

Empirical Evidences Regarding Okun's Law in the Central and Eastern Europe in the Post – Financial Crisis Period

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Abstract. Numerous studies have been conducted based on Okun's Law (1962), researchers proposing various approaches, while the two most common are the difference approach, which reflects the link between the variation of unemployment rate and the output growth, and the gap approach, which shows the relationship between the deviation of the actual unemployment rate from the natural unemployment rate and the Gross Domestic Product (GDP) gap. In order to see how the relationship looks like over time and how the Okun's coefficient varies from country to country, this study analyzes the sensitivity of unemployment at output changes while carries out a comparative analysis for Central and Eastern Europe (CEE) countries, regarding Okun's Law applicability in the post-financial crisis period, taking into consideration previous relevant researches. Therefore, the assessment is based on quarterly data, between 2010 and 2019, for unemployment and economic growth, recorded in five CEE countries, members of the Organization for Economic Co-operation and Development (OECD): Bulgaria, Czech Republic, Hungary, Poland and Romania. While the research is based both on the gap and difference method, it may lead to results sensitive to the method chosen in order to assess the unobservable variables, namely potential output and natural unemployment rate. In order to determine the structural components of the GDP and unemployment rate, it is used the Hodrick-Prescott univariate filter, applied on quarterly data. Before estimating the Okun's coefficient, the study also examines the causality relationship between unemployment and GDP using Granger causality test.

Keywords: Okun's Law, Granger causality test, potential GDP, natural rate of unemployment, Hodrick-Prescott filter, output gap, structural components.

Introduction

Nowadays, production and development patterns vary among countries, while the primary goal of any economy is to maximize the use of available resources and policy makers aim to achieve full employment and sustained economic growth.

For both developed and developing economies, reducing unemployment and attaining strong economic growth rank first. Economic growth together with employment are the two crucial macroeconomic determinants of a country's economic success. Depending on whether a country is developed or underdeveloped, unemployment arises from different reasons, for example capital inadequacy in case of underdeveloped economies, or technological progress otherwise.

Historically, unemployment has been a top priority for all countries. This is a difficult problem with significant socio economic ramifications, particularly if it persists for decades, as seen in European economies. Even the creation of one single market did not solve the EU countries unemployment issue, while in the first decades of the 21st century, the Euro Area countries faced a lot of significant economic challenges.

Munich and Svejnar (2017)¹ analyze the evolution of unemployment between 1991 and 2005 in former communist economies from CEE, using the mature economy of West Germany as a benchmark. The study highlights the fact that high unemployment rate from CEE countries may be the result of external shocks, macroeconomic policies or economic structures.

Unemployment is well known as an important macroeconomic issue in all economies, but moreover in developing economies, while a high rate of unemployment reflects the fact that the labor resources are not used efficiently and maximizing the employment rate may lead to an improved output.

Arthur Okun (1962)² demonstrates the negative relationship between economic growth and the unemployment rate, but this is not supported empirically in all cases, considering that a major impact in this sense is provided by the economic context in which the analysis is carried out.

In his article, published in 1962, Okun depicted the inverse relationship between economic growth and unemployment rate, using quarterly data, through two linear regression models, based on the “levels” and “changes” methods, highlighting that a 1% change in unemployment rate is associated with a production variation in the opposite direction of around 3%.

This empirical relationship is usually used by policy-makers to measure losses generated by high unemployment, but it is well known that the assessment of Okun coefficient is sensitive to the duration of economic expansion and recession and also to the nature of Gross Domestic Product gap. According to Okun's, preventing unemployment rate growth is possible only if the real Gross Domestic Product grows the same as its potential value.

Even if there are numerous other more advanced models that could be used to examine the connections and causal relationships of the fundamental macroeconomic determinants, scientific research still uses the further application of basic models. This paper addresses unemployment, the core issue facing the Euro Area, using fundamental economic concepts.

