Testing Phillips Curve For Serbian And Romanian Economy

Srdjan Furtula (furtulas@kg.ac.rs)
Faculty of Economics in Kragujevac, Serbia

Danijela Durkalić (durkalicdanijela@gmail.com)
University of Kragujevac

Mihaela Simionescu (mihaela_mb1@yahoo.com)
Institute for Economic Forecasting, Centre for Migration Studies in Prague Business School, Romania

ABSTRACT

The subject of this work is the Phillips curve paradigm in macroeconomics with an emphasis on its development in New Keynesian theory. The main objective of the work is to reach scientifically relevant and practically useful knowledge on the concept of the Phillips curve and development its application to the related macro-economic variables in Serbia and Romania. The dependence between inflation and unemployment rate will be analysed on empirical data were chosen in Romania and Serbia using Bayesian linear regression models. For this study, these two countries which experienced a period of transition were chosen. Furthermore, Serbia aspires to join the EU, while Romania has been its member since 2007. The results of this paper will show that the model of traditional Phillips curve exists only in the short term.

Key words: *Phillips curve, unemployment, GDP deflator, BVAR models.*

1. INTRODUCTION

The Phillips curve appeared as a response to the question of relations between inflation and unemployment. Designed in the 1960s, the Phillips curve became analytical instrumentation used for the elaboration of macro-economic analysis that discussed the question of relations of inflation and unemployment. For this reason there was a need for a study of this kind of analysis, and for this purpose we analysed the influence of different schools of economic thought in modification of the Phillips curve and its effect on the Republic of Serbia and Romania.

Empirical evaluation of the level of unemployment and inflation of econometric methods clearly identifies different results. Based on the defined object of research and consistent with the goal of research, we started from the hypothetical framework:

H1: The traditional Phillips curve, which shows the trade-off between inflation and unemployment, cannot be applied in contemporary long term conditions in the Republic of Serbia and Romania. The results that appeared as a product of conceived_objectives and tasks led to adequate scientific knowledge. A key contribution of this work is reflected in the definition and implementation of the Phillips curve as an analytical instrument of the empirical facts through by using the Bayesian linear regression model, and also in the development of scientific thought about the phenomenon of the Phillips curve.

2. LITERATURE REVIEW

It is known that economists deal with the relationship between the individual indicators, and comparative analysis of macroeconomic indicators. However, improving the position of one of the macroeconomic aggregates is influenced by the deterioration of the situation of the other. It is also proved in the relationship between inflation and unemployment, which are key macroeconomic indicators for each national economy. Moreover, the successful development of a national economy is ensured by the performance of commercial banks (Gavurova, Belas, Kocisova, Kliestik, 2017; Balcerzak, Kliestik, Streimikiene, Smrčka, 2017).

In 1958, English economist Alban Phillips (A.W.Phillips), a professor at the Faculty of Economics in London, published an article in the journal *Economica* entitled *The relationship between unemployment and the rate of change of money wages in the UK*, *from 1861 to 1957* (Phillips, AW 1958). This article created initial spark that launched Phillips; there, he pointed out the negative correlation of the unemployment rate and inflation rate of wages. After the initial form of Phillips curve was formed, it was developed at different schools of economics.

Keynes and his ideas dominated in the context of macroeconomic thinking process from 1929 until the 1970s. During the 1970s, the growth of unemployment became a major problem but the Keynesians were unable to explain this rise in inflation and unemployment (stagflation) at the same time. Their reasoning was related mainly to the dispute concerning the adjustment of prices and wages on the market. Normally, the model became the basis for further research (non)existence of trade-off between inflation and unemployment.

The results of the initial analysis of the Phillips served many economists to develop their research in the same direction. Based on the original Phillips curve and the idea of change of unemployment and wages, the critics of Keynesian theory, American economists Paul Samuelson and Robert Solow, indicated the negative correlation between unemployment and price inflation on the basis of data for the United States. Thus, they modified the Phillips curve so that it became an analysis of the relationship of unemployment and price inflation. They concluded the same fact as Philips that unemployment and price inflation moved approximately as the ratio of unemployment and wage inflation. (Samuelson, Solow, 1960).

Further development of these curves was processed by New Keynesian schools. In addition to these positions, New Keynesian model overcame some limitations and accepted a new postulate in the improvement of the analysis and the introduction of monopolistic competition, nominal and real rigidities in prices and wages, thus contributing to the approximation of the real developments in the economy.

