Okun's law revisited through testing Cyprus economy empirical results in 1999-2018

November, 2019

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Abstract

The Okun law states that 1 percentage point GDP growth is associated with 0.5 percentage point reduction of the actual short run unemployment rate.

Estimations on the Cyprus economy reveal that if data is estimated either quarterly or annually GDP has to grow by 2.4 percentage points to reduce the actual unemployment rate by 1 percentage point.

Additionally, if the actual unemployment rate is regressed at t-1 against GDP growth at t, then the Okun coefficient equals to 0.5 percent validating the Okun's law.

Moreover, by running a two variable OLS regression between the actual unemployment rate at time t and at time t-1 (lag) with the GDP growth at time t, it is found that the summation of Okun's coefficient equals to -0.38 corroborating the empirical results of Eurozone countries estimated at -0.36.

Expansions are found to have insignificant impact to changes in unemployment, mostly if the unemployment rate is lower than its natural rate. On the other hand, downturns have statistically significant correlation, thereby causing an asymmetric correlation.

Keywords: Unemployment rate, Okun's law, GDP growth, economic cycle

E01, E24, J01, J21

[1] The views expressed herein are those of the author and do not necessarily reflect the views of the Ministry of Finance or the Government of the Republic of Cyprus.

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1. INTRODUCTION

The fluctuation of GDP growth rate in association with the movement of the unemployment rate becomes statistically interesting especially when the fluctuation of both variables exhibit significant variation. It is necessary to clarify that the ratio of GDP growth to unemployment rate is not one to one as long as changes in output cause at the same time changes in the labour force participation rate, in the hours worked as well as in productivity.

The time domain used in this working paper covers the period from 1999 to 2018 and sheds light to a quite uncertain and high-risk period in terms of economic developments that occurred in the Cyprus economy. Such economic events were the stock exchange bubble of 1999-2000, the 2002 tax reform, the EU accession in 2004, the 2006-2007 construction boom, the adoption of Euro in 2008, the 2012-2014 financial turmoil and the significant economic recovery in 2016-2018. The aforementioned economic period covers all parts of a complete economic cycle and thus it can be considered as a sufficient and unbiased time series layout.

In Okun's[2] original work, the relationship for the US economy was that a 2% increase in output corresponds to a 1% decline in the rate of short run unemployment. It is worthy to note that cyclical unemployment is the precise type of unemployment affected by the business cycle. By estimating cyclical unemployment, Okun's[2] law enable us to focus on the type of unemployment, which is associated with the business cycle, whereby avoiding other[3] types of unemployment that are not purely related to the business cycle. Furthermore, the previous connotation implies that **Okun's law can expand its explanatory domain by examining that an extra upwards percentage point of the short run actual unemployment rate corresponds to 2 percentage points of output gap (1:2 ratio).**

The first Section of the paper analyzes the economic policy rationale of Okun's law by examining the connotations made, which bring together short run unemployment with GDP growth. The issue of simplicity against complexity in economic policy making is discussed to look into the Okun's law as a law like policy proposal that it can provide noteworthy results.

The next Section appraises empirical estimations by using both quarterly and annual data. Annual data ranges from 1999 to 2018 using the real (seasonally adjusted) economic growth.

For the unemployment rate the results of the Labor Force Survey are used as well as Eurostat data. In quarterly data, the sample consists of 60 observations for each variable and the above mentioned sources are used. Moreover, the Eurostat GDP at constant prices compared with the same quarter of the previous year is also used.

The following section focuses on the critical assessment of Okun's law by paying more attention on some limitations that seem to be restricting and eventually rendering it more as

[2] Okun Arthur M. "Potential GNP, its measurement and significance", 1962.

[3] Such types of unemployment are the frictional and the long run unemployment, which are not related much with the business cycle but are more rigid types of joblessness and thus they are mostly irrelevant to the business cycle.

a law like proposition rather than as a universal one. Hence, it could be analyzed as an approximation of reality implying that it can be true within some margin of error or to put it differently, it can be seen as an inexact[4] law, which states how human beings usually and not always behave.

The conclusions drawn corroborate Okun's law, thereby providing a useful feedback for a better understanding of the relationship in question for the Cyprus economy.

