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A sustainable rate of real GDP growth is one of the best ways to promote the rise of living standards. From a neoclassical point of view the underlying factors that affect economic growth are saving, population growth and technological progress. Unemployment is also very important for obtaining a sustainable economic growth. If unemployment is below its natural level, economic growth will generate higher inflation .This paper emphasizes the link between real GDP growth and unemployment, as described by Okun's law. The empirical analysis shows that a rise of one percentage point of unemployment is associated with a decline of roughly half percentage point of real GDP growth.

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I. Introduction

Economic growth is one of the key macroeconomic variables and is closely monitored by both policy makers and the public. Alongside with inflation, the exchange rate and the unemployment rate it helps to create an overview picture of a country's economy and its level of development. For the measurement of the economic growth, usually data regarding gross domestic product are used, because it quantifies the total income of everyone in the economy. Thus, differences in the growth rate of real GDP can explain the observed differences in the living standards across countries. It must be stated that even small differential in the growth rates can create important gaps between countries determined by the compounding effect. For example the average annual growth rate of the Unites States over the 1870-1990 periods was about 1.75 percents. If this rate would have been smaller by 1 percentage point the United States would have been as developed as Mexico and Hungary. In contrast if the growth rate would have been 1 percentage point higher, real GDP per capita would have been 3 times higher the current level.

II. Underlying factors of real GDP growth

From a neoclassical point of view the underlying factors that affect economic growth are saving, population growth and technological process.
The Solow model shows that the saving rate is one of the most important factors of the steady-state capital stock for an economy. The steady-state capital stock describes a point at which the amount of investments equals the amount of depreciation. At this level capital stock and output are constant over time. This point is important because it can be seen as long run equilibrium for the economy: no matter the level of capital that characterizes an economy at some moment in time; in the end the capital stock will reach its equilibrium value. This observation can explain large rates of economic growth observed in Japan and Germany after the Second World War. Even though, important parts of the capital stock were destroyed, if the saving rate – the fraction of output devoted to saving and investment- remain unchanged the economy will experience a period of high growth until it will reach the steady state. The output grows because more capital

is added than lost through depreciation. Thus, even if GDP initially falls as a result of the destruction of the capital stock, the economy will experience higher growth rates afterwards.
The saving rate is crucial for the determination of a country's steady-state capital stock. If the saving rate is high the country will have an important capital stock and as a consequence larger output. If, by contrast, the saving rate is low, the accumulation of capital will be a slow process and the output will be low. This finding of the Solow growth model suggests that persistent budget deficits are detrimental for economic growth in the long time because they reduce national saving and lower output.
As a conclusion, a higher saving rate induces a larger output on the long run. But there is only one value for the steady state capital stock that also maximizes consumption. This point is called The Golden Rule level of capital. The policy makers find this point as the most desirable but reaching here is a tradeoff of consumption of the present generation versus consumption of the future generation. An economy that already has a steady state, different than the one requested by the Golden Rule and disposes of too little capital has to increase its rate of saving and accept a period of lower consumption in order to increase its capital stock and maximize consumption on the long term.
Another underlying factor of real GDP per capita is population growth. It has been observed that there is a negative correlation between the rate of population growth and the level of income but this correlation not imply also causation. Population growth shed light of raising capital and total output at the steady-state even though capital per worker and output per worker are constant. If the population growth rate increases output per worker will fall and the steady state level of capital per worker will be reduced. Thus, in order to obtain or to maintain high standards of living, policy makers closely observe the population growth rate and interfere sometimes if the growth rate is considered unsustainable. Is has been observed that, in the most cases, low population growth is associated with high levels of income. But there can be others factors that link low population growth to high levels of income: the degree of women employed the level of education, the availability of birth-control methods.
The last underlying factor that affects real GDP growth from the neoclassical point of view is technological progress. In fact, this factor is considered as essential in explaining persistently rising living standards. Technological progress is introduced in the model as a factor causing the efficiency of labor to rise by a fixed percent. Now, in the steady state the change in the capital stock equals investment minus break-even investment (depreciation, population growth and the growth rate induce by technological process).Thus, a rise in saving will cause a rise in the economic growth until the steady state is reached. After this point is reached, the growth rate depends only of the rate of technological progress.
The rate of unemployment is another key macroeconomic variable because it shows how well an economy is using its resources. Unemployment cannot be zero even if the economy it's operating at full capacity because of the frictional and structural unemployment. Frictional unemployment is determined by the time spent to match workers and jobs. This period can vary quite a lot because of imperfect information regarding job vacancies, relative geographic immobility of the workers and wage rigidity. Sectoral shifts appear quite often in an economy, because the demand for goods shifts over time. Thus, it will take time for the workers to adjust to this sectoral shift. The natural rate of unemployment is defined as the rate of unemployment at which the economy is operating at its full capacity. Thus, there is some unemployment but it is due to frictional unemployment. This natural rate of unemployment is sometimes associated with NAIRU- Non Accelerating Inflation Rate on Unemployment. If the actual unemployment falls below NAIRU, inflation will rise quickly as employers will pay higher wages to attract the workers. If the actual unemployment is higher than NAIRU inflation will be lower because salaries will be lower. Although, according to Trifan (2007) the output gap seemed to have a relative small impact over the inflation in Romania.

