Macroeconomic Variables and Gross Domestic Product: Evidence from Sri Lanka

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Abstract

The main objective of the study is to investigate the empirical relationship between macroeconomic variables and real gross domestic product (GDP) in Sri Lanka. Exchange rate, government spending, interest rate, money supply and unemployment rate were considered as selected macroeconomic variables. real GDP was considered as a dependent variable. The current study used annual time series data over the period from 1990 to 2019 which were collected from the annual reports of the Central Bank of Sri Lanka. Stationary of the data was tested using the Augmented Dickey-Fuller test. Johansen co-integration rank test, max Eigen value test, Vector Error Correction along with Wald causality test were used to estimate the relationship between macroeconomic variables and GDP. At the 5% level of significance, the co-integration rank test and max Eigen value test revealed that there are four co-integration equations exist in this study. Therefore, it was concluded that selected macroeconomic variables have long-run impact on GDP. Likewise VEC and Wald test revealed that the all the selected macroeconomic variables causes GDP in the short run. The results support the theoretical prediction that macroeconomic variables would play an active role in GDP. The study, therefore, concludes that macroeconomic variables are driving GDP in Sri Lanka. Thus, growth-oriented macroeconomic policies should be established for protecting poor people in the country.

Keywords: *macroeconomic variables, GDP, Vector Error Correction Model, Sri Lanka.*

1. Introduction

Economic growth referred to the rise in national income, per capita income and production, which means increase in total output of the country. In another word, an increase in market value of goods and services produced by a particular country is called as economic growth of the country. It is the major priority of macroeconomic policy in any country. Gross Domestic Product (GDP) is considered as a key indicator of economic growth (Semuel and Nurina, 2015). When the GDP grows faster than population growth of the country, per capita income will be increased and standard of living of the people will also be increased, it is named as economic growth. Value of total productions on goods and services for a specific period is determined by GDP. Rise in economic growth alleviate the people's living standards and prosper in terms of increase consumption on goods and services. Changes of GDP is determined by many variables such as inflation, interest rate, government spending, money supply, exchange rate, foreign direct investment, unemployment rate, household consumption and so on (Mamo, 2012; Anaripour, 2011; Jakob, 2015; Kibria et al., 2014. These are considered as macro economic variables. Current trend of economic system of a country is communicated with macro economic variables. They are used by government and corporations for helping to formulate economic policies and strategies.

Economic growth of Sri Lanka was 5% in 2015 and it decreased to 2.3% continuously in 2019 (Annual Reports, Central Bank of Sri Lanka, 2019). Further it was -1.7% and -16.3% in first two quarters in 2020 and it was increased to 1.5% in third quarter due to the effect of COVID 19 pandemic. But, the major reasons for continuous decrease from 2015 to 2019 should be analyzed and recommendation regarding policy formulation to the government should be given with the help of research. Therefore, researchers understood needful of this research currently. Most of the studies carried out in Sri Lanka as well as in other countries focus on analyzing influence of macroeconomic variables on stock

market performance or performance of the firm or market value of the firm. Very limited studies investigated how far macroeconomic variables drive economic growth of the country has been identified. Even though there are studies to investigate such influence, most of the researchers used basic analysis of correlation and pooled ordinary least square regression analysis. Therefore, this study is carried out to analyze role of selected macroeconomic variables in GDP of the country with the analysis of time series.

In the succeeding section, various literatures are highlighted, followed by methodology consists model specification and data collection. Then, the results are presented together with relevant discussions. Finally, study is concluded together with future recommendations.

2. Literature Review

Theories behind this study are economic growth theories and macroeconomic theory. Economic growth theories consist of Classical Growth Theory, Neoclassical Growth Model and Endogenous Growth Theory. Classical Growth Theory says that economic growth of a country will decrease with an increase in population and limited resources. The Neoclassical Growth Theory postulates steady economic growth can be identified when labor, capital and technology plays major role in an economy. The simplest and most popular version of the Neoclassical Growth Model is the Solow-Swan Growth Model. The Endogenous Growth Theory states that economic growth is generated with the changes of internal factors in the economy. This theory contrasts neoclassical growth theory (Chizonde, 2016).

There are very limited recent research arguments on impact of macroeconomic variables on economic growth. Omar and Nor (2020) have done a study to examine the linkage between macroeconomic variables namely population, unemployment and export with the economic growth in Malaysia using multiple linear regressions analysis for a time series quarterly data from 2006 to 2016. They found that population and export had significant and negative impact on economic growth.

Yeaseen Chowdhury et al. (2019) carried out a study to find the impact of macroeconomic variables on economic growth of Bangladesh using GDP as a representative of economic growth. Inflation, real interest rate, exchange rate, and household consumption expenditures growth were selected to represent the macroeconomic variables for the period from 1987 to 2015. It was found that the independent variables explained 75.60% of the variability of GDP and macro economic variables selected in the study except real interest rate had positive and significant impact on economic growth in multiple regression analysis.

