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Some Considerations on the Application of Okun's Law for Romania during 1999-2010

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Abstract

This paper started from the fact that, currently, because of the globalization which has widened the economic, social and cultural gaps between the countries of the world, we face the following situation: any economic program of a State must include a set of policy measures intended to achieve the main objectives of macroeconomic policy in that country. Two of the objectives of macroeconomic policy are quantified using macroeconomic variables: GDP growth and unemployment. The correlation between these two variables is reversed (negative) and is known as Okun's law.

In this paper I tried a mathematical modeling of Okun's Law, applied to the Romanian economy, using data series from 1999 to 2010.

Key words: *GDP growth (GDP), unemployment rate, Okun's law, economic growth*

JEL Classification: *J49*

Introduction

Economic growth in contemporary societies is conditioned, among other things, by the public education. Consequently, "*human capital*" becomes as important as the natural resources or energy for the development of human society. Moreover, being determined by knowledge and information, it is virtually unlimited and the man may exceed his limits, becoming - in himself - a major factor for achieving economic and social sustainable development.

In the current context of economic globalization (where "New economy" is based on knowledge) the human capital, also called the creative potential of people, is regarded as a complex subsystem of the national wealth. The spiritual side of the human capital - the intellectual capital - is the one that 'gives value to people' (both an economic value, but above all a social value).

Most of the real income obtained by the developed countries, especially in the last decades, was due to the investments in human capital. Modern societies are facing a phenomenon called 'human gap', meaning a much greater increase of the complexity of problems facing mankind, in relation to our ability to solve them. The solution identified by the researchers in this case is the 'societal learning', according to which, there are not only individuals involved in the learning process, but also groups, companies, thus developing new methodologies, skills, attitudes and values, in order to face the new world dynamism.

Thus, the future depends especially on the increase of the capacity of human understanding and action, integrated in their turn into the educational system. In this process it is achieved what is essential in the formation of professions and socio-professional structures, namely the decisions taken on the basis of *desirability* (desirability is a way of conceptualizing the extent to which what is possible it is also socio-human acceptable – desirable). We can say that workers of nowadays exploit services of the knowledge-based society. Jobs today require a good education and a high level of training. Employees' ability to develop strategic solutions, to apply specialized knowledge and collaborate in terms of chaotical contextual demands represents *the new essential capability of the organizations.*

Economic growth is inextricably linked to sustainable development, generally, and to sustainable human development, in particular. Sustainable human development can not be achieved, especially in the knowledge economy, if investment in human resources (human capital) does not become a priority.

Currently, due to the globalization that has widened the economic, social and cultural gaps between the countries of the world - we face the following situation, namely: any economic program of a State must include a set of political measures designed to achieve the main objectives of the macroeconomic policy in that country.

Any country, regardless of its development level, has, typically, as its main objectives of macroeconomic policy the following concepts: economic growth, employment, price stability, improving external balances, real income growth, that is achieving sustainable human development in general. These multiple objectives of macroeconomic policy can be quantified using macroeconomic variables (they are four in number, but in this paper, we deal with only two *macroeconomic variables*). In this study we focused only upon two macroeconomic variable implications - namely *GDP growth* and *unemployment*.

Economic theory and practice relating to the two variables, *GDP growth rate (GDPR) and unemployment rate (UER),* has recorded the following correlation: When an economy is in recession phase, characterized by a decreasing growth rate of GDP, the unemployment rate is increasing; when there is economic expansion, GDPR increases, while UER decreases. This inverse correlation (negative) is known as Okun's law. Analyzed in terms of the U.S. economy, the law has resulted in the following relationship'[1]:

$$GDPR_{t/t-1} = 3\% - 2\left(UER_t - UER_{t-1}\right) \quad (1)$$

where: $GDPR_{t/t-1}$ - GDP growth in period t to period t – 1

3% - GDP growth trend (trend relative to time);

$UER_{t/t-1}$ - GDP growth trend (trend relative to time).

In this paper I tried a mathematical modelling of Okun's law applied to the Romanian economy, based on data sets from 1999 to 2010.

Mathematical modeling of Okun's Law according to Romania's particularities between 1999-2010

In this modeling we took into account the relevant data series of annual unemployment rate and the GDP growth rate - annual rhythm - in the period 1999-2010, using as a data source the

[1] Isaic-Maniu, Al., Mitruț, Ct., Voineagu, V. *Macroeconomie şi analiză macroeconomică*, Editura Constantin Brâncoveanu, Rm. Vâlcea , 1995, pp. 101-106.

Statistical Yearbook of Romania and Statistical Breviary and operational statistics of the Romanian National Bank.

