6 ALTERNATIVE METHODS OF ESTIMATING THE OKUN COEFFICIENT. APPLICATIONS FOR ROMANIA

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The purpose of this study is to estimate the Okun coefficient for Romania for the 1991-2004 period. In order to derive it, I use a few alternative methods. As a dependent variable I use the gap of the unemployment rate while the independent variable is the gap of the production, where the aggregate production is approximated by the industrial production. I estimate the relationship through an ARDL model and through a bivariate structural VAR. The results indicate an Okun coefficient of about -0.17 which suggests some rigidity of the labor market.

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1. Introduction

Okun's coefficient is one of the key parameters in the macroeconomics field. Although there is a general agreement upon the definition of Okun's coefficient and upon its significance both at a theoretical and at a policy level, there is still a continuous debate on the most efficient methods to estimate the coefficient and on the actual value of it.

The first rank contribution that led to a whole line of research is Okun's study of 1964 which was republished in Okun (1970). In this study, Okun showed that there was a stable relationship between the rate of growth of unemployment and the rate of growth of production. In the standard form, his model predicted that a growth in production of 3% led to a decrease in unemployment of 1%.

The statistical studies on the American economy show that indeed, the unemployment grows during the recession, confirming a basic prediction of the economic theory. Romer (2001) showed that the employment is procyclical while the unemployment rate is countercyclical in the American economy. Thus, along the recessions between 1947 and 1999 the employment decreased each time and moreover it decreased on the average by 3.6%. These relations were confirmed for the other developed economies, too.

The studies that continued the line started by Okun either sought to confirm this relation for USA by developing alternative methods of estimating or they tried to

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estimate this relation under various specifications for other economies, mostly of the G7 group.

In this study I apply a few models of estimating Okun's coefficient for the Romanian economy. This study offers the possibility of a discussion about the unemployment – production relationship during the transition, with implications for an analysis of this relationship in the period after the European Union integration.

This study is structured as follows: the second section discusses the main econometric models used in the estimation of Okun's relation; the third section analyses the dynamic of the unemployment and industrial production cycles in Romania during the transition period and also applies a few methods to estimate this coefficient; the fourth section discusses the results, summarizing the main findings.

2. Alternative Methods of Estimating Okun Coefficient

An interesting line of research was launched by Gordon and Clark (1984). They introduced the idea of estimating Okun's coefficient starting with an identity between the aggregate production and several variables of the supply side, like the productivity, the hours worked or the labor force. By estimating regressions between these variables and the production both at current and lagged values, they found a short run Okun's coefficient of -0.23 and a long-run one of -0.5.

More recently, Prachowny (1993) introduced the possibility of estimating the coefficient with the help of a production function. The results estimate an Okun's coefficient of a smaller value than the reference value.

A distinct line of research of this phenomenon was started by Evans (1989). His study introduces the VAR model as a way to identify Okun's coefficient. He estimated a coefficient of -0.30, thus confirming Okun's result.

Blanchard and Quah (1989) improved Evans' approach in their famous study which uses the structural VAR. In the following paragraphs I detail the methodology of Blanchard and Quah that founds an entire research literature about the business cycles.

Blanchard and Quah started from an unanimously accepted fact in the macroeconomic theory, namely that the demand shocks do not have long run effects upon the level of production. They showed how to impose such a long run restriction in a bivariate model consisting in production and unemployment[1]. They used as variables the GDP growth and the unemployment rate.

We can write this model starting with the following notations:

$$X_t = \begin{pmatrix} \Delta y_t \\ u_t \end{pmatrix} \quad (1)$$

[1] *Both variables must be stationary.*

Where X_t is the vector of the endogenous variables, y_t is the aggregate production, while u_t is the unemployment rate.

$$\varepsilon_t = \begin{pmatrix} \varepsilon_{d,t} \\ \varepsilon_{s,t} \end{pmatrix} \quad (2)$$

Where ε_t contains the two structural shocks, the demand one and the supply one.

Using the lag operator L, this model can be rewritten as:

$$X_t = \sum_{i=0}^{\infty} L^i \begin{bmatrix} \Theta_{11,i} & \Theta_{12,i} \\ \Theta_{21,i} & \Theta_{22,i} \end{bmatrix} * \varepsilon_t \quad (3)$$

Where θ is matrix that represents the impulse response function of the variables in X_t.

