Is Sri Lankan economic behaviours consistent with Okun's Law?

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Abstract

The Okun's Law reveals the relationship between unemployment rate and economic growth through an empirical study using US quarterly data. This paper investigate the equilibrium relationship between unemployment rate and economic growth in the context of Sri Lankan economy over the period of quarter 1, 2003 to quarter 1, 2015. This empirical analysis has employed the difference model, dynamic model, error correction model and vector error correction model to validate the relationship between unemployment rate and economic growth suggested by Okun's Law. The error correction and vector error correction models in this empirical study specify that, there is short run and long run equilibrium relationship between unemployment rate and economic growth in the Sri Lankan economy.

Keywords: *Economic growth, Unemployment rate, Okun's Law, and Sri Lanka*

1. Introduction

The rate of unemployment is a very important indicator to economies all around the world. Thus, unemployment has been considered as a more important problem especially for developing countries. However, most of the economies implements programs for solving this unemployment problems and in growing their economy. The economist, Arthur Okun in 1962 (Okun's law),basically states that if real Gross Domestic Product (GDP) grows rapidly, the unemployment rate would decline. On the other hand, if growth is low or negative, the unemployment rate would rise (Higgins, 2011).

Sri Lanka's unemployment rate stood at 4.3 percent in 2014. Subsequently, Sri Lankan economy is targeted to grow at a higher percentage in the coming years. Also, all the resources available in the country should be fully utilised to support this growth. If there is a higher growth rate of the GDP of an economy, there would be an increase in employment and a reduction in unemployment rate. Therefore, a decreasing unemployment rate in an economy is considered as a positive development. This is usually seen as a favourable signal because majority of the people who are seeking for jobs have succeeded in their search.

The Okun's law describes one of the most famous empirical analyses in macroeconomics. This is an empirical analysis relationship between unemployment rate and GDP growth through the use of quarterly data. Therefore, the objective of this paper is to estimate the empirical relationship between economic growth (GDP) and unemployment rate by applying the Okun's law for the case of Sri Lankan economy. This study analysis of Okun's coefficient was conducted using four types of models such as the difference version, the dynamic version, error correction model, and the Vector Error Correction Model with quarterly data covering from Q12003 to Q12015.

2. Literature Review

The economic literature of this paper is rich with numerous studies that reflect the empirical

relation between Unemployment rate and economic growth. Initially, Arthur Okun (1962) states that if the unemployment rate falls to 1%, then the output will be increased by 3%. Therefore, to avoid losses due to unemployment, the economy should expand continuously. Economists call it the Okun's Law. The most important conclusion of the Okun's law is that the actual GDP must grow faster than the potential GDP. Okun's law provides the vital link between the market of goods and services and the labor market. Furthermore, Arthur Okun describes two empirical relationships which are "quarterly changes in the unemployment rate were related to quarterly growth in real Gross Domestic Product (GDP)" and "deviations in the unemployment rate were related to deviations in GDP from its potential." Thus, these became known as the difference and gaps versions of Okun's Law.

Basically, most researchers target developed countries such as US and European countries in examining the relationship between Unemployment rate and economic growth rate. However, only few researchers analyze some of the developing countries. Dogru (2013) investigated the relationship between unemployment rate and economic growth in Euro zone. He found that there is evidence supporting the unemployment hysteresis in most of the European countries. Thus, panel cointegration tests shows that there is a long term relationship between real output and unemployment rate. Long-run cointegration coefficient estimation results suggest that Okun's Law is valid and equal to -0. 60 for all countries pooled. The long run coefficient estimated from panel data sets in this study is lower compared to the coefficient obtained by Okun for America.

Hasan et al. (2015) estimated the relationship between unemployment and economic growth in Turkey. They stated that a fast economic growth process alone is not a sufficient way in fighting against unemployment. Policy makers should take into consideration that the reflection of economic growth on employment depends on some conditions. Doh-khul (2005) study states the effects of labour unionization on economy by focusing on unemployment and economic growth in Korea. Furthermore, he found that unemployment, economic growth, and unionization are correlated with each other in the long run.

