Professor Marin DINU, PhD
Lecturer Marius-Corneliu MARINAŞ, PhD
Email: marinasmarius@yahoo.fr
Associate Professor Cristian SOCOL, PhD
Lecturer Aura-Gabriela SOCOL, PhD

TESTING OF THE OKUN'S LAW IN ROMANIA

Abstract. *The objective of this study is to estimate the Okun's coefficient, and to check the validity of Okun's law in Romania during the period 1999-2008. For this purpose, we used data series of the unemployment rate, calculated according to Eurostat methodology and industrial production index, used as a proxy for the change in real GDP. Firstly, we have presented theoretical arguments of the asymmetric relationship between unemployment and economic growth. Secondly, we tested the hypothesis of unemployment hysteresis in Romania. Finally, we estimated Okun`s coefficient based on the ADL (autoregressive distributed lag) model, which we introduced two dummy variables to capture the impact of hysteresis in unemployment. The estimated value was -0.26, a value greater than previous estimates for the period 1992-2004 (-0.17), but close to the coefficient estimated by Okun (-0.3).*

Keywords*: hysteresis in unemployment; Okun law; output-gap; stationarity; ADL model.*

JEL Classification: E24, E27, J08

According to Okun's law, a reduction of domestic production below its potential causes an increase in unemployment over the natural rate of unemployment, its changing being less than the production. Due to specific rigidities of the labour market and good market (such as menu costs, efficiency wages, minimum wages) prices and wages do not respond simultaneously to change of aggregate demand. Consequently, an increase of demand will induce an increase in production in the short term, which will be reflected in reducing unemployment. Testing Okun law is sensitive to the nature and intensity of the economy's business cycle phase. Thus, in periods of economic recession, the unemployment rate will react to a greater extent to the variation in production than in periods of inflationary gap when the unemployment rate remains around the natural unemployment rate. The structure of this study is consistent with objective namely testing Okun law in Romania. Thus, in the first section we have presented a series of theoretical arguments of the asymmetric relationship between unemployment and economic growth. In the next section we tested the hypothesis of unemployment hysteresis in Romania. Its presence is a sign of manifestation of structural breaks that prevent a return to past values of unemployment. In the third

section I estimated Okun coefficient based on the ADL model, which we introduced two dummy variables to capture the impact of hysteresis.

The relationship between production and unemployment

To illustrate the asymmetric response of unemployment to change of production we used the model proposed by Shapiro and Stiglitz (1984). We realised the decomposition of output (Y), according to the following equation:

$$Y = \frac{Y}{L} \cdot L \Rightarrow Y = f(Y/L, L); Y'_{Y/L} > 0; Y'_{L} > 0 \quad (1)$$

where L is the employed population, and Y/L labour productivity (affected only by the workers).

The two variables are in a positive relationship with the output and its variation is approximately equal to the amount of labour productivity and changes employment. A decrease in employment will involve ceteris paribus, an increase of unemployment rate (U_R) and consequently an increase in labour productivity. Depending on the positive relationship between unemployment and productivity, the previous equation can be rewritten in terms of unemployment rate, as follows:

$$\frac{dY}{dU_R} = \frac{dY}{dY/L} \cdot \frac{dY/L}{dU_R} + \frac{dY}{dL} \cdot \frac{dL}{dU_R} \quad (2)$$

Since the first derivative of employment with respect to the unemployment rate is negative (inverse relationship of these variables) and the productivity is positive, then the first derivative of output is influenced by the ratio between these two terms:

- if $\frac{dY}{dY/L} \cdot \frac{dY/L}{dU_R} > \frac{dY}{dL} \cdot \frac{dL}{dU_R}$, then will be a positive relation between output and unemployment rate, at low levels of unemployment (area I, in figure 1);
- if $\frac{dY}{dY/L} \cdot \frac{dY/L}{dU_R} < \frac{dY}{dL} \cdot \frac{dL}{dU_R}$, then will be a negative relation between output and unemployment rate (area II, in figure 1).

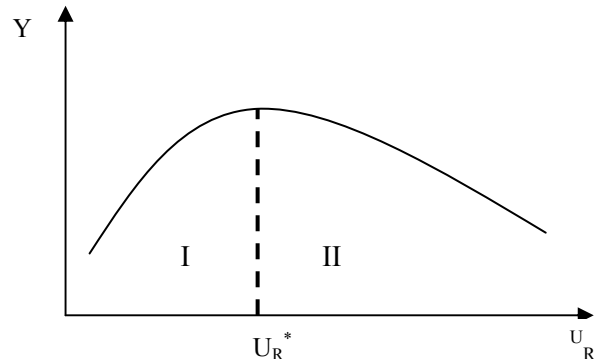


Figure1. The relationship between output and unemployment

Okun's law is validated in the second area of the figure, in the event of negative shocks to aggregate demand or aggregate supply. The first area corresponds to structural changes of the economy that generate both short-term output and unemployment (structural) increases, meaning that law Okun is not checked. Another possible explanation of the incompatibilities inverse relationship between production and unemployment is the result of the unemployment rate dependence of other factors such as degree of mobility of labour, demand for foreign labour force, labour law and the shadow economy. For example, the emergence of a recession in an economy (the relative output decrease) may be accompanied by the migration of unemployed (thus lowering the internal rate of unemployment) to other economies characterized by labour force deficit.

