POLYNOMIAL DISTRIBUTED LAG APPROACH TO ANALYSE THE FACTORS AFFECTING ECONOMIC GROWTH OF SRI LANKA

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Abstract

The purpose of this study is to examine the effects of various factors on economic growth of Sri Lanka, using the annual data over the period of 1975 to 2014. The stationarity properties were checked by ADF, PP and KPSS unit root tests. Polynomial distributed lag approach was employed to determine the impact of various factors on economic growth. Findings of distributed lag structure show that the impact of consumption and trade balance on economic growth are not significant to the model whereas the impact of consumer price index, expenditure, foreign direct investment and investment on economic growth are significant.In addition to that the Granger causality test was performed to assess the causal relationship between two variables. The results were confirmed that the existence of unidirectional causality from foreign direct investment to economic growth and from economic growth to trade balance and also the existence of bidirectional causality between economic growth and expenditure and investment and economic growth.

Keywords: Sri Lanka, Economic growth, Polynomial distributed lag model, Almon model

Introduction

Sri Lanka is a lower-middle income developing nation. The economy of the country has been affected by natural disasters such as the 2004 Indian Ocean earthquake and a number of insurrections, such as the 1971,the 1987-89 and the 1983-2009 civil war, since becoming independent from Britain in February 1948. The government during 1970-77 period applied pro-left economic policies and practices. Between 1977 and 1994 the country came under United National Party (UNP) rule in which under President J.R Jayawardana Sri Lanka began to shift away from a socialist orientation in 1977. Since then, the government has been deregulating, privatising, and opening the economy to international competition, between 1994 and 2004 under Sri Lanka Freedom Party (SLFP) rule. In 2001, Sri Lanka faced bankruptcy, with debt reaching 101% of Gross Domestic Product (GDP).

The impending currency crisis was averted after the country reached a hasty ceasefire agreement with the Liberation Tigers of Tamil Eelam (LTTE) and brokered substantial foreign loans. After 2004 the United People's Freedom Alliance (UPFA) government has concentrated on mass production of goods for domestic consumption such as rice, grain and other agricultural products. However, twenty five years of civil war slowed economic growth, diversification and liberalisation, and the political group JanathaVimukthi Peramuna (JVP) uprisings, especially the second in the early 1980s, also caused extensive upheavals.

Following the quelling of the JVP insurrection, increased privatisation, economic reform, and a stress on export-oriented growth helped improve the economic performance,

increasing GDP growth to 7% in 1993. Economic growth has been uneven in the ensuing years as the economy faced a multitude of global and domestic economic and political challenges. Overall, average annual GDP growth was 5.2% over 1991-2000.

In 2001, however, GDP growth was negative 1.4% - the first contraction since independence. The economy was hit by a series of global and domestic economic problems and affected by terrorist attacks in Sri Lanka and the United States. The crises also exposed the fundamental policy failures and structural imbalances in the economy and the need for reforms. The year ended in parliamentary elections in December, which saw the election of United National Party to Parliament, while Sri Lanka Freedom Party retained the Presidency.

During the short lived peace process from 2002 to 2004, the economy benefited from lower interest rates, a recovery in domestic demand, increased tourist arrivals, a revival of the stock exchange, and increased foreign direct investment (FDI). In 2002, the economy experienced a gradual recovery. During this period Sri Lanka has been able to reduce defence expenditures and begin to focus on getting its large, public sector debt under control. In 2002, economic growth reached 4%, aided by strong sector growth. The agricultural sector of the economy staged a partial recovery. Total FDI inflows during 2002 were about $246 million.

The MahindaRajapakse government halted the privatisation process and launched several new companies as well as re-nationalizing previous state owned co-operations. As a result, many state owned corporations became overstaffed and less efficient making huge losses. During this time European Union (EU) revoked (Generalized System of Preferences) GSP plus preferential tariffs from Sri Lanka due to alleged human rights violations, which cost about USD 500 million a year at the time.The resumption of the civil war in 2005 led to a steep increase defence expenditures. The increased violence and lawlessness also prompted some donor countries to cut back on aid to the country.

A sharp rise in world petroleum prices combined with economic fallout from the civil war led to inflation that peaked 20%. However, as the civil war ended in May 2009 the economy started to grow at a higher rate of 8.0% in the year 2010 and reached 9.1% in 2012 mostly due to the boom in non-tradable sectors. However the boom didn't last and the GDP growth for 2013 fell to 3.4% in 2013 and only slightly recovered to 4.5% in 2014.

The factors affect economic growth is one of the most important issue in that economists study since several years. Therefore, the main purpose of the paper is to establish the empirical link between some determinants of economic growth of Sri Lanka, using polynomial distributed lag model.

Many researchers were carried out on the topic of economic growth using distributed lag approach and the impact of various factors to the economic growth.Chaudhry et. al., (2013) conducted the study to found the relationship between foreign direct investment (FDI) and economic growth and also highlighted the relationship status between the variables included in the model, either long- or short-run in case of China. An autoregressive distributive lag (ARDL) approach to co-integration was used to analyse the data. The results provide evidence that there is an empirical relationship among FDI and economic growth.