Sadiku et al. (2015) tested Okun's Law in FYR of Macedonia using four models: the difference, dynamic, ECM, and the VAR models. However, they found that there was no robust evidence about the linkage between unemployment rate and economic growth already in all models. From the ECM model, they concluded that there is no short term relationship between these two variables. In addition, the VAR model does not suggest a long-term relationship. Therefore, they can conclude that the change in unemployment rate cannot be a predictive variable of the change in real GDP growth. Further, Knotek (2007) empirically estimated Okun's law using three model: the difference, the gap, and the dynamic models. He calculated the effects on unemployment rate by current output, past unemployment rate, and past output level. Then, he analyzed the slowdown in the economy which coincided with the increase in unemployment rate. Furthermore, Malleyet al. (2008) also tested Okun's law in the G7 countries and found that threshold is significantly positive in all the countries in G7.

Karfakis et al.(2014) in their study described unemployment and output relationship in the Greek economy. Thus, they found that asymmetric analysis show that the response of unemployment to real output is stronger during contractions of real economic activity than in expansionary periods. Moreover, Mosikari (2013) studied about South African unemployment rate on gross domestic product. He found that no

causality exists between unemployment rate and GDP growth in South Africa. However, after detecting a long run relationship among variables used in this study, it implies that all the variables in the system have the tendency to revert back to their equilibrium position.

A study by Lal et al. (2010) on some Asian countries including Sri Lanka reveled that Okun's law interpretation may not be applicable in developing countries. However, I was unable to find more literature about the analysis of the relationship between unemployment rate and economic growth in Sri Lanka relation to Okun's Law.

3. Data and Methodology

The data used in this paper is quarterly time series data which covers the period from first quarter 2003 to first quarter 2015 for this study. The GDP data series were directly obtained from the Statistic department of the Central Bank of Sri Lanka. Consequently, unemployment data series were obtained from the Department of Census and Statistics, Sri Lanka and the International Monetary Fund e Library data.

This study empirically examines the relationship between economic growth (GDP growth) and unemployment rate in Sri Lankan economy for the period of 2003 quarter 1 to 2015 quarter 1, by initially using "Okun's Law" difference version (A Okun, 1962). In addition to this model, this study estimated the dynamic model of Okun's law which includes more explanatory variables such as lagged variables of unemployment rate and economic growth. This paper also used another model which is the Error Correction Method (ECM) for estimating the coefficient of Okun, using the procedure of Engle- Granger (1987). Finally, this study uses Vector Error Correction Model (VECM) methodology for testing the long run causality and the short run causality between GDP growth rate and unemployment rate case of Sri Lanka.

Initially, this paper used the difference version which was proposed by A Okun (1962). Therefore, the relationship between GDP growth and unemployment rate differences is expressed in the following OLS regression:

$$\Delta U_t = \beta_0 + \beta_1 * \Delta G_t + \varepsilon_t \qquad (1)$$

Where ΔU_t represents the changes in unemployment rate between current quarter and previous year quarter, ΔG_t is the GDP growth rate between current quarter and previous year quarter, β_0 is the constant, and β_1 is Okun's coefficient. The ratio β_0/β_1 should be interpreted to be the required level of GDP growth by holding the unemployment rate constant through time. Thus, this represents a reason why this version is more suitable for this empirical analysis.

From the above difference version of Okun's law, it implies that some relevant variables have been omitted from the right side of the difference version equation. Therefore, many economists now use a dynamic version of Okun's law (Knotek, 2007) in estimating there lationship between GDP growth rate and unemployment rate. Thus, this paper also used the dynamic version of Okun's Law that is expanded. This includes more explanatory variables, such as lagged variables of unemployment rate and GDP growth. The interpretation of the results is not the same as in the earliest model. Therefore, these variables show the individual effect of the respective model by controlling the effect of others. The dynamic version empirical model can be expressed as follows:

$$\Delta U_t = \beta_0 + \beta_1 * \Delta G_t + \beta_2 * \Delta G_{t-1} + \beta_3 * \Delta U_{t-1} + \varepsilon_t \quad (2)$$

Where ΔG_{t-1} and ΔU_{t-1} are repressors with one period lagged of GDP growth and unemployment rate respectively. The β_1 is Okun's coefficient, it should be negative. In addition, β_2 Coefficient should be negatively related to the changes in the unemployment rate, while β_3 Coefficient should be positively related to the changes in the unemployment rate. The reason for including past changes in the unemployment rate as variables on the right side of the dynamic version of Okun's law is to eliminate serial correlation in the error terms from regressing the difference version of Okun's law (Knotek, 2007).

