Paper prepared for the

Euroacademia Global Forum of Critical Studies

Asking Big Questions Again

Prague, 13 – 15 December 2012

This paper is a draft

Please do not cite

Test of Okun's Law in Albania during the period 1995-2010

-Okun's law is one of the most reliable empirical regularities of macroeconomics- James Tobin

Dritan Shoraj (PhD Candidate), Lecturer, Faculty of Economy, Department of Management, University of Tirana, Albania.

dritan@shoraj.com

Fejzi Kolaneci, **PhD, Professor.** Lecturer, University of New York in Tirana, Albania.

fkolaneci@unyt.edu.al

Abstract

The main objective if the study is to test the validity of Okun's law during the period 1995-2010 in Albania and to find a confidence interval for Okun's coefficient. When the annual real GDP growth and annual unemployment rates are estimated for Albanian economy over the specified period, it is found that one percent reduction in the annual unemployment rate would produce approximately 1.54% increase in the annual real GDP. The absolute value of Okun's coefficient for Albania is lower to those estimated by some authors for other countries. The coefficient of correlation between successive differences in annual unemployment rates and successive differences in annual GDP is -35%. The 95% confidence interval for Okun's coefficient is
(-4.012;0.926).

Key words: Okun's law, Okun's coefficient, unemployment, GDP growth.

1. Introduction

Okun's law (Okun, 1962) [i] postulates a negative correlation between the change in unemployment rate and percentage change in real gross domestic product (GDP). As originally formulated by A. M. Okun, based on US data, the law stated that an increase of 1% in the unemployment rate, on average, leads to a fall of 3% in the real GDP. Equivalently, a reduction of 1% in the unemployment rate is, on average, associated with 3% increase in the real GDP [ii]. A more accurate estimation of the current relationship in US is 1 to 2.5 or 1 to 2.

Okun's law involves two important macroeconomic variables: unemployment rate and real GDP. In the last two decades, a large number of empirical studies have tasted the validity of the Okun's law in different countries. While the exact numerical value of the coefficient of correlation seems to be varying over time and from country to country, the results of empirical research for US and many other countries support Okun's law. [iii] [iv] [v] [vi] [vii] [viii] The strong empirical support for Okun's law has led Blinder (1997) to suggest that Okun's law should be considered as one of the cornerstones of modern practical macroeconomics, relating the level of activity in the goods market to the level of activity in the labor market over the business cycle. [ix] Okun's law was a major part of macroeconomic justification for President Kennedy's tax cuts.

Okun's law is a reminder that the forces that govern short-run business cycles are very different from those that govern long-run economic growth. The long-run growth in GDP is determined primarily by technological progress. By contrast, short-run movements in GDP are correlated with utilization of the economy's labor force. The declines in the production of goods and services that occur during recession are always associated with increases in the unemployment rate.

Okun's law is important for both theoretical and empirical reasons. From a theoretical point of view, Okun's law is a macroeconomic building, as the aggregate supply curve is derived by combining Okun's law with Phillips' curve. From an empirical perspective, Okun's law is regarded as a benchmark for policy-makers to evaluate the cost of higher unemployment. In addition, Okun's law has been used in macroeconomic models.[x]

Okun's law is only a "rationale rule of thumb" or a statistical relationship, rather than a structural feature of the economy. Therefore, it may be subject to revisions in an ever-changing macroeconomics. The relationship between real GDP and unemployment rate can be different in expansions or recessions.

As Okun suggested (1970), there are two classes of Okun's law specifications: the first-difference model and the "gap" model. According to the first-difference model, the relationship between the real GDP (y_t) and the unemployment rate (u_t) is given by the formula:

$$\frac{y_t - y_{t-1}}{y_{t-1}} = a + b(u_t - u_{t-1}), \qquad (1)$$

where a denotes the average growth rate of full-employment output (potential output), and $b<0$ denotes Okun's coefficient. [xi] If the unemployment rate remains constant, the real GDP grows by a. this normal growth in the production goods and services is due to the growth in the labor force, capital accumulation, and the technological progress.