Table 1. Unemployment rate and GDP* growth between 1999-2010**

Year	The annual average unemployment (%)	GDP growth rate of value (percentual change of the real GDP value in comparison with the previous year. The real GDP value is adjusted for inflation)	Rs(t)-Rs(t-1)
1999	11.8	-1.2	
2000	10.5	2.1	-1.3
2001	8.8	5.7	-1.7
2002	8.4	5.1	-0.4
2003	7.4	5.2	-1
2004	6.3	8.4	-1.1
2005	5.9	4.2	-0.4
2006	5.2	7.9	-0.7
2007	4.1	6	-1.1
2008	3.9	9.4	-0.2
2009	6.3	-7.1	2.4
2010*	7.9	-2	1.6

* real GDP

** The statistical summary of the unemployment stock at September 30, 2010, recalculated with the active civil population on 01/01/2010 (http://www.anofm.ro/files/EVOLUTIE%20RATE%20_0.xls)

Source: Data summarized by the author

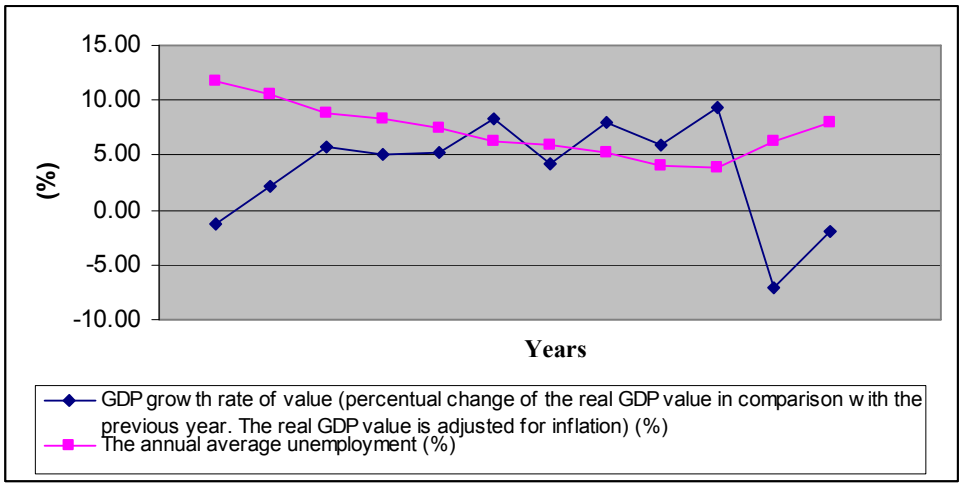

Fig. 1. Evolution of the two rates - the rate of unemployment and annual GDP growth rate

Based on the data from Table 1, Figure 1 above was developed which led to a unifactorial econometric model as explained below:

$$y = f(x) + u \tag{2}$$

For this equation, *u, the residual variable* describes the influences of other unspecified, factors insignificantly acting upon *y variable*,

x variable represents the real values of the dependent variable (growth rate of GDP) and y variable represents the real values of the independent variable (unemployment changes).

In this analysis, these two variables from OKUN's Law have the following significations: 'x' describes the growth rhythm of GDP and 'y', the dependent variable regarding y changes, represents the unemployment rate modification.

Thus, in the case of a unifactorial model, as in our case, we used the method of corelograme which represents the analysed data, as shown in Figure 2.

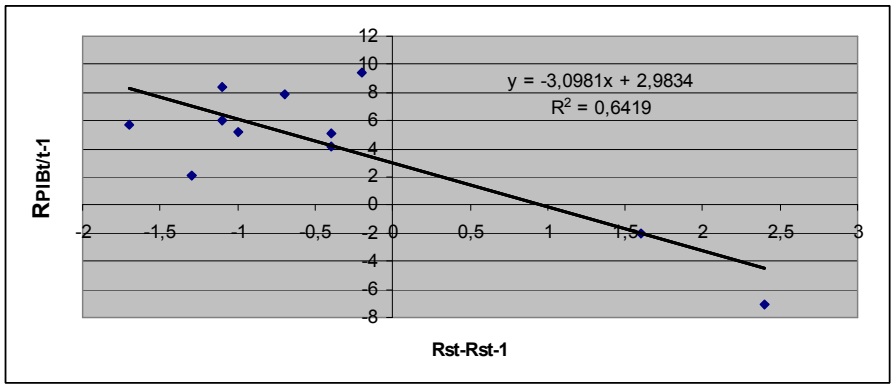

Fig. 2. The link between unemployment and annual GDP growth rate

Using the graph in figure 2 the links between GDP growth rate (variable resulting) and changes in unemployment were represented.

The analysis showed that the GDP growth rate was influenced, not only by the unemployment change (namely, 'y' variable), but by other factors as well. However, the latter were eliminated by the adjustment procedure which led to the establishment of the theoretical regression line. The concentration of the frequencies around the diagonal reflects that the two variables, 'x' and 'y' are closely connected.