The GDP obtained when the economy is operating at full capacity is called natural or potential GDP. If the GDP is above its natural level, the output gap will be positive and the economy will experience inflationary pressures. The only way for GDP to rise without a higher inflation is either a larger capital stock or an improvement of the technological process which will determine an upward shift of the production function. The potential GDP is not observable and in order to calculate it we must determine the long term trend of real GDP. This can be done for example by using a Hodrick-Prescott filter.

The correlation between unemployment and real GDP growth should be a negative one. Intuitively, employed workers produce goods and services and unemployed workers do not. Arthur Okun (1962) was the first economist who studied the empirical relationship between unemployment and economic growth. He started his study with a scatterplot, using data on the United States, of the change in the unemployment rate on the horizontal axis and the percentage change in the real GDP on the vertical axis. The graph showed a negative correlation; thus increases in unemployment tend to be associated with lower than normal growth in real GDP.

The initial form of the Okun's law can be written as:

$$\omega(U^* - U) = (Y - Y^*)/Y^* \quad (1),$$

where U is the unemployment rate, Y is real GDP and an asterisk represents potential or natural rate levels of the variables. The above equation states that for every percentage point the unemployment is below the natural rate, GDP is ω% above potential GDP. Okun empirically demonstrated that for the United States ω is approximately 2. Thus, GDP falls by 2 percent relating to its potential if the unemployment rate falls by 1 percentage point.

In order to empirically estimate Okun's law, giving the fact that U^* and Y^* are difficult to estimate we will use a reduced form of the previous equation.

To derive the growth rate version, we first expand equation 1:

$$\omega U^* - \omega U = Y/Y^* - Y^*/Y^* \quad (2)$$

Now, we differentiate equation 2 with respect to all variables. In order to simplify our analysis we will consider Y^* as a constant, stating the potential GDP is not changing on the short term. Thus:

$$\omega dU^* - \omega dU - dY/Y^* - dY^*/Y^* \quad (3)$$

Also, we shall assume that the change of the natural rate of unemployment dU^*=0. Using this assumption and rearranging we obtain:

$$dY/Y^* = -\omega dU + dY^*/Y^* \quad (4)$$

The natural real GDP growth rate is usually close to the real growth rate. Therefore we can approximate dY^*/Y with dY/Y. This modification can be invalidated on the short run but on the long run it is consistent. Thus:

$$dY/Y = -\omega dU + dY^*/Y^* \quad (5).$$

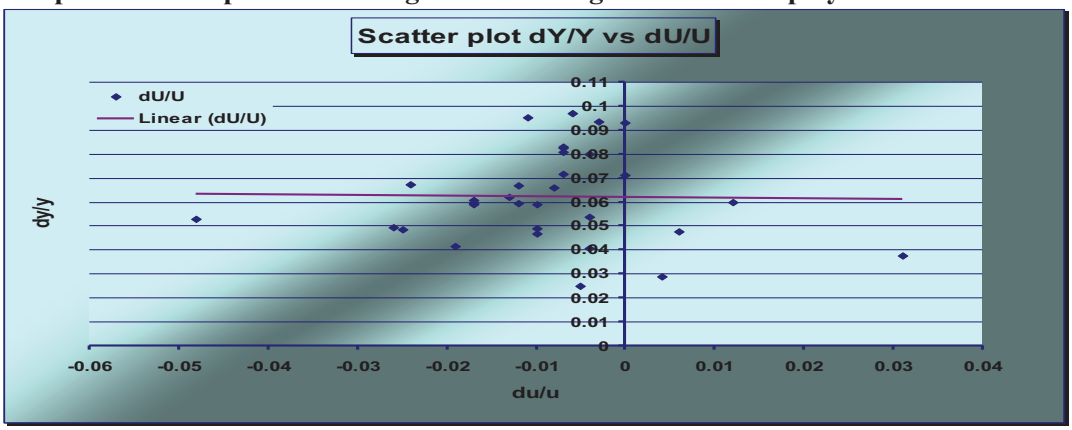
This equation states that the real GDP growth rate is equal to the potential GDP growth rate less the product of Okun's law coefficient and the change in unemployment rate. Using ordinary least squares Okun has obtained $\omega \cong 2$ and $dY^*/Y^* \cong 3$. Thus potential GDP growth rate is about 3 percentage points while a rise in unemployment by 1 percentage point will lower real GDP growth rate by 2 percentage points.

III. Testing the validity of Okun's law for Romania

In order to empirically test Okun's law for Romania, we have used data for real GDP growth and unemployment in the period 2000Q1-2008Q4. The source of the data is The National Institute of Statistics, the frequency is quarterly and all the series have been seasonally adjusted using TramoSeats.