There are many studies that have confirmed Okun's finding, which has become a main macroeconometric tool for linking unemployment and economic growth. Still, some economists, as Cazes et al. (2012)³ and Ball et al. (2013)⁴ and (2019)⁵, studied the instability of the law in many countries. Based on this it has been proved that the accuracy of the relationship varies from country to country, the variation being attributed to different unemployment policies. This is why other researchers introduced more explanatory variables in the model.

However, there is no consensus regarding the value of Okun's coefficient, but only a general acceptance of the existence of a negative relationship between the two variables. For example, Freeman (2000)⁶ considers Okun's law to be “a rule of thumb” which may provide guidelines to policy makers regarding the relationship between output and unemployment changes, because even

¹ Jackman, R. (2005). The impact of the European Union on unemployment and unemployment policy. In *Beyond the Market* (pp. 70-89). Routledge.

² Okun, A. (1962). Potential GNP, its measurement and significance. Cowles Foundation, Yale University.

³ Cazes, Sandrine, Sher Verick, and Fares Al-Hussami (2012). Diverging trends in unemployment in the United States and Europe: Evidence from Okun's law and the global financial crisis. Employment Working Papers, ILO.

⁴ Ball, L. M., Leigh, D., & Loungani, P. (2013). Okun's Law: fit at fifty? (No. w18668). National Bureau of Economic Research.

⁵ Ball, L., Furceri, D., Leigh, D., & Loungani, P. (2019). Does one law fit all? Cross-country evidence on Okun's law. *Open Economies Review*, 30(5), 841-874.

⁶ Freeman, D.G. (2000). Regional Tests of Okun's Law, *International Advances in Economic Research*, VOL. 6, NO.3, pp. 557-570.

if demographic and industrial differences may change the relationship between unemployment and output, there are still some regional conclusive patterns.

Literature review

In order to prove the link between unemployment rate and output changes, Okun developed in his study two different approaches: the gap approach, based on the natural rate of unemployment (NAIRU) and the gap between real GDP and potential output, and the difference approach, based on unemployment rate and GDP variations from period to period. The natural rate of unemployment is considered to be the trend component of the unemployment rate, while the potential output is known as the trend component of GDP. The difference between unemployment rate and NAIRU is the cyclical unemployment and results from a low effective demand, in comparison to the production volume. Many researchers use, for the purpose of estimating NAIRU and the potential output, the Hodrick-Prescott (1997)⁷ filter, even if it is not considered to be a very reliable technique because it does not use information related to other economic variables and due to the arbitrary choice of the smoothing parameter, an assumption criticized by Hamilton (2017)⁸. However, the method attracts with its simplicity and transparency and it is widely used to extract trend components of time series and, therefore, to determine the cyclical components.

Kliber (2014)⁹ studies the diversity of Okun's coefficient in the regions of Poland, based on quarterly data between 2006-2010, in order to find similarities, due to the fact that it is well known the unemployment represents one of the most serious problems in Poland since 1990. For this purpose, the author uses the different form of Okun's model because he considers it difficult to estimate potential GDP and the natural rate of unemployment since time series are short.

Gajderowicz and Grotkowska (2014)¹⁰ analyze the unemployment sensitivity to GDP fluctuations in Poland between 1995 and 2011, using both difference and gap versions. They agree that the Okun's parameter is about -0.4, which places Poland in the middle of OECD countries in terms of unemployment sensitivity relative to GDP.

Soylu et al. (2018)¹¹ investigates the applicability of Okun's Law for 8 Eastern European Countries, including countries which are subject to this paper, between 1992-2014, using panel data framework. The authors find that in this case, a GDP rise of 1% will determine a fall of unemployment rate by 0.08%.

Mielcova (2011)¹² analyzes the relationship between economic growth and the unemployment rate in Czech Republic from 1996 to 2009, using the different version of Okun's Law for quarterly data, and finds out that, based on OLS estimations, the Okun's coefficient is small.

⁷ Hodrick, R., Prescott, C. (1997). Postwar U.S. Business Cycles: An Empirical Investigation. *Journal of Money, Credit, and Banking*. 29 (1): 1–16.

