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Structural Breaks in Unemployment: Evidence for Bulgaria, Croatia, Greece, Romania and Slovenia

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Abstract

ThispaperdeterminesendogenouslythetimeofstructuralbreaksinunemploymentforBalkancountries – member countries of European Union- during the period 1991-2019. UsingZivotandAndrews (1992) approach and Perronand Vogelsang (1992) approach, we find that these countries experienced structural breaks in different time periods at the end of 2000 and during 2010. The Structural Variations Signaled a sharp increase of unemployment which happened due to worldwide financial crisis in the USA 2007, due to Eurozone crisis in the beginning of 2009 as well as due to the Greek debt crisis which has started during the last quarter of 2008 until the end of the Third Memorandum at the end of 2019. Applying the above Endogenous Structural Tests, we detect different structural breaks in unemployment for each examined country.

Keywords: unemployment, structural breaks, Balkan Countries in EU

JEL Classification: H56, O53, C22

1. Introduction

This Part of Research Has Questioned the Beliefs of traditional views for facing economic time serie a temporary fluctuations around a deterministic trend function as opposed to the permanent changes reflected in trend. The decrease of unemployment is considered the most important priority for both developed and developing economies worldwide. Economic growth and employment are two principal macroeconomic variables and constitutes essential elements for economic policies in all governments. Economic growth is an index of prosperity for a country and is measured based on GDP or per capita GDP. Another macroeconomic variable which is crucial for economic growth and is an issue of interest for many countries is unemployment. Unemployment arises from the economic structure of a country and for different reasons depending if the country is developed or underdeveloped. The main cause for unemployment in underdeveloped countries is lack of capital whereas for developed countries technological progress (Yilmaz, 2005)

Okun (1962) in his study for USA economy, found out empirically the reverse relationship between unemployment rate and production. Okun claimed that the increasing human capital must produce more goods and services. Moreover, Okun noted that the unemployment rate was reduced during the years where growth rate

was in high levels, whereas unemployment rate increased during the period where growth rate was low or even negative.
In the present paper, we will examine the unemployment for countries-members of EU in the Balkan peninsula as a stationary time series with a structural break. This examination is important for economic modeling of unemployment on these examined countries because if a variable is stationary with structural breaks but is wrongly considered as a series with unit root, will lead us inevitably to misleading conclusions.

The rest of the paper is organized as follows: Section 2 refers to the consequences of the economic crisis to unemployment. Section 3 present methodology analysis. Section 4 describe the data. Empirical results are provided in Section 5. Finally, the last section provides summary and conclusions.

2. The impact of economic crisis in unemployment

The launch of the international financial crisis is placed in the USA at the beginning of 2007. Later on, the bankruptcy of the investment company Lehman Brothers, led to the destabilisation of the international financial system while threatening the banking sector at the same time. The crises soon moved from the USA economy to the rest of the world affecting investments, consumption and above all employment. The market composition transferred the baking system crisis to Europe. European banks, insurance funds and investments companies were all faced with a "bubble" similar to the one in the USA. There are three aspects of the European crises; the Banking sector crises, crises in public debt and crises in investments. Eurozone banks were undercapitalised and were faced with liquidity and debt problems. Furthermore, economic growth was slow in Eurozone overall and unevenly distributed among its country-members.

The crisis affected Eurozone countries at the beginning of 2009 when a group of 10 banks from the Central and Eastern Europe asked to receive a rescue package. Moreover, crises made it impossible for some countries to pay off their public debt without help from the European Central Bank or the International Monetary Fund. From the late 2009 onwards, fears of bankruptcy emerged among investors as a result of the increasing private and public debt worldwide in combination with a wave of degradation of public debt of some European member states by the international rating agencies. The reasons behind the crisis were different between each country-member of the European Union. Concerns were escalated at the beginning of 2010 onwards, leading European countries to impose a number of financial support measures such as the European Financial Stability Fund (EFSF) and the European Stability Mechanism (ESM). Besides the implementation of policy measures and rescue packages in addressing the Eurozone crisis, the European Central Bank also took some measures by lowering interest rates and providing cheap loans reaching 1 trillion Euros in order to sustain the flow of money among European banks (Shambaugh 2012).