New Keynesian Phillips curve assumes that inflation expectations are rational and not adaptive, which is withheld from Lucas' theory. As a result, there was a New Keynesian Phillips curve which was different from the Phillips curve developed by Friedman and Phelps. It also differed from the Phillips curve developed by Lucas and Rapping (Lucas, Rapping, 1969). Their version of the Phillips curve coupled with rational expectations suggested that only non-anticipated inflation (change in money supply) could affect output. In 1969, Lucas and Raping are empirically demonstrated that the Phillips curve was not stable over time (Lucas, Rapping, 1969), i.e. it changed with time. So, economists Mankiw and Rice (2001) pointed out that the relationship between inflation and output still remained a puzzle for macroeconomists, a conclusion also formulated by Simionescu (2017).

In recent years, many economists used inflation expectations and price adjustment in their research. The New Keynesian Phillips curve model was built on the works of John Taylor (John Taylor, 1980), Rotemberg Julio (Julio Rotemberg, 1982), and Calvo Guillermo (Guillermo Calvo 1983). Rotemberg's work highlighted the microeconomic framework within which the reduction of the cost of price changes were discussed. The Calvo model (Calvo, 1983), based on the price of company, pointed out that every company kept a fixed price while employers did not receive the "random signal" about the price change. During the formation of the new price, the company took into account that the prices of other firms had to change. Bearing in mind that the prices of other companies were set up in the past, the company took into account the previous prices in the formation of the current price.

The results which indicate the existence and formation of the Phillips curve were firstly empirical. However, it should explain that empirical result on the basis of theoretical knowledge. Richard G. Lipsey was the first who processed Phillips curve empirically and formed the initial equation as a gradual adjustment of imbalances on the labor market (Palley, T., 2012):

$$w=f(u-u^{*}) \quad f(0)=0, f'<0, f''<0 \tag{1}$$

Where w - is the nominal inflation wages, u - the actual unemployment rate, u * - unemployment rate (friction and structural) that corresponds to full-time employment (natural rate). Based on the econometric model of Lipsey, it is shown that the excessive demand for labor causes wages inflation, while a surplus of labor supply causes deflation of wages. The equation was quickly accepted; however, the empirical data showed instability, hence this situation led to/resulted in modifications of the originally defined theoretical curve.

In recent research, Phillips curve model is widely used for theoretical analysis of monetary policy. Thus John Roberts (Roberts, 1995) pointed out that the main contribution to the New Keynesian Phillips curve explicitly emphasized the role of nominal rigidities of the model. In his work, Roberts performed theoretical comparison of Phillips curves over time. What he said referred to the fact that the New Keynesian models included expectations of future inflation, while the Lucas supply curve included current expectations and current inflation. The reason for consideration of future inflation related to the New Keynesian model in which prices were "sticky" or rigid. As noted, alternative Phillips curve model was based on rational expectations of rigid price and was present in models of Taylor, Calvo and others. As Robert pointed, all those models were the model of New Keynesian Phillips curve, which included the forward-looking in current inflation expectations

$$\pi t=\beta E_t\pi_{t+1}+\gamma x_t \qquad (2)$$

In their work, Gali, and Gertler (Gali, Gertler, 1999) provided a good description of the process of inflation by using alternative approach to assess whether the New Keynesian Phillips, especially focused on the role of delayed inflation. They discussed the popular version of the Phillips curve "New Keynesian Phillips curve", which included rational expectations.

Using Calvo model of price adjustment, Woodford (2003) showed that the aggregation of linear optimal price-adjustment of individual firms could show the current and expected future inflation and aggregate marginal cost, (mc). In this way the New Keynesian model introduced a component of marginal costs (Hornstein, 2008):

$$\pi_t =\gamma_f E_t\pi_{t+1}+\lambda mc_t+\xi_t \qquad (3)$$

This equation shows the structural New Keynesian Phillips curve model where λ and γ_f are functions of structural parameters, including the probability of price adjustment, where α, ξ_t is a random variable. Random variables are usually interpreted as an exogenous shock to the company. Solving this equation by "looking ahead" leads to the conclusion that the current and expected future marginal costs are bearers of current inflation.

Although the New Keynesian Phillips curve model is superficially similar to the traditional Phillips curve, this model nevertheless introduces different implications in terms of practical questions for the optimal conduct of monetary policy and the costs of deflation. (Rudd, Whelan, 2005). Gali and Gertler (1999) interpreted hybrid model of Phillips curve by the equation:

$$\pi_t=\lambda s_t+ \gamma_f E_t\{ \pi_{t+1}\}+\gamma_b \pi_t \tag{4}$$

Performing these results, they indicated that New Keynesian Phillips curve model could be a good way to predict the dynamics of inflation.