Thus, as the production enters the model in a growth rate form, the identifying restriction that the demand shocks do not have long run effects on production is equivalent to fact that the cumulative effect of this shock on the rate of change of production is null. Formally, we can write that:

$$\sum_{i=0}^{\infty} \Theta_{11,i} = 0 \quad (4)$$

This model can also be rewritten under a different form, as far as we fulfill the condition that both variables are stationary. Thus the model can also be written under a specification in which the first variable is the production cycle while the second variable is the unemployment cycle, like in Weber (1995).

3. Application for Romania

In order to identify Okun's coefficient in Romania I use both the linear regression and the structural VAR approach, for the latter following Blanchard and Quah (1989) methodology.

First of all I construct the variables which estimate the production cycles and the unemployment cycles by using Weber (1995) approach. The two variables are estimated by using the following equations:

$$y_t^c = y_t - y_t^n \quad (5)$$

$$u_t^c = u_t - u_t^n \quad (6)$$

Where: y_t^c represents the production cycle, y_t represents the production, y_t^n represents the potential production, u_t^c is the unemployment cycle, u_t represents the unemployment rate and u_t^n stands for the natural rate of unemployment.

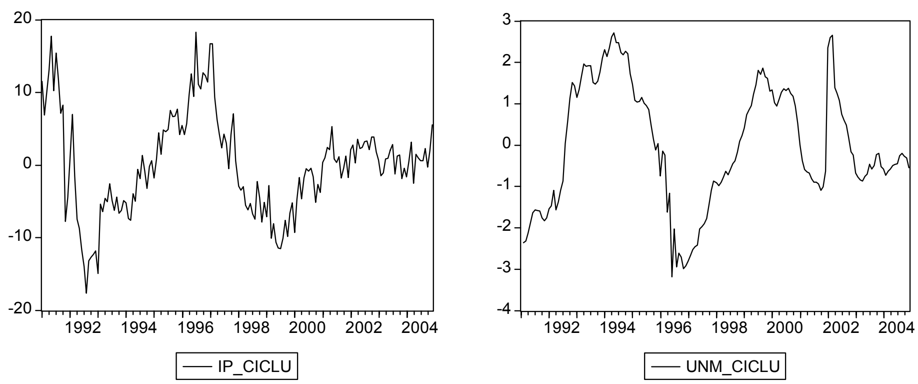
As variables I use the monthly index of industrial production for the aggregate production, while for unemployment I use the monthly unemployment rate. Thus the industrial production is used as an approximation of the aggregate production. The fact that the industrial production is observed at a monthly frequency is a reason to choose this measure of production. Moreover, there are studies about the business cycles that choose this measure of the production, like Gottshalk and Van Zandweghe

(2001) in their modeling of the business cycles in Germany using bivariate VAR models. It is also a know fact that there is a strong correlation between the industrial production cycles and the GDP cycles.

As an indicator of the production I use the index of the industrial production with a fixed base in December 1990. After removing the seasonality, I extract the potential level of production with the help of the Hodrick-Prescott filter, see Hodrick and Prescott (1980), using a value for the λ parameter λ=129600, as Ravn and Uhlig (2002) suggested. The industrial production cycle is extracted as a difference between the deseasonalized series of production and its potential value. I proceed in a similar manner to obtain the unemployment cycle. The below graphics present the results.

Figure 1

Industrial Production Cycles and Unemployment Cycles



The figures suggest several fundamental properties of the two variables discussed. First of all, both the industrial production and the unemployment rate have a certain degree of comovement along the business cycle: the unemployment rises in the two recessions (the initial fall of output at the beginning of transition and the 1997-1999 recession) and shrinks in the periods of growth (1993 to 1996 period and the period after 2000). Moreover both the industrial production and the unemployment rate are characterized by some irregularities suggesting the need for adjusting the series by dummy variables. For example, we may notice the spike in unemployment at the beginning of 2002, which was the result of a change in the labor market regulations. I extend the analysis of these two variables by using basic descriptive statistics.

Table 1

Descriptive Statistics of the Variable Cycles

Variables	Average	Standard Deviation	Correlation With production
Production Cycles	0	6.86%	1
Unemployment Cycles	0	1.47%	-0.55

This table shows that the industrial production has a much greater volatility than the unemployment, as Okun's law predicts. Moreover, the correlation coefficient between these two variables is strongly negative, suggesting a high degree of comovement of them, as the supply side theory predicts: the unemployment moves into an opposite sense relative to the production.