Sehrawat and Giri (2015) conducted the research to examine the relationship between financial development and economic growth in India using annual data from 1982 to 2012. The autoregressive distributed lag (ARDL) approach to co-integration confirms a long-run relationship in financial development and economic growth for India.
Egbetunde and Fasanya, (2013) conducted a study to analyse the impact of public expenditure on economic growth in Nigeria using the (ARDL) bounds testing approach. It was suggested that the variables of interest put in the framework were bound together in the long-run. The associated equilibrium correction was also significant confirming the existence of long-run relationships.

Srinivasan et. al., (2012) conducted the research to examine the impact of tourism on economic growth in Sri Lanka through the Autoregressive Distributed Lag (ARDL) bounds testing approach, for the period from 1969 to 2009. The results revealed that the tourism has a positive impact on economic growth in Sri Lanka both in the short-run and long-run.

Fouda (2010) conducted a study to examine the effects of various economic variables on the Cameroonian economic growth using distributed lag models for the period of 1960 to 2006. The results obtained from Geometric Lag Model, found that 50% of the total effect of variables used is accomplished in less than half of a year and results of polynomial distributed lag, show that even if investment has a positive impact on growth in the current year, but in the presence of government expenditures, this effect becomes negative after one year due probably to the eviction effect. Furthermore, found that the consumption causes economic growth after three years whereas economic growth causes the consumption after only one year.

Agrawal (2001) conducted the research on the heading of"The relation between savings and growth: cointegration and causality evidence from Asia". Granger causality analysis was undertaken for seven Asian countries using the VECM (Engle and Granger) and VAR procedures. It was found that in most cases, the direction of causality runs primarily from growth to savings, although in some countries, there is also evidence of a feedback effect from savings to income and growth. Estimation of the savings functions are presented using Engle and Granger' s Static OLS and Stock and Watson' s dynamic OLS (DOLS) procedures where appropriate.

Research Methodology

Almon or Polynomial Distributed Lag Models (PDLM)
The technique of using polynomials to approximate distributed lags has become widespread since its initial proposal by Shirley Almon in 1965. The L^{th} order polynomial distributed lag model of the form is:

$$y_t = \alpha + v_0 x_t + v_1 x_{t-1} + v_2 x_{t-2} + \ldots + v_P x_{t-L} + \epsilon_t \quad (1)$$

where the impulse response function is constrained to lie on a polynomial of degree p. Requiring the impulse response function to lie on a polynomial imposes $L - p$ constraints on the structural parameters of the model. Following is possible to determine the form of the constraints. The first one concern the effect of changes in x_{t-1} on expected y_t $[E_{(y_t)}]$ is:

$\frac{\partial E_{(y_t|x)}}{\partial x_{t-l}} = v_l = a_0 + a_1 l + a_2 l^2 + a_3 l^3 + \ldots + a_p l^p$,where l=0,1,…,L. (2)

The further constraint in considering equation (2) is:

$$p < L$$

Substituting the constraints equation (2) into the finite order distributed lag model equation (1) yields a reduced form representation:

$y_t = \alpha + \sum_{l=0}^{L}(a_0 + a_1 l + a_2 l^2 + a_3 l^3 + \ldots + a_p l^p)\, x_{t-l} + \epsilon_t.$ (3)

Consistent and efficient estimates of the structural parameters, subject to the $L - p$ constraints, can be obtained via Constrained Ordinary Least Squares (COLS). But according to Gujarati et. al., (2009), it is also possible to get consistent and efficient estimates by using OLS if the reduced form of equation (3) is used. To obtain this reduced form, transformed the equation (3) as follows:

$y_t = \alpha + Z_{0,t}a_0 + Z_{1,t}a_1 + Z_{2,t}a_2 + Z_{3,t}a_3 + \ldots + Z_{p,t}a_p + \epsilon_t$(4)

where$Z_{0,t} = \sum_{l=0}^{L} x_{t-l}$, $Z_{1,t} = \sum_{l=0}^{L} l x_{t-l}$, $Z_{2,t}=\sum_{l=0}^{L} l^2 x_{t-l}$,…. $Z_{p,t}=\sum_{l=0}^{L} l^p x_{t-l}$

One of the important functional assumptions of the PDLM is that the immediate impact might well be less than the impact after several years, quarters, or months. After reaching its maximum, the policy effect diminishes for the remainder of the finite lag. The main advantages of this model are flexibility and reduction of the multicollinearity issue.

Research study data set

The data set that used for this study is mainly quantitative and secondary. The set of annual data for the period of 1975 to 2014 was collected from Central Bank Annual Report of Sri Lanka and the Annual Report of World Bank.

Data analysis

Due to the presence of negative values in foreign direct investment and trade balance, both variables were transformed to get the positive values. Fouda (2010) notes a method to transform the negative values into positive values and the equation that used to transform the variables is $X_t^{Tr} = X_t + | k | + 1$ with $k = \min(X_t)$ if $X_t \in [0, -\infty]$. All the variables are divided by GDP except consumer price index and expressed in natural logarithm. The analysis was done by using E-VIEWS 9, MINITAB 16.