At the beginning, crisis struck the economies of the Eurozone country-members but later on affected the Balkan countries as well. The Greek economic crisis was due to the failure of the Greek State to borrow with low interest rates from the international markets. As a result of its inability to meet its debt, the bonds expired at the beginning of 2010 and the budget deficit reached 15.4%. Crisis had social implications mainly with unemployment increasing gradually and reaching 27%, prices and poverty also increased as opposed to the living standards and income of the Greek citizens which dropped.

The debt crisis in Eurozone brought a heavy blow to the economy of Balkan countries. Their strong economic dependence from the European Union did not leave any trace of optimism about the immediate improvement of their situation. Before the economic crisis in the EU, the activity of Greek Banks in Balkan countries was very intense and especially in the regions of Bulgaria and Romania with the Greek Banks counting 1,900 branches and employing more than 23,000 workers. While featuring 15% of the main capital of all Balkan banks, Greek banks were a main point of reference to the local economies. Meanwhile, the lack of liquidity in Greece was so great that led the Greek banks withdrawing their capital from their neighbouring countries which in turn resulted to their further borrowing inability.

The above though was not the only problem in the Balkan region. Balkan countries are hit nowadays to a great extent by the European debt crisis. The main reason is the very close relations of Balkan countries with Eurozone countries. The decrease of exports towards Eurozone as well as the drop of foreign investments, had a great impact on the development of the Balkan countries. The consequences are so immense that unemployment reached high levels while more and more people are forced to immigrate. The employment market in Eurozone has not fully recovered yet by the financial crisis of 2008. Unemployment still fluctuated in double digits figures in many countries and the income inequality has expanded in Europe even more. At first sight, unemployment in Europe has receded enough during the last decade. Without doubt, the South of Europe has experienced the greatest hit from the 2008 financial crises. Despite the latest drop in unemployment, the unemployment rate seen in the 15-24-year-old age group, is still high.

3. Econometric Methodologies

Many methodologies have been applied in order to examine unit root and structural breaks. Firstly, we check for unit root test without structural breaks using Augmented Dickey-Fuller-ADF test as well as Phillips-Perron test. After we examine endogenous breaks with one structural break using Zivot and Andrews and Perron and Vogel sang respectively.

3.1 Unit root tests without structural break

Unit Root Tests Correspond To null hypothesis $H_0 : \rho = 1$for autocorrelation equation. It Is Reasonable That When Estimating The Equation $Y_t = \rho Y_{t-1} + u_t$ using least squares methodology we employ the test of $H_0 : \rho = 1$ using *t*-Student. The most common tests for testing unit root is the Augmented Dickey Fuller (ADF) (1979, 1981) and Phillips-Perron (PP) (1988).

3.1.1 Augmented Dickey Fuller (ADF) unit root test

Dickey-Fuller (1979) through Monte-Carlo Simulation Found a suitable asymmetric distribution used for unit root testing. In Dickey-Fuller (1979) test we make the assumption that the disturbance term u_t is an independent and stationary process. If the term u_t is not independent due to possible correlations in time series, then we use Augmented Dickey-Fuller Test (1981) which is a modified Dickey-Fuller test. In other words, the previous Dickey-Fuller (DF) test examined the existence of unit root in an autoregressive model first order AR(1). In the case where a time series follows an auto regression scheme higher order then when testing for unit root in AR(p) models we use the Augmented Dickey Fuller test (ADF). This modification contains the time lags of the dependent variable and is given as follows:

$$\Delta Y_t = \delta_0 + \delta_1 t + \delta_2 Y_{t-1} + \sum_{i=1}^{\rho} \beta_i \Delta Y_{t-i} + u_t \qquad (1)$$

where:
i = 1,2,...,ρ number of time lagso
u_t = error term which must be white noise

3.1.2 Phillips-Perron test

Phillips-Perron (1988), in order to test for the existence of stationary in time-series, suggested methodology where the assumption so error term referring to autocorrelation hypothesis are not valid. Phillips-Perron Proposed a non-parametric test for the parameters' estimation of the model making a modification in t statistic. This test differs from the Augmented Dickey-Fuller Test mainly on the way of examination on autocorrelation and heteroscedasticity in errors. Regression test on Phillips-Perron Given In the following form:

$$\Delta y_t = \beta' D_t + \pi y_{t-1} + u_t \qquad (2)$$

where u_t termisk integrated first orderI (1)and can be heteroscedastic.