Testing of unemployment hysteresis in Romania (1999-2008)

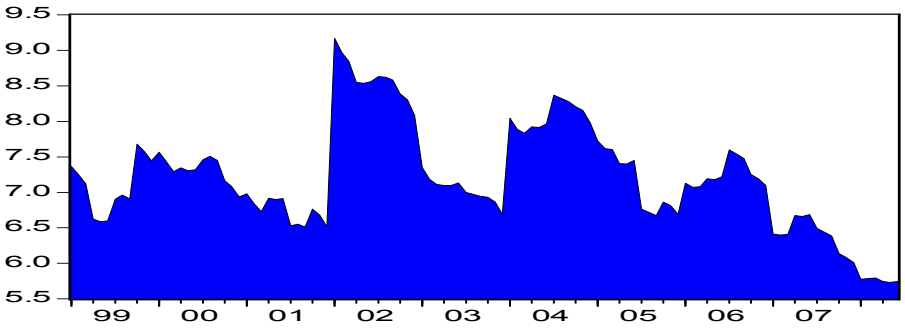
Unemployment hysteresis term was introduced by Phelps (1972) with the significance of unemployment persistence at a given level after transitory shocks. Persistence of unemployment (or almost hysteresis) means a very low adjusting speed to the steady-state level. According to Lindbeck and Snower (1986) the hysteresis phenomenon must be interpreted according to the model coordinates of insiders-outsiders, so unions maintain wages at a level which generates increase of unemployment. Romer (2001) considers that there are two other causes of hysteresis. The first concerns the reduction of qualifications for the unemployed, which will make harder finding a job when aggregate demand will rise. Under the second, people in long-run unemployment surrenders to a large proportion of the job search. It follows that the validation of unemployment hysteresis hypothesis is a signal to enhance the active labour market policies.

The absence of hysteresis in unemployment is the consequence of stationarity. If unemployment rate is a stationary process at the initial level, the effects of various shocks will always be transitory and the unemployment rate will tend to the natural rate (assumed to be identical to the NAIRU). If the unemployment rate is non-stationary (becomes stationary by integrating with the first difference), then the shocks that affect this series will have permanent effects on it, causing its displacement from a point of equilibrium to another. Thus, cyclical fluctuations will exert an influence on long-run unemployment, the economy had the capacity to shock eliminate.

From an econometric viewpoint testing the hysteresis hypothesis involves the use of unit root tests. Studies that have estimated the unemployment hysteresis are sensitive to both the economy and analyzed chosen as a reference. Using data from the period 1853-1984 for France, Germany, UK and USA, Blanchard (1986) concluded that only the U.S. were characterized by a stationarity of unemployment (lack of hysteresis in unemployment). Roed (1996) validated the results to the U.S. for the period 1970-1995 and estimated the presence of hysteresis in 16 OECD countries. León-Ledesma (2002) used a panel methodology and identified the existence of hysteresis in the European Union countries and its absence in the U.S. León-Ledesma (2004) estimated that the Central and Eastern European countries

are characterised by an unemployment hysteresis in the absence of dummy variables that highlight certain structural breaks.

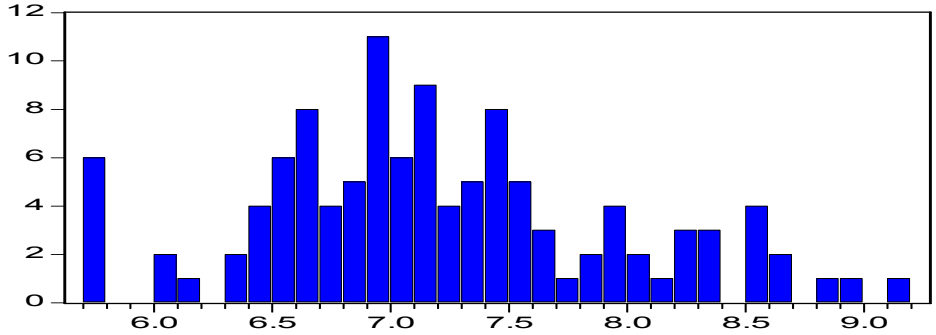
In order to test the hypothesis of unemployment hysteresis in Romania we used monthly data rate of unemployment for the period 1999:1-2008:6, the source of data being Eurostat. Since economic activities are seasonal, we used Census X12 procedure to eliminate the influence of seasonality (Figure 2).