The development of the Phillips curve and models for predicting the relationship of inflation and unemployment (output gap), developed the concepts such as “sticky” information and “sticky” prices, as well as attempts to explain the model of dynamic price adjustment under the assumption that information and prices moved slowly. (Gertler et.al, 2002). With the advent of “sticky” prices, many papers on prices, wages and the information that “stick” to the market appeared. Thus the estimations of sticky information based on the Phillips curve in the USA were made (Khan, Zhu, 2006) together with optimal fiscal and monetary policy on the basis of the sticky prices (Schmitt-Grohe Uribe, 2004), and the theory of real wage rigidity in the New Keynesian model (Blanchard , Galí, 2007).

Using the data for the period 1983 to 2013, Orrenius and Kumar (2015) showed that the ratio of prices and wages was nonlinear and convex; it decreased when the unemployment rate was below the average rate, while significant increase in the wages caused change of unemployment above the historical average. They also came to the conclusion that the short-term unemployment rate had a strong relationship with the average and median wage growth, until the long-term unemployment rate appeared, which affected the median wage growth only. Some papers are concerned with analysis of employment and inflation in Europe and variation in the NAIRU (non-accelerating inflation rate of unemployment) (Posta, 2015), while some authors deal with sectorial neo-Keynesian curve and dynamics of the European monetary policy (Norkute, 2015). In more recent work, the focus is on the Phillips curve in an open and closed economy, looking forward and looking backward, as well as the hybrid Phillips curve (Abbas, Bhattacharya, Sgro, 2016). It is clear that the issues related to inflation and unemployment might affect business environment, not only the consumers and human resources (Kliestik, Kocisova, Misankova, 2015; Simionescu, 2016).

3. INFLATION AND UNEMPLOYMENT POLICY IN SERBIA AND ROMANIA

One of the challenges facing monetary policymakers is related to the selection of appropriate monetary policy strategy, which will be conducted in the future. Economic policy makers can apply various alternatives in the conduct of monetary policy such as the strategy of targeting monetary aggregates, exchange rate targeting, inflation targeting and monetary strategy based on an implicit monetary anchor (Swank & Velden, 1997). The implementation of any of strategies can leave positive and negative effects. Since 1990, some countries have adopted inflation targeting as a monetary policy regime, and among them are the observed countries, Serbia and Romania.

Monetary Policy Framework for selected counties

Table 1

	Monetary Policy Framework	
Exchange rate arrangement	**Inflation targeting framework**	**Other (EMU)**
Floating	Albania, Hungary, **Romania, Serbia**, Turkey	-
Free Floating	Poland, Sweden, United Kingdom	Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia , Luxembourg, Malta, Netherlands, Portugal, Slovakia, Slovenia, Spain
Other managed arrangement	Czech Republic	-

Source: IMF data, Annual report on exchange arrangements and exchange restrictions 2014 : https://www.imf.org/external/pubs/nft/2014/areaers/ar2014.pdf

Inflation targeting as a monetary policy strategy includes five key elements (Mishkin, 2007): 1) public announcement of the numerical value of inflation during medium time period, 2) institutional commitment to price stability as the primary objective of monetary policy, to which all other goals are subordinated, 3) a comprehensive strategy in which many variables, not only the money supply or the exchange rate are used for decision-making and creating monetary policy instruments, 4) transparent monetary policy, 5) responsibility of central banks in the implementation of inflation targets.

Regarding the Republic of Serbia, monetary authorities decided to change the monetary strategy of exchange rate and adopt a strategy of inflation, targeting combined with a floating exchange rate regime due to the growing negative effects of macroeconomics. (Josifidis et el., 2009). Bearing in mind that the strategy of exchange rate targeting started from rigid to crawling, Serbia officially abandoned exchange rate targeting as a nominal anchor in September 2006 when the National Bank of Serbia announced preparation for the implementation of the inflation targeting strategy.