2. THE ECONOMIC POLICY RATIONALE BEHIND OKUN'S LAW

Okun's law has been used during the last decades as a "rule of thumb" to determine the percentage change of GDP growth -vis a vis- unemployment. Its use was found valuable in economic policy formulation and projections. Its advantages are not concentrated on exactness but merely on bringing together the jobless rate with the GDP growth and through this channel its connotation can be extended to other **extremely significant economic policy variables, such as the output gap and the potential output.**

The Okun law can be analyzed in two distinct mathematical forms; one is related to the "level" form and the other to the "differences" form.

Another crucial point which can make the estimation more robust is concerned with the variables that the regression could entail. One such variable is related with the fact that the actual unemployment rate is the type of unemployment that can be analyzed instead of using other types of unemployment. Another model-related issue is concerned with the use of time lag variables. The paper examines the actual unemployment rate in one year time lag (t-1).

The 'levels' form of the Okun relationship between the actual unemployment rate with the GDP growth can be written as:

$$(U_t-U^*)=a-\beta\,(Y_t-Y^*)+e_t \Rightarrow \beta=a-(U_t-U^*)/(Y_t-Y^*)+e_t \qquad (1)$$

in which, Ut is the actual unemployment rate at t, U* is the full employment unemployment rate or the natural rate of unemployment, Yt is the level of actual real GDP at t, Y* is the potential GDP growth rate and et consists of the residual. It is obvious from the abovementioned equation that when the potential rate of GDP is higher to the actual rate, the output gap turns positive and for equilibrium reasons it needs the actual unemployment rate to decline towards the NAIRU[5] or towards the natural rate of unemployment. It is noted that in a situation in which the NAIRU equals to the natural rate of unemployment ensures macroeconomic stability conditions via simultaneous equilibrium in the goods and services and the labour market.

[4] D.M. Hausman "The inexact and separate science of economics", 1992.

[5] NAIRU refers to the Non-Accelerating Inflation Rate of Unemployment.

A similar relationship can be rewritten in differences form as:

$$\Delta U_{t(0,1)} = a - \beta * \Delta Y_{(0,1)} + e_t \Rightarrow \beta = a - \Delta U_{t(0,1)} / \Delta Y_{(0,1)} + e_t \quad (2)$$

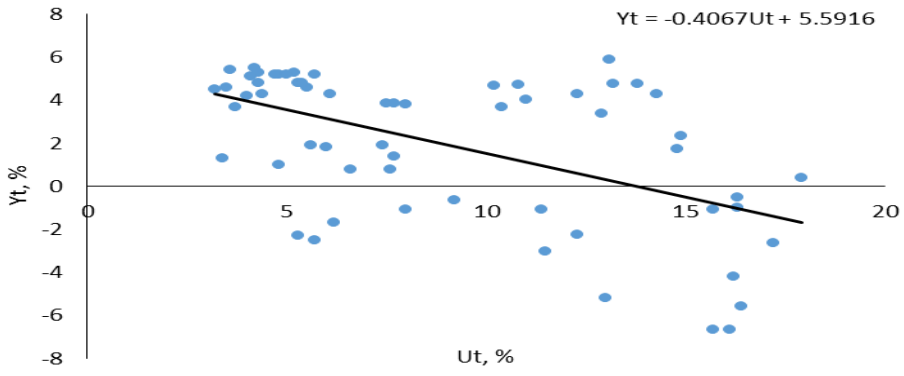
β denotes the Okun's coefficient and based upon Okun's law it takes a minus sign determining the inverse relationship between unemployment with GDP growth. In addition, equations 1 and 2 show the linear correlation between U and Y.

The results of the OLS regression ran between the actual unemployment rates to the GDP growth rates in annual terms[5] is shown in Table 1. The result exhibit that 1 percentage point increase of the GDP growth rate annually can reduce the actual unemployment rate by 0.41 percentage points. Alternatively, the unemployment rate to decline by 1 p.p. needs growth to expand by 2.4% on an annual basis.

Table 1	coefficient
a	5.5916
Ut	-0.406
p<0.01	stat significance
R-squared	0.341137
Prob(F-statistic)	0.00685
Durbin-Watson stat	0.671653

In Figure 1 below, the sample is in quarterly terms and the single variable regression exhibits that a 1% increase of the GDP growth can reduce the unemployment rate by 0.41 percentage point or to put it differently for the unemployment rate to decline by 1% needs the growth rate to expand by 2.46%.