3.2 Unit Root Tests with one endogenous structural break

One of the assumptions in unit root test without structure a breaks is that time series are developing smoothly in relation to time. However, there are conditions that time series present abrupt variations due to various economic events such as an oil crisis. In this case, the unit root tests are not reliable. Thus, the result so traditional Tuscan be biased because there is not much information related to structural breaks appearing on the series. So, a common problem with all the traditional test so fun it root is that they don't allow one or more structural breaks.

Supposing that time variation is an exogenous phenomenon, Perron (1989) showed that the potential to reject the unit root null hypothesis is decreasing when at the same time on the alternative hypothesis stationary, with structural break, is ignored.

Perron's unitroottest (1989) for a structural break was criticized mainly from Christiano (1992) for the way he uses data with structural break. Since then, many papers have been developed using different methodologies oren dogenous determination of structural point. The sepapers are that of Zivotnd Andrews (1992) as well as Perron and Vogelsang (1992).

3.2.1 ZivotandAndrewstest

Zivotand Andrews (1992) suggested version of Perron (1989) test where they consider that the exact time of structural break is unknown. Zivotand Andrews also thought that the structural break is endogenous phenomenon. Following the characteristical structure of Perron's models with structural breaks, Zivotand Andrews suggested three models for testing unit root which are the following:

Model A, allowing time variation in the levels of time series.

$$y_t = \hat{\mu}^A + \hat{\vartheta}^A DU_t(\hat{\lambda}) + \hat{\beta}^A t + \hat{\alpha}^A y_{t-1} + \sum_{j=1}^{k} \hat{\gamma}_j^A \Delta y_{t-j} + \hat{e}_t \qquad (3)$$

Model B, allowing time variation in the slope of the trend function.

$$y_t = \hat{\mu}^B + \hat{\beta}^B t + \hat{\rho}^B DT_t^*(\hat{\lambda}) + \hat{\alpha}^B y_{t-1} + \sum_{j=1}^{k} \hat{\gamma}_j^B \Delta y_{t-j} + \hat{e}_t \qquad (4)$$

Model C, whichcombinesatimevariationinthelevelsoftimeseriesandaslopeonthetrendfunction.

$$y_t = \hat{\mu}^C + \hat{\vartheta}^C DU_t(\hat{\lambda}) + \hat{\beta}^C t + \hat{\rho}^C DT_t^*(\hat{\lambda}) + \hat{\alpha}^C y_{t-1} + \sum_{j=1}^{k} \hat{\gamma}_j^C \Delta y_{t-j} + \hat{e}_t \qquad (5)$$

where DU_t is a dummy variable for the mean shift appearing in every possible variation (TB) while DT_t^* is the corresponding variable for the mean shift and trend

$$DU_t(\lambda) = \begin{cases} 1, & if \quad t > \mathrm{T}\lambda \\ 0 & in \quad every \quad 'other \quad case \end{cases}$$

$$\mathrm{DT}_\tau^*(\lambda) = \begin{cases} t - T\lambda, & if \quad t > \mathrm{T}\lambda \\ 0 & in \quad every \quad 'other \quad case \end{cases}$$

Null hypothesis in all the above model S $\hat{\alpha} = 0$ which entails that y_t time series contains unit root with slope excluding every structural break where asana alternative hypothesis $\hat{\alpha} < 0$ meaning that time series is a stationary procedure with an endogenous time structural break taking place in an unknown point in time.