The section of estimating methodology is crucial for the time series. The most disturbing is the non-stationary time series which may cause a spurious regression. A spurious model is not desirable. This paper shows that equations (1) and (2) have two variables and assume that both variables are the unit root level. Therefore, they are non-stationary. However, this study further assumes that both variables are becoming stationary after the first difference. Nevertheless, the above equations (1) and (2) regression models may be spurious.

Hence, in order to avoid been spurious, this paper used the error correction method (ECM) empirical method. In the above case, equation (1) will be estimated using the Enger-Granger (1987) procedure. Also, a long run relationship of equation by OLS was estimated with variables which are integrated to be non-stationary. Thereafter, to avoid spurious, this paper will make use of a residual based cointegration test. If the residual of the above model was found stationary, then the variables in the above model were co-integrated. Those variables that are co-integrated have a long run relationship between themselves. As the variables are been cointegrated, it can be estimated that the ECM model is described as follows:

$$\Delta G_t = \beta_0 + \beta_1 * \Delta U_t + \beta_2 * R_{t-1} + \varepsilon_t \quad (3)$$

Where ΔG_t & ΔU_t are the first differenced variables of GDP growth and unemployment respectively , β_0 is the intercept, β_1 is the short run coefficient, and R_{t-1} is one period legged of residual. R_{t-1} is also known as equilibrium error term of one period legged. However, R_{t-1} is an error correction term that guides the variables of the model back to equilibrium. The sign of error term should be negative after the estimation of question. The coefficient of β_2 tells us at what rate it corrects the previous period disequilibrium of the model. When β_2 is significant and has a negative sign, it validate that there exists a long run equilibrium relationship among the variables.

Generally, the equations have non-stationary variables and they are integrated of same order. These variables can be covert into the first difference, and then becomes stationary. In these conditions, this study employed Vector Error Correction Model (VECM). Therefore, in addition to the above ECM estimation, this paper uses VECM in finding the long run and short run equilibrium relationship between economic growth and unemployment rate.

The VECM estimation is commonly used with Johansen cointegration procedure. This study makes use of two variables. If both are integrated to be of same order, they become non-stationary at that level. When both variables are converted to first differenced, then they become stationary. The conditions which satisfy this study can employ VECM model for the

identification of the long run and short run relationship of the variables. Furthermore, this paper analysis consists of two time series which are economic growth (GDP) and unemployment rate. Therefore, two equations will similarly be estimated. Regressors in both equations are lagged variables of GDP growth and unemployment rate. Therefore, the VECM equations are as follows:

$$G_t = \beta_0 + \sum_{i=1}^{k} \beta_i U_{t-i} + \sum_{i=1}^{k} \gamma_i G_{t-i} + \varepsilon_{1t} \quad (4)$$

$$U_t = \alpha_0 + \sum_{i=1}^{k} \alpha_i U_{t-i} + \sum_{i=1}^{k} \delta_i G_{t-i} + \varepsilon_{2t} \quad (5)$$

Where G_t is real GDP growth ratio, U_t is unemployment rate, β_0 and α_0 are constants indicating intercepts, U_{t-i} and G_{t-i} are the lagged variables, and ε_{1t} and ε_{2t} are random error terms with a zero mean.

4. Empirical Results

This section explains the estimated result of five equations in the previous section with unit root test for stationary of the time series used in this study. The following table explains the result of Augmented Dickey-Fuller (ADF) and Philip-Perron (PP) stationary tests of the GDP growth and unemployment rate.