Figure 1:



Nonetheless, it should be noted that the Okun's relationship can vary a lot depending on each country's specific characteristics under consideration. Certainly, under distinct economic setups the correlation between the growth rate with the joblessness rate varies a lot and thus, it is imperative the estimations to be considered properly to avoid any misinterpretations.

It is necessary to mention that in analyzing the related trend of growth with unemployment it is important to bear in mind that the employment variable is a lagging indicator. Once employment is a lagging indicator, it is reasonable enough to consider that all other variables related to employment to be lagging indicators too. These variables are the unemployment rate, hours worked, wages and productivity.

The economic rationale behind it is based on the behaviour of employers, who in periods of economic recession react by either cutting wages or laying off personnel or reducing hours worked or a combination of all. On the contrary, in periods of expansion employers react with a significant delay to add labour or raising hours or increasing wages or a combination of all.

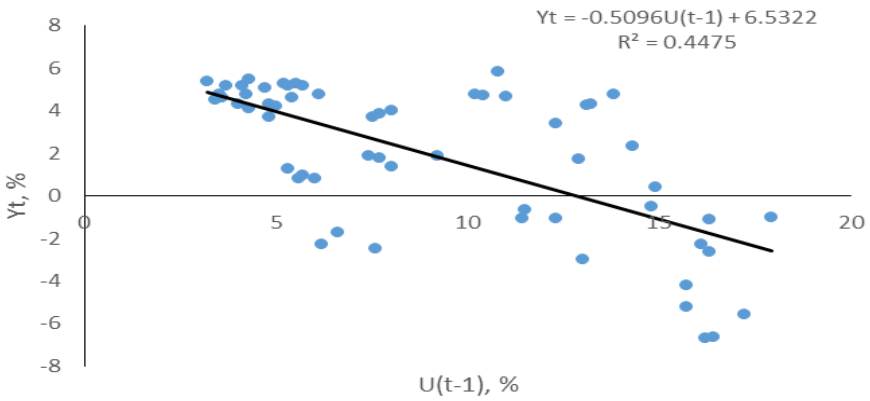
Therefore, it is expected that all these variables to adjust with some delay and it is interesting to run a single variable OLS linear regression to see how the actual unemployment rate at t-1 reacts, when the dependent GDP growth variable changes. The results of this regression are found underneath and the relevant equation of Figure 2 is:

$$\mathbf{Y_t = a-\beta^* U^*(t-1) + e_t} \qquad \mathbf{(3)}$$

Table 2	coefficient
a	6.5322
Ut-1	-0.51
p<0.01	stat significance
R-squared	0.4475
Prob(F-statistic)	0
Durbin-Watson stat	0.21384

The results of the above mentioned regression is illustrated diagrammatically in Figure 2 underneath, which validates the original Okun law for the Cyprus economy.

Figure 2:



Equation 3 can be rewritten by adding another independent variable (Ut) and run the regression to see how it reacts and see what the results of the independent variables are:

$Yt=a-\beta*Ut-\gamma*U_{(t-1)} + et$ **(4)**

From equation 4 the OLS regression results computed are found below in Table 3. Hence, the values of the coefficients of the linear regression are: β=-1.1 and γ=0.7, thus $\beta+\gamma$=-0.39.

Table 3	coefficient
a	5.421265
Ut	-1.08196
Ut-1	0.696867
p<0.01	stat significance
R-squared	0.345295
F statistic	14.76734
Prob(F-statistic)	0
Durbin-Watson stat	0.523262

The results corroborate that the summation of the Okun's coefficient at t plus the Okun coefficient at t-1 equals -0.39 validating the results investigated above where an increase of the GDP growth rate by 1% is approximately associated with a reduction of the actual unemployment rate by 0.4 percentage point.

It is worthy to note that the above results of the Cyprus economy validates the inferences drawn by the ECB back in 2011 when the Okun coefficients were appraised for the Eurozone countries (ECB, St. Garavan, 2011).

In the following Table 4 the outcome of an additional regression is presented. The interesting result is that apart from the actual annual unemployment rate, the unemployment rate during crisis years is also regressed exhibiting a very high value, meaning that the unemployment rate in Cyprus amid crisis years took a value of approximately 5 leading to the inference that a 1% reduction of the GDP growth is associated with approximately 5 percentage points increase of the actual unemployment rate within the crisis years, 2011q3-2014q3.