This study aims to test Okun's law for Albania's economy during the period 1995-2010. We use the first-difference model of Okun's law. The obtained results will motivate Albanian policy-makers to adopt strategies that will rescue the economy from the problem of unemployment. The data are the annual unemployment rate, the successive changes in annual unemployment rate, and the successive changes in the annual real GDP. [xii] (see Table 1)

The Kolmogorov-Smirnov-Lilliefars test is a supreme distance statistical test designed only for normal distribution. The Shapiro-Wilk test for normality compares a set of sample data (x_1, x_2, …, x_n) against the normal distribution. The Shapiro-Wilk test is of regression type and assesses how well the observed cumulative frequency distribution curve fits the expected normal cumulative curve. This test for normality is sensitive to both skewness and kurtosis. In general, Shapiro-Wilk test is more accurate than Kolmogorov-Smirnov-Lilliefars test, Cramer-Von Mises test, Durbin test, Chisquared test, and b_1 test.[xiii] [xiv]

This paper is organized as follows: in section 2 a brief statistical analysis of the annual unemployment rate is developed. Section 3 reports a statistical analysis of the successive changes in annual real GDP. Section 4 provides the estimation of the Okun's law parameters a and b for Albania, while section 5 offers the conclusions.

2. Statistical analysis of the annual unemployment rate

The data set is the annual unemployment rate during the period 1995-2010 in Albania.

We calculate the statistical parameters for the data:

Sample size	16
Mean	14.77
95% confidence interval for mean	13.81 ; 15.73
Median	14.25
Variance	3.24
Standard deviation	1.80
Coefficient of variation	0.12 = 12%
Maximum	18.40
Minimum	12.40
Range	6.00
Interquartile range	3.00
Skewness	0.75
Kurtosis	-0.45

Using Kolmogorov-Smirnov-Lilliefars test as well as Shapiro-Wilk test for normality, we test the following hypothesis.

H_0: The annual unemployment rates over the period 1995-2010 in Albania follow the normal distribution.

H_1: The annual unemployment rates over the period 1995-2010 in Albania follow a non-normal distribution.

Using SPSS (2009), we find the observed value of Kolmogorov-Smirnov-Lilliefars (KSL) test = 0.112 and the associated significance 0.200 (that is a lower bound of the true significance). The observed value of Shapiro-Wilk (SW) test is = 0.947 and the associated significance is 0.202.

Decision Rule: Reject the null hypothesis $\mathbf{H_0}$ at the confidence level 0.797.

Now, consider the successive differences in annual unemployment rate. We present the statistical parameters related to this data set.

Sample size	15
Mean	0.02
95% confidence interval for mean	0.66 ; 0.70
Median	0.40
Variance	1.50
Standard derivation	1.22
Coefficient of variation	61 = 6100%
Maximum	2.90
Minimum	-1.60
Range	4.50
Interquartile range	1.20
Skewness	1.51
Kurtosis	1.88

Test the hypothesis

$\mathbf{H_0}$: The successive differences in annual unemployment rate over the period 1995-2010 in Albania follow a normal distribution.

$\mathbf{H_1}$: The successive differences in annual unemployment rate over the period 1995-2010 in Albania follow a non-normal distribution.

We use SPSS (2009). The significance level of KSL test is = 0.001 and the significance level of SW test is = 0.002.

Decision Rule: Reject the null hypothesis $\mathbf{H_0}$ at the confidence level 0.998.

3. Statistical analysis of the successive differences in annual real GDP

The data set is the successive differences in annual real GDP over the period 1995-2010 in Albania, see Table 1.

We present the statistical parameters related to the data set.

Sample size	15
Mean	6.04
95% confidence interval for mea	3.178.91
Median	5.90
Variance	29
Standard derivation	5.38
Coefficient of variation	0.89 = 89%
Maximum	13.50
Minimum	-10.80
Range	24.30
Interquartile range	4.23
Skewness	-1.93
Kurtosis	6.56

Test the hypothesis

$\mathbf{H_0}$: The successive differences in annual real GDP over the period 1995-2010 in Albania follow a normal distribution.