⁸ Hamilton, J.D. (2017). Why You Should Never Use the Hodrick-Prescott Filter, *The Review of Economics and Statistics*, vol 100(5), pages 831-843

⁹ Kliber, P. (2014). The Diversity of Okun's Coefficient in the Regions of Poland. Available at SSRN 2461427.

¹⁰ Gajderowicz, T., Grotkowska, G., Wincenciak, L., & Wirtek, E. (2014). Unemployment rate sensitivity to GDP fluctuations across Polish voivodeships. *Central European Economic Journal*, 39.

¹¹ Soylu, Ö. B., Çakmak, İ., & Okur, F. (2018). Economic growth and unemployment issue: Panel data analysis in Eastern European Countries. *Journal of International Studies* Vol, 11(1).

¹² Mielcová, E. (2011). Economic growth and unemployment rate of the transition country: the case of the Czech Republic 1996-2009.

Ball et al. use both difference and gap versions of Okun's Law in their cross-country evidence between 1980 and 2015, concluding that, based on the average R-square value, the fit is poorer in developing countries, for which also that unemployment is less responsive to output fluctuations. For example, the Okun's coefficients from the gap version applied to Czech Republic, Hungary, Romania and Bulgaria are quite low compared to advanced economies, namely -0.244, -0.338, -0.049, -0.291, and they keep low while applying the difference version.

Also, Kostov (2017)¹³ studies the impact of economic growth in Bulgaria on unemployment, taking into consideration quarterly data between 2006 and 2016. The analysis shows that, even if the Okun's Law is confirmed, their negative relationship between economic growth and unemployment has a decreasing tendency. The author stands by the idea that the phase of the economic cycle is of great importance in such assessments.

Gibescu (2013)¹⁴ analyzes the relationship between unemployment and GDP in Romania based on data from 1995 to 2007, described by a vice-versa powerful connection, on which the financial crisis had a great impact. Ruxandra (2015)¹⁵ obtains the Okun's coefficient specific to Romanian economy after 2007 as -0.61, while using the gap model.

Boulton (2010)¹⁶ applies the gap method in order to assess Okun's coefficient between 1992 – 2008 in some European countries, including Bulgaria, Czech Republic, Hungary, Poland and Romania, while using data on labor force and capital stock to estimate the natural rate of unemployment. Only in the case of Poland and the Czech Republic, the study depicts a small positive correlation between the drop of unemployment and the drop of real GDP, which contradicts basic economic principles. Hungary, Romania and Slovenia registered a negative Okun's coefficient, with very high variation in real GDP caused by changes in unemployment rate in case of Hungary.

To conclude, there are many studies proving the existence of a causality relationship between unemployment rate and economic growth over time and in different types of economy, but it is always a subject of great importance to determine how these two macroeconomic variables influence each other.

Methodology

In order to establish if there is a causal relationship between unemployment and real gross domestic product value, the study focuses on the result of Granger causality test.

Further, the paper proceed to estimate the value of Okun's coefficient, taking into consideration both approaches stated by Okun in order to determine the economic relationship between unemployment and economic growth: the approach based on „levels” or gap equation (1), which implies to measure the natural rate of unemployment (U_t^n) and the potential output (Y_t^*), and the approach based on “changes” or differences, as in equation (2), which takes into account unemployment rate and output variations from the previous period, under the conditions of a constant unemployment level on long-term and under the premise of constant economic growth.

¹³ Kostov, L. (2017). The impact of economic growth on inflation and unemployment in Bulgaria, 2006-2016. SEER: Journal for Labour and Social Affairs in Eastern Europe, 85-99.

¹⁴ Gibescu, P. L. O. M. (2013). The Correlation Between Gross Domestic Product and Unemployment, In Romania Starting With 1995. *Revista Română de Statistică nr.* 91.