Empirical strategy

The used variables for this study are Consumption, Investment, Government Expenditures, Trade Balance, Foreign Direct Investment, Inflation and Gross Domestic Product.

The empirical pattern of Almon model is:

The empirical pattern of Almon model is:

$$\Delta \ln(\text{GDP})_t = \alpha + \sum_{l=0}^{L} v_{1,l}\, ln(\text{Cons})_{t-l} + \sum_{l=0}^{L} v_{2,l}\, ln(\text{CPI})_{t-l} + \sum_{l=0}^{L} v_{3,l}\, ln(\text{GE})_{t-l} + \sum_{l=0}^{L} v_{4,l}\, ln(\text{FDI})_{t-l} + \sum_{l=0}^{L} v_{5,l}\, ln(\text{Inv})_{t-l}$$

$$+\sum_{l=0}^{L} v_{6,l}\, ln(\mathrm{TB})_{t-l} + u_t \quad (5)$$

Akaike Information Criterion (AIC) used to assess the goodness of fit for lag lengths. In accordance with this criterion, it was found 2 as a maximum length of lag (see Table 5). Order of the polynomial should be smaller than the number of lag, it was chosen 1. Equation (2) can be rewritten as follows:

$$v_l = a_0 + a_1 l \text{ with} l = 0,1,2. \quad (6)$$

Finally, the empirical equation used in the case of PDLM is as follows:

$$\Delta \ln(\mathrm{GDP})_t = \alpha + \sum_{l=0}^{L} (a_0 + a_1 l)\, ln(\mathrm{Cons})_{t-l} + \sum_{l=0}^{L} (a_0 + a_1 l)\, ln(\mathrm{CPI})_{t-l} + \sum_{l=0}^{L} (a_0 + a_1 l)\, ln(\mathrm{GE})_{t-l} + \sum_{l=0}^{L} (a_0 + a_1 l)\, ln(\mathrm{FDI})_{t-l} + \sum_{l=0}^{L} (a_0 + a_1 l) ln(\mathrm{Inv})_{t-l} + \sum_{l=0}^{L} (a_0 + a_1 l)\, ln(\mathrm{TB})_{t-l} + u_t \quad (7)$$

It can be reduced as follows:

$$\Delta ln(\mathrm{GDP})_t = \alpha + Z_{0,t} a_0 + Z_{1,t} a_1 + u_t \quad (8)$$

where

$$Z_{0,t} = \sum_{l=0}^{2} ln(\mathrm{Cons})_{t-l} + \sum_{l=0}^{2} ln(\mathrm{CPI})_{t-l} + \sum_{l=0}^{2} ln(\mathrm{GE})_{t-l} + \sum_{l=0}^{2} ln(\mathrm{FDI})_{t-l} + \sum_{l=0}^{2} ln(\mathrm{Inv})_{t-l} + \sum_{l=0}^{2} ln(\mathrm{TB})_{t-l}$$

$$Z_{1,t} = \sum_{l=0}^{2} l(ln(\mathrm{Cons})_{t-l}) + \sum_{l=0}^{2} l(ln(\mathrm{CPI})_{t-l}) + \sum_{l=0}^{2} l(ln(\mathrm{GE}))_{t-l}) + \sum_{l=0}^{2} l(ln(\mathrm{FDI})_{t-l}) + \sum_{l=0}^{2} l(ln(\mathrm{Inv})_{t-l}) + \sum_{l=0}^{2} l(ln(\mathrm{TB})_{t-l})$$

where $\alpha\ is$ the intercept, GDP is is the real Gross Domestic Product (dollar of ten million), Cons represents the consumption (divided by Gross Domestic Product), CPI is the consumer price index, GE is the government expenditures (divided by Gross Domestic Product), FDI is the foreign direct investment (transformed and divided by Gross Domestic Product), Inv is the investment (divided by Gross Domestic Product), TB is the trade balance (transformed and divided by Gross Domestic Product) and u_t is the random disturbance term of classical linear regression model.

Results and Discussion

The correlation between the variables should be checked before running the model and resolved it by using proper techniques. If fitted a regression model with correlated variables, it will lead to get the estimators that are biased.

Stationary of the variables

In prior information and many research studies experience it was found that the economic variables are often non-stationary. In regression analysis non-stationary variables may

lead to the spurious results. In the case of polynomial distributed lag model, the Augmented Dickey-Fuller (ADF), Phillips–Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) unit root tests were employed to test the stationarity of the variables and test results are given below.

Table 1.ADF teststatistics

Variables	Levels		First Difference	
	Intercept	Intercept and Trend	Intercept	Intercept and Trend
ln(GDP)	1.2947	-2.1897	-7.0909***	-7.5232***
ln(Cons)	-3.5782**	-4.7159***	-7.2678***	-7.1642***
ln(CPI)	-1.1459	-1.0983	-4.6909***	-4.9205***
ln(GE)	-1.3365	-4.4010***	-9.7150***	-10.0358***
ln(FDI)	-4.5113***	3.8736**	-10.8664***	-12.1561***
ln(Inv)	-3.4667**	-3.5367**	-5.2423***	-4.6063***
ln(TB)	1.3671	2.5321	2.0648	1.4461

Note: ***, ** and * denotes significance at 1%, 5% and 10% level, respectively.

