.08673) [-16.7626]
C	-10.61990	2.809226

The first normalized equation is estimated as follows:

LNHFCE (-1) = -10.620 – 1.320*LNGDS (-1) + 0.685*LNGNI (-1)

According to first normalized equation, LNHFCE shows significantly negative relation with LNGDS and statistically significant positive relationship with LNGNI in the long run.

The second normalized equation is estimated as follows:

LNGDP (-1) = 2.809 + 0.361*LNGDS (-1) – 1.454*LNGNI (-1)

According to second normalized equation, LNGDP shows significantly positive relation with LNGDS and significantly negative relationship with LNGNI.

Vector Error Correction Model (VECM)

The relationship among LNHFCE, LNGDP, LNGNI and LNGDS is given as follows:

D(LNHFCE) = C(1)*(LNHFCE(-1) - 1.320151049*LNGDS(-1) + 0.685*LNGNI(-1) - 10.620) + C(2)*(LNGDP(-1) + 0.361*LNGDS(-1) - 1.454*LNGNI(-1) + 2.809) + C(3)*D(LNHFCE(-1)) + C(4)*D(LNHFCE(-2)) + C(5)*D(LNGDP(-1)) + C(6)*D(LNGDP(-2)) + C(7)*D(LNGDS(-1)) + C(8) *D(LNGDS(-2)) + C(9)*D(LNGNI(-1)) + C(10)*D(LNGNI(-2)) + C(11)

The coefficients of this model were estimated and indicated in table 5

Table 5: VECM Coefficients estimates

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.588423	0.174083	-3.380120	0.0021
C(2)	-2.351568	0.423179	-5.556906	0.0000
C(3)	-0.475980	0.574814	-0.828060	0.4146
C(4)	-1.640007	0.468738	-3.498767	0.0016
C(5)	-3.719037	0.983756	-3.780445	0.0008
C(6)	1.265286	1.009023	1.253971	0.2202
C(7)	0.242031	0.118822	2.036921	0.0512
C(8)	-0.208359	0.127480	-1.634443	0.1134
C(9)	3.670186	0.729256	5.032782	0.0000
C(10)	0.925325	0.770369	1.201146	0.2398
C(11)	0.048933	0.019899	2.459080	0.0204
R-squared	0.807475	Mean dependent var		0.074488
Adjusted R-squared	0.738716	S.D. dependent var		0.112753

S.E. of regression	0.057635	Akaike info criterion	-2.636644
Sum squared resid	0.093009	Schwarz criterion	-2.167434
Log likelihood	62.41456	Hannan-Quinn criter.	-2.468295
F-statistic	11.74359	Durbin-Watson stat	2.058305
Prob(F-statistic)	0.000000		

C(1) and C(2) are coefficients of the co-integrating models. Those are also called error correction terms and as well as speed of adjustment towards long run equilibrium. According to Table 5: C(1) is negative and significant. Therefore, there is long run causality running from LNHFCE(-1), LNGDS(-1) and LNGNI(-1) towards D(LNHFCE). This suggests that with absence of changes in first lag value of variables LNHFCE, LNGDS and LNGNI, deviation of the model from the long run part is corrected by 59% increase in D(LNHFCE) per annually. This means that deviation from the long run relationship takes approximately 1.7 (1/0.588) years to eliminate disequilibrium.

C(2) is also negative and significant. Therefore there is long run causality running from LNGDP(-1), LNGDS(-1) and LNGNI(-1) towards D(LNHFCE). This suggests that with absence of changes in first lag value of LNGDP, LNGDS and LNGNI, deviation of the model from the long run part is corrected by 235% increase in D(LNHFCE) per annually. This means that deviation from the long run relationship takes approximately 0.4 (1/2.35) years to eliminate disequilibrium.

Determination Short Run Relationships among Variables

Wald test was used to determine significant short run relationships among each macroeconomic variable. Results are indicted as follows:

Table 6: Wald test for LNHFCE coefficients

Test Statistic	Value	df	Probability
F-statistic	6.125299	(2, 28)	0.0062
Chi-square	12.25060	2	0.0022
Null Hypothesis: C(3)=C(4)=0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(3)		-0.475980	0.574814
C(4)		-1.640007	0.468738

According to table 6, probability value of Chi-square is 0.0022<0.05. Therefore, H_o: C (3) = C(4) = 0 is rejected at 5% significance level and concluded that there is short run relationship between LNHFCE coefficients.