Ayyoub et al. (2011) observed significant inverse relationship between inflation and economic growth in Pakistan used data for the period from 1973 to 2009 in their study. Similar finding was identified by Faria and Carneiro (2001) in the economy of Brazil for the period from 1981 to 1997 in short term but it was found that there was no impact of inflation on output of the economy in long term. Most of the developed and developing countries are facing problems with high rates of unemployment since unemployment increases poverty and reduces standards of living Shorbaji (2009). Negative effect of unemployment on economic growth was found in studies done by Noor et al (2007) in Malaysia, Alamro, and Al-dalaien (2014) in Jordan and Michael et al (2016) in Nigeria. In contrast, Ahmed and Ambreen (2014) in Pakistan found positive relationship while Mosikari (2013) in South Africa, Alhdiy et al (2015) in Egypt argued that there was no relationship between unemployment rate and economic growth.

Sharma et al. (2011) intended to compare impact of macroeconomic variables on economic growth between India and Sri Lanka. The econometrics tools such unit root test, Granger Causality Test, co integration test, vector auto regression, Variance decomposition, and Variance Decomposition Analysis have been used for the analysis. Monthly data was used from 2002 to 2009 of both of the countries. At the end of the study, researchers did not come to a common conclusion as results from all the models are different. Granger model and Vector Auto Regression model indicates that Consumer Price Index, Whole Sale Price Index and Exchange

rate does not have any influence on each other in the case of both of the countries but the Variance decomposition model shows visible impact of macroeconomic variables on each other in some of the cases in Indian and Sri Lankan data.

No recent study analyzing impact of macroeconomic variables on economic growth was identified. However, there are studies that found relationship between macro economic variables and stock market performance. Jahfer and Inoue (2017) intended to examine long run relationship of macroeconomic factors with stock market performance in Sri Lanka. In order to conduct the study researchers collected quarterly data of economic variables for the period 1996 to 2014. Initially, it was found that all variables are stationary on first differencing using Augmented Dickey Fuller (ADF) test. Johansen co-integration tests, and Ordinary Least Square test were used to investigate the relationship between macro economic variables and stock market performance. It was revealed that there was a long-run relationship between macro economic factors namely; gross domestic product, money supply, treasury bill rate, exchange rate, inflation rate and stock market performance indicators in Sri Lanka by employing Co-integration test. Further, they have found that money supply and inflation were positively related with stock market performance while exchange rate, GDP and treasury bill rate were negatively related to the stock market performance.

Even though limited similar studies have been done in Sri Lanka, there is no recent clear idea on real GDP of Sri Lanka due to the changes of macroeconomic variables as there is lack of research in that context.

This study hypothesized that selected macroeconomic variables have a significant relationship with real GDP contribution in Sri Lanka.

3. Methodology

Data Collection

The current study is mainly based on time series data gathered from secondary sources. The annual reports of the Central Bank of Sri Lanka from 1990 to 2019 were the main data sources for this research. For each of the variables, 30 annual observations were used in the study. Secondary data is justified by the fact that it is more

precise in terms of gathering high-quality data from a variety of sources while still saving time. In this study, real GDP was dependent variable, while real exchange rate, government spending, interest rate, money supply and unemployment rate were considered as independent variables to investigate the relationship between selected macroeconomic variables and real GDP in Sri Lanka.

Variables and their measurements are given in table 1 below:

Table 1: Variables and their measurements

Variables	Measurements
Gross Domestic Product	Log of real GDP
Real Exchange Rate	Log of Exchange Rate (rupees against dollar)
Government spending	Log of Government spending
Interest Rate	Log of Prime Lending Rate
Money Supply	Log of Money Supply
Unemployment rate	Log of Unemployment Rate

Empirical Model Specification

The long-run and short-run dynamic equilibrium relationships between macroeconomic variables and GDP in Sri Lanka are investigated using Johansen co-integration with VECM in this study.

VECM requires that the time series should be co-integrated in the same order as a starting point. The sequence can be various periods until it becomes stationary if it is non-stationary. According to Granger et al. (1986), VECM can be used to determine the equilibrium relationship between the variables in order to find long run relationships between variables if the variables are co-integrated under the same conditions. The Wald test is used to look at all of the factors in the study's short run dynamic relationships. The error correction model was used in this analysis to analyze the relationship between selected macroeconomic variables and real GDP. The VECM takes the following general form (Seneviratna and Jianguo, 2013)

$$ECT_{t-1} = \left[y_{t-1} - n_j X_{t-1} - \varepsilon_m R_{t-1}\right]$$

$$\Delta y_t = \sigma + \sum_{i=1}^{k-1} \gamma_i \Delta y_{t-i} + \sum_{j=1}^{k-1} n_j \Delta X_{t-j} + \sum$$

$$+ \lambda ECT_{t-1} + u_t$$

Where:

k-1 = the lag length is reduced by 1

ECT_{t-1} is the error correction term lagged one period,

λ is the short-run coefficient of the error correction term ($-1 < \lambda < 0$),

and ε is the white noise.

u_{it} - residuals

The current research focuses on empirical methodologies such as Unit Root, Johansen co-integration, Vector Error Correlation Model, and Wald Test, which are used to understand long and short term predictability.