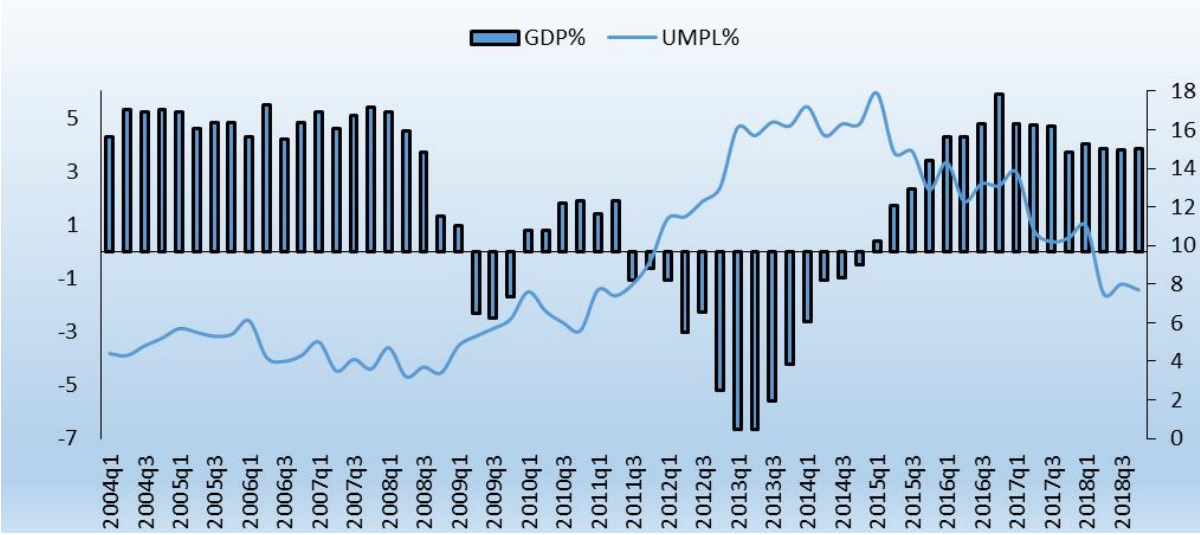
Table 4	coefficient
a	5.24158
Ut	-0.2513
CRISIS	-4.9677
p<0.01	stat significance
R-squared	0.61449
F statistic	13.5489
Prob(F-statistic)	0
Durbin-Watson stat	1.201783

Moreover, the next figure 3 exhibits another quarterly illustration of GDP growth with the unemployment rate between 2004q1 to 2018q4. As it is depicted, the explicit relationship between them is found negative hence, validating the primary connotation of Okun's law.

Nonetheless, the graph indicates that in expansions unemployment begins falling late and only after the GDP denotes an upswing, whereas in slumps unemployment rises early as a reaction of employers to reduce labour costs. Furthermore, and by using Dummy variables it is found that during upsurges the Okun's coefficient is not validating the usual Okun's law, whereas amid contractions it seems to be corroborated.

This finding enhances the possibility of having an asymmetry during upswings and downswings of GDP growth.

Figure 3:



As a result, it can be inferred that in expansions the Okun's coefficient becomes much lower with limited explanatory power than in recessions. In paticular[5] in the period 2004q1-2008q4 the Okun's coefficient becomes zero causing a failure of the Okun's coefficient to provide essential explanation with respect to GDP growth vis a vis the actual unemployment rate.

The above analysis is leading to the inference that an asymmetric[6] behavior is identified reflecting that in expansions unemployment falls quite slow while in contractions unemployment rises quite fast. This asymmetry confirms also the statement that the unemployment indicator is a time lag indicator based upon the behaviour of the employers whose reaction is justified in their effort to minimize their costs. This is the case for Cyprus too as investigated by the data under consideration.

3. LIMITATIONS OF OKUN's LAW

The limitations of the Okun law are primarily concerned with that under certain conditions the inverse relationship between the GDP growth rate seems not always to be sound. One of its major drawbacks concerns its failure to capture all other drivers that could influence the change of the unemployment rate. As a result, its interpretation on its own cannot provide us with a total representation of this relationship. For instance, in the case of Cyprus, it is found that during 2004-2008 the Okun law is not validated, since the association of growth with unemployment is not estimated as statistically significant.