¹⁵ Ruxandra, P. (2015). The specifics of Okun's law in the Romanian economy between 2007 and 2013. *Annals-Economy Series, 1*, 50-53.

¹⁶ Boulton, T. (2010). Test of Okun's Law for the 10 Eastern European countries. London Metropolitan Business School, Economics Subject Group

$$U_t - U_t^n = \beta(Y_t - Y_t^*) + \varepsilon_t, \beta < 0 \quad (1)$$

$$\Delta U_t = \alpha + \beta \Delta Y_t + \omega_t \quad (2)$$

To build the gap model, long-term values for production and employment are needed, which fluctuate around their potential values when total demand varies.

One of the main problems is the fact that if the levels approach is used, it is needed to estimate unobservable variables, for which in many countries the assumptions regarding a constant long-run rate are not appropriate. This is the reason why, in this case, it is preferred to use smoothing techniques in order to determine the natural rate of unemployment and the potential output.

The study uses Eurostat unadjusted quarterly data from 2010 to 2019 regarding real GDP in 2010 prices and unemployment rate between 15 and 74 years as a percentage of active population. Since the study presents evidence on both Okun's Law versions, for measuring the cyclical output and unemployment rate for the gap approach it is used the Hodrick-Prescott filter with a smoothness parameter equal to 1600, which is applied to the logarithm of the variable, while for the difference method are used the original variables, if stationary, or the first or second difference if not. Both methods parameters are estimated using ordinary least squares (OLS).

Results and discussions

Before determining the Okun's coefficient for the analyzed countries, by applying both gap and difference versions of Okun's Law, it is checked if there is any causality between unemployment rate and GDP, using Granger causality test after concluding that the variables are stationary at the same level. Therefore, unemployment rate and GDP are tested for stationarity with Augmented Dickey-Fuller (ADF) test.

Table 1: Granger Causality Test Results

Country	Null Hypothesis:	F-Statistic	Prob.	Integration order (ADF)
Bulgaria	Y does not Granger Cause U	1,8397	0,1503	I(2)
	U does not Granger Cause Y	7,2600	0,0004	
Czech	Y does not Granger Cause U	3,6732	0,0163	I(2)
	U does not Granger Cause Y	6,0302	0,0013	
Hungary	Y does not Granger Cause U	4,3481	0,0076	I(1)
	U does not Granger Cause Y	1,6336	0,1947	
Poland	Y does not Granger Cause U	7,7448	0,0003	I(2)
	U does not Granger Cause Y	7,1197	0,0005	
Romania	Y does not Granger Cause U	7,9531	0,0002	I(1)
	U does not Granger Cause Y	1,2619	0,3092	

Source: Authors' calculations

The results of Granger causality test, as it is seen in Table 1, reveals significant causation between unemployment rate and real gross domestic product in all five CEE countries. However, in case of Hungary and Romania, only real GDP value is significantly influencing unemployment rate, while in case of Bulgaria the causality relationship is invert, meaning unemployment rate is influencing GDP. The causality relationship is bi-directional only in case of Czech Republic and Poland.

Further, in order to estimate Okun's coefficient, the variables included in the regression models are also tested for stationarity and the results are presented in Table 2. Unit root test is necessary before estimating the Okun's coefficient because it allows to see if the generated processes are stationary, so the results are stable and adequate from economic point of view. In the Augmented Dickey-Fuller test, the null hypothesis is that the process generating the time series is non-stationary. In case if the null hypothesis is rejected, the series is stationary. On the other hand, in case of a non-stationary series, it must be differenced in order to become stationary.