H_1: The successive differences in annual real GDP over the period 1995-2010 in Albania follow a non-normal distribution.

We use SPSS (2009). The significance level of KSL test is = 0.024 and the significance level of SW test is = 0.002.

Decision Rule: Reject the null hypothesis **H_0** at the confidence level 0.997.

4. Confidence interval for Okun's coefficient

In this section we test the first-difference model of Okun's law and construct the 95% confidence interval for Okun's coefficient over the period 1995-2010 in Albania.

The random variable ***X*** denotes the successive changes in annual unemployment rates (in percents) from one year to the next one, and the random variable ***Y*** denotes the successive changes in annual real GDP (measured in percents). We use the formula:

$$Y = a + bX + \varepsilon \,, \qquad (2)$$

where ε represents the stochastic error term (disturbance term), $\varepsilon \sim N(0, \sigma^2)$.

X is the explanatory variable, and ***Y*** is the variable to explain. The first differences in annual unemployment rates are regressed on annual real GDP growth rates.

Now, we are ready to calculate:

the sample covariance

$$s_{xy} = \frac{1}{14}\sum_{k=1}^{15}(x_k - 0.002)\left(y_k - 6.04\right) = -2.31 \,,$$

the coefficient of correlation between ***X*** and ***Y***

$$r = \frac{s_{xy}}{s_x \cdot s_y} = \frac{-2.31}{1.22 \cdot 5.38} = -0.35 \,,$$

the coefficient of determination between ***X*** and ***Y***

$$d = r^2 = 0.12 \,,$$

the Okun's coefficient

$$b = r\frac{s_y}{s_x} = -0.35\,\frac{5.38}{1.22} = -1.54 \,,$$

and the parameter

$$a = \bar{y} - \beta\bar{x} = 6.04 - (-1.54)\cdot 0.02 = 6.07$$

The linear regression equation is

$$y = 6.07 - 1.54x \qquad (3)$$

The following interpretation is valid for Albania:

i. One percent point reduction in the annual unemployment rate would produce approximately 1.54% growth in the annual real GDP.
ii. If the unemployment rate remains constant, then the annual real GDP grows approximately by 6.07%.

The Okun's coefficient b is a random variable, depending on the country and time period. Typically, $b \approx -2.5$ in US and Canada, $b \approx -4$ in Europe for industrial countries, $b \approx -8$ in Japan, $b \approx -4$ in Russia, $b \approx -4.5$ in Czech Republic, $b \approx -3.7$ in Hungary, $b \approx -3.6$ in Bulgaria and Slovak Republic, $b \approx -12$ in Slovenia, $b \approx -4.2$ in Greece, Spain and Turkey, $b \approx -3.8$ in Macedonia, $b \approx -5.1$ in Poland. [xv] [xvi] [xvii] [xviii] [xix] [xx]

We compute:

$$S_{xx} = \sum_{k=1}^{15} (x_k - \bar{x})^2 = 14 (s_x)^2 = 20.96 ,$$

$$S_{yy} = \sum_{k=1}^{15} (y_k - \bar{y})^2 = 14 (s_y)^2 = 405.94 ,$$

$$S_{xy} = \sum_{k=1}^{15} (x_k - \bar{x})(y_k - \bar{y}) = 14 \cdot s_{xy} = -32.34 ,$$

$$(S_{xy})^2 = 1045.88 ,$$

$$s_e^2 = \frac{1}{n-2} \sum_{k=1}^{n} \left[y_k - (\alpha + \beta x_k) \right]^2 = \frac{1}{15-2} \left[S_{yy} - \frac{(S_{xy})^2}{S_{xx}} \right] = 27.39 ,$$

and the standard error of estimate s_e=5.23.

The confidence limits for linear regression coefficients are calculated by the formulas

$$a \pm t_{\frac{\alpha}{2}} (n-2) \cdot s_e \cdot \sqrt{\frac{1}{n} + \frac{\bar{x}^2}{S_{xx}}} \quad ,$$

and

$$b \pm t_{\frac{\alpha}{2}} (n-2) \cdot s_e \cdot \frac{1}{\sqrt{S_{xx}}} \quad ,$$

where α denotes the significance level, t denotes the "Student's" t-distribution, and df=n-2 denotes the degree of freedom.