4. Results and discussions

Unit Root Analysis to check the stationary status of the variables

Table 2 : Unit root analysis of variables

	Zero Level		1st Level	
Variables	t statistics	Prob.	t statistics	Prob.
Gross Domestic Product (GDP)	-0.7861	0.8081	-3.4881	0.0160
Real Exchange Rate (EXC)	-1.0367	0.7263	-4.7238	0.0008
Government spending (GS)	-1.9810	0.2930	-5.7747	0.0001
Interest Rate (IR)	-2.1450	0.2296	-5.5919	0.0001
Money Supply (MS)	0.0452	0.9552	-7.3449	0.0000
Unemployment rate (UEMP)	-1.4974	0.5207	-4.1930	0.0029

Source: Survey data

Augmented Dickey-Fuller (ADF) test was performed to check the stationary status of the data. According to the results of the unit root test presented in Table 2, all the variables considered in this study were not stationary at level zero. Therefore, it was conducted the first level difference for all the variables and the results were found to be stationary at first difference. As a result, the stationary status of GDP and was 5% level of significance. Exchange rate, government spending, interest rate, money supply and unemployment rate have shown the stationary at first difference with 1% level of significance. Finally, all variables are considered stationary. Therefore, it was decided to perform the Johansen Co-integrating Test.

Co- integrating Test and Vector Error Correction Model

The null hypothesis (proposing no Co-integration) should be rejected at 5% significant level, according to the Johansen Co-Integration test results. It was performed to test the presence of long run relationship among the variables using Johansen's maximum

likelihood approach. The long run co-integrating relations between the selected macroeconomic variables and GDP normalized on GDP as given below:

Normalized co integration coefficients (standard error in parentheses)					
GDP	EXC	GS	IR	MS	UNEMP
1.000	0.9660	0.4268	-0.5900	-2.1076	2.1864
	(0.1566)	(0.1096)	(0.0671)	(0.1266)	(0.1067)

So the model can be re parameterized as

GDP_t = -0.9660EXC - 0.4268GS +0.5900IR + 2.1076MS - 2.1864 UNEMP

The coefficients of exchange rate, government spending and unemployment rate are negative sign with GDP. And also interest rate and money supply are positive with GDP in this observation.

-Table 3: Co-Integration Test using Johansen Model

Hypothesized no. of CE(s)	Trace test			Maximum eigenvalue test		
	Test Statistic	Critical value 5%	Prob.**	Test Statistic	Critical value 5%	Prob.**
Series: GDP_EXC_GS_IR_MS_UNEMP						
None *	192.3436	95.7536	0.0000	77.5382	40.0775	0.0000
At most 1 *	114.8054	69.8188	0.0000	38.6746	33.8768	0.0124
At most 2 *	76.1307	47.8561	0.0000	34.7520	27.5843	0.0051
At most 3 *	41.3786	29.7970	0.0015	21.1685	21.1316	0.0494
At most 4 *	20.2101	15.4947	0.0090	19.1564	14.2646	0.0078
At most 5	1.0536	3.8414	0.3047	1.0536	3.8414	0.3047

Notes: *Denotes rejection of the hypothesis at the 0.05 level

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

Table 3 shows that at most 1 should be rejected at the 5% significant level. Because at most 1 P value (0.0000) less than the 1% significance level. And

Trace statistic value (114.8054) is higher than the 0.05 level critical value (69.8188). And also Maximum Eigenvalue test value (38.6746) is higher than the 0.05 level critical value (33.8768). Likewise, At most 2 should be rejected at the 5% significant level. Because at most 2 P value (0.0000) less than the 5% significance level. And Trace statistic value (76.1307) is higher than the 0.05 level critical value (47.8561). And also Maximum Eigenvalue test value (34.7520) is higher than the 0.05 level critical value (27.5843).

A similar pattern was observed At most 3 and At most 3 should be also rejected at the 5% significant level. Because at most P value (0.0015) less than the 5% significance level. At most 4 also should be also rejected at the 5% significant level. Because at most P value (0.0090) less than the 5% significance level.

At most 5 should be accepted as it is not significant level. Because at most 5 P value (0.3047) which is greater than the 5% significance level. And Trace statistic value (1.05) is less than the critical value (3.84). And also Maximum eigenvalue test value (1.05) is also less than the critical value (3.84)..