Starting from relations (5) and (6), a first estimation of Okun's coefficient can be done through the following equation:

$$u_t^c = \alpha * y_t^c \tag{7}$$

where: α is a coefficient with a negative value, as the theory predicts.

Since the statistical tests suggest that running a regression in the specification (7) leads to misspecification, I respecify Okun's relation as an autoregressive distributed lag regression, given by the following relation:

$$u_t^c = \sum_{j=0}^{q} b_j * y_{t-j}^c + \sum_{i=1}^{p} a_i * u_{t-i}^c + \sum_{l=1}^{m} d_l * D_l \tag{8}$$

where: a_i are the estimated coefficients of the AR (autoregressive) variables up to order p, while b_i are the estimated coefficients of the DL (distributed lags of the independent variable) up to order q and d_l are the estimated coefficients of the dummy variables up to number m.

On the basis of the informational test, AIC and SIC, I choose an ARDL (2,0) model. The results are given below[1]:

UNM_CICLU = 1.017*UNM_CICLU(-1)[23.28] - 0.087 * UNM_CICLU(-2)[-2.14] - 0.011*IP_CICLU[-3.27] - 0.771* DUMMY924* [-28.5]+ 0.527*DUMMY928[3.56] - 0.790 * DUMMY961[-26.4] + 0.679*DUMMY962[9.68] - 1.240 *DUMMY964[-41.9] +0.618* DUMMY965[8.05] - 2.055 * DUMMY966[-46.6] + 1.278*DUMMY967[8.94] - 1.162 * DUMMY968[-7.77] + 2.784*DUMMY201[43.6] + 0.1386 * DUMMY203[2.8] - 1.100*DUMMY204 [-22.9]

Where Unm_ciclu represents the unemployment cycle, IP_ciclu represents the production cycle and the Dummy variables model the irregularities or the changes in the labor market rules as follows: dummy924 represents April 1992, dummy928 stands for August 1992, dummy961, 962, 964, 965, 966, 967, 968 stand for January, February, April, June, July and August 1996, and dummy 201, 203, and 204 represent January, February and April 2002.

The equation (8) allows the estimation of Okun's relation by using the following equation:

$$\alpha = \frac{\sum_{j=0}^{q} b_j}{1 - \sum_{i=1}^{p} a_i} \tag{9}$$

[1] *In brackets I give the t statistics.*

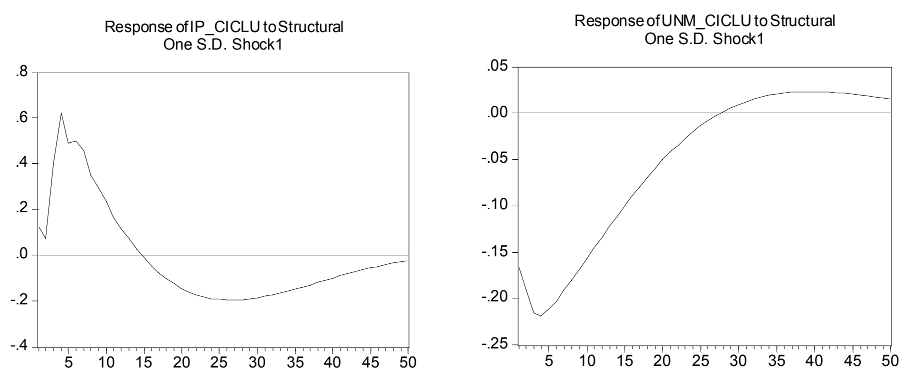
where α is Okun's coefficient, a_i are the estimated coefficients of the AR (autoregressive) variables up to order p, while b_i are the estimated coefficients of the DL (distributed lags of the independent variable) up to order q.

Starting from the estimated of an equation of ARDL (2,0) type, I could derive the Okun coefficient on the basis of the relation (9), the estimated value being of α=-0,17.

Another possibility of estimating Okun's coefficient can be done through a structural VAR modeling. I estimate a VAR[1] model with four lags (based on the information given by AIC criterion) which uses the same two endogenous variables: the production cycle and the unemployment cycle. I impose on this VAR a long-run restriction which specifies that the long run effect of the demand shocks on the production is null. Starting from this model, I analyze the impulse response functions for the structural version of the model.

