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# Impact of Inflation and Economic Growth on Unemployment in Sri Lanka: A Study of Time Series Analysis

By A. Thayaparan

*Vavuniya Campus of the University of Jaffna, Vavuniya, Sri Lanka*

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**GJMBR-B Classification:** *JEL Code: O40, O49*



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# Impact of Inflation and Economic Growth on Unemployment in Sri Lanka: A Study of Time Series Analysis

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**Abstract-** This paper examines the effect of inflation and economic growth on unemployment in Sri Lanka for the period 1990-2012. To achieve this objective, secondary data has been taken from Central Bank annual reports for the above period. To test unit root or stationary, Augmented Dickey Fuller Test was used. In addition to that, ordinary least square technique and to determine the causality among the above variables Granger Causality test also were applied. Results of the unit root test indicate that only Gross Domestic Product (GDP) has stationary and unemployment and inflation have unit root problem or non- stationary at level. But when these two variables are tested at first difference then the problem of unit root has disappeared and hence they have become stationary at first difference. Regression results revealed that the coefficient of inflation is negative and statistically significant influence on unemployment whereas gross domestic product is positive but it has no significant effect on unemployment. Finally the study concludes that only inflation significantly reduces unemployment and gross domestic product positively but insignificantly influences on unemployment. Causality results proved that there is only a unidirectional causality between inflation and unemployment but there is bidirectional causality between unemployment -

gross domestic product and inflation- gross domestic product in Sri Lanka.

**Keywords:** rate of unemployment, gross domestic product, inflation, granger causality test, economic growth.

## I. INTRODUCTION

Sri Lankan economy since the political independence in 1948 has undergone fundamental structural changes in various aspects in the country. Inflation, economic growth which is measured by gross domestic product and unemployment, are the significance variables in any macroeconomic decision making and they are subject of social and economic life of every country. In case of Sri Lanka unemployment was 15.9 percent in 1990 and it has decreased continuously until 2001 and achieved to 7.9 percent in 2001 and after that it started increasing until 2003 and again from 2004 it started to declining and recorded 4 percent in 2012.

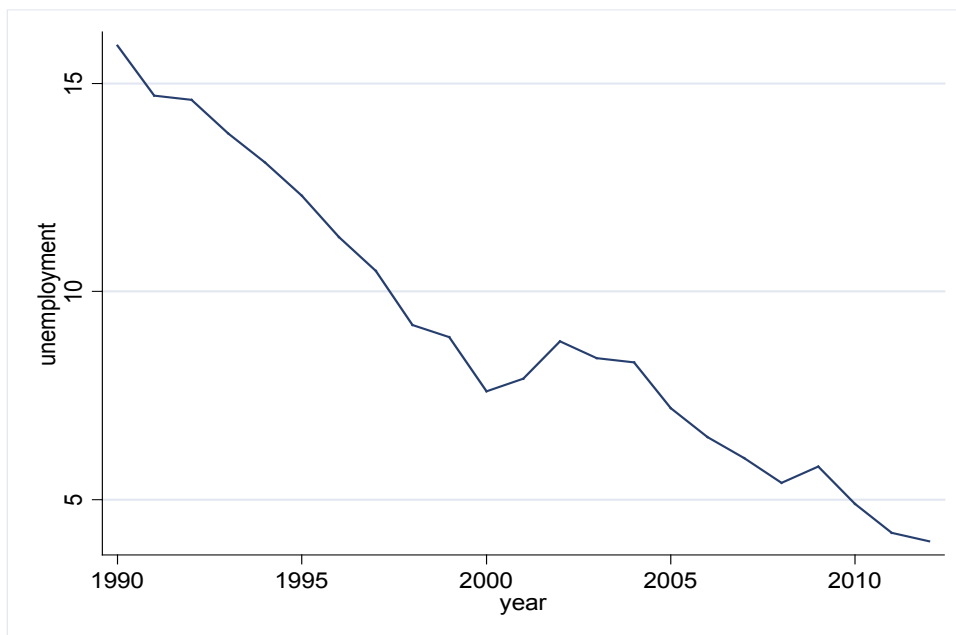


Figure 1 : Trend of unemployment, 1990-2012

Source : Central Bank annual reports, 1990- 2012

Author : Senior Lecturer, Park Road, Vavuniya Campus of the University of Jaffna, Vavuniya, Sri Lanka. e-mail: aruppillathayaparan@yahoo.com

Besides unemployment, inflation which was measured by gross domestic product deflator (GDP deflator) is another macroeconomic problem hurts both economic and social indicators in the country. Sri

Lankan economy has also come across with this macroeconomic problem and the inflation rate was 56.3 percent in 1990 and after that it has increased continuously and reached to 398 in percent 2012.