Table 1 Stationary Test Results

Variables	Test	Levels		First difference	
		t-statistics	p-value	t-statistics	p-value
GDP growth	ADF*	-3.434	0.0145	-5.366	0.0000
	PP	-2.429	0.1392	-5.275	0.0001
Unemployment rate	ADF*	-2.117	0.2391	-8.777	0.0000
	PP	-2.195	0.2107	-8.967	0.0000

*The number of lag length was determined in line with the Schwarz Information Criterion. The critical values were taken from MacKinnon (1996)

The above results indicate that unemployment rate is non-stationary in their level at both ADF and PP test. However, it becomes stationary in the first difference as the t-statistics is higher than the critical values. At the same time, GDP growth is stationary at 5 percent level in their level of ADF test. However, in the PP test, GDP growth is non-stationary in their level. Therefore, this study assumesthat GDP growth also non stationary in their level and it becomes stationary in the first difference.

Firstly, this paper estimate equation (1) difference version of Okun's Law. The following table represents the estimation result:

Table 2 Regression output of the difference version

Dependent Variable, U	Coef.	p-value
Constant	8.233458	0.0000
GDP	-0.376284	0.0137
No. of observations	49	
R-squared	0.1225	
F-statistic	6.5651	
Prob (F-statistic)	0.0136	
DW statistic	0.1459	

Here, this study can conclude that there is a negative relationship between the GDP growth rate and the unemployment rate. This is because GDP coefficient has a negative sign and the result is significant at 5% level, thus the null hypothesis is rejected. At the same time, model f-statistic is also significant at 5% level.

Furthermore, the estimation of the equation (2) dynamic version of Okun's law and its results are shown Table 3.

As per the above estimation, GDP coefficient has a negative sign, but it is not significant. Also, GDP lagged variable is not also significant. Therefore, it cannot reject the null hypothesis in dynamic version. This signifies that there are no

relationships between GDP and unemployment rate. However, Unemployment lagged variable is significant at 1% level,while f-statistic is also significant at 1% level in this dynamic version.

Table 3 Regression output of the dynamic version

Dependent Variable U	Coef.	p-value
Constant	1.17915	0.0108
GDP	-0.045912	0.4801
U_{t-1}	0.889218	0.0000
GDP_{t-1}	-0.050224	0.4503
No. of observations	48	
R-squared	0.9309	
F-statistic	197.81	
Prob (F-statistic)	0.0000	
DW statistic	2.3831	

The third part of the empirical analysis of this study is estimating the Error Correction Model (ECM).When the paper analysis and estimated result of equation (1) is in the table 2, that model has two non-stationary variables and that equation R-squared value is similar to DW statistic value. Therefore, equation (1) is spurious. Theresultof the stationary test of residual of equation (1) is as follows:

Table 4: Stationary test of Residual

	Test	t-statistics	p-value
Residual of Equation (1) [et]	ADF	-9.263430	0.0000
	PP	-9.370158	0.0000

As per the estimation, Residual of model (1) is found stationary. Therefore, GDP growth and unemployment rate are cointegrated and they have a long run relationship. As the variables are cointegrated, equation (3) can be run. Thus, the results are as follows:

Table 5 Regression output of the ECM

Dependent Variable D(U)	Coef	p-value
Constant	-0.073091	0.2219
D(GDP)	-0.041004	0.4892
R_{t-1}	-0.377968	0.0123
No. of observations	47	
R-squared	0.1392	
F-statistic	3.5582	
Prob (F-statistic)	0.0369	
DW statistic	1.8832	

As per the above result, short run coefficient value has been -0.0410 and it is not significant. Therefore, this model variable has no short run equilibrium relationship. The coefficient of error term (R_{t-1}) has been 0.377 percent, which means that the system corrects its previous period dis-equilibrium at the speed of 0.377 percent quarterly. Moreover, the sign of R_{t-1} has been negative and significant, which indicate the validity of the long run equilibrium relationship between GDP growth and unemployment rate. ECM model explains that there are no short run equilibrium relationship between GDP growth and unemployment rate. However, at the same time, both variables have long run equilibrium relationship.

Finally, GDP growth and unemployment rate is estimated by VECM model. The first step of this estimation is lag selection. Accordingly the VAR Lag Order Selection Criteria were used to select appropriate lag length and the results are given in Table 6.