3.2.2PerronandVogelsangtest

Perron and Vogelsang (1992), suggested category of statistical tests which allow two different forms of structural breaks. These breaks represent models. The model of Additive Outlier - A O and the model of Innovational Outlier-IO. The first model allows a sudden break in the mean of time series, while the second model allows the gradual shift of time series. The forms of these models are given below:

The model of Innovational Outlier (IO)

$$y_t = \mu + \delta DU_t + \vartheta D(T_b)_t + \alpha y_{t-1} + \sum_{i=1}^{k} \gamma_i \Delta y_{t-i} + e_t \qquad (6)$$

The model of Additive Outlier (AO) occurred in two stages is developed as follows:

$$y_t = \mu + \delta DU_t + \hat{y}_t \qquad \text{(firststage)} \qquad (7)$$

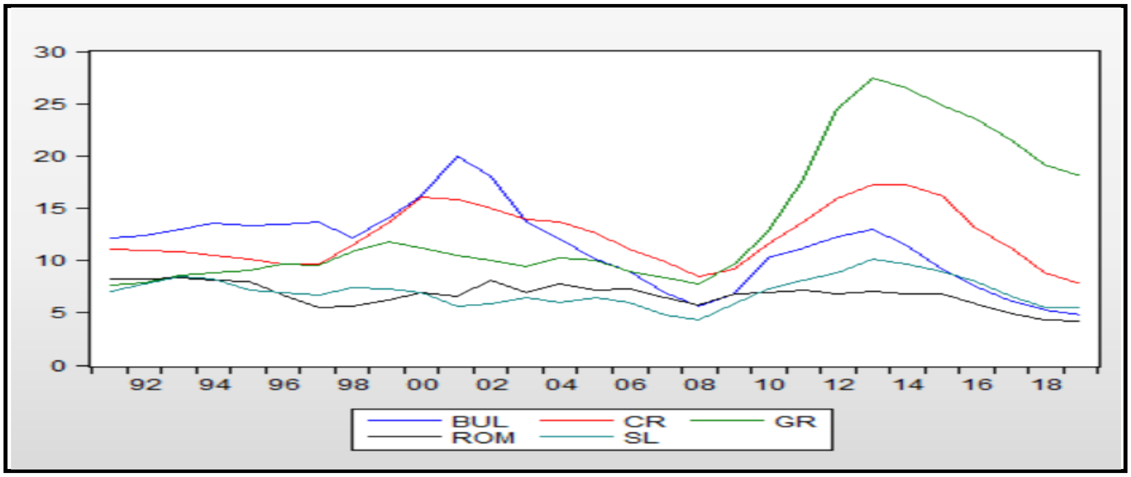
$$\hat{y}_t = \sum_{i=0}^{k} w_i D(T_b)_{t-i} + \alpha \hat{y}_{t-1} + \sum_{i=1}^{k} \gamma_i \Delta \hat{y}_{t-i} + e_t \quad \text{(secondstage)} \tag{8}$$

where $\hat{y}_t$ in equation (8) represents the data of y_t time series released by trend. Perronand Vogelsang (1992, pp.303) claimedthatthetestsontheabovemodelsareemployedusingtheminimumvalueof*t*statistic in the sum of autocorrelation parameters' in all the possible structural points of the suitable auto regression.

4 Data Description and Sources

Daily data for unemployment rates for the Balkans countries, members of European Union, derive from development indices of World Bank. Data cover the period from 1991 until 2019. The following diagram presents the trend of unemployment rates for the five Balkan countries for the period 1991-2019.

Diagram1: Unemployment Rates of Balkan countries of EU



From diagram 1 we can see that on 2013 all five Balkan countries of EU showed increase on unemployment where the highest is that of Greece 27.46% and the lowest in Romania 7.09%. Then the descriptive statistics of unemployment are presented.