Table 2: ADF Results

Country	Variable	Integration order	ADF		Exogenous
			t-statistic	p-value	
Bulgaria	ΔY	I(1)	-7,9847	0,0000	Constant, Linear Trend
	ΔU	I(0)	-1,0982	0,0000	Constant, Linear Trend
	Y gap	I(0)	-3,8080	0,0301	Constant, Linear Trend
	U gap	I(0)	-2,4289	0,0165	None
Czech	ΔY	I(1)	-51,1745	0,0000	Constant, Linear Trend
	ΔU	I(0)	-9,3735	0,0000	Constant, Linear Trend
	Y gap	I(0)	-3,1140	0,0028	None
	U gap	I(0)	-2,7898	0,0067	None
Hungary	ΔY	I(0)	-4,8440	0,0025	Constant, Linear Trend
	ΔU	I(0)	-7,7985	0,0000	Constant, Linear Trend
	Y gap	I(0)	-5,3258	0,0008	Constant, Linear Trend
	U gap	I(0)	-2,7875	0,0065	None
Poland	ΔY	I(1)	-5,3900	0,0005	Constant, Linear Trend
	ΔU	I(1)	-15,2581	0,0000	Constant, Linear Trend
	Y gap	I(0)	-2,7119	0,0082	None
	U gap	I(0)	-2,5806	0,0114	None
Romania	ΔY	I(0)	-4,1826	0,0116	Constant, Linear Trend
	ΔU	I(0)	-7,8596	0,0000	Constant, Linear Trend
	Y gap	I(1)	-3,0782	0,0031	None
	U gap	I(0)	-3,9264	0,0202	Constant, Linear Trend

Notes: p-value less than 5% leads to rejection of the null hypothesis of the ADF test, that is the series are not stationary, at a confidence level of 95%.

Source: Authors' calculations.

Most of the time series used in estimating Okun's coefficient are stationary, except output variation in case of Bulgaria, Czech Republic and Poland, unemployment variation in case of Poland and output gap in case of Romania, which become stationary by taking first difference. The difference and gap models are estimated depending on the integration order. The results regarding Okun's coefficient are presented in Table 3, together with the p-value, which depicts the significance of the coefficients and with the R-square value.

Table 3: Assessment of Okun's Law

Country	Okun's Coeff.		p-value		R-square	
	Gap method	Difference method	Gap method	Difference method	Gap method	Difference method
Bulgaria	-0,355761	-0,276274	0,0014	0,0000	0,238934	0,398863
Czech	-1,018398	-0,878123	0,0030	0,0000	0,209863	0,630227
Hungary	-0,517058	-0,478577	0,0000	0,0302	0,429898	0,117735
Poland	-0,273637	-0,294104	0,1242	0,0008	0,061074	0,271945
Romania	-0,149257	-0,162064	0,0006	0,0004	0,277237	0,294792

Source: Authors' calculations.

Figure 1 depicts the existence of an inverse relationship between economic growth and unemployment rate in Bulgaria. The Okun's coefficient varies from -0,35 and -0,27, depending on the version used, it is significant at a 99% level of confidence and it is in line with most of the previous researches. The R-square value is higher in the case of difference method.

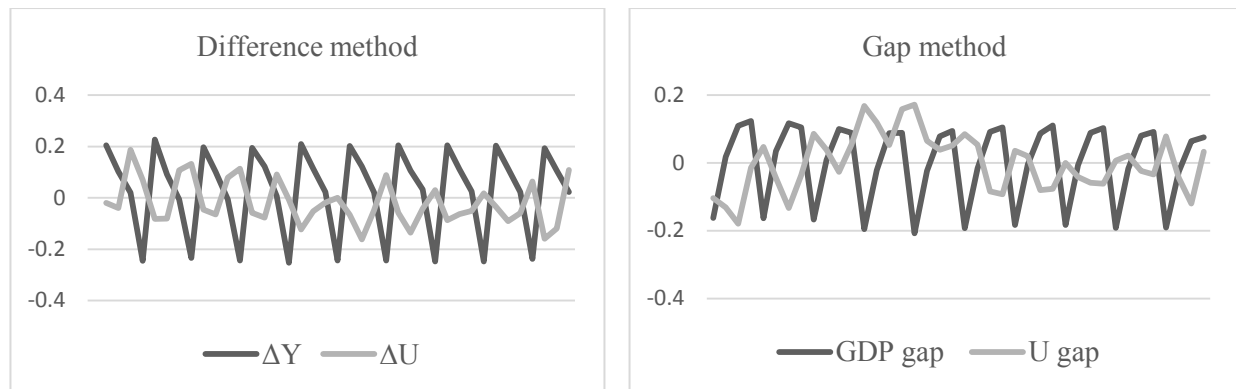


Figure 1: Graphic representation of the time series – Bulgaria

Source: Authors' work.