As the majority of the lag selection criterions such as Sequential modified LR test statistic (LR),Final Prediction Error(FPE), Akaike Information Criterion (AIC) and Hannan-Quinn Information Criterion (HQ) support to lag length of two this paper used lag length of two to estimate VECM model.

Table 6 VAR Lag Order Selection Criteria Result

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-160.8389	NA	4.766176	7.237284	7.317580	7.267217
1	-82.58223	146.0791	0.175807	3.936988	4.177876*	4.026789
2	-75.03685	13.41401*	0.150394*	3.779415*	4.180896	3.929083*
3	-73.07781	3.308593	0.165210	3.870125	4.432198	4.079660
4	-71.51889	2.494281	0.185221	3.978617	4.701282	4.248020

* indicates lag order selected by the criterion

The estimation procedures of VECM model initially tests the Johansen cointegration test. When the Johansen cointegration test is performed, the result shows that the Trace statistics value is 17.69, Critical value is 15.49, and Probability (Prob.) is 0.0230. Here, the Trace value is higher than the critical value, and it is significant. Therefore, Trace test indicate that GDP growth and unemployment rate are Cointegrating. Furthermore, result shows that Max-Eigen value is 15.14, critical value is 14.26, and Prob. is 0.0362.Here, the Max-Eigen value is higher than the critical value, and it is also significant. Therefore, Max-Eigen value test also indicate that both variables are Cointegrating. In addition, variables are integrated. Thus, this paper can run the equation (4) and (5) in the VECM model. The system equations (1) of the VECM models are as follows:

Equation: D(U) =C(1)*(U(-1) + 2.52803852159*GDP(-1) - 22.3865597279) + C(2)*D(U(-1)) + C(3)*D(U(-2)) + C(4)*D(GDP(-1)) + C(5)*D(GDP(-2)) + C(6)

Table 7.The VECM model (1) coefficient, t-statistic and the p-value are as follows:

Variables	Coefficient	Prob.
C(1)	-0.034820	0.0874
C(2)	-0.261394	0.0961
C(3)	-0.119169	0.3886
C(4)	-0.147952	0.0195
C(5)	0.056348	0.4248
C(6)	-0.112430	0.0703

As per this result, C (1) coefficient sign is negative but not significant. So,in the above equation, there is no long run equilibrium between unemployment rate and GDP growth. Thus,this paper is required to test the short run relationship through Wald statistics test. Consequently, the above equation's independent variable is the GDP. Therefore, null hypothesis is C(4) = C(5) = 0. The wald test is performed. Thus, the result shows that test statistic value is 6.409 and is significant at the 5% level. Moreover, a short run equilibrium exists between unemployment rate and GDP growth.

The system equations (2) of VECM models are as follows:

D(GDP) = C(7)*(U(-1) + 2.52803852159*GDP(-1) - 22.3865597279) + C(8)*D(U(-1)) + C(9)*D(U(-2)) + C(10)*D(GDP(-1)) + C(11)*D(GDP(-2)) + C(12)

Table 8. The VECM model (2) coefficient, t-statistic, and the p-value are as follows:

Variables	Coefficient	Prob.
C(7)	-0.158594	0.0020
C(8)	-0.065875	0.8593
C(9)	-0.265692	0.4243
C(10)	0.431677	0.0053
C(11)	0.130167	0.4437
C(12)	-0.043845	0.7648

The result shows that C(7) coefficient is 0.158 and the sign is negative. Also, it is

significant. Here, there are long run equilibrium between GDP growth rate and unemployment rate. The speed of adjustment towards long run equilibrium is 0.158. Thus, when the short run relationship is tested through wald test, the dependent variable is unemployment rate (U); and the null hypothesis should be defined as C(8) = C(9) = 0. Also, the wald test should be performed. The result shows that the Wald test statistic is 11.01 and the p-value is significant at 5% level. Therefore, there are short run relationship between GDP growth rate and unemployment rate.