The fact that it doesn't capture all GDP growth drivers such as productivity growth, makes its explanatory power less comprehensive. This weakness reduces its possibilities to make precise economic policy projections. Also, the Okun law is by definition impossible to capture each country's specific labour market characteristics, like the labour market institutions that may play a significant role in the configuration of the unemployment rate. **Though, its usefulness seems to be valuable as a rule of thumb, especially, as far as the economic policy is concerned.**

It is understandable that for unemployment to fall there must be a strong growth generator, once always the growth rate needs to exceed the increase of the sum of the labour force plus the labour productivity.

Apart from the above mentioned limitations it is crucial to look into some quick ideas related to unemployment as explained below related to the distinct manner the labour market should be approached:

a) Low or moderate economic growth will not reduce unemployment, but there can be a "paradox" where the economy is in good health, with 1.5% growth and a relentless increase in unemployment.
b) Increase in productivity is bad news for employment (we need fewer people to produce the same). Increase in productivity is touted by politicians for "competitiveness", thereby destroying jobs, but this is obvious.

[6] Clerides. S. "Retail Fuel Price Response to Oil Price Shocks in EU Countries", Department of Economics and Economics Research Centre, University of Cyprus, 2010.

c) Reduction in working hours (in fact, increased flexibility) has perhaps helped to limit the damage in terms of employment (-0.9% in the French example), reductions in working hours automatically create jobs but it also promotes increased productivity through reorganization, increases in part time employment, etc. This adjustment generally remains favorable for the company than for the employee even if it is difficult to determine.

In spite of the above mentioned limitations of the Okun law, it is necessary to mention that its usefulness becomes more important, if combined with the augmented Philips curve (Friedman, 1968).

In such a case, the output gap is associated with the natural rate of unemployment and with the expected inflation rate. In economic policy terms, the above relationship causes substantial and significant implications on whether a government it is sensible to pursue an expansionary or recessionary policy.

As a consequence, the way the Okun law is interpreted should be cautious in terms of its explanatory domain. It is rather superior to using the Okun coefficient in such a way to maximize its forecasting possibilities. Once its accuracy is questioned, then it is much safer to use it as an auxiliary explanatory tool when it comes to predictions in economic policy terms.

4. CONCLUDING REMARKS

This working paper provides a useful framework of economic policy formulation regarding the growth and unemployment rate variables.

The conclusions reached by the aformentioned analysis could be roughly summarized as follows:

a) The Okun law has been found by the preceeding analysis to hold in the case of the Cyprus economy as a lawlike rather than as a univeral proposition.
b) The core inference of the analysis exhibits that 1 percentage point of GDP growth, is associated with a reduction of the unemployment rate by approximately 0.4 percentage point. This emphasizes and corroborates the fact that the Okun proposition can well function as an economic policy tool bringing together the actual unemployment rate with the GDP growth rate, either estimated annually or quarterly.
c) Running a regression with the GDP growth rate as the dependent variable with respect to the actual unemployment rate with 1 year time lag, it validates the original Okun law, which states that 1 percentage point GDP growth is asociated with a half percentage point reduction of the actual unemployment rate.
d) In a two variables setup with independent variables (U_t, U_{t-1}), it is found that the Okun coefficient equals -0.385 validating an older estimation on Eurozone countries that was appraised to -0.36.
e) Moreover, if the unemployment rate is kept constant, then the Okun law provides the economic policy makers an estimate of the percentage change the economy should grow to maintain the unemployment rate fixed. This is another statistically

significant rationale drawn by the estimated Okun coefficient and for the case of Cyprus, it is found that for the unemployment rate to remain fixed, the GDP growth rate should move upwards by 2.4 percentage points.

f) Furthermore, the previous connotation implies that the Okun law can expand its explanatory domain by interpreting that an extra upwards percentage point of the actual unemployment rate corresponds to 2.4 percentage points of output gap (1:2.4 relation).
g) The Okun law also provides the economic policy makers with an approximation of how many jobs could be created in the following year when formulating their projections.
h) The Cyprus economy is found that the Okun coefficient is statistically more significant amid economic downturns than in economic expansions signalling an asymmetric corelation.

The observed asymmetry could become another area of further investigation, while it can be used as an additional economic policy tool to policy makers on which they can utilize their corresponding economic policy.

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