Figure 2

Impulse Response Functions to the Demand Shocks



The figures above suggest that the demand shocks lead to the expected dynamics for the production and the unemployment. The peak of the response of the production cycles is after four month. Afterwards it steadily declines so that after one year it becomes insignificant. The response of the unemployment is weaker. It peaks after four months too, suggesting a comovement of the two variables.

By using the impulse response functions to the demand shocks, I determine Okun's coefficient through a regression between the unemployment cycle response to a demand shock and the production cycle response to a demand shock (Shock 1 in the above figure). For this regression I use an ARDL (3,3) model. The results are given below[2]:

[1] *The estimation is done for the 1994-2004 period.*
[2] *In brackets I indicate the t statistics.*

UN_SHOCK1 = -0.007*IP_SHOCK1 [138.1] + 1.301*UN_SHOCK1(-1) [1819.3] - 0.222*UN_SHOCK1(-2) [-192.2] - 0.135*UN_SHOCK1(-3) [-182.8] +0.007* IP_SHOCK1(-1) [179.1] - 0.001*IP_SHOCK1(-2) [-64.4] - 0.007*IP_SHOCK1(-3) [-230.0]

Where UN_shock1 represents the response of the unemployment cycle to the demand shock while IP_shock1 represents the response of the production cycle to the same demand shock.

I use again the equation (9) for estimating Okun's relation. The computation gives again an Okun's coefficient estimation of -0.17, thus making the first result more credible.

4. Conclusions

This study tries to estimate the Okun coefficient. I start by presenting Okun's Law and the place of this relation in the macroeconomic theory. Starting on these considerations I describe a few of the most important methods of estimating it, as the simple OLS, the ARDL regression and the structural VAR.

In order to estimate this coefficient for the Romanian economy I construct the variables that enter the models, namely the industrial production cycle and the unemployment cycle, and then describe their dynamic. They move in opposite directions during the cycles and there is also a high degree of comovement between them which suggests the possibility of constructing econometric variables to estimate the relationship between them.

Using an autoregressive distributed lags model I estimate an Okun coefficient of -0.17. This result is confirmed through the use of a structural VAR with a long run restriction. Running a regression between the answer of the unemployment and respectively of the industrial production to the demand shocks I obtain an estimation for the Okun coefficient of -0.17.

The estimated value of the parameter is considerably more reduced, in an absolute sense, than the standard Okun coefficient of -0.30. Usually such a result is interpreted as an indication of a certain degree of rigidity of the labor market.

References

Blanchard, Olivier and Danny Quah. 1989. "The Dynamic Effects of Aggregate Demand and Supply Disturbances", *American Economic Review*, 79: 655-673.

Evans, George W. 1989. "Output and Unemployment Dynamics in the United States: 1950 – 1985", *Journal of Applied Econometrics 4*: 213-238.

Gordon, Robert and Peter Clark.1984. "Unemployment and Potential Output in the 1980's." *Brooking Papers on Economic Activity 15* (2): 537-564.

Gottshalk Jan and Van Zandweghe Willem. 2001. "Do Bivariate SVAR Models with Long-Run Identifying Restrictions Yield Reliable Results? The Case of Germany", *Kiel Working Paper No. 1068*.

Hodrick Robert and Edward Prescott. 1980. "Post-War US Business Cycles: An Empirical Investigation." *Journal of Money, Credit and Banking 29* (1): 1-16.

Okun, Arthur. 1970. "Potential GNP: Its Measurement and Significance." In *The Political Economy of Prosperity*. New York: Norton, 132-145.

Prachowny, Martin. 1993. "Okun`s Law: Theoretical Foundations and Revised Estimates." *Review of Economics and Statistics No. 55* (May): 331-336.

Ravn, Morten and Harald Uhlig. 2002. "On Adjusting the Hodrick-Prescott Filter for the Frequency of the Observations", *Review of Economics and Statistics 84* (2): 321-380.

Romer, David. 2001. *Advanced Macroeconomics*. 2nd Edition. New York: McGraw Hill/Irwin.

Weber, Christian. 1995. "Cyclical Output, Cyclical Unemployment, and Okun's Coefficient: A New Approach." *Journal of Applied Econometrics 10* (4): 443-44.