Table 2.PP test statistics

Variables	Levels		First Difference	
	Intercept	Intercept and Trend	Intercept	Intercept and Trend
ln(GDP)	1.2947	-2.2082	-7.0667***	-7.5232***
ln(Cons)	-3.6502***	-4.7323***	-13.6874***	-17.5729***
ln(CPI)	-1.0497	-1.0983	-4.6543***	-5.1842***
ln(GE)	0.9752	-4.8019***	-11.0246***	-14.3783***
ln(FDI)	-4.4427***	-4.9949***	-26.4480***	-30.6651***
ln(Inv)	2.8484*	2.7019	-5.3031***	-5.2493***
ln(TB)	-4.5823***	-5.7252***	-33.1203***	-32.8113***

Note: *, ** and *** denotes significance at 1%, 5% and 10% level, respectively.

Table 3.KPSS test statistics

Variables	Levels		First Difference	
	Intercept	Intercept and Trend	Intercept	Intercept and Trend
ln(GDP)	0.7599***	0.1632**	0.3435	0.0421
ln(Cons)	0.8544***	0.0727	0.2142	0.2084**
ln(CPI)	0.7744***	0.1881**	0.2033	0.0567
ln(GE)	0.6794**	0.2438***	0.4049*	0.5000***
ln(FDI)	0.4739**	0.1522**	0.5000**	0.5000***
ln(Inv)	0.3656**	0.0696	0.1366	0.1053
ln(TB)	0.5569**	0.1188	0.5000**	0.5000***

Note: *, ** and *** denotes significance at 1%, 5% and 10% level, respectively.

Stationarity of GDP

Figure 1 shows that the time series graph for natural logarithm of GDP. The graph shows that the series have intercept and trend. There was a sudden change also appear in the

series. Therefore,the KPSS test with trend and intercept is applicable to test the stationary of the series.

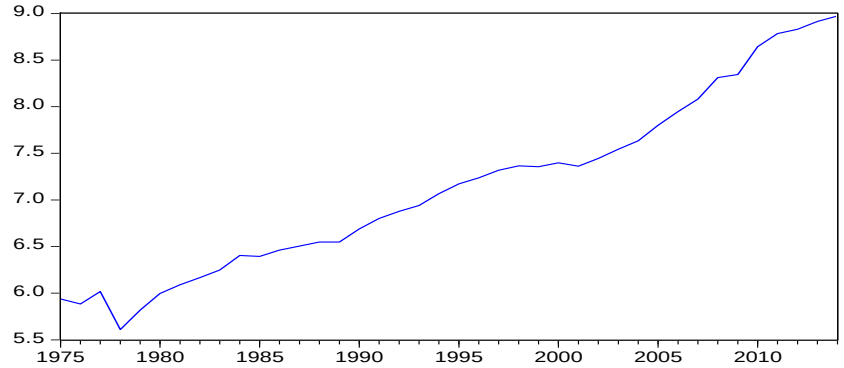

Figure 1. Time series graph of GDP

KPSS test results of Table 3 reveal that the GDP is stationary after first differencing. Also the ADF test results of Table 1 and PP test results of Table 2 give the same results as in the KPSS test at first differencing.

Stationarity of consumption

Figure 2 shows that the time series graph for natural logarithm of consumption. The graph shows that the series have intercept and trend. Also the graph shows structural break of the series. Therefore, the PP test with trend and intercept can be used to test the stationary of the series.

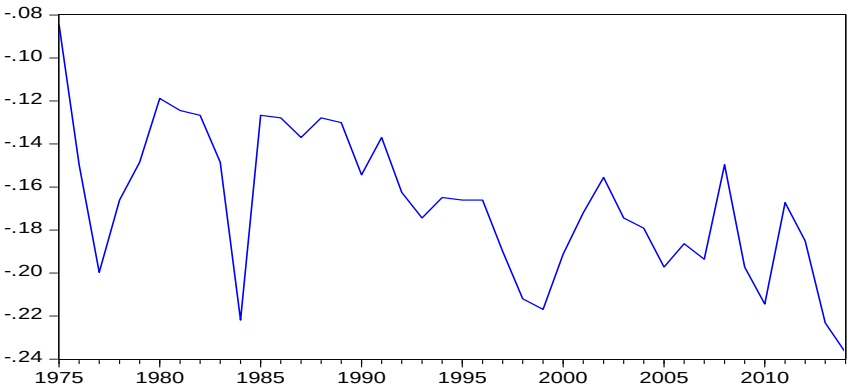

Figure 2.Time series graph of consumption

PP test results of Table 2 tell that the consumption is stationary at level. Also the ADF test results of Table 1 and KPSS test results of Table 3 give the same results as in the PP test at level.