Table 7: Wald test for LNGDP coefficients

Test Statistic	Value	df	Probability
F-statistic	7.162502	(2, 28)	0.0031
Chi-square	14.32500	2	0.0008
Null Hypothesis: C(5)=C(6)=0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(5)		-3.719037	0.983756
C(6)		1.265286	1.009023

According to table 7, Null hypothesis of Wald test is rejected due to probability value of chi-square test statistic is 0.0008<0.05 at 5% significance level. It is implied that there is short run relationship between LNGDP and LNHFCE.

Table 8: Wald test for LNGDS coefficients

Test Statistic	Value	df	Probability
F-statistic	4.527236	(2, 28)	0.0198
Chi-square	9.054471	2	0.0108
Null Hypothesis: C(7)=C(8)=0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(7)		0.242031	0.118822
C(8)		-0.208359	0.127480

According to table 8, there is evidence to reject null hypothesis of Wald test due to probability value of Chi-square is 0.0108<0.05 at 5% significance level. Therefore, it is concluded that there is short run causality between LNGDS and LNHFCE.

Table 9: Wald test for LNGNI coefficients

Test Statistic	Value	df	Probability
F-statistic	16.26109	(2, 28)	0.0000
Chi-square	32.52217	2	0.0000
Null Hypothesis: C(9)=C(10)=0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(9)		3.670186	0.729256
C(10)		0.925325	0.770369

Table 9 is implied there is short run causality between LNGNI and LNHFCE due to availability of strong evidence to reject null hypothesis (probability value of Chi-square statistic is 0.0000<0.05) at 5% significance level.

Impulse Response Function

Impulse response analysis allows an analysis of the dynamics of a VEC model in its vector moving average (VMA) representation. Substantively, this allows us to trace out the dynamic impacts of changes in each of the endogenous variables over time.

Table 10: Impulse response of LNHFCE

Period	LNHFCE	LNGDP	LNGDS	LNGNI
1	0.057635	0.000000	0.000000	0.000000
2	0.061282	0.028780	-0.003039	0.058355
3	0.080716	0.025059	-0.037454	0.053877
4	0.088057	0.010848	-0.032236	0.046990
5	0.084853	0.026260	-0.030689	0.053528
6	0.083720	0.028719	-0.036236	0.047719
7	0.082253	0.025837	-0.030383	0.046756
8	0.080135	0.026250	-0.028941	0.049116
9	0.081476	0.024592	-0.030844	0.047261
10	0.082069	0.023515	-0.030345	0.047240

According to impulse response of LNHFCE, when one standard deviation of positive impulse is given on LNHFCE, LNHFCE is laid in positive direction in short runs as well as long run. Further, when one standard deviation of positive impulse is given on LNGDP, the LNHFCE is fluctuated in positive direction. But when one standard deviation of positive impulse is given on LNGDS, the LNHFCE is laid in negative direction, when one standard deviation of positive impulse is given on LNGNI the LNHFCE is decreased in positive direction from short runs to long runs.

Variance Decomposition

Variance decomposition is used as a tool for evaluating the dynamic interactions and strength of casual relations among variables in the system.

Table 11: Variance Decomposition of LNHFCE

Period	S.E.	LNHFCE	LNGDP	LNGDS	LNGNI
1	0.057635	100.0000	0.000000	0.000000	0.000000
2	0.106396	62.51951	7.317119	0.081605	30.08176
3	0.150893	59.69757	6.395983	6.201640	27.70481
4	0.184086	62.99162	4.644652	7.233331	25.13040
5	0.213505	62.62333	4.965603	7.443414	24.96765
6	0.238764	62.36887	5.417277	8.255124	23.95872
7	0.259905	62.65075	5.560083	8.333345	23.45583
8	0.279126	62.56164	5.705102	8.300247	23.43301
9	0.297219	62.69112	5.716253	8.397352	23.19528
10	0.314293	62.88339	5.671828	8.441980	23.00280