The influence of these factors will be eliminated by unidentified accidental adjustment, ie by setting the theoretical regression line. There is a relatively tight relationship between x - rate of growth of GDP - and y - change in unemployment, shown by the concentration around the diagonal frequencies.

I used Excel for data processing for the period and got the results shown in Table no.2.

Table 2. Regression coefficient

Regression Statistics	
Multiple R	0.801206
R Square	0.641931
Adjusted R Square	0.602146
Standard Error	0.792529
Observations	11

After calculation, it resulted a correlation coefficient r: -0.80121.

Therefore, the correlation coefficient r of -0.80, previously calculated, and the linear relationship between the two are inverse, but strong. Values close to -1 indicate strong links (relatively representative) between model variables.

R2 = 0.6419 as growth rate variation explains 64% unemployment and the remaining 36% can be allocated to local factors considered random factors in the model (u).

Indicators of Quality Adjustment

Table 3. ANOVA Test

ANOVA					
	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	10.13435	10.13435	16.13485	0.003033
Residual	9	5.652926	0.628103		
Total	10	15.78727			

Table 4. The residual value and the residual value standard

Observation	**Predicted Y**	**Residuals**	**Standard Residuals**
1	0.056088	-1.35609	-1.80365
2	-0.68983	-1.01017	-1.34356
3	-0.56551	0.165513	0.220138
4	-0.58623	-0.41377	-0.55033
5	-1.24927	0.149273	0.198539
6	-0.37903	-0.02097	-0.02789
7	-1.14567	0.445673	0.592761
8	-0.75199	-0.34801	-0.46286
9	-1.45647	1.256473	1.671155
10	1.962329	0.437671	0.582118
11	0.905608	0.694392	0.923566

Source: Own processing based on table1 data

Indicators of Quality Adjustment

The standard deviation (standard error) of the residue is a measure of absolute quality adjustment based on regression in the sample, and *the coefficient of determination* is a relative indicator.

It is seen from Table 5 that:

$$y_i - \overline{y} = (y_i - \hat{y}_i) + (\hat{y}_i - \overline{y}) \quad (3)$$

Table 5. ANOVA to determine the coefficient of determination

y	**x**	$y - \overline{y}$	$\hat{y}$	$y - \hat{y}$	$\hat{y} - \overline{y}$
2.1	-1.3	-1.9818	7.01093	-4.9109	2.92911
5.7	-1.7	1.61818	8.25017	-2.5502	4.16835
5.1	-0.4	1.01818	4.22264	0.87736	0.14082
5.2	-1	1.11818	6.0815	-0.8815	1.99968
8.4	-1.1	4.31818	6.39131	2.00869	2.30949
4.2	-0.4	0.11818	4.22264	-0.0226	0.14082
7.9	-0.7	3.81818	5.15207	2.74793	1.07025
6	-1.1	1.91818	6.39131	-0.3913	2.30949
9.4	-0.2	5.31818	3.60302	5.79698	-0.4788
-7.1	2.4	-11.182	-4.452	-2.648	-8.5339
-2	1.6	-6.0818	-1.9736	-0.0264	-6.0554
$\overline{y}$ =4.08182					

Table 5. ANOVA to determine the coefficient of determination (cont.)

$(y - \hat{y}) + (\hat{y} - \overline{y})$	$(y - \overline{y})^2$	$(y - \hat{y})^2$	$(\hat{y} - \overline{y})^2$
-1.98182	3.92760331	24.1172335	8.57968539
1.61818	2.6185124	6.50336703	17.3751417
1.01818	1.03669421	0.76976057	0.01983027
1.11818	1.25033058	0.77704225	3.9987201
4.31818	18.6466942	4.03483552	5.33374406
0.11818	0.01396694	0.00051257	0.01983027
3.81818	14.5785124	7.55111928	1.14543506
1.91818	3.67942149	0.15312352	5.33374406
5.31818	28.2830579	33.6049771	0.22924944
-11.18182	125.033058	7.01169216	72.8267665
-6.08182	36.9885124	0.00069907	36.6676269
	$\Delta^2_y = \sum_{i=1}^{n} (y_i - \overline{y})^2$ 236.056364	$\Delta^2_e = \sum_{i=1}^{n} (y_i - \hat{y}_i)^2$ 84.5243626	$\Delta^2_{y/x} = \sum_{i=1}^{n} (\hat{y}_i - \overline{y})^2$ 151.529774

Source: Own processing based on Table 1 data

Yaverage ≈ 4,08;

236.056364=84.5243626+151.529774;

Rounded: $\Delta^2_y = 236$;

$s_3 = 3{,}06$.