On the other hand, in the Czech Republic the coefficient registers much higher value than expected, based on previous studies. The relationship between unemployment rate and output is highlighted in Figure 2. In this case, considering only the post-crisis period seems to improve the results. Referring to the gap method, an increase of 1% of GDP gap leads to a drop of 1,02% in unemployment rate deviation from natural rate of unemployment, while an increase of 1% in real economic growth implies a drop of 0,88% in unemployment variation, based on difference model which has a higher R-square. This might indicate an increasing trend for the linkage between GDP growth and unemployment.

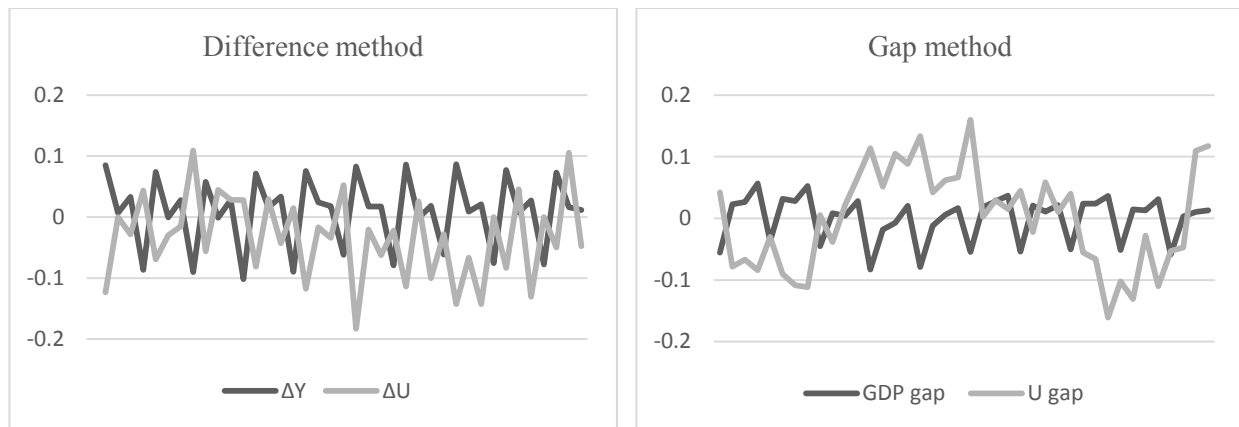


Figure 2: Graphic representation of the time series – Czech Republic

Source: Authors' work.

Hungary also registers a high Okun's coefficient, while the regression model based on the gap method, applied in case of Poland, is not significant. However, estimation of different versions of Okun's Law for Poland depicts decreasing persistence of the rule in this case, in regards to previous studies.

In the case of Romania, both versions of Okun's law lead nearly to the same results, although for the rest of the assessment the difference between the results obtained with the two methods can be assigned to the structural factors that influence the unemployment rate.

Conclusion

In this paper it was analyzed the relationship between unemployment and GDP in developing Central and Eastern Europe countries, from causality point of view and in line with the theoretical framework of Okun's law, using quarterly data from 2010 to 2019. The main aim of this research was to check the causality relationship between the two variables, to estimate Okun's coefficient, based on both gap and difference method, during post-crisis period, in Bulgaria, Czech Republic, Hungary, Poland and Romania, and to compare the obtained results with previous researches in order to highlight possible differences. The assessment of the empirical relationship between unemployment rate and economic growth provides results related to most of the previous studies.