We construct a 95% confidence interval for the linear regression coefficients a and b:

$$S_{xx} = 20.96,\ s_e = 5.23,\ t_{\frac{\alpha}{2}} (n-2) = t_{0.025} (13) = 2.160,\ \frac{1}{n} = \frac{1}{15} = 0.067,\ \bar{x} = 0.02,\ \sqrt{S_{xx}} = \sqrt{20.96} = 4.58,$$

$$\sqrt{\frac{1}{n} + \frac{\bar{x}^2}{S_{xx}}} = 0.26.$$

The 95% confidence interval for Okun's coefficients is

P(-4.012 < b < 0.926) = 95% ,

and the 95% confidence interval for parameter a is

P(3.104 < a <8.984) = 95%

Confidence limits of prediction for $y=a+bx$ when $x=x_0$.

We indicate a method constructing an interval in which a future observation y can be expected to lie with a given probability $\gamma=1-\alpha$, when $x=x_0$. Limits of prediction for y are given by the formula

$$(a+bx_0)\pm t_{\frac{\alpha}{2}}(n-2)\cdot s_e\cdot\sqrt{1+\frac{1}{n}+\frac{(x_0-\bar{x})^2}{S_{xx}}}$$

5. Conclusions

Okun's law has endured as a stylistic fact of the US economy for 50 years. The Okun's type relationship between unemployment rate and GDP growth continues to be cited from famous scientists as part of a set of core beliefs in macroeconomics. Okun's law claims that the linear correlation between unemployment rate and real output growth is negative. Okun's coefficient is a random variable, depending on the country and time period. First of all, Okun's law holds for Albanian economy over the period 1995-2010. It is found that 1% reduction in the annual unemployment rate would produce approximately 1.54% increase in the annual real GDP. Okun's coefficient is regarded as a benchmark for policy-makers to measure the cost of higher unemployment.

The absolute value of Okun's coefficient for Albania is much lower than those estimated by authors such as Moosa (1997), Lee (2000), Freeman (2001), Tavera and Perman (2004), Adam (2005), Knotek (2007), Perman and Tavera (2007), Malley and Molana (2008), Villaverde and Moza (2009), Lal, Muhammad, Jalil and Hussain (2010), for the other countries.

For those countries (like Albania) for which the absolute value of Okun's coefficient is sufficiently small, demand for labor and supply of output policies would be more adequate. In these cases, tax and benefit system reforms, and greater wage flexibility might be pertinent, in order to contribute to the fall in unemployment. One option is to increase the flexibility of labor market (to raise the absolute value of Okun's coefficient). Another option is to support output growth at a higher rate that has been done.

The coefficient of correlation between successive changes in annual unemployment rates and the successive changes in annual real GDP in Albania over the period 1995-2010 is -35%, which indicates a weak negative correlation. The 95% confidence interval for Okun's coefficient is (-4.012; 0.926).

The linear regression equation is

$$y = 6.07 - 1.54x\ ,$$

where x denotes the successive differences in annual unemployment rates, and y denotes the successive differences in annual real GDP.

The Central Limit Theorem is not valid during the period 1995-2010 in Albania:

i. For the annual unemployment rates at the 79.7% confidence level.
ii. For the successive differences in annual unemployment rates at the 99.8% confidence level.
iii. For the successive differences in annual real GDP at the 99.7% confidence level.

The main deficiencies are found for the successive differences in annual unemployment rates as well as for the successive differences in annual real GDP.

---

[i] Arthur Melvin Okun, Potential GNP: *Its measurement and significance. American Statistical Association*,(Proceedings of the Business and Economic Statistic Section, 1962), 101.

[ii] Arthur Melvin Okun, *The Political Economy of Prosperity*, (New York: Norton, 1970), 32-38.

[iii] Anthonie Knoester, *Okun's Law Revisited*: (Weltwirtschaftliches Archiv, 122, 1986), 657-666.