According to Variance decomposition of LNHFCE results, the impulse to LNHFCE is caused to keep approximately constant the variance fluctuations of LNHFCE from short run to long run. For example at the period 2, it contributes 62.52% variance fluctuation of LNHFCE. At the period 10, LNHFCE contribute 62.88% variance fluctuation of LNHFCE. Further, the impulse on LNGDP is caused to decrease the variance fluctuation of LNHFCE from short run to long run. For example at the period 2, impulse on LNGDP can cause 7.32% variance fluctuation of LNHFCE. At the period 10, impulse on LNGDP can cause 5.67% variance fluctuation of LNHFCE. The impulses on LNGDS is contributed much variance fluctuation of LNHFCE in long runs than short run. At the period 2, LNGDS contributes 0.82% variance fluctuation of LNHFCE. At the period 10, it has increased up to 8.44%. But impulse on LNGNI is caused to decrease variance fluctuations of LNHFCE gradually from short run to long run. For example at the period 2, LNGNI can cause 30.08% variance fluctuation of LNHFCE. At the period 10, it becomes 23.00%.

Residual Diagnostics

Model accuracy was checked using diagnostic tests such as Breusch-Godfrey serial correlation LM test for serial correlation, Breusch-Pargon-Godfrey test for Heteroskedasticity, Jarque-Bera test for normality, CUSUM test for stability of parameters.

Table 12: Breusch-Godfrey serial correlation LM Test

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.377373	Prob. F(2,26)	0.6894
Obs*R-squared	1.100183	Prob. Chi-Square(2)	0.5769

Table 12 indicates the probability value of chi square Breusch-Godfrey serial correlation LM test (0.5769) is not less than the 0.05. Therefore, there is no strong evidence to reject null hypothesis of the Breusch-Godfrey serial correlation LM Test. Therefore, it can be concluded that there is no serial correlation in model residuals.

Table 13: Breusch-Pagan-Godfrey heteroskedasticity test

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	0.497740	Prob. F(12,26)	0.8972
Obs*R-squared	7.285625	Prob. Chi-Square(12)	0.8382
Scaled explained SS	2.453928	Prob. Chi-Square(12)	0.9983

According to table 13, there is no heteroskedasticity of this model due to unavailability of evidences to reject null hypothesis of heteroskedasticity test (Probability value of observed R squared is 0.8382 > 0.05). Therefore, it can be concluded that model residuals are homoscedastic at 5% significance level.

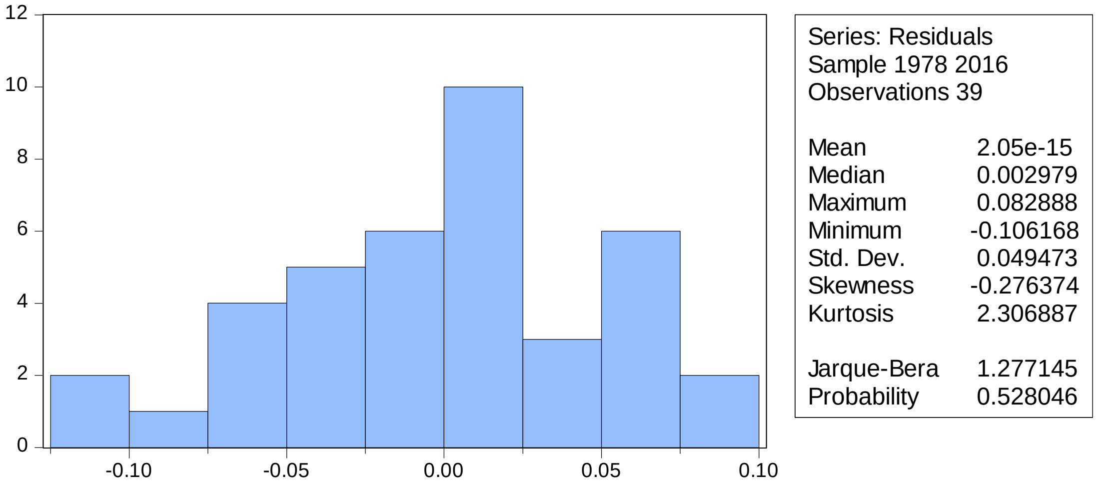

Figure 1: Histogram of residuals

The normality of residuals is confirmed by Jarque-Bera test since the probability value (0.528) is greater than the critical value at 5% significance level.