Note: Unemployment rate is represented by Y axis and is expressed as a percentage of the labour force.
Source: Eurostat

Figure 2. The unemployment rate in Romania (without seasonality)

Graphic representation shows that the unemployment rate reaching a maximum of 9.17% in January 2002 and a minimum of 5.73% in May of 2008. Also, there is the possible break of the structural data series in January of 2002, 2004, 2006, the corresponding halting the downward trend of unemployment. Since August 2006 there is a descending trajectory of the variable, in the emphasis on labour force deficit in the Romanian economy. From a statistical viewpoint, the characteristics of a normal distribution of data series are reflected by the coefficient of 0 for the asymmetry (skewness) and 3 for the flatted (kurtosis). If unemployment kurtosis value is close to 3, so the probability of extreme values and persistent unemployment is about the same as for a normally distributed series. Series data shows a positive asymmetry (skewness = 0.33) indicating a slight upward trend in unemployment over the interval examined (Figure 3).



Note: the values of the statistical tests are: 0.337107 for Skewness, 2.902914 for Kurtosis and 2.203952 for Jarque-Bera test. The probability value is 0.332214, higher than 5% significance level. Thus it accept null hypothesis of normal distribution of residual.

Figure 3. Statistical distribution of unemployment rate

Jarque-Bera test indicates whether a series is normally distributed. It measures the difference between the coefficient of asymmetry and the flatted of distribution when analyzed in comparison with the normal. Since the associated probability is 33.22%, then accept the null hypothesis of a normally distributed series of unemployment rate.

To test the hypothesis of hysteresis in unemployment rate we used stationary Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. If you accept null hypothesis (H0) that the series has a unit root and the variable is not stationary. A stationary time series is one whose statistical properties such as mean, variance, autocorrelation, etc. are all constant over time. Also, a stationary series tends revert to the mean value and fluctuate around it (has a finite variation). In contrast, a non-stationary series has a different mean at different moments in time. In accordance with the ADF test with constant, the series is non-stationary baseline to any of the thresholds of significance of 1%, 5% or 10%. The *t* statistic value is smaller in absolute value compared to critical values and associated probability is 0248, which suggests accepting null hypothesis (H0) of non-stationary. The same result is obtained by using Phillips-Perron test with constant probability is also higher than reference values of 1%, 5% and 10% (Table 1).

Table 1. Testing the unemployment rate stationarity

Critical values t-statistic	**ADF(0) -2.105939**	**PP(0) -2.163649**	**ADF(1) -11.25261**	**PP(1) -11.25261**
1%	-3.489117	-3.489117	-2.585773	-2.585773
5%	-2.887190	-2.887190	-1.943714	-1.943714
10%	-2.580525	-2.580525	-1.614834	-1.614834

Note: The two tests examine the null hypothesis of non-stationarity. The unemployment rate is non stationary at level, but become stationary after first differencing at 1% level of significance (calculated values are less than critical values). The estimation procedures of stationarity were carried out in Eviews 6.

Applying the test for first difference, unemployment rate shows values significantly higher than the critical values for ADF and Phillips-Perron (without trend and constant), the latter taking into account structural breaks. It follows that the variable becomes stationary in first difference, ie is integrated at first order. Thus, between 1999-2008 years the monthly rate of unemployment in Romania registered hysteresis, shocks that have generated the variation being followed by a return to the previous variable. Taking into account observations from Figure 2 we tested stationarity of unemployment rate series whereby excluded structural break in January 2002. In these circumstances, the ADF and PP tests (with constant) highlights data series stationarity at the level, which contradicts the hysteresis hypothesis previously estimated (Table 2).

Table 2. The lack of hysteresis in unemployment rate

Critical values t-statistic	**ADF(0)** **-4.370371**	**PP(0)** **-7.275489**
1%	-3.489659	-3.489117
5%	-2.887425	-2.887190
10%	-2.580651	-2.580525

Note: The unemployment rate is stationary at level; the calculated values in Eviews 6 are less than critical values.

It follows that of unemployment rate hysteresis is consequence of structural break in data series. This was generated by applying from 1 January 2002 a law on minimum income. Under it, the persons entitled to receive social assistance should obtain proof of income below the guaranteed minimum wage. In these circumstances, many people have registered at National Agency of Employment, although not in the job search. Consequently, the unemployment rate was artificially increased from December 2001, which is located at 6.51%. Thus confirming results obtained by León-Ledesma (2004) for a panel that has been included and Romania. During the transition period have been both structural changes in these economies and changes in labour law and social protection, which were reflected in the emergence of hysteresis in unemployment. Its existence implies the use of dummy variables to estimate the Okun coefficient in the case of Romania.