[iv] Roger T. Kaufman, "An International Comparison of Okun's Law," *Journal of Comparative Economics* 12 (1988): 198.

[v] Imad A. Moosa, "A cross-country comparison of Okun's coefficient," *Journal of Comparative Economics* 24 (1997): 351.

[vi] Jim Lee, "The robustness of Okun's law: Evidence from OECD countries," *Journal of Macroeconomics* 22 (2000): 343.

[vii] Donald G. Freeman, " Panel tests of Okun's law for ten industrial countries," *Economic Inquiry* 39 (2001): 522.

[viii] Leopold Sögner and Alfred Stiassny, "An analysis of the structural stability of Okun's law," *A cross-country study, Applied Economics* 34 (2002):1782.

[ix] Alan S. Blinder, "Is there a core of practical macroeconomics that we should all believe?" *The American Economic Review* 87 (1997): 79.

[x] Christian Dreger and Massimiliano Marcellino, " A macroeconomic model for the Euro economy," *Journal of Policy Modeling* 29 (2007):11.

[xi] Jesus Crespo Cuaresma, "Okun's law revisited," *Oxford Bulletin of Economics and Statistics* 65(4) (2003): 438.

[xii] Bank of Albania, *Monetary Policy Report, Q2* (2011): 22.

[xiii] Robert V. Hogg, *Probability and Statistical Inference* (Prentice Hall, 2009), 45-51.

[xiv] Andy Field, Discovering Statistics Using SPSS (3 ed.) (London: Sage, 2009), 16-34.

[xv] Nicholas Apergis and Anthony Rezitis, "An examination of Okun's law: Evidence from regional areas in Greece," *Applied Economics* 35 (2003): 1150.

[xvi] Dimitris Christopoulios, "The relationship between output and unemployment. Evidence from Greek regions," *Papers in Regional Science* 83 (2004): 619.

[xvii] Hubert Gabrisch and Herbert Buscher, "The relationship between unemployment and output in post-communist countries," Post-Communist Economics 18(3) (2006): 269.

[xviii] Roger Perman and Christophe Tavera, "Testing for convergence of the Okun's coefficient in Europe," *Empirica* 34 (2007): 49.

[xix] Christian Pierdzioch., Jan C Rülke and Georg Stadtmann, "Do professional economists' forecasts reflect Okun's law? Some evidence for the G7 countries," *Applied Economics* 41 (2009): 4.

[xx] José Villaverde and Adolfo Maza, "The robustness of Okun's law in Spain, 1980-2004. Regional evidence." *Journal of Policy Modeling* 31 (2009): 292.

References

Adanu, Kwami. "A cross-province comparison of Okun's coefficient for Canada," *Applied Economics* 17 (2005): 561-570.

Apergis, Nicholas and Rezitis, Anthony. "An examination of Okun's law: Evidence from regional areas in Greece," *Applied Economics* 35 (2003): 1147-1151.

Bank of Albania. Monetary Policy Report, Q2: 2011, p22.

Blinder, Alan S. "Is there a core of practical macroeconomics that we should all believe?" *The American Economic Review* 87 (1997): 24-243.

Dimitris, Christopoulios. "The relationship between output and unemployment. Evidence from Greek regions," *Papers in Regional Science* 83 (2004): 611-620.

Cuaresma, Jesus C. "Okun's law revisited," *Oxford Bulletin of Economics and Statistics* 65(4) (2003): 430-451.

Dreger, Christian and Marcellino, Massimiliano. "A macroeconomic model for the Euro economy," *Journal of Policy Modeling* 29 (2007):1-13.

Field, Andy. Discovering Statistics Using SPSS (3 ed.) (London: Sage, 2009).

Freeman, Donald G. "Panel tests of Okun's law for ten industrial countries," *Economic Inquiry* 39 (2001): 511-523.

Gabrisch, Hubert and Buscher, Herbert. "The relationship between unemployment and output in post-communist countries," Post-Communist Economics 18(3) (2006): 261-276.

Hogg, Robert V. *Probability and Statistical Inference* (Prentice Hall, 2009).