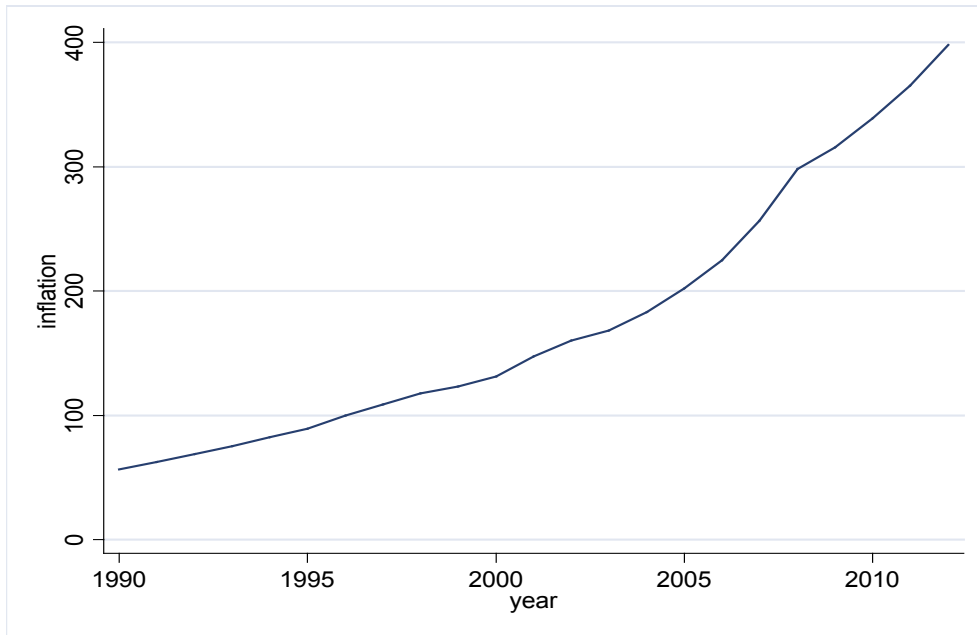


Figure 2 : Trend of inflation, 1990-2012

Source : Central Bank annual reports, 1990- 2012

Gross domestic product growth rate is used as proxy for economic growth in this study and it is generally perceived that when economic growth takes place in the country, it increases the pace of economic activity in the country, due to the employment increases. The increase in employment opportunities will enhance

the purchasing power of the people in the country and as a result, consumption increases which leads to raise aggregate demand and hence inflation in the country. In case of Sri Lanka, GDP growth rate is recorded 6.2 percent in 1990 and it was negatively grows at 1.5 percent in 2001. It recorded 6.4 percent in 2012.