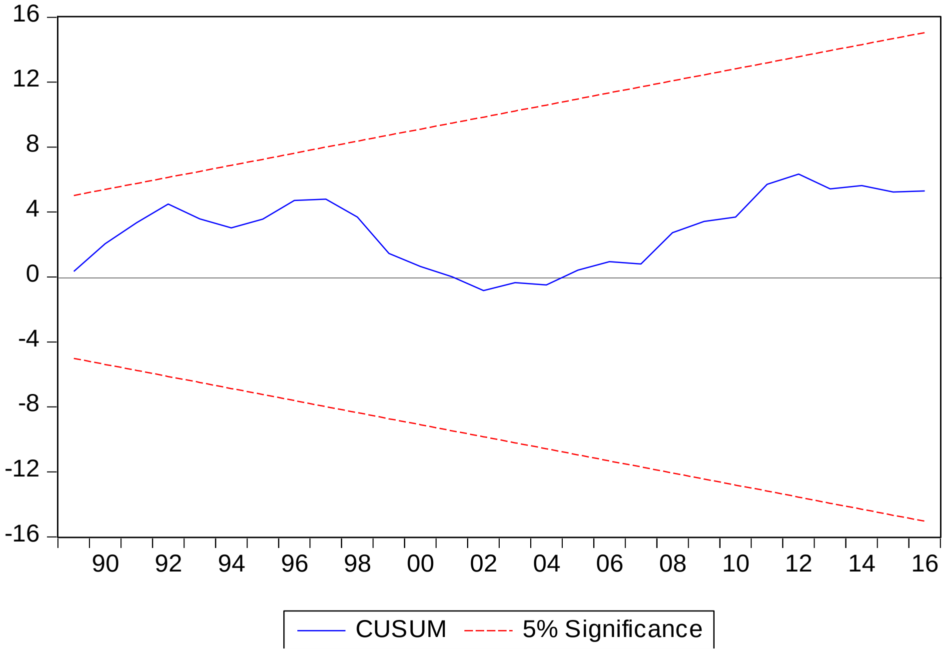

Figure 2: Recursive Estimates-CUSUM test

According to CUSUM test results in figure 2, model lies within the 5% significance boundary. Therefore, test finds parameter stability that parameter constancy exists in the sample period.

CONCLUSIONS

This study investigated the behaviors of macroeconomic variables namely gross domestic product, gross domestic savings and gross national income on household final consumption expenditure in Sri Lanka.

The Box-Cox transformations suggest that appropriate exponents of all macroeconomic variables which are considered for this investigation are 0.00. It is revealed the importunacy of natural log transformation of series to decrease the variability of series and make series more close to the normal. All the series used in this analysis were found non-stationary at levels but stationary at first difference.

Johansen's test of co-integration suggests that there are at least two co-integrated vectors among log transformed macroeconomic variables. In the long run, log transformed household final consumption expenditure showed a significantly negative relation with log transformed gross domestic product and there was a statistically significant positive relationship with log transformed household final consumption expenditure and log transformed gross national income. In addition to that, in the long run, log transformed gross domestic product showed significantly positive relation with log transformed gross domestic savings and significantly negative relationship with log transformed gross national income.

Wald test results revealed coefficients of log transformed series namely household final consumption expenditure, gross domestic product, gross domestic savings and gross national income are significant. That implied that the model showed short run effects from household final consumption expenditure, gross domestic product, gross domestic savings and gross national income. The variance decomposition analysis revealed that major proportion of the forecast error variability in the log value of household final consumption expenditure is explained by its own innovations.

Impulse response analysis showed that the one standard deviation of positive impulse on log of household final consumption expenditure, it laid in positive direction in short runs as well as long runs. When given one standard deviation of positive impulse on log of gross domestic product and log of gross national income, those have positive impact on log of household final consumption expenditure. One standard deviation of positive impulse on log of gross domestic savings, it has negative impact on log of household final consumption expenditure in short runs as well as in long runs.

This study gives important guidance for policymakers, economists and researches those who are great deal of interest on consumption expenditures, economic growth and savings. In this study macroeconomic variables namely gross domestic product, gross domestic savings and gross national income were used to identify effects on household final consumption expenditure. In addition to that other macroeconomic variables, for instances exchange rate, inflation rate, interest rate, unemployment rate and other variables particularly price of oil, price of gold might be affected to household final consumption expenditure. Therefore, future researches can extend including those variables as well.

For this study annual data from 1978 to 2016 were used. But if use longer data periods than that, would be able to get more comprehensive results.

In practice household consumption expenditures depends on the individual income and rather than the gross national income. Therefore, better get variables which represent the accurate individual income for the future studies.

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