Theoretical framework and the empirical evidence on Okun's law

Okun (1962) estimated that an increase in real GDP by 1 percentage point from GDP potential causes a decrease by about 0.3 percentage points of unemployment below its natural rate other words, keeping unemployment at its natural level implies a level of output equal to that potential, according to the following equation:

$$(U_{Rt} - U_{Rt}^{*}) = -\beta \cdot (Y_t - Y_t^{*}) + \varepsilon_t, \quad (3)$$

where:

Y_t – current level of GDP; Y_t^{*} - potential GDP; U_{Rt} – current level of unemployment rate;

U_{Rt}^{*} - natural rate of unemployment (NAIRU); β – Okun coefficient; ε_t – residual

Okun coefficient value (β) is mainly influenced by three factors:

- *employment laws*. Firms change their employment levels during the course of business and depending on the labour law relating to hiring and firing. Thereby the Okun coefficient values will be lower in economies characterized by higher level of employment protection.
- *the degree of labour market flexibility*. In economies characterized by a reduced flexibility of the labour market (ie diminishing accommodation of firms and working age population to the economic changes) will continue a high level of unemployment in periods of recession and job vacancies in periods of expansion. Therefore, the Okun coefficient will be lower.

- *business cycle phase and its intensity*. Because is not linear relation between changing production and the employment, it is expected that during of overheating unemployment is less responsive to changes in production. In this case the coefficient β will have a lower value. In contrast, during periods of prolonged recession, the unemployment rate will react more to output decrease. β coefficient will have a value greater than the first case.

Studies that have tested the Okun coefficient are sensitive to the nature of the output gap recorded and to the duration of expansion and economic recession. Lee (2000) established that the relationship between unemployment and growth is not stable over time but concluded that the impact of output growth on employment is still valid. He also estimated that structural breaks of the Okun law model is caused by reduction in productivity and restructuring companies. Sőgner (2002) has analyzed the Okun coefficients for the 15 OECD countries during 1960-1999 years and has estimated the 0.012 absolute value in Japan and 0.82 in the case of the Netherlands. Coefficients were not statistically significant for four of the 15 economies examined: Austria, Italy, Belgium and Switzerland. Gabrisch (2006) has tested the relationship between unemployment and economic growth between 1992 and 2004 for eight of the new EU countries and identified the existence of a stable relationship between these variables only in the last stage of transition. Okun coefficients had values between 0.85 for Hungary and Latvia 2.3 case in the interval 1998:1 - 2004:4. In Poland and Slovakia the Okun coefficient was not different from zero, one explanation being that the existence of a high natural rate of unemployment.

Empirical investigation of Okun coefficient in Romania (1999-2008)

In this study we estimate Okun coefficient by ordinary least squares (OLS) procedure using Eviews 6 software. To test this coefficient in the case of Romania we used equation (3) relating to the cyclical values of output and unemployment. As a proxy for the output changes we used index of industrial production, because this variable influences the cyclical evolution of GDP and employment level of the Romanian economy. For example, industrial production decreases in periods of recession, which reduce the employment and the aggregate demand in the whole economy. Therefore it will shrink the contribution of services to GDP and the decline of domestic output.

The sources of monthly data series on unemployment and industrial production index are Eurostat database and the Tempo database of National Institute of Statistics form Romania. To assure comparability of dates, industrial production index was calculated using the fixed base year 2000. The period analysis is 1999:1 and 2008:6 years i.e. 112 observations. To remove seasonality of these variables we used the procedure Census X-12 in Eviews 6 software. We obtained the cyclical values of these variables by removing trend components of series from data series. The trend where extracted using Hodrick-Prescott filter with lambda parameter λ = 14400, that corresponds to monthly data series.

The trend of industrial production index has been climbing in the analysis period, registering an increase of approximately 50% compared to 2000. This trend reflects the increased production potential of Romanian industry, as a result of intensification of competitive pressure that accompanied the development of trade relations with developed economies. Trend unemployment rate (corresponding natural rate of unemployment, NAIRU) did not react immediately to developments in industrial production. Thus, it increased from 7% in 1999 to 7.7% in 2003:2, after which it decreased to a level of 5.81% at the end of the period analyzed. An industrial production index below its trend describes a negative output-gap and one higher than its trend describes a positive output-gap. As regards the cyclical unemployment that take negative values when the current rate of unemployment is lower than the natural and positive otherwise (Figure 4).

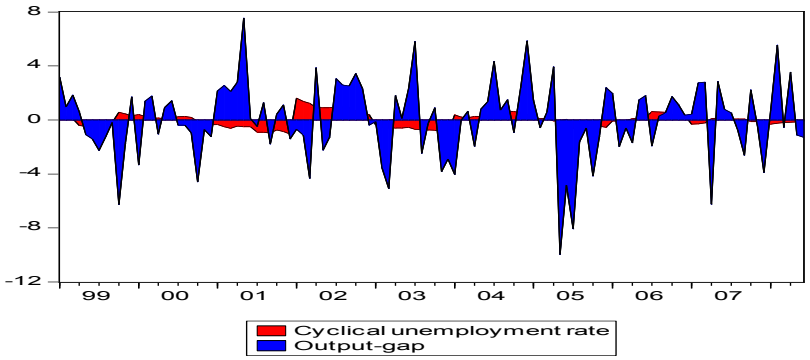


Figure 4. The relation between output-gap and the cyclical rate of unemployment

Note: On the Y axis are the changes (in percents) of the output-gap and cyclical unemployment rate.
Source: Eurostat and National Institute of Statistics (Romania)