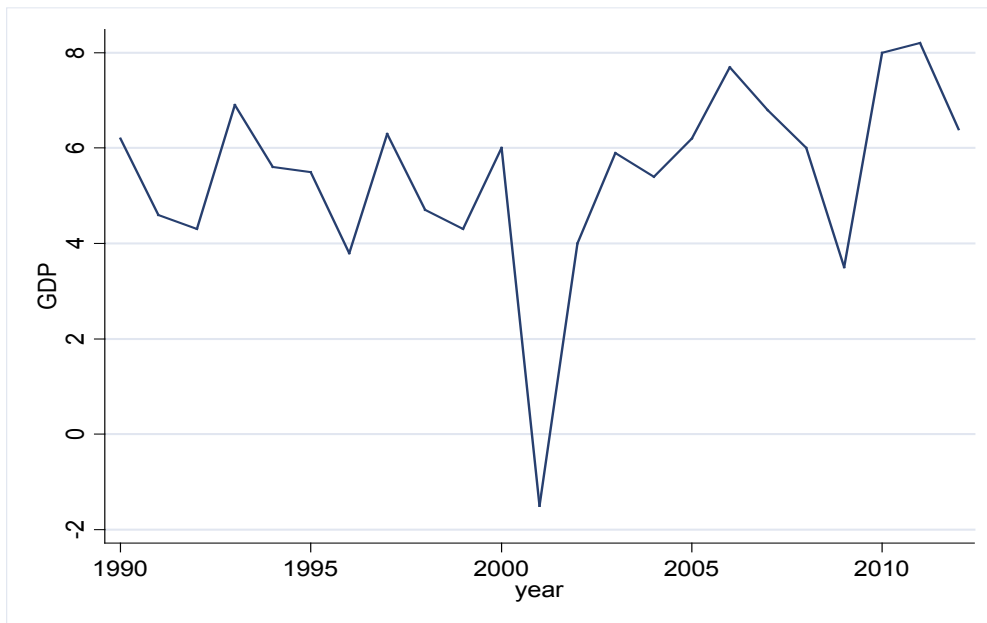


Figure 3 : Trend of gross domestic product growth rate, 1990-2012

Source: Central Bank annual reports, (1990-2012)

Objectives of this study are to identify the effect of inflation and economic growth on unemployment and also to determine the causality among the above variables in Sri Lanka.

## II. THEORITICAL FRAMEWORK AND LITERATURE REVIEW

Tahir Mukhtar and Sarwat Rasheed (2010), testing the relationship between exports and imports: evidence from Pakistan using quarterly data for the period 1972- 2006. The econometric frame work such as Johansen maximum likelihood co-integration technique was used in the study. The findings show that there is a long run relationship between exports and imports and the Granger causality test it has found that there is a bidirectional causality exports and imports in Pakistan.

A Study was carried by Asoluka Njoku and Okezie A. Ihugba (2011) has examined the unemployment and Nigerian economic growth for the period 1985-2009. The study recommends that the agricultural sector as a medium of reducing unemployment in Nigeria should be harnessed and advises that Government and all relevant stakeholders continue in their quest towards reducing unemployment, as well as give their support in ensuring that the agricultural sector is not downtrodden but embraced in this task.

Mahmoud Ali Jaradat(2013) has analyzed impact of inflation and unemployment on Jordanian GDP from (2000-2010) and the results of the study indicate that there is a negative relation between unemployment and GDP, and there is a positive relation between Inflation and GDP.

Muhammad Umair and Raza Ullah (2013) have analyzed the impact of GDP and inflation on unemployment rate of Pakistan Economy in (2000-2010) and their study concluded that inflation has a role which influential but for GDP and unemployment with insignificant levels in the macroeconomics factors of Pakistani economy.

Ayesha Wajid (2013) empirically analyzes the impact of inflation and economic growth on unemployment by using time series evidence from (1973 – 2010) in Pakistan.

This study used Augmented Dickey Fuller (1981) test to test unit root problem and in order to find out the long run relationship among unemployment, inflation, economic growth, trade openness and urban population he applied Johansen – Juselius (1990) Maximum Likelihood Approach. This study concludes that inflation significantly increases unemployment in the long term; economic growth has a significant adverse impact on unemployment in the long run and in the short run respectively, and the impact of trade openness on unemployment is positively and insignificant in the long run but this impact becomes significant in the short run.

Karaçor, Zeynep, (2013), have analyzed the causal relationship between unemployment, inflation and the minimum wage: Case of Turkey from (1987 to 2010). Their study has found that the level of minimum wages and inflation variables is Granger reason for the unemployment in short period.

Another study carried out by Auwal Abubakar Muhammad, (2013) analyzed the effect of unemployment and inflation on wages in Nigeria using Ordinary Least Square (OLS) method, Augmented Dickey-

Fuller (ADF) technique and Granger causality test. The result of the regression revealed that the coefficient of unemployment is positive and statistically significant influence wage rate whereas inflation is positive but has no significant effect on it. Moreover, result of the unit root indicates that all the variables in the model are stationary while, the result of causality test suggests that unemployment Granger causes wage rate and not inflation.

## III. HYPOTHESIS FORMULATION

This study tries to identify the effect of inflation and economic growth on unemployment and also to determine the causality among the unemployment, GDP growth rate and inflation in Sri Lanka. Based on the objectives, the following hypotheses were developed.