Table 1: Descriptive statistics of unemployment

	Bulgaria	Croatia	Greece	Romania	Slovenia
Mean	11.29	12.30	13.66	6.75	7.03
Median	12.18	11.39	10.31	6.85	6.91
Maximum	19.92	17.29	27.46	8.40	10.10
Minimum	4.81	7.76	7.65	4.15	4.37
Std. Dev.	3.74	2.75	6.49	1.12	1.39
Skewness	0.07	0.32	0.99	-0.61	0.30
Kurtosis	2.71	1.96	2.40	2.94	2.61
Jarque-Bera	0.13	1.79	5.17	1.86	0.61
Probability	0.936	0.406	0.075	0.394	0.733
Sum	327.44	356.73	396.32	195.87	204.04
Sum Sq. Dev	391.76	212.99	1181.78	35.28	54.26
Observations	29	29	29	29	29

The results on table 1 show that the rates of unemployment on the five countries follow normal distribution. The largest deviation from the mean in unemployment appears for Greece (6.49) and the smallest for Romania (1.12). Asymmetry coefficient for all countries is positive (except for Romania) whereas the coefficient kurtosis is less than 3 (platykurtic distribution) in all examined countries.

5. Empirical Results

Table 2 presents the results of Augmented Dickey-Fuller test as well as Phillips-Perron test.

Table 2: ADF and P-P test on unemployment series

Country	**Level**			
	ADF		P-P	
	C	C,T	C	C,T
Bulgaria	-2.077(1)	-3.190(1)	-1.098[1]	-1.652[0]
Croatia	-4.322(5)**	-4.203(5)**	-1.977[3]	-1.654[2]
Greece	-1.266(2)	-2.897(1)	-1.345[3]	-1.880[3]
Romania	-1.131(0)	-1.808(0)	-1.316[2]	-1.858[1]
Slovenia	-2.853(1)	-2.921(1)	-1.769[1]	-1.714[1]

Notes:

1. ***, ** and * show significant at 1%, 5% and 10% levels respectively.
2. The numbers within parentheses followed by ADF statistics represent the lag length of the dependent variable used to obtain white noise residuals.
3. The lag lengths for ADF equation were selected using Schwarz Information Criterion (SIC).
4. Mackinnon (1996) critical value for rejection of hypothesis of unit root applied.
5. The numbers within brackets followed by PP statistics represent the bandwidth selected based on NeweyWest (1994) method using Bartlett Kernel.
6. C=Constant, T=Trend.

The results from the above table shows that the null hypothesis for both tests cannot be rejected in all countries in the levels of variables (mainly with Phillips-Perron test). Moreover, total results of Phillips-Perron test present that there is random walk, regardless the fact that unemployment consists time trend or not. This effect shows that there are shocks on unemployment as a permanent effect. So, both Phillips-Perron test and ADF test which ignore structural breaks will provide misleading results.

Hence, we should addle stone endogenous structural break on unit root tests. For the one structural break on this paper we use not only the Zivot-Andrews test but also Perronand Vogelsang (1992) test which allows two different forms of structural breaks. These forms represent two models. The Additive Outlier (AO) model and the Innovational Outlier (IO) model. The following two tables, table 3 and 4, present the results on the above tests respectively.

Table 3: One endogenous structural break Zivot-Andrews unit root test

	Level					
Country	Intercept		Trend		Both	
	t-stat	Break	t-stat	Break	t-stat	Break
Bulgaria	-3.991[1]	1999	-3.638[1]	2000	-3.816[1]	1999
Croatia	-4.923[2]	1998	-4.678[2]	2000	-5.103[2]	2005
Greece	-6.242[1]***	2011	-4.818[1]**	2007	-5.543[1]***	2011
Romania	-3.850[2]**	2002	-3.941[2]**	2015	-4.834[2]*	2013
Slovenia	-4.428[1]***	2009	-4.136[1]*	2002	-3.631[1]**	2012

Notes:

1.The optimal lag length is selected using *t*-sig, with the maximum lag set to 4.
2.Critical values intercept: -5.34 (1%), -4.93 (5%), -4.58(10%), trend: -4.80 (1%), -4.42 (5%), -4.11(10%), both: -5.57 (1%), -5.08 (5%), -4.82(10%).
3. *, **, *** denote significance at the 10%, 5%, and 1% levels, respectively.

From The results of the above table we observe that the unit root test with one structural break for the variable of unemployment cannot be rejected in two examined countries.