Estimation method

According correlation between unemployment and output described by Okun in equation (3), the existence of a positive output gap generates a reduction in unemployment below its potential, ie a negative cyclical unemployment. This correlation is validated between 2001 and 2002 years and a time shift some of the other years. Thus, a positive output gap at the end of 2002 reflected a reduction in unemployment in 2003, and the negative gap at the end of 2003 the unemployment rate increased from trend in 2004. According to Figure 4, the response of cyclical unemployment to negative output-gap has been relatively low since 2007, as increased tendency to overheating of the economy has generated a weak compensation of the deficit of labour occurred.

Testing equation (3) in Romania we have obtained an insignificant regression from a statistical viewpoint, which proves that the cyclical unemployment rate does not vary depending on the current output gap, but in light of the delayed operation.

Therefore we estimated Okun coefficient for Romania, using the the dynamic model ADL (autoregressive distributed lag), which takes the following form:

$$U_{R\,t}^{\,c} = \alpha + \sum_{j=1}^{m} \beta_j \cdot U_{R\,t-i}^{\,c} + \sum_{i=0}^{n} \gamma_i \cdot Y_{t-i}^{c} + \sum_{l=1}^{p} \delta_l \cdot Dummy_{\;l} + \varepsilon_t \qquad (4)$$

where,
U_R^c – cyclical rate of unemployment; Y^c – cyclical industrial production index (output-gap)

The dependent variable of the above equation is influenced both by the lagged rate of cyclical unemployment, output-gap and dummy variables, which will be introduced to reflect structural breaks of unemployment rate. We estimated long-run equilibrium of the Okun's coefficient by equalisation actual values with lagged variable.

$$U_{R,t}^{c} = U_{R,t-1}^{c} = ... = U_{R,t-m}^{c} = U_{R}^{c*} \qquad (5)$$

$$Y_{t}^{c} = Y_{t-1}^{c} = ... = Y_{t-n}^{c} = Y^{c} \qquad (6)$$

According with equations (5) and (6), equation (4) is rewriting:

$$U_{R}^{\,c} * (1 - \sum_{j=1}^{m} \beta_j) = \sum_{i=0}^{n} \gamma_i (Y_{t-i}^{c}) \qquad (7)$$

According to the above relationship, long-run response of unemployment cyclical to output-gap levels will be calculated as follows:

$$\beta^* = \frac{\sum_{i=0}^{n} \gamma_i}{1 - \sum_{j=1}^{m} \beta_j} \qquad (8)$$

Empirical results

Based on the Akaike information criterion (AIC) and Schwarz information criterion (SIC)[3] we chosed the ADL (1,3), to which we added two dummy variables relating to January of 2002, and 2004, to characterize the structural breaks of unemployment rate. The coefficients from the OLS estimation for equation (4) are reported in below equation:

$$U_R^c = 0.924 \cdot U_R^c(-1) - 0.001 * \cdot Y^c + 0.009 * \cdot Y^c(-1) + 0.004 * \cdot Y^c(-2) - 0.019 \cdot Y^c(-3) + 2.61 \cdot Dummy_{\;2002} + 1.38 \cdot Dummy_{\;2004} - 0.03 \qquad (9)$$

The model is valid from a statistical viewpoint, because:

- the value of explanatory regression is high – adjusted R^2 is 0.88 (as a result of the inclusion of lagged temporary variables also);
- the errors of regression are not auto-correlated; Durbin-Watson test is 1.75 and the probability associated of Breusch-Godfrey test is 61% (with 3 lags);
- the criteria for choice of model has negative values and minimum (compared to other simulations performed): AIC = -0.44, and SIC = -0.25;

- there is not the phenomenon of errors heteroskedasticity, the probability associated with this test is 42%, a value higher than the acceptance of null hypothesis;
- regression coefficients are stable, which reflected both the CUSUM test and CUSUM of squares (Figures 5).