Stationarity of consumer price index

Figure 3 shows that the time series graph for natural logarithm of consumer price index. The graph shows that the series have intercept and trend. Therefore, the ADF test with trend and intercept can be applicable to test the stationary of the series.

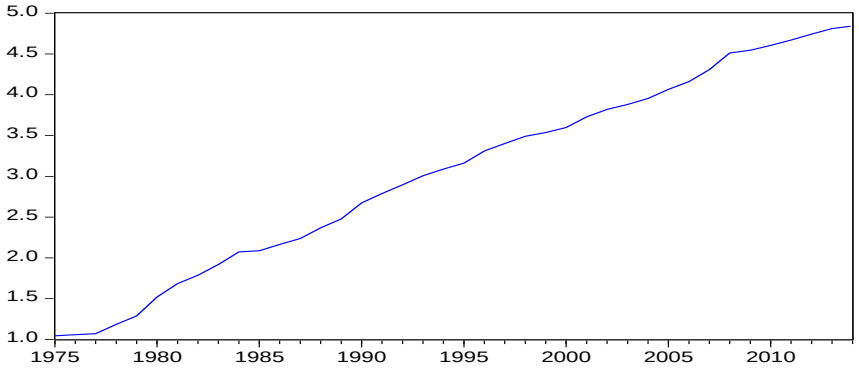

Figure 3.Time series graph of consumer price index

ADF test results of Table 1 tell that the consumer price index is stationary after first differencing. Also the PP test results of Table 2 and KPSS test results of Table 3 give the same results as in the ADF test at first differencing.

Stationarity of government expenditures

Figure 4 shows that the time series graph for natural logarithm of government expenditures. The graph shows that the series have intercept and trend. Also the graph shows structural break of the series. Therefore, the PP test with trend and intercept can be used to test the stationary of the series.

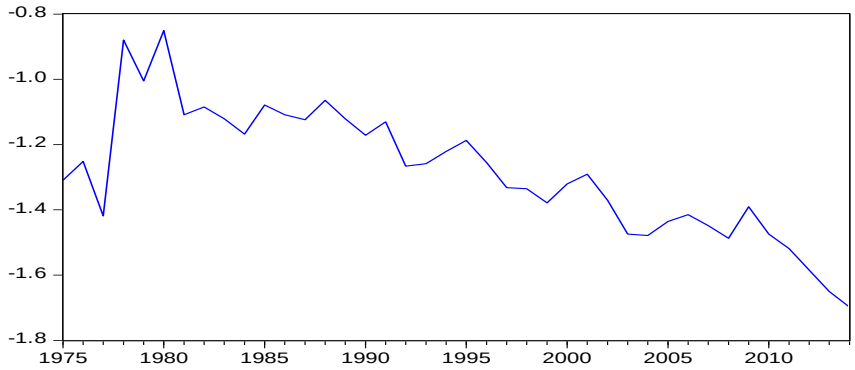

Figure 4.Time series graph of government expenditures

PP test results of Table 2 tell that the government expenditures is stationary at level. Also the ADF test results of Table 1 give the same results as in the PP test at level. But the KPSS test results of Table 3 says that the government expenditures is non-stationary at level and after the first difference also.

4.1.5 Stationarity of foreign direct investment

Figure 5 shows that the time series graph for natural logarithm of foreign direct investment. The graph shows that the series have intercept and a sudden change also appear in the series. From this, it can be conclude that the KPSS test with intercept is applicable to test the stationary of the series.

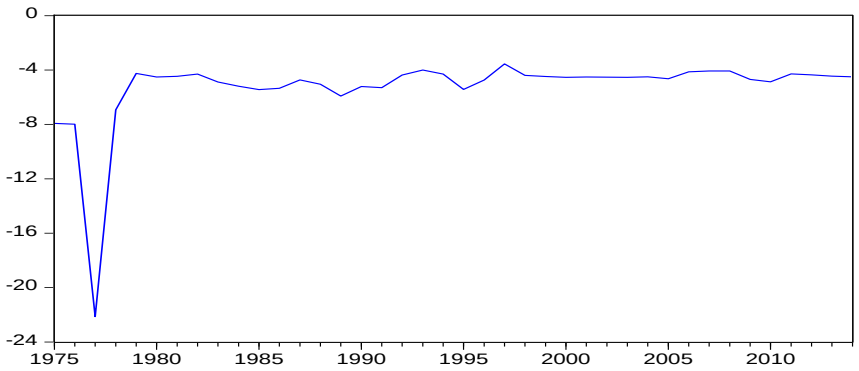

Figure 5: Time series graph of foreign direct investment

KPSS test results of Table 3 reveal that the foreign direct investment is non-stationary after first differencing. But the ADF test results of Table 1 and PP test results of Table 2 says that the foreign direct investment is stationary at level. Therefore, based on ADF and PP test results it can be assumed that the foreign direct investment is stationary at level.

Stationarity of investment

Figure 6 shows that the time series graph for natural logarithm of investment. The graph shows that the series have intercept and trend. Also the graph shows structural break of the series. Therefore, the PP test with trend and intercept can be used to test the stationary of the series.