Kaufman, Rogner T. "An International Comparison of Okun's Law," *Journal of Comparative Economics* 12 (1988): 182-203

Knoester, Anthonie. *Okun's Law Revisited*: (Weltwirtschaftliches Archiv, 122, 1986).

Knotek II, Edward S. "How useful is Okun's law," *Economic Review, Federal Reserve Bank of Kansas City, fourth quarter* (2007): 73-103.

Malley, Jim and Molana, Hassan. (2008). "Output, unemployment and Okun's law: Some evidence from the G7," *Economic Letters* (2008): 113-115.

Lal et al., Sulajman.. "Test of Okun's law in some Asian countries co-integration approach," *Europian Journal of Scientific Research* (2010):67-73.

Lee, Jim. "The robustness of Okun's law: Evidence from OECD countries," *Journal of Macroeconomics* 22 (2000): 331-356.

McBride, Bill. "Real GDP growth and the unemployment rate," *Calculated Risk* (2010): 2.

Moosa, Imad A, "A cross-country comparison of Okun's coefficient," *Journal of Comparative Economics* 24 (1997): 335-356.

Okun, Arthur M. Potential GNP: *Its measurement and significance. American Statistical Association*,(Proceedings of the Business and Economic Statistic Section, 1962), 98-104.

Okun, Arthur M. *The Political Economy of Prosperity*, (New York: Norton, 1970).

Perman, Roger and Tavera, Christophe. "Testing for convergence of the Okun's coefficient in Europe," *Empirica* 34 (2007): 45-61.

Pierdzioch, Christian., Rülke, Jan C., and Stadtmann, Georg. "Do professional economists' forecasts reflect Okun's law? Some evidence for the G7 countries," *Applied Economics* 41 (2009): 1-9.

Sögner, Leopold and Stiassny, Alfred. "An analysis of the structural stability of Okun's law," *A cross-country study, Applied Economics* 34 (2002):1775-1787.

Tavera, Christophe and Perman, Roger. *A cross-country analysis of the Okun's law coefficient in Europe*, (University of Strathclyde: Glascow, 2004).

Villaverde, José and Maza, Adolfo. "The robustness of Okun's law in Spain, 1980-2004. Regional evidence." *Journal of Policy Modeling* 31 (2009): 289-297.

Appendix

Table 1. The annual unemployment rate (%), successive differences of the annual unemployment rates, and annual real growth GDP (%) over the period 1995-2010 in Albania

Year	Annual unemployment rate (%)	Successive diff. of the annual unemployment rate (%)	Annual real growth GDP (%)
1995	13.1	--	13.3
1996	12.4	-0.7	9.1
1997	14.9	2.5	-10.8
1998	17.8	2.9	9.0
1999	18.4	0.6	13.5
2000	16.8	-1.6	6.7
2001	16.4	-0.4	7.9
2002	15.8	-0.6	4.2
2003	15.0	-0.8	5.8
2004	14.4	-0.6	5.7
2005	14.1	-0.3	5.8
2006	13.8	-0.3	5.5
2007	13.2	-0.6	6.0
2008	13.0	-0.2	8.0
2009	13.8	0.8	3.1
2010	13.4	-0.4	3.9

A short bio-note on the authors:

Drtitan Shoraj, I'm a lecturer of subjects "*Basics of Finance*", *"Management*", "Leadership" and "*Financial Institutions*", at Tirana University, Faculty of Economics, Management Department, where also provide my academic and scientific contribution. Since 2010 to present I continue PhD third cycle of studies at Tirana University. My theme of PhD studies is "Organizational Effectiveness of Business Organizations in Albania." I have been involved in several researches in these areas and I have published some national and international papers.

Fejzi Kolaneci, Head of Mathematics and Natural Sciences Department, University of New York, Tirana, Albania, since 2002. My research interests are in the fields of Functional Analysis, Probability Theory, Deterministic and Stochastic Partial Differential Equations and their applications in Economy, Physics, Biology, and Medicine. I have been involved in several researches in these areas. During my academic career, I have published more than sixty national and international papers.