Table 4: One endogenous structural break Perron-Vogelsang unit root analysis

	Trending data with intercept break			
	Additive Outlier-AO		Innovational Outlier-IO	
Country	min-t	optimal breakpoint	min-t	optimal breakpoint
Bulgaria	-3.934(1)	2004	-3.975(3)	2004
Croatia	-5.404(1)***	2004	-4.86(5)**	2013
Greece	-5.769(1)***	2010	-6.199(5)***	2010
Romania	-4.221(2)	2001	-5.610(5)***	2017
Slovenia	-4.372(6)	2008	-4.216(1)	2008
	Trending data with trend break			
	Additive Outlier-AO		Innovational Outlier-IO	
Country	min-t	Optimal breakpoint	min-t	Optimal breakpoint
Bulgaria	-3.887(1)	1998	-4.391(5)*	2001
Croatia	-5.500(5)***	1998	-5.159(5)***	2001
Greece	-5.203(1)***	2004	-6.199(5)***	2010
Romania	-3.819(2)	2017	-6.850(5)***	2016
Slovenia	-3.450(1)	2005	-5.069(6)***	2009
	Trending data with intercept break and trend break			
	Additive Outlier-AO		Innovational Outlier-IO	
Country	min-t	Optimal breakpoint	min-t	Optimal breakpoint
Bulgaria	-4.178(1)	2005	-5.652(5)**	2001
Croatia	-5.503(1)***	2004	-5.239(6)**	2007
Greece	-5.563(1)**	2010	-4.920(5)*	2007
Romania	-4.198(2)	2001	-6.550(5)***	2014
Slovenia	-5.822(1)***	2001	-6.997(6)***	2005

Notes:

1. min-t is the minimum t-statistics calculated.
2. The optimal lag length is selected using *t*-sig, with the maximum lag set to 4.
3. Critical values intercept: -5.34 (1%), -4.93 (5%), -4.58(10%), trend: -4.80 (1%), -4.42 (5%), -4.11(10%), both: -5.57 (1%), -5.08 (5%), -4.82(10%).
4. *, **, *** denote significance at the 10%, 5%, and 1% levels, respectively.

On Table 4 present the results of Perron Vogelsang test. From these results we can see that unit root test with one endogenous break for unemployment is rejected in all countries that we study mainly for the Innovational Outlier (IO) model Therefore, we can regard unemployment stationary with one endogenous structural break variable using the Innovational Outlier (IO) model of Perron and Vogelsang test. Applying all the above endogenous structural break tests, we detect various structural breaks on unemployment for every examined country. From the above results we notice that the structural break for unemployment on Bulgaria was found in 2001 (from the market loss of COMECON and the "therapy shock" which followed on the economic system causing sharp decline in industrial and agricultural production and unemployment increase), for Croatia in 2007 (Worldwide Financial crisis), for Greece in 2010 (Greece appealing to support mechanisms jointly International Monetary Fund, European Central Bank, European Union), for Romania in 2017 (wages' increase with simultaneous debt increase) and for Slovenia in 2008 (Eurozone crisis).

6. Summary and Conclusions

Thispaperprovidesanintegratedexaminationonthehypothesisoftheunitrootandstructuralbreaks for unemployment in five Balkan countries of EU using annual data from 1991 until 2019. Using Augmented Dickey-Fuller (ADF) test and Phillips-Perrontest (PP) this paper finds very weak evidence against the unit root null hypothesis as the unit root null hypothesis could be rejected only for Croatia and only for ADF test. However, applying the endogenous test of structural one break as much as Zivot-Andrews test and Perron and Vogelsang test, it was found that evidence against the unit root hypothesis increased. More specifically, unemployment in three examined countries in the present study reject the null hypothesis of unit root for the stationarity of a one break with Zivot-Andrews test and for all countries with the Innovation Outlier model of Perron and Vogelsang test. Some of the estimated changes were significant both for the same countries and worldwide because they corresponded main economic events such as financial crisis in USA on 2007, the crisis of Eurozone in the beginning of 2009 as well as the Greek debt crisis in 2010. These findings of unemployment for the countries that we studied as stationary series with one structural break are quite important for econometric modeling in all macroeconomic variables because if a variable is stationary with structural break (s), but incorrectly regarded as a unit root series, will inevitably lead us to misleading inferences.

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