5. Conclusion

This study empirically analyzes the relationship between unemployment rate and GDP growth based on Okun's Law in the Sri Lankan economy. This paper examined four types of models for any possible analysis relationship between unemployment rate and GDP growth in the short run and long run in the previous section. This study found that the difference version of Okun's law was significant at 5% level in the Sri Lankan economy. Further, if GDP has increased by 21.88percent, unemployment rate will be remaining same. However, the difference version model was spurious. The estimation result of the dynamic version of Okun's law was not significant. Thus, there were no relationship between unemployment rate and GDP growth in the economy.

Furthermore, the ECM model result shows that the residual of both variables were stationary. Therefore, GDP growth and unemployment rate were cointegrated and they had long run relationship. At the same time, ECM estimated result alsoshows that short run coefficient was not significant and there were no short run relationship between both variables. Nevertheless, residual were significant and has a negative sign. Also, this shows that there is a long run relationship between GDP growth and unemployment rate in the Sri Lankan economy. Finally, VECM model result shows that equation (5) had short run relationship at 5% level between both variables. Also, equation (4) had short run and long run relationship between unemployment rate and GDP growth in the Sri Lankan economy. However, this paper empirically found that GDP growth and unemployment rates had short run and long run equilibrium relationship in the Sri Lankan economy.

Furthermore, this study noted that there were some shortcoming and limitations. The first limitation was the limited number of observation due to unavailability of quarterly unemployment rate data before 2003.The second limitation was that this study had not included any effects of labour market regulations and labour market efficiency. However, this study was the first attempted that empirically explores the casual relationship between unemployment rate and GDP growth by examining it with several regression models in the Sri Lankan economy.

References

Akram, M., Hussain, S. & Raza, H. (2014).An Empirical Estimation of Okun's Law in Context of Pakistan. Developing Country Studies, 4 (14), 136-142.

Attfield, C. L. F. (1998). Okun's Law, Cointegration and Gap Variables. Journal of Macroeconomics, 20(3), 625-637.

Chamberlin, G. (2011). Okun's Law revisited. Economic & Labour Market Review, 104-132.

Daly, M. & Hobijn, B. (2010). Okun's Law and the Unemployment Surprise of 2009. FRBSF Economic Letter, 2010-07.

Dogan, H. G.(2015). Evaluation as Econometrics of the Relationship between Unemployment and Economics Growth in Turkey (Okun's Law Case). Journal of New Results in Science, 8, 13-2.

Dogru, B. (2013). The link between unemployment rate and real output in Eurozone: A panel error correction approach. Procedia Social and Behavioral Science, 99, 94-103.

Engle, R.F. & Granger, W.J. (1987). Co-Integration and Error Correction: Representation, Estimation and Testing. Econometrica, 55(2),251-276.

Javeid, U. (2007). Validity of Okun's Law: Empirical Evidence from Pakistan. Department of Economics, Sodertorn university.

Higgins, P. (2011). GDP Growth, the Unemployment Rate, and Okun's Law. Econ South, 02-03.

Karfakis,C., Katrakilidis, C. &Tsanana, E. (2014). Does output predict unemployment? A look at Okun's law in Greece. International Labour Review, 153(3), 421-433.

Kim, D. K. (2005). Unionization, Unemployment, and Growth in Korea: A Cointegration Approach. Atlantic Economic Journal, 33, 225-233.

Knotek, E.S. II (2007). How Useful is Okun's Law?. Economic Review, 4, 73-102.

Lal, I., Muhammad, S.D., Jalil, M.A. &Hussain, A. (2010).Test of Okun's Law in Some Asian Countries Co-Integration Approach. European Journal of Scientific Research, 40(1), 73-80

Malley, J. &Molana, H. (2008).Output, unemployment and Okun's law: Some evidence from the G7. Economics Letter, 101, 113-115.

Mosikari, T. J. (2013). The effect of Unemployment Rate on Gross Domestic Product: Case of South Africa. Mediterranean Journal of Social Science, 4(6),429-434.

Okun, A. M. (1962). Potential GNP: Its measurement and significance. American Statistical Association, Proceedings of the Business and Economics Section, 98-103.

Sadiku, M., Ibraimi, A. & Sadiku, L.(2015). Econometric Estimation of the Relationship between Unemployment Rate and Economic Growth of FYR of Macedonia. Procedia Economics and Finance, 19, 69-81.