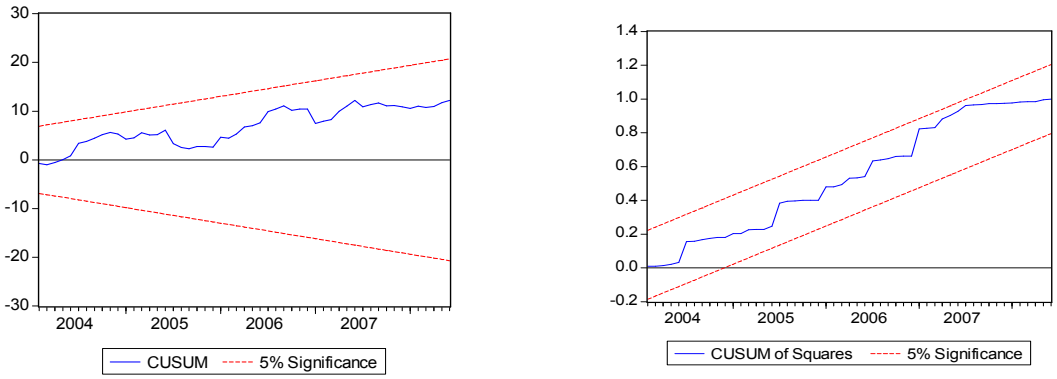


Fig. 5. The CUSUM and the CUSUM of Squares tests of coefficients stability

Note: The CUSUM test takes the cumulative sum of recursive residuals and plots its value against the upper and lower bounds of the 95% confidence interval at each point. The CUSUM of squares statistic is a cumulative sum of squares residuals, expressed as a fraction of these squared residuals summed over all observations. The test is plotted with 5% confidence bounds. As CUSUM test, we can find the parameter instability when the cumulative sum of squares goes outside the area between the two critical lines.

The insignificant coefficients of regression (9) at the 1% significance level are written with asterisk. According to it, negative relationship between short-term output-gap and cyclical unemployment rate is statistically valid if the independent variable is delayed with three lags. Such increase of one percentage point of the output gap will be reflected in a reduction in cyclical unemployment of more than three months to 0.02 percentage points. Also, 92.4% increase in unemployment in the previous month was found in the current rate of unemployment, which is evidence of persistent unemployment in the Romanian economy. The variable $dummy_{2002}$ has generated an increase in cyclical unemployment to 2.61 percentage points, and $dummy_{2004}$ an increase with 1.38 percentage points, which contributed to the increase to a significant extent of unemployment in those years. For example, increased unemployment in early 2002 was reflected by an increase of over 1 percentage point in the year (figure 6).

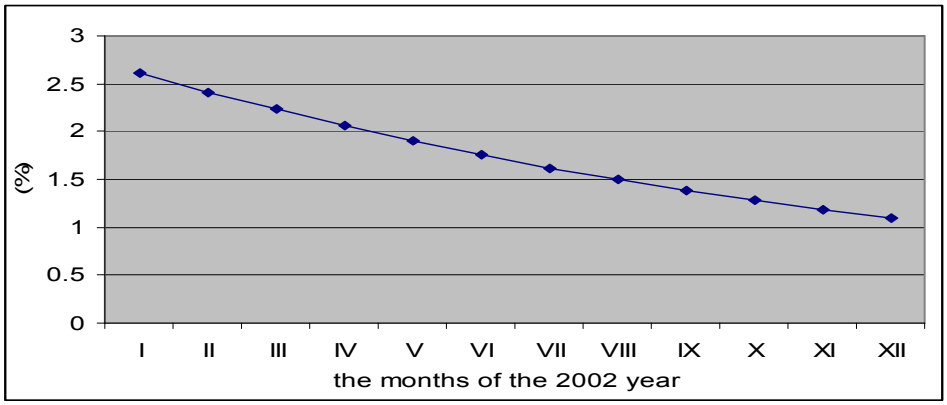


Figure 6. The impact of unemployment rate increase in January 2002

Note: On the Y axis is the increase of unemployment rate (in percentage points) brought about by structural break from January 2002.

To calculate the coefficient Okun on the basis of (7) and (8) equations we hold the significant regression coefficients and the value obtained was -0.26. Consequently, an increase of industrial production over its trend by 1 percentage point will cause a long-run reduction of 0.26 percentage points below the rate of natural rate of unemployment (the trend of unemployment rate). The result for Okun coefficient in the case of Romania is relatively close to the standard (about -0.3) and higher than estimated Caraiani (2006) for the period 1992-2004 (-0.17). It follows that the sensitivity of the unemployment rate gap to change in domestic production increased as a result of further growth in the period 2005-2008. Improving flexibility of labour force, migration of the working-age population and rise of investments may be other explanations of the Okun coefficient increase (absolute value). If the initial analysis would exclude the last 14 months, the range has been the tendency of the economy overheating, then the absolute value of estimated Okun coefficient is higher (0.35). Therefore, an inflationary gap causes a weak reaction of employment and unemployment rate will react less to production changes.

Testing for asymmetry in Okun coefficient in Romania

The asymmetry of unemployment rate to changes in production has been validated in the United States by Rothman (1991), Brunner (1997) and Silvapulle (2004). According to their cyclical unemployment rate is more sensitive to negative output-gap than in the positive output-gap (ie inflationary gap). To test the asymmetrical reaction of unemployment to intensity and duration of output-gap we

used the following methodology used by Lee (2000). First we divided the output-gap data series in two sub-periods, an inflationary output-gap gap (DI) and the other restrictive output-gap (DR), using the below variables.

$$I_{DI} = \begin{cases} 1, if Y^{c} > 0 \\ 0, if Y^{c} < 0 \end{cases}; \; I_{DR} = \begin{cases} 1, if Y^{c} < 0 \\ 0, if Y^{c} > 0 \end{cases} \quad (10)$$