Given the results generated, the null hypothesis of no co-integration equation is rejected at the 5% level. As a result, Jahansen's co-integration indicated that there are four co integration equations exist at the 0.05 level of significance, In the long run, the findings indicate a significant relationship between GDP and the selected macroeconomic variables. Indeed, co-integrated findings revealed that variables have a long-term relationship and are moving in lockstep over time.

Table 4 : Co-integrated results

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.444413	0.103666	4.286986	0.0009
C(2)	0.031918	0.479213	0.066605	0.9479
C(3)	0.276542	0.446421	0.619464	0.5463
C(4)	1.487905	0.575737	2.584347	0.0227
C(5)	1.490395	0.641872	2.321953	0.0371
C(6)	0.130874	0.090670	1.443413	0.1726
C(7)	0.143284	0.102857	1.393048	0.1870
C(8)	0.082437	0.054132	1.522892	0.1517
C(9)	0.083961	0.045455	1.847118	0.0876
C(10)	0.839513	0.243653	3.445534	0.0043
C(11)	0.331131	0.232849	1.422088	0.1785
C(12)	-0.861067	0.341399	-2.522168	0.0255
C(13)	-0.357038	0.285558	-1.250318	0.2332
C(14)	-0.077687	0.031075	-2.499959	0.0266

R-squared	0.834886	Mean dependent var	0.034719
Adjusted R-squared	0.669771	S.D. dependent var	0.033383
S.E. of regression	0.019184	Akaike info criterion	-4.763331
Sum squared resid	0.004784	Schwarz criterion	-4.091416
Log likelihood	78.30497	Hannan-Quinn criter.	-4.563535
F-statistic	5.056410	Durbin-Watson stat	2.000439
Prob(F-statistic)	0.003151		

D(GDP) = C(1)*(GDP(-1) + 0.966025191989*EXCHANGE_RATE(-1) + 0.426876501432*GS(-1) - 0.5900823661*INTEREST_RATE(-1) - 2.10762012268*MS(-1) + 2.1864014171*UNEMP(-1) - 10.5996465172) + C(2)*D(GDP(-1)) + C(3)*D(GDP(-2)) + C(4)*D(EXCHANGE_RATE(-1)) + C(5)*D(EXCHANGE_RATE(-2)) + C(6)*D(GS(-1)) + C(7)*D(GS(-2)) + C(8)*D(INTEREST_RATE(-1)) + C(9)*D(INTEREST_RATE(-2)) + C(10)*D(MS(-1)) + C(11)*D(MS(-2)) + C(12)*D(UNEMP(-1)) + C(13) *D(UNEMP(-2)) + C(14)

Table 4 shows that the coefficient of co-integrated is significant at the 0.05 level of significance (P < 0.05) and has a positive sign (0.4444). It means that the short-run relationships between macroeconomic variables and GDP are causal.

Table 5 : Results of Wald Test

GDP	Exchange rate	Government Spending	Interest rate	Money supply	Unemployment
Chi-Square	17.7	18.38	18.48	18.52	18.16
Probability	0.000	0.0004	0.0010	0.0024	0.0001

The short-run changes along the co-integrating equilibrium relationships were then established to see whether independent and dependent variables had any short-run causality. The short run causality running from exchange rate (p < 0.01), government spending (p < 0.05), interest rate (p < 0.05), money supply (p < 0.05), and unemployment (p < 0.05) to Gross domestic product is revealed by the Vector error- correlation estimates with Wald statistic results in Table 5. This implies that lag values of 0 have no impact on GDP.

Diagnostics test

Table 6: Lagrange-multiplier test

Lag	Chi2	Df	prob>chi2
1	38.8036	36	0.3444
2	39.3337	36	0.3229

Source: Survey data

Lagrange multiplier test was performed to exam the autocorrelation among the variables. As per the results presented in table 6, probability values are more than 0.05. It clearly says that there is no auto correlation in this study.

5. Conclusion and recommendation

The empirical relationship between macroeconomic variables and GDP is explored in this report. As proxies for macroeconomic variables, the exchange rate, government spending, interest rate, money supply and unemployment rate were used. Annual reports from the Central Bank were used to compile data from 1990 to 2019. The data was checked for stationery using the ADF test. The relationship between macroeconomic variables and GDP was estimated using the Johansen co-integration test, VECM, and Wald test. The findings of the co-integration test showed that selected macroeconomic variable have a significant long-run effect on GDP. Likewise VCE along with Wald test causality showed that, in the short run, selected macroeconomic variables have a effect on GDP. The findings back up the theory that macroeconomic variables play a significant role in GDP. As a result, the study concludes that macroeconomic variables are driving Sri Lanka's GDP.

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