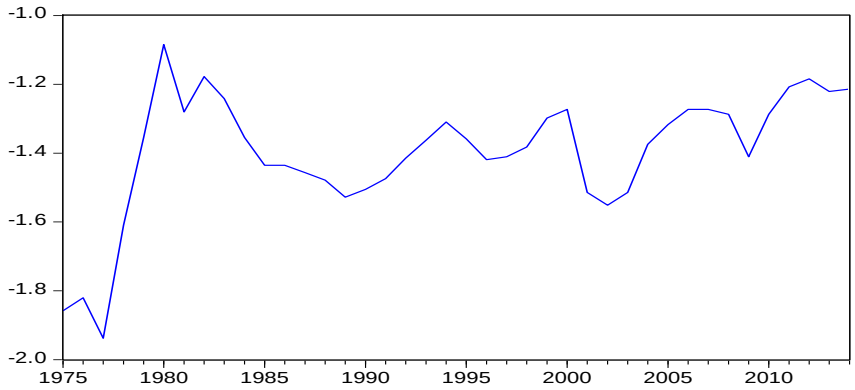

Figure 6: Time series graph of investment

PP test results of Table 2 tell that the investment is stationary after first. But the ADF test results of Table 1and KPSS test results of Table 3 show that the investment is stationary at level.

Stationarity of trade balance

Figure 7 shows that the time series graph for natural logarithm of trade balance. The graph shows that the series have intercept and trend. There was a sudden change also appear in the series. Therefore, the KPSS test with trend and intercept is applicable to test the stationary of the series.

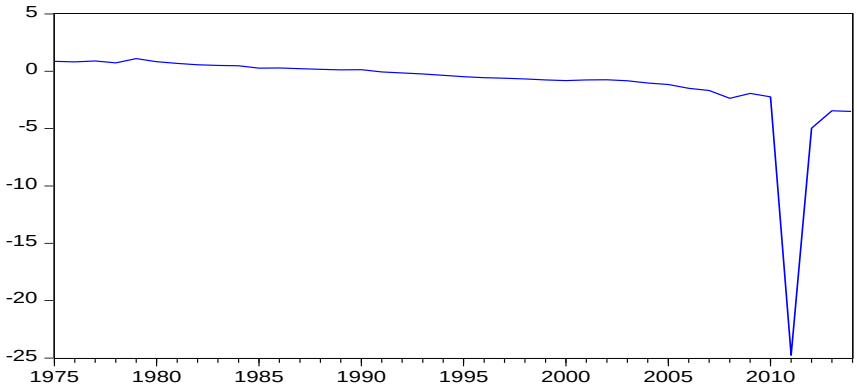

Figure 7: Time series graph of trade balance

KPSS test results of Table 3 reveal that the trade balance is stationary at level. Also the PP test results of Table 2 give the same results as in the KPSS test at level. But in the case of ADF test it is not stationary at level.

Almon or Polynomial distributed lag model

Before fit the model, stationary of the variables should be considered. Due to the purpose of this study, first difference of the natural logarithm of GDP was used as the dependent variable and the natural logarithm of GDP is stationary at first difference. Consumption, Consumer Price Index, Government Expenditures, Foreign Direct Investment, Investment and Trade Balance are the independent variables for the model. Because of the stationarity condition Consumption, Government Expenditures, Foreign Direct Investment, and Trade Balance are used at level and Consumer Price Index and Investment are used at the first difference.

Correlationanalysis

Table 4.Variance inflation factor values

Variables	VIF
***ln*(Cons)**	2.3
Δ(*ln*(CPI))	1.4
***ln*(GE)**	3.2
***ln*(FDI)**	1.2
Δ(*ln*(Inv))	1.2
***ln*(TB)**	1.4

The above table show that the variance inflation factor values of the independent variables. All the VIF values are less than 5. It shows that the variables are not strongly, linearly correlated.

Selection of lag and degree of Polynomial model

Before apply the Almon technique, the maximum length of lag and degree of the polynomial should be specified.

Table 5.AIC values of fitted lag models

Lag order	AIC values
1	-2.5312
2	**-2.7373**
3	-2.6136

Above Table 5 shows that the AIC values for different lag values of fitted models. Lag length two has smaller Akaike information criterion value among the other lag lengths. It says that the lag two is preferable to fit the model. Order of the polynomial should be smaller than the lag length. Therefore, first degree polynomial will be a good approximation.