The following *indicators* were calculated:

- *The determination coefficient*: $R^2 = \frac{151.5}{236} = 0.6419$

- *Covariation: Cov(x,y) = 48.9108949/11=4.4463*
- *Correlation coefficient: r = -0.80*
- *Correlation Report:* $|r| = 0.64$

Table 6. ANOVA table for testing the quality adjustment

Variation Source	Variation	Degrees of Freedom	Corrected Dispersion
Regression	$\Delta^2_{y/x} = \sum_{i=1}^{n} (\hat{y}_i - \bar{y})^2$	k	$s^2_{y/x} = \frac{\Delta^2_{y/x}}{k}$
Residual	$\Delta^2_e = \sum_{i=1}^{n} (y_i - \hat{y}_i)^2$	n-k-1	$s^2_e = \frac{\Delta^2_e}{n-k-1}$
Total	$\Delta^2_y = \sum_{i=1}^{n} (y_i - \bar{y})^2$	*n-1*	$s^2_y = \frac{\Delta^2_y}{n-1}$

Source: Bărcescu-Cărbunaru, A., Ţiţan, E., Ghiţă, S.[2]

So the equation becomes: y = -3.0981x + 2.9834.

So Okun's Law for Romania is reflected in the following relationship:

$$GDPRt / t-1 = 2.9834\% - 3.0981(UERt - UERt-1)$$

meanings : GDPRt / t−1 = 3%− 3(UERt − UERt−1)

where : y=GDPRt / t−1, x=UERt − UERt−1

It must be borne in mind, according to the U.S. economy particularities (if unemployment remains the same, GDP will grow by about 3%, and if reducing of unemployment by one percentage point is desired, then RPIB must reach the 5%), that Okun's law is statistical in nature. It does not apply to any country, but only U.S. and only for the phase in which Okun did this research. Such a statistical relationship can be derived for each country depending on the specific conditions of the stage it crosses.

Conclusion

The statistical analysis, according to the conditions of the Romanian economy over the past 11 years (1999-2010), shows that Okun's law is valid, but obviously in a specific form. In other words, if our country wants to reduce unemployment by one percentage point, RPIB will have to reach 6%.When the GDP reaches 6%, we can say that this growth is both qualitative and sustainable.

In this context, it was launched the idea that sustainable economic growth (growth that is achieved through measures to allow its dissociation from the negative impact on the environment) should be judged not only according to the Gross Domestic Product (GDP), but also on the basis of the *Sustainable Domestic Product* (SIP).

We must note that the relationship between the unemployment rate and the GDP growth rate, is mediated by inflation. Referring to this relationship, the famous economist, Milton Friedman, Nobel Laureate in Economics (1976), emphasized that "there is no stable substitution between inflation and unemployment; there is a 'natural rate of unemployment' that reflects real forces

[2] Bărcescu-Cărbunaru, A., Ţiţan, E., Ghiţă, S., Statistica macroeconomică, Bucureşti, Meteora Press Publishing House, 2001, p. 383.

and correct perception: unemployment below this level can be maintained only by accelerated inflation; or - over it - only by a rapid deflation.'[3]

Also the relationship between the growth rate of GDP and unemployment rate should be sized so as to reflect the natural unemployment evolution trend.

It is necessary an appropriate involvement of the inflation rate, in addition to the creation of an appropriate relationship between the GDP growth rate and the unemployment rate, so that a political strategy in the value of labour should be encountered in the process of social sustainable growth.

The laureates of Nobel Prize for Economics say that natural unemployment may not be associated with the level suggested and demonstrated by W. Paretto (3%). It is estimated that the natural unemployment rate in the range 7-10% corresponds to a competitive statement on the labor market. It is not by accident that in the developed countries the unemployment rates registered between 7-10%, due to the development of a social economy and, last but not least, of human solidarity.

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[3] Friedman, M., *Laureaţii Premiului Nobel în Economie, Discursuri de recepţie*, vol. 2, 2001, p.73

Unele considerații privind aplicarea legii lui Okun în cazul României, în perioada 1999-2010

Rezumat

Acest articol are ca principală motivație faptul că, în ultimul timp, reducerea decalajelor economice, sociale şi culturale între statele lumii – care s-au accentuat atât ca mărime absoluta cât şi relativă - nu poate avea loc decât în condițiile în care oricare stat îşi construieşte un set adecvat de politici. În cadrul acestuia, printre obiectivele fundamentale ale politicii macroeconomice cuantificate cu ajutorul variabilelor macroeconomice, trebuie înscrise şi următoarele două: rata de creştere a PIB (produsul intern brut) şi rata şomajului. Între cele două variabile (ritmul de creştere a PIB şi rata şomajului) există o corelație inversă (negativă), cunoscută în literatura de specialitate sub denumirea de legea lui Okun. În articolul de față se încearcă modelarea matematică a legii lui Okun aplicată în cazul economiei româneşti, folosind seriile de date din perioada 1999-2010.