The results obtained, in both difference and gap versions of Okun's law, support the hypothesis of a negative relationship between unemployment and GDP, but even if the Okun's coefficient divergence between countries remains one of the most significant criticisms, it can still be used as a tool to compare the performances of the labor markets across countries.

Okun's coefficient might be sensitive to the approach used to determine the cyclical components. Therefore, other methods than Hodrick-Prescott filter might be used in further studies.

Based on the assessment, we conclude that, in most cases, for the Okun's coefficient estimated using the two different methods, the coefficient of determination is quite low, highlighting the fact that the parameter doesn't have a very strong statistical significance, but it can be used with satisfactory predictive results. Anyway, the relationship between economic growth and unemployment is not stable, which may lead to an incorrect assessment of the possible determinants of the Okun's coefficient.

In regards to previous studies, this paper depicts once again that usually, in developing countries, unemployment is less responsive to output fluctuations than in advanced economies,

even if there is a causal relationship between these two variables. This situation is generally attributed to various unemployment policies.

All in all, the assessment of Okun's Law shows an empirical persistent relationship between economic growth and unemployment in all countries subject to this study, even though the tendencies are not quite the same as those stated by the original model. From the results of this assessment we may conclude that Okun's coefficient is sensitive to the duration of economic periods and also to the type of GDP gap.

References

- Ball, L., M., Leigh, D., & Loungani, P. (2013). Okun's Law: fit at fifty? (No. w18668), National Bureau of Economic Research.
- Ball, L., Furceri, D., Leigh, D., & Loungani, P. (2019). Does one law fit all? Cross-country evidence on Okun's law, *Open Economies Review*, 30(5), 841-874.
- Boulton, T. (2010). Test of Okun's Law for the 10 Eastern European countries, London Metropolitan Business School, Economics Subject Group.
- Cazes, Sandrine, Sher Verick, and Fares Al-Hussami (2012). Diverging trends in unemployment in the United States and Europe: Evidence from Okun's law and the global financial crisis, *Employment Working Papers*, ILO.
- Freeman, D.G. (2000). Regional Tests of Okun's Law, *International Advances in Economic Research*, VOL. 6, NO. 3, pp. 557-570.
- Gajderowicz, T., Grotkowska, G., Wincenciak, L., & Wirtek, E. (2014). Unemployment rate sensitivity to GDP fluctuations across Polish voivodeships, *Central European Economic Journal*, 39.
- Gibescu, P. L. O. M. (2013). The Correlation between Gross Domestic Product and Unemployment in Romania Starting With 1995, *Revista Română de Statistică* nr. 91.
- Hamilton, J.D. (2017). Why You Should Never Use the Hodrick-Prescott Filter, *The Review of Economics and Statistics*, vol. 100(5). pages 831-843.
- Hodrick, R., Prescott, C. (1997). Postwar U.S. Business Cycles: An Empirical Investigation, *Journal of Money, Credit, and Banking*, 29 (1): 1-16.
- Jackman, R. (2005). The impact of the European Union on unemployment and unemployment policy, In *Beyond the Market* (pp. 70-89), Routledge.
- Kliber, P. (2014). The Diversity of Okun's Coefficient in the Regions of Poland, Available at SSRN 2461427.
- Kostov, L. (2017). The impact of economic growth on inflation and unemployment in Bulgaria, 2006-2016, *SEER: Journal for Labor and Social Affairs in Eastern Europe*, 85-99.
- Mielcová, E. (2011). Economic growth and unemployment rate of the transition country: the case of the Czech Republic 1996-2009.
- Okun, A. (1962). Potential GNP, its measurement and significance, Cowles Foundation, Yale University.
- Ruxandra, P. (2015). The specifics of Okun's law in the Romanian economy between 2007 and 2013, *Annals-Economy Series*, 1, 50-53.
- Soylu, Ö. B., Çakmak, İ., & Okur, F. (2018). Economic growth and unemployment issue: Panel data analysis in Eastern European Countries, *Journal of International Studies* Vol. 11(1).