Estimators of Polynomial Model

Table 6.Estimated Almon coefficients

Dependent variable = Δ(*ln*(GDP))			
Variables	**Estimates**	**Std.Error**	**Probability**
Intercept	0.3476	0.2066	0.1055
Z(*ln*(Cons))$_0$	-0.2195	0.4995	0.6633
Z(*ln*(Cons))$_1$	0.4846	0.3829	0.2178
Z(Δ(*ln*(CPI)))$_0$	0.6211	0.3038	**0.0483**
Z(Δ(*ln*(CPI)))$_1$	-0.1876	0.2010	0.3671
Z(*ln*(GE))$_0$	0.3243	0.1959	0.1066
Z(*ln*(GE))$_1$	-0.3563	0.1829	**0.0631**
Z(*ln*(FDI))$_0$	0.0517	0.0008	**0.0000**
Z(*ln*(FDI))$_1$	-0.0247	0.0056	**0.0002**
Z(Δ(*ln*(Inv)))$_0$	0.2349	0.1295	**0.0781**
Z(Δ(*ln*(Inv)))$_1$	-0.2050	0.1124	**0.0806**
Z(*ln*(TB))$_0$	-0.0036	0.0032	0.2643
Z(*ln*(TB))$_1$	0.0016	0.0025	0.5341
Prob.>F	0.0002		
No.obs	37		
R^2	0.7393		
Adj.R^2	0.6089		
Breusch-Godfrey LM(P>F)	0.2752		
Breusch- Pagan LM(P>F)	0.1212		
Jarque-Bera(P>Z)	0.1433		

Table 7.Results from the Regression using Almon first order distributed lags

Dependent variable = Δ(*ln*(GDP))

Variables	Estimates	Std.Error	Probability
Intercept	0.3476	0.2066	0.1055
$(ln(Cons))_0$	-0.2195	0.4995	0.6633
$(ln(Cons))_{-1}$	0.2651	0.3365	0.4359
$(ln(Cons))_{-2}$	0.7497	0.5198	0.1579
$(\Delta(ln(CPI)))_0$	0.6211	0.3038	**0.0483**
$(\Delta(ln(CPI)))_{-1}$	0.4364	0.1893	**0.0271**
$(\Delta(ln(CPI)))_{-2}$	0.2516	0.2453	0.3122
$(ln(GE))_0$	0.3243	0.1959	0.1066
$(ln(GE))_{-1}$	-0.0319	0.0549	0.5635
$(ln(GE))_{-2}$	-0.3883	0.1858	**0.0438**
$(ln(FDI))_0$	0.0517	0.0008	**0.0000**
$(ln(FDI))_{-1}$	0.0269	0.0051	**0.0000**
$(ln(FDI))_{-2}$	0.0023	0.0067	0.7387
$(\Delta(ln(Inv)))_0$	0.2349	0.1295	**0.0781**
$(\Delta(ln(Inv)))_{-1}$	0.0299	0.0654	0.6509
$(\Delta(ln(Inv)))_{-2}$	-0.1752	0.1306	0.1883
$(ln(TB))_0$	-0.0036	0.0032	0.2643
$(ln(TB))_{-1}$	-0.0021	0.0022	0.3484
$(ln(TB))_{-2}$	-0.0005	0.0034	0.8769
Prob.>F	0.0002		
No.obs	37		
R^2	0.7393		
Adj.R^2	0.6089		
Breusch-Godfrey LM(P>F)	0.2752		
Breusch- Pagan LM(P>F)	0.1212		
Jarque-Bera(P>Z)	0.1433		

Table 6 gives the summarised Almon polynomial coefficients and the Table 7 shows the Almon first order distributed lag estimators.F-statistics probability value of the fitted model is 0.0002 it is less than the critical of 0.05. It says that the model is significant at 95% of confidence level. The R^2 value of the model is 0.7393. It indicates thatthe 73.93% of the variabilitycan be explain by the fitted model.

The Breusch-Godfrey LM test was performed to test the constancy of error variance. F-statistics probability value of LM test is 0.2752. It is greater than the critical value of 0.05. Therefore, the null hypothesis of constant error variance has been accepted in the model. The Breusch- Pagan LM test was performed to test the serial correlation of the disturbances. F-statistics probability value of the test statistic is 0.1212. It is greater than the critical value of 0.05. From tis it can be conclude that there is no serial correlation between disturbances for the fitted model. The Jarque-Bera test was employed to test the normality of the disturbances. The probability value of the test conforms that the errors are normally distributed.

Table 7 shows that effect of consumption is negative at the present year and it became positive for next two years. But the impact of ratio of consumption to GDP on economic growth is not significant.

The results presented in Table 7 showed that the first difference of consumer price index effects the economic growth significantly and positive. The 1% increases in the first difference of consumer price index increase the economic growth by 62.11% at the present year and it increase the economic growth by 43.64% for the next year also.
Impact of ratio of government expenditures to GDP on economic growth is positive at the present year and it became negative for next two years. But the impact of ratio of government expenditures to GDP on economic growth is significant after two years only. Table 7 reveals that the 1% increase in ratio of government expenditures to GDP runs down the growth rate about 38.83% after two years.

Table 7 shows that the ratio of foreign direct investment to GDP is positively correlated on economic growth. The effect of foreign direct investment is significant at the present year and after one year but it became not significant after two years. The effects of foreign direct investment to growth at the present year and after one year are 5.17% and 2.69% respectively.

First difference of ratio of investment to GDP is significantly and positively effects the economic growth at the current period. But it becomes not significant for the next two years and the effect turns in to negative after two years. Also the Table 7 reveals that the effect of ratio of trade balance to GDP on economic growth is negative and it is not significant.

Causality test
To assess the causal relationship between variables, Granger causality test was performed. It used to test the direction of the relationship between the variables that are stationary.