### a) Hypothesis 1

$H_{1_0}$ : Inflation has positive impact on unemployment in Sri Lanka.

$H_{1_1}$ : Inflation has negative impact on unemployment in Sri Lanka

### b) Hypothesis 2

$H_{2_0}$ : GDP has positive impact on unemployment in Sri Lanka

$H_{2_1}$ : GDP has negative impact on unemployment in Sri Lanka

### c) Hypothesis 3

$H_{3_0}$  = there is unidirectional granger causality exists between inflation and unemployment

$H_{3_1}$  = there is bidirectional granger causality exists between inflation and unemployment

## IV. THE RESEARCH METHODOLOGY

The model of this study contains the variables of GDP and inflation which are affecting on unemployment in Sri Lanka. The annual data for unemployment rate as the dependent variable and other independent variables such as, economic growth and inflation which were measured by gross domestic product and gross domestic product deflator respectively was taken from Central annual reports for the period (1990-2012).

To find out the impact of independent variables on dependent variable, Ordinary Least Square (OLS) method was used and the model is written as:

$$Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \epsilon_t$$

Where,

- t = 1, 2, 3,..... 22 (time period is from 1990 – 2012)
- Y = Rate of unemployment,
- X<sub>1</sub> = Gross domestic product,
- X<sub>2</sub> = Rate of inflation and
- ε = Error term.

Because of the nature of the time series nature of the data initially, the unit root problem is tested by using Augmented Dickey Fuller (1981) for all three variables at the level and in case of non-stationary variables they were tested at first difference and thereby they became as stationary. Thus, unit root tests are important to test the integration between the variables involved in the study.

Maximum lag length for the model was estimated by using Vector Autoregressive (VAR) Model and afterwards, the long run relationship among the variables is tested by using Johansen co-integration test. This approach comprises of two test statistics such as Trace Statistic and Maximum Eigen-Value Statistic. Long run relationship among the variables is confirmed if the calculated value from the both test statistics is greater than their respective critical values. The following equations were used to estimate these test statistics:

$$\lambda_{\text{trace}} = L_A - L_0$$

$$\lambda_{\text{max}} = -T \log(1 - \hat{\lambda}_{r+1})$$

To find out the dynamic relationships among the variables Vector Error Corrected Model (VECM) also used and it will use full where the existence of co-integration is established. Finally, to determine the causality among the variables and to verify whether change in any series is unidirectional or bidirectional, granger causality test was applied.

## V. RESULTS AND DISCUSSIONS

### a) Hypothesis test results

Unit root problem is tested in each variable by using Augmented Dickey Fuller (1981) test and its results are given in Table 1. These results have shown that all variables are not integrated in the same order and fail to reject the null hypothesis of non-stationary of all variables used except GDP growth rate at levels in the study.

Thus, only GDP growth rate has stationary at level and other two variables have unit root problem when they are tested at level. But when these variables are tested at first difference then the null hypothesis is accepted and the problem of unit root has disappeared from them. Also, all the variables are now integrated of order one {I (1)} and the variables have become stationary at first difference.

Table 1 : Results of unit root test

Augmented Dickey Fuller Test											
At level						At first difference					
Variables	t-statistics	Critical levels			p-value*	Variables	t-statistics	Critical levels			p-value*
		1%	5%	10%				1%	5%	10%	
Unemployment	-1.60	-3.75	-3.0	-2.63	0.482	Unemployment	-4.44	-3.75	-3.0	-2.63	0.0002
GDP	-3.904	3.75	-3.0	-2.63	0.0020	GDP	-6.983	-3.75	-3.0	-2.63	0.0000
Inflation	6.325	-3.75	-3.0	-2.63	1.0000	Inflation	-5.342	-3.75	-3.0	-2.63	0.043

Source: Central Bank annual reports, 1990- 2012

\*Mackinnon approximate p-value (5%)

According to the above table, GDP has the p-value of 0.002 proves that only it has stationary at level and other two variables have unit root problem or they are non-stationary. To overcome this problem, these variables are tested at first difference then all the variables have become stationary.

After the unit root test, the maximum lag length of the model is found by using Vector Autoregressive (VAR) lag order selection criteria. The results are presented into (Table 2) and it has confirmed that the maximum lag length of the model is '1' and it is selected on the basis of the minimum value of each criterion and based on that the maximum number of 'lag 1' was selected. The estimated results for lag length criteria are given in the below (table 2).