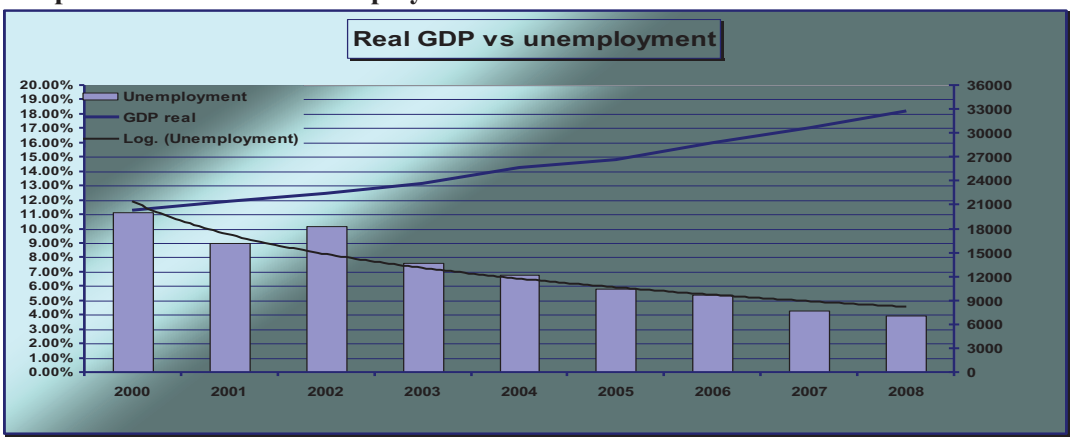
The first step in analyzing Okun's law is to plot the data in a standard data plot:

Graph 1: Scatter plot real GDP growth versus growth of unemployment



The graph suggests that higher values of economic growth can be associated with lower values of unemployment growth rate. Also, a downward trend can be identified.
The second step of the analysis is to create a graph using historical values for real GDP and the actual rate of unemployment

Graph 2: Real GDP vs. unemployment



It is obvious that, during this period of high growth, unemployment has fallen dramatically.
In order to test the relationship between the GDP growth and unemployment growth rate a series of preliminary tests were made in order to select the best regression model. First step was to test if the variables are stationary by running ADF and PP tests. The results are shown in the table below:

Table 1: Stationary tests for GDP growth rate (dy/y) and unemployment growth rate (du/u)

Variable	Test	t-statistic	p-value
dy/y	ADF	-3.896084	0.0059
	PP	-4.816665	0.0005
du/u	ADF	-5.732910	0.0001
	PP	-2.711391	0.0084

Both tests confirmed that the variables are stationary in level. Further it was observed that for the dependent variable (DY/Y) the partial autocorrelation function showed a dependence in the first two lags; as a consequence for better results we included in the regression the first two AR terms. After running several regression equations which included different lags for the unemployment growth rate it was choose the one which consider du/u (-2) based on statistically significance criterion. Therefore the equation found to describe the best the relationship between the two variable on significance and information criteria was:

$$dy/y = c + \beta_1 ar(1) + \beta_2 ar(2) + \beta_3 du/u(-2) + \varepsilon$$

Table 2: The regression results

Dependent Variable: dy/y Method: Least Squares				
Sample (adjusted): 2002Q1 2008Q4				
Included observations: 28 after adjustments				
Convergence achieved after 6 iterations				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	0.057634	0.004384	13.14642	0.0000
du/u(-2)	-0.492784	0.215824	-2.283264	0.0316
AR(1)	1.002398	0.192709	5.201616	0.0000
AR(2)	-0.734719	0.201197	-3.651743	0.0013
R-squared	**0.467900**	Mean dependent var		0.063236
Adjusted R-squared	0.401388	S.D. dependent var		0.019665
S.E. of regression	0.015215	Akaike info criterion		-5.401504
Sum squared resid	0.005556	Schwarz criterion		-5.211189
Log likelihood	79.62106	F-statistic		7.034777
Durbin-Watson stat	**2.053652**	**Prob(F-statistic)**		**0.001480**

The coefficient of dU is around -0.49 and is statistically significant. A rise by one percentage point of unemployment will reduce real GDP growth by 0.49 percentage points with a delay of 2 lags. The intercept can be interpreted as potential GDP growth; so the level of economic growth which will not generate inflation is below 5.76 percentage points. Also we can observe a high value for R-squared which means that the explanatory variables describe well the variation in economic growth. The Durbin-Watson statistic is around 2 which means that there is no autocorrelation in the residuals. The correlogram of residuals confirmed the absence of autocorrelation while the White test showed that the errors are homoskedastic with a p-value of 96%.

IV. Conclusions

The correlation between real GDP growth and unemployment is very important for policy makers in order to obtain a sustainable rise in living standards. If GDP growth rate is below its natural rate it is indicated to promote employment because this rise in total income will note generate inflationary pressures. In contrast, if the GDP growth is above its natural level, policy makers will decide not to intensively promote the creation of new jobs in order to obtain a sustainable growth rate which will not generate inflation.

The slope of unemployment in Okun's law in around -0.5 and potential GDP growth is around 5.7 percentage points and the variables are negatively correlated as predicted by the theory. These values are particularly important for policy makers in order to obtain an optimal relation between

unemployment and real GDP growth. In the previous years, economic growth in Romania was above potential which has generated inflationary pressures.

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