Causality between Economic Growth and Consumption
Table 8 shows that the results of Granger causality test between economic growth and consumption.

Table 8.Causality results of Economic Growth and Consumption

Number of lags	*ln*(Cons) does not Granger Cause Δ(*ln*(GDP))		Δ(*ln*(GDP)) does not Granger Cause *ln*(Cons)	
	F-Statistic	**Probability**	**F-Statistic**	**Probability**
1	0.38814	0.5373	0.23909	0.6279
2	0.23979	0.7882	1.67672	0.2030
3	0.17574	0.9120	1.72633	0.1835

Results of the table reveal that, the growth does not cause the consumption and the consumption does not cause the growth.

Causality between Economic Growth and Consumer Price Index
Granger causality test results between economic growth and consumer price index are given below Table 9.

Table 9.Causality results of Economic Growth and Consumer Price Index

Number of	Δ*ln*(CPI) does not Granger Cause Δ(*ln*(GDP))	Δ(*ln*(GDP)) does not Granger Cause Δ*ln*(CPI)

lags	F-Statistic	Probability	F-Statistic	Probability
1	1.82711	0.1851	0.08737	0.7693
2	2.15129	0.1329	2.04537	0.1459
3	0.17279	0.9139	1.51455	0.2316

Results of the table show that the consumer price index does not Granger cause economic growth and the growth does not cause the consumer price index.

Causality between Economic Growth and Government Expenditures

Table 10 shows that the results of Granger causality test between economic growth and government expenditures.

Table 10.Causality results of Economic Growth and GovernmentExpenditures

Number of lags	*ln*(GE) does not Granger Cause Δ(*ln*(GDP))		Δ(*ln*(GDP)) does not Granger Cause *ln*(GE)	
	F-Statistic	Probability	F-Statistic	Probability
1	0.12105	0.7300	1.62192	0.2112
2	1.46444	0.2463	3.85899	**0.0315**
3	2.91349	**0.0511**		

According to this test, the government expenditures Granger causes economic growth after three years but economic growth Granger causes government expenditures after two years. It was observed that in the couple economic growth and government expenditure, growth affects government expenditures first.

Causality between Economic Growth and Foreign Direct Investment

Granger causality test results between economic growth and foreign direct investment are given below Table 11.

Table 11.Causality results of Economic Growth and Foreign Direct Investment

Number of lags	*ln*(FDI) does not Granger Cause Δ(*ln*(GDP))		Δ(*ln*(GDP)) does not Granger Cause *ln*(FDI)	
	F-Statistic	Probability	F-Statistic	Probability
1	40.1915	**0.0000**	1.18547	0.2837
2			1.11539	0.3402
3			0.54898	0.6528

Results of the table show that the foreign direct investment Granger cause economic growth at lag 1, further confirming a unidirectional causality from foreign direct investment to growth.

Causality between Economic Growth and Investment

Table 12 shows that the Granger causality test results between economic growth and investment.

Table 12.Causality results of Economic Growth and Investment

Number of lags	Δ*ln*(Inv) does not Granger Cause Δ(*ln*(GDP))		Δ(*ln*(GDP)) does not Granger Cause Δ*ln*(Inv)	
	F-Statistic	**Probability**	**F-Statistic**	**Probability**
1	2.92250	**0.0962**	0.70646	0.4063
2			2.91713	**0.0686**
3				

From this test, it can be conclude that the investment Granger causes economic growth after one year but economic growth Granger causes investment after two years. It was observed that in the couple economic growth and investment, investment affects economic growth first.

Causality between Economic Growth and Trade Balance

Granger causality test results between economic growth and trade balance are given below Table 13.

Table 13.Causality results of Economic Growth and Trade Balance

Number of lags	*ln*(TB) does not Granger Cause Δ(*ln*(GDP))		Δ(*ln*(GDP)) does not Granger Cause *ln*(TB)	
	F-Statistic	**Probability**	**F-Statistic**	**Probability**
1	0.02345	0.8792	5.71353	**0.0224**
2	0.06624	0.9360		
3	0.11003	0.9536		

Results of the above table show that the economic growth Granger causes trade balance, also confirming a unidirectional causality from economic growth to trade balance at lag one.

Conclusion

This paper examined the effects of various variables on economic growth of Sri Lanka, using the annual data over the period of 1975 to 2014. The methodology employed to analyse the data in this study is known as Almon or Polynomial model.

Findings of distributed lag structure show that the impact of consumption and trade balance on economic growth are not significant to the model. The impact of consumer price index, government expenditures, foreign direct investment and investment on economic growth are significant.

Granger causality test was performed to assess the causal relationship between two variables econometrically. The findings suggest that causal relationship does not exist between economic growth and consumption and between economic growth and consumer price index also. Unidirectional causality exists from foreign direct investment to growth and from economic growth to trade balance at lag one. The bidirectional causality exists between economic growth and government expenditures and investment and economic growth also. Government expenditures causes economic growth after three years whereas the economic growth Granger causesgovernment expenditures after two years. Investment causes economic growth after one year but economic growth causes investment after two years.

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