Table 2 : Results of lag length criteria

Selection-order criteria					Number of observations = 19			
Sample: 1994 - 2012								
Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	- 180.01				46697.6	19.26	19.29	19.41
1	- 103.82	152.38	9	0.000	40.35*	12.19	12.29*	12.78*
2	- 97.34	12.966	9	0.164	57.54	12.45	12.63	13.50
3	- 86.75	21.166	9	0.012	62.12	12.29	12.54	13.78
4	-75.15	23.216*	9	0.006	83.01	12.01*	12.34	13.95

Source: Central Bank annual reports, 1990- 2012

Note 1 :

\* indicates lag order selected by the criterion  
 Endogenous: unemployment, GDP growth rate, inflation  
 Exogenous: Constant  
 LL: Log L  
 LR: Sequential Modified LR Test Statistic (Each Test At 5% Level)  
 FPE: Final Prediction Error

Based on the selection criterion, maximum lag length 1 is selected and it was used in all model in the system.

Note 2 :

AIC: Akaike's Information Criterion,

HQIC: Hannan-Quinn Information Criterion,  
 SBIC: Schwarz's Bayesian Information Criterion.

To test the Johansen tests for cointegration, the variables must be non- stationary at level 1. But after converted them into first differenced, they become a stationary at first difference. This is the necessary condition for the Johansen tests.

As it has found that all variables have become free from unit root problem at first difference and thus, it is more suitable to apply Johansen Maximum Likelihood Approach (Year....). The estimated results of the Johansen cointegration test are illustrated in (Table3).

Table 3 : Results of Johansen test for co-integration

Maximum Rank	Parms	LL	Eigen value	Trace statistics	5% critical value
0	12	- 123.38	.....	33.85	29.68
1	17	-110.95	0.693	8.99*	15.41
2	20	-107.89	0.252	2.88	3.76
3	21	-106.45	0.128		

Maximum Rank	Parms	LL	Eigen value	Trace statistics	5% critical value
0	12	-123.38	.....	24.86	20.97
1	17	-110.95	0.69	6.10*	14.07
2	20	-107.89	0.25	2.88	3.76
3	21	-106.45	0.12		

\*Source: Central Bank annual reports, (1990- 2012).

Note: \*Refers that there is one co-integration exists among the variables at level (5%)??

Trend: constant  
 Sample: 1992 – 2012

Number of observations = 21  
 Lags = 2

The above results are based on two methods such as trace statistic and maximum statistic tests and both results are the same. Here, (0) means there is no co-integration among the variables and (1) means there is 1 co-integration among the variables and (2 and 3) are represents that there is (2 and 3) co-integrations among them. At zero, test statistic which is 33.85 greater than critical value which is 29.68 at 5% then rejects the null hypothesis ( $H_0$  ?) and showed that there is a co-

integration. Since the trace statistics is less than its critical value at 1, cannot reject the null hypothesis and accept the alternative hypothesis ( $H_1$  ?) at 5% level is suggesting that there is one 1 co-integration exists among the variables. This implies that all the variables are co-integrated and also they have long run association ships. Also it means that, unemployment and other two explanatory variables moves together closely to achieve the long run equilibrium.



When the variables are co-integrated, proves that the presence of co-integration between variables and it suggests a long term relationship among the variables under consideration. In the presence of co-integration, the Granger causation test cannot be

estimated in a simple VAR model but requires the model to be specified in the more restricted vector error correction (VEC) framework. Therefore, vector error correction model can be applied in this study.

Table 4 : Results of Vector Error Correction Model

Beta	Coefficient	Std. Err.	z	P>  z	[95% Conf. Interval]	
Ce1						
Unemployment	1	-----	-----	-----	-----	-----
GDP	-2.92	.474	-6.17	0.000	-3.85	-1.99
Inflation	-.028	.009	3.15	0.002	.010	.046
Constant	-6.72	-----	-----	-----	-----	-----

Source: Central Bank annual reports, (1990-2012)

Based on the table, the long run relationship between unemployment, GDP and inflation in Sri Lanka for one co-integrating vector for the period (1990-2012) is displayed below.

$$\text{Unemp} = -6.72 - 2.92 \text{ GDP} - 0.028 \text{ Infl} \quad (1)$$

The equation represents the normalized cointegrating coefficients of each explanatory variable and in the above (table 4) shows that, the equation consists of a trend value at (-6.72) and further it illustrates that the coefficient of GDP has statistically significant at 5% level in the long run relationship. The negative sign of the variable GDP which is 2.92 indicates that, every one unit

increase in GDP, leads to reduce in unemployment by 2.92 units assuming the rate of inflation is constant.