Equation (4) is rewriting:

$$U_{Rt}{}^{c} = \alpha + \sum_{j=1}^{m} \beta_j \cdot U_{Rt-i}^{c} + \sum_{i=0}^{n} \gamma_i \cdot I_{DI} \cdot Y_{t-i}^{c} + \sum_{i=1}^{n} \gamma_i \cdot I_{DR} \cdot Y_{t-i}^{c} + \sum_{l=1}^{p} \delta_l \cdot Dummy_{\ l} + \varepsilon_t \quad (11)$$

Depending on the AIC and SIC criteria we selected three lags for the restrictive output-gap and no lag for inflationary output-gap. We also have used the unemployment rate lagged by one month and two dummy variables used in previous regression and the model thus obtained satisfies the conditions of validity and stability coefficients in equation (12) by OLS procedure[3].

$$\begin{aligned} U_{R}^{c} = {} & 0.929 \cdot U_{R}^{c}(-1) - 0.014 \; {}^{*} \cdot I_{DR} \cdot Y^{c} + 0.012 \; {}^{*} \cdot I_{DR} \cdot Y^{c}(-1) + \\ & 0.016 \; {}^{*} \cdot I_{DR} \cdot Y^{c}(-2) - 0.026 \cdot I_{DR} \cdot Y^{c}(-3) + 0.012 \; {}^{*} \cdot I_{DI} \cdot Y^{c} + \\ & 2.63 \cdot Dummy_{\ 2002} + 1.38 \cdot Dummy_{\ 2004} - 0.06 \end{aligned} \quad (12)$$

The insignificant coefficients of regression at the 5% significance level are written with asterisk. Cyclical unemployment rate is sensitive to the restrictive output-gap lagged by three months, while the response to inflationary output gap is zero with a probability of 25%. Thus output decrease by 1 percentage point below potential was reflected by a gap of three months the unemployment rate rising to 0.026 points. Calculating the long-run Okun's coefficient (based on the equation 8) we obtained a value of -0.37, a value higher (as absolute value) than initial value estimate in equation (9) (-0.26). It thus confirms the results of other studies that the unemployment rate tends to change more in the event of a restrictive output-gap. It thus validates the asymmetric Okun's coefficient in the case of the Romanian economy.

Conclusion

In order to estimate the Okun coefficient for the Romanian economy we construct the variables of the model, namely the industrial production cycle (proxy for output-gap) and the unemployment cycle, and then describe their dynamic. Using an ADL model in which we included two dummy variables were surprised that the impact event of rupture of the structural unemployment rate, we obtained a -0.26 value for long-run version of Okun's coefficient. This value is close to the standard (approximately -0.3), but higher than estimated in 2006 for the period 1992-2004 (-0.17). Increasing (in absolute terms) of the Okun coefficient is the effect of further economic growth in Romania and reduced labour market rigidities. It also recorded the highest values if we excluded from initial estimation the period characterized by a labour market deficit. In addition, this coefficient has reacted to

a greater extent restrictive output-gap, confirming the results of other estimates. Even in this study we have analyzed the relationship between unemployment and industrial production during the economic expansion, though the results obtained are also useful for the period of economic crisis. Romania's entry into recession since the third quarter of 2008 generated a rapid increase in the unemployment rate up to a maximum of 8.4% in March 2010. Therefore, the Okun coefficient will be higher than the value estimated in this study, showing asymmetric reaction of unemployment to economic change.

Notes

1. ***This paper represents a partial dissemination of the postdoctoral research project CNCSIS, HUMAN RESOURCES type, Macroeconomic modeling of the relationships between the asymmetric shocks, convergence of business cycles and mechanisms of adjustment in the context of Romania's adhesion to the euro area, No 78/03.08.2010, Project Manager Marinaş Marius-Corneliu.***
2. ***AIC and SIC are methods of comparing alternative specifications by adjusting the sum of squared residuals (SSE) for the sample size (n) and the number of coefficients in the model (K). AIC = Log(ESS/n) + 2(K) / n; SIC = Log(ESS/n) + Log(n)(K) / n. To use AIC and SC, estimate two or more models and calculate AIC and SC for each equation. The lower AIC and SC are the better specification.***
3. ***AIC and SIC values are -0.43, respectively -0.24 and adjusted R-squared is 0.88. The coefficients of the linear regression model are stable over time according with stability tests of the coefficients (CUSUM and CUSUM of Squares). The detect the autocorrelation in the residuals from regression, we have used the Breusch–Godfrey serial correlation LM test. The null hypotesis of the test is H0: no autocorrelation and it is accepted because the test probability is 27.3% higher than 5% critical value. To test for heteroskedasticity we have used White Test; its null hypothesis H0: errors are homoskedastic. The probability is 94.5% higher than critical values thus it rejects presence of heteroskedasticity.***

REFERENCES

[1] **Altig, D., Fitzgerald, T., Rupert, T.(2002), *Okun's Law Revisited: Should We Worry about Low Unemployment?.*** *Public Administration and Public Policy*, 97, 135–142;