On the other hand, inflation rate also has negative sign with statistically significant proves that one unit increase in inflation rate leads to a decrease in unemployment rate by 0.028 units keeping GDP is constant. The results of this finding which examine the relationship between unemployment and GDP and unemployment and inflation have supported to the hypothesis stated by the researcher by rejecting the null hypothesis and accepting the alternative hypothesis.

Rest of other parts of the vector error correction model was displaced in the following table.

Table 5

Equation	Parms	RMSE	R-sq	$\chi^2$	P> $\chi^2$
D_Unemployment	5	.503	0.654	30.368	0.0000
D_GDP	5	1.936	0.594	23.408	0.0003
D_Inflation	5	5.775	0.928	208.613	0.0000

Source: Central Bank annual reports, 1990-2012

Note :

No. of observations = 21

Log likelihood = -110.9546  
 Det (Sigma\_ml) = 7.794931

AIC = 12.18615  
 HQIC = 12.36966  
 SBIC = 13.03172

In the above table, three variables, such as unemployment, GDP and inflation automatically converted into first differences. That is represented by D\_unemplo-

yment, D\_gdp and D\_inflation and they represent that three of them were considered as dependent variables with statistically significant at 5% level.

Table 6

	Coefficient	Std. Err.	z	P>  z	[95%Conf. Interval]	
D_Unemployment						
Ce1						
L1.	.081	.0432	1.89	0.058	-.002	.166
Unemployment						
LD	-.438	.287	-1.52	0.127	-1.00	.125
GDP						
LD	.053	.076	0.70	0.485	-.095	.202
Inflation						
LD	.037	.015	2.43	0.015	.007	.067

LD	.037	.015	2.43	0.015	.007	.067
Constant	-.619	.252	-2.45	0.014	-1.113	-.124

Source: Central Bank annual reports, 1990- 2012

In the D- unemployment equation, the short run coefficient of GDP is not significantly different from zero while the coefficient of inflation is significantly different from zero. But in the D-GDP equation all short run coefficients are not significantly different from zero. In

the D-inflation equation, short run coefficients for unemployment and inflation have positive but GDP has negative significant and thus they are significantly different from zero.

Table 7

D_GDP						
Ce1						
L1.	.207	.166	1.25	0.211	-.117	.533
Unemployment						
LD	1.791	1.104	1.62	0.105	-.373	3.957
GDP						
LD	-.094	.292	-0.32	0.747	-.667	.478
Inflation						
LD	.0106	.059	0.18	0.857	-.105	.126
Constant	2.687	.970	2.77	0.006	.786	4.589
D_Inflation						
ce1						
L1.	-1.692	.495	-3.42	0.001	-2.663	-.722
Unemployment						
LD	7.519	3.294	2.28	0.022	1.062	13.97
GDP						
LD	-2.078	.871	-2.38	0.017	-3.787	-.369
Inflation						
LD	.393	.1762	2.23	0.026	.047	.738
Constant	.300	2.89	0.10	0.917	-5.369	5.969

Source: Central Bank annual reports, (1990- 2012)

In the above (table 7), Ce1 represents the error correction term or speed of adjustment towards equilibrium and for each variable one lag has chosen. The coefficient of error correction term of unemployment has .081 with positive sign and statistically (L1=.....\*, p<.05: Sig. 000), it is insignificant. It shows that the divergence from equilibrium will take place with the speed of 8.1% and thus unemployment is adjusted by 8.1% of the past years deviation from equilibrium.

The coefficient of error correction term of GDP growth rate has positive sign of .207 and it is not statistically significant which implies that divergence from equilibrium will take place with the speed of 20.7% of the past years deviation from equilibrium. The coefficient of the error correction term of inflation has negative sign of '1.692' with statistically significant at 5% level (L1=.....\*, p<.05: Sig. 000), indicates that convergence towards the equilibrium path will take place with the speed of 169.2%.

If 'L1' is negative in sign and significant then we can say there is long run causality running from GDP growth rate and inflation to unemployment. Here 'L1' is positive and p value also greater than '0.05' (L1=.....\*,

p<.05: Sig. 000),. There is no long run causality running from independent variables such as GDP growth rate and inflation to unemployment meaning that GDP growth rate and inflation has no influence on unemployment in the long run. Similarly, L1 for D- GDP also has positive sign and p-value also greater than 0.05 (L1=.....\*, p<.05: Sig. 000), indicates that, there is no long run causality running from unemployment and inflation to GDP meaning that unemployment and inflation has no influence on GDP growth rate in the long run. But in case of inflation L1 has negative with the significant p-value which is less than 0.05 (L1=.....\*, p<.05: Sig. 000), shows that there is a short run causality running from unemployment and GDP growth rate to inflation meaning that unemployment and GDP growth rate has influence on inflation in the short run.

Finally, the short run causal relationship between unemployment, GDP growth rate and inflation for each equation has been tested using the VEC Granger causality. The  $\chi^2$  test statistics (p>.05: Sig. 000), and its significance were considered for the above lagged variables



Table 8 : Vector error granger causality test

Dependent variable -: D-unemployment		
Excluded	$\chi^2$	probability
D-GDP	0.49	0.485
D-Inflation	5.91	0.0151
Dependent variable -: D-GDP		
Excluded	$\chi^2$	probability
D- Unemployment	2.63	0.1048
D- Inflation	0.03	0.8565
Dependent variable -: D-Inflation		
Excluded	$\chi^2$	probability
D- Unemployment	5.21	0.0225
D- GDP	5.68	0.0172

Source: Central Bank annual reports, (1990- 2012)

According to the table 8, it proves that unemployment granger caused by inflation while GDP does not granger cause unemployment. Unemployment and inflation both does not granger cause GDP growth rate but unemployment and GDP growth rate both cause inflation. So, there is bi- directional (H3) granger causality exists between inflation and unemployment while there is unidirectional granger causality exists between inflation and GDP in the economy of Sri Lanka. Thus, the above results indicate that two way causation flowing from inflation to unemployment and unemployment to inflation.

In case of GDP it concerned that both unemployment and inflation are not granger causing it. This implies that there is a one – way causation or unidirectional causality is running from GDP to inflation only. The above results have supported to reject the null hypothesis and accepted the alternative that is there is bidirectional granger causality exists between inflation and unemployment in Sri Lanka.

## VI. CONCLUSION

This paper examines the effect of inflation and economic growth on unemployment in Sri Lanka for the period (1990-2012) using multivariate time series techniques such as Augmented Dicky Fuller test, Lag length criteria, Johansen test for co-integration, Vector error correction model and Granger causality test.

The results of the Augmented Dicky Fuller unit root test illustrate that all series are non- stationary except GDP at their levels but after they converted into their first difference then all became as stationary. For getting optimal lag length of this model, vector autoregressive lag model was used based on FPE, HQIC and SBIC criteria. These criteria suggested that optimal lag length as (1) and it was used for Johansen co integration test.

This statistic based on both trace and maximum statistic indicate that there is only one co-integrating relationship exists among unemployment, GDP and inflation. Then move forward by applying the Johansen multivariate co-integration test to investigate the long run relationship among the variables. The result implies that, the above three variables establish a long run steady state equilibrium relationship in Sri Lanka. Vector Error Correction model estimated the normalized coefficients of the variables and it suggests that both GDP and inflation have negatively and significantly affect the unemployment in Sri Lanka. It is, therefore, concluded that both GDP and inflation have a role which influential significant levels in the macroeconomics factors of Sri Lankan economy.

Further, stability of equilibrium also tested by using vector error correction model and its results indicate that coefficient of the error correction term for lagged of unemployment and GDP have not statistically significant while inflation has negative sign but statistically significant at 1% level.

Finally, Granger causality test also examined based on vector error correction model and the results reveal that, there is bi-directional granger causality exists between inflation and unemployment while there is unidirectional granger causality exists between inflation and GDP in the economy of Sri Lanka.

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