[2] **Blanchard, O.J., Summers, L.H. (1986), *Hysteresis and the European Unemployment Problem***. *NBER Macroeconomics Annual* 1, 15-78;

[3] **Brunner, A. D.(1997*), On the Dynamic Properties of Asymmetric Models of Real GNP***. *Review of Economics and Statistics*, 79, 321-326;

[4] **Caraiani, P. (2006), *Alternative Methods of Estimating the Okun Coefficient. Applications for Romania***. *Journal for Economic Forecasting*, Institute for Economic Forecasting, vol. 3(4), 82-89;

[5] **Dreger, C. ; Marcellino, M. (2007), *A Macroeconomic Model for the Euro Economy*** . *Journal of Policy Modeling*, *29*(1), 1-13;

[6] **Freeman, D. (2000), *A Regional Test of Okun's Law***. *International Advances in Economic Research*, 6, 557–570;

[7] **Gabrisch, H.; Buscher, H. (2006) , *The Relationship between Unemployment and Output in Post-communist Countries***. *Post-Communist Economies*, Vol.18, No. 3, 261-276;

[8] **Gordon, R.J.(1984), *Unemployment and Potential Output in the 1980's***, *Brookings Papers on Economic Activity*, Vol. 2, pp. 537-564;

[9] **Izyumoy, A.;Vahaly. J. (2002), *The Unemployment-output Tradeoff in Transition Economies: Does Okun"s Law Apply***? *Economics of Planning*, Vol.35, 317-331;

[10] **Lee, J. (2000), *The Robustness of Okun's Law: Evidence from OECD Countries***. *Journal of Macroeconomics* 22 (2), 331 – 356;

[11] **León-Ledesma, M. A.; McAdam, P. (2004), *Unemployment, Hysteresis and Transition*** . *Scottish Journal of Political Economy*, 51(3), 277-401;

[12] **León-Ledesma, M. A. (2002), *Unemployment Hysteresis in the US States and the EU: A Panel Approach .*** *Bulletin of Economic Research*, 54, 95-103;

[13] **Lindbeck, A.; Snower, D. J. (1986), *Efficiency Wages versus Insiders and Outsiders*** . *European Economic Review*, 31, 407-416;

[14] **Malley,J.; Molana, H. (2008) , *Output, Unemployment and Okun's Law: Some Evidence from the G7*** .Elsevier, *Economics Letters* 101, 113–115;

[15] **Moosa, I. (1997), *A Cross – country Comparison of Okun's Coefficient***. *Journal of Comparative Economics*, 24, 335–356;

[16] **Murphy, K. M.; Topel, R. (1997*), Unemployment and Nonemployment.*** *The American Economic Review*, 87, 295-300;

[17] **Okun, A.M. (1962) ,*Potential GNP: Its Measurement and Significance***. American Statistical Association, *Proceedings of the Business and Economics Section*, 98–103;

[18] **Phelps, E. S. (1972),** ***Inflation Policy and Unemployment Theory*** . New York: W. W. Norton and Co.;

[19] **Prachowny, M. (1993),** ***Okun's Law: Theoretical Foundations and Revised Estimates.*** *The Review of Economics and Statistics,* 75, 331–336;

[20] **Røed, K. (1996),** ***Unemployment Hysteresis – Macro Evidence from 16 OECD Countries****. Empirical Economics*, 21(4), 589-600;

[21] **Romer, D. (2001) ,** ***Advanced Macroeconomics***. 2nd ed. New York: McGraw-Hill/Irwin;

[22] **Rothman, Ph. (1991) ,** ***Further Evidence on the Asymmetric Behaviour of Unemployment Rates over the Business Cycle***. *Journal of Macroeconomics*, 13(2), 291-298;

[23] **Schnabel, G. (2002),** ***Output Trends and Okun's Law*** . *BIS Working papers, Monetary and Economic Department*, 111, 1-34;

[24] **Shapiro, C.; Stiglitz, J.E. (1984),** ***Equilibrium Unemployment as a Worker Discipline Device***. *American Economic Review,* 74, 433–444;

[25] **Silvapulle, P.; Moosa, I. A.; Silvapulle, M. (2004),** ***Asymmetry in Okun's Law*** . *Canadian Journal of Economics*, 37 (2), 353-374;

[26] **Sögner, L.; Stiassny, A. (2002),** ***An Analysis on the Structural Stability of Okun's Law – A Cross-country Study*** . *Applied Economics*, 14, 1775-1787;

[27] **Solow, R. M. (2000),** ***Unemployment in the United States and in Europe: A Contrast and the Reasons***. *CESifo Working Paper*, 46 (1), pp. 1-13;

[28] **Villaverde, J.; Maza A. (2008),** ***The Robustness of Okun'sLlaw in Spain, 1980–2004 Regional Evidence***. *Journal of Policy Modeling* 31, 289–297.