By applying the inflation targeting strategy and appropriate conduct of monetary policy, the inflation (measured by the GDP deflator) declined from 10.62% in 2008 to 2.68% in 2015. This is the lowest inflation rate in the observed period from 1996 to 2015. However, both goals of macroeconomic policy cannot be achieved at the same time, which is shown in the movement in the unemployment rate. The unemployment rate increased significantly in

Serbia and it is still in double digits. It varied from 13.63% in 2008 to 17.66% in 2015. It culminated in 2012, when it was 23.9%. The BTI report (BTI, 2016) states that the poverty rate in Serbia is high because of large families, a great number of one-parent families, high unemployment and the large Romani population. Also, the report estimates that the grey economy employs about 1 million of population, which is about 40% of GDP. Conducting the policy of stable inflation and exchange rate prevents the use of expansionary monetary policy in Serbia, while the unemployment is a burning political and economic problem in Serbia.

Instruments of monetary policy in Serbia and Romania

Table 2

Country	National Bank of Romania	National bank of Serbia
Used instruments of monetary policy of targeting inflation	1. open market operations 2. standing facilities 3. reserve requirements	1. open market operations 2. standing facilities 3. reserve requirements 4. interventions on the foreign exchange market

Source: National Bank of Serbia, National Bank of Romania

Another country in transition that has been taken into consideration in addition to Serbia is Romania. Due to similar economic structure, transitional reforms and implementation of the strategy of inflation targeting, these countries are interesting for comparison.

The National Bank of Romania (NBR) moved on to direct inflation targeting in August 2005. Romania conducts fluctuating exchange rate. The BTI report (BTI, 2016) for Romania states that the central bank is a strong and independent institution that withstands the pressure of the government to change monetary policy. NBR carried out anti-inflationary policy and strict banking supervision. The inflation rate in Romania reached a historically low level in 2014 (1.69%). The inflation rate varied from 15.5% in 2008 to 2.92% in 2015. Although inflation is within the target values in Romania and EU member states, the political decision to adopt the Euro and EMU membership has not yet been made.

In Romania, the imbalances caused by the transition to a free market economy and the economic downturn caused quite an explosion of unemployment in the early years of the transition (Dănăcică, 2014). But, if we talk about unemployment in Romania compared with Serbia, its rate in Romania is quite smaller than in Serbia. The unemployment rate in Romania did not exceed 8% throughout the period from 1996-2015, and ranged from 5.79% (2008) to 6.81% (2015). The main reason for the extremely low unemployment rate in Romania is primarily found in the migration of Romanian working population to some EU countries, such as Italy and Spain. Like in Serbia, the situation with the

Romani population also deserves special attention in Romania; particularly as a separate issue in the field of education, health and social protection. Corruption and red tape continue to permeate the business environment in Romania.

Based on the monetary policy instruments in the countries that implement inflation targeting (in our case, Serbia and Romania) it can be seen that countries generally apply open market operations as a basic monetary policy instrument. Taking into account the Keynesian thinking, we can get the impression that the Keynesians created a starting point in creating a monetary policy based on discretion, and raising interest rates as the main monetary policy instrument.

4. DATA AND RESULTS

The dependence between inflation and unemployment rate will be analyzed on empirical data in Romania and Serbia, two countries that experienced the transition to a market economy. However, more issues were reported on the Serbian labour market where unemployment became a more acute problem.

Due to the short data series, we built few Bayesian linear regression models for inflation rate and unemployment rate in both countries.

The Bayesian linear regression model has the form:

$$Y_i = X_i \cdot \beta + u_i$$
$$u_i \rightarrow N(0, s^2)$$

Y = dependent variable (n * 1 vector)

X = explanatory variables (n * k matrix)

u_i- error term

β - coefficient

s^2- variance corresponding to the normal distribution of the errors

For the estimation, we employed Gibbs sampling method using the priors of Lindley and Smith (1972):

$$\beta \rightarrow N(m, V)$$
$$s^2 \rightarrow IG(a, b)$$

m and V- mean and variance-covariance matrix for the normal distribution of the coefficient

a and b- parameters corresponding to the inverted gamma distribution of the variance

The variables used in this study are: unemployment rate in Serbia (us), inflation rate in Serbia (is), unemployment rate in Romania (ur), inflation rate in Romania (ir). When the inflation rate was considered as dependent variable in both countries, a low and positive correlation with unemployment rate was observed. The BVAR models with prior normal distributon of the coefficients confirm these results (Appendix 1 and 2). The positive correlation between inflation and unemployment rate in both countries is contrary to economic theory. This positive correlation could be benefical for the economy only if both indicators have low values. Lower values for inflation and unemployment were observed in Romania compared to Serbia. In this case, fiscal policymakers should come with a particular set of challenges. This type of correlation was also met in the US during 1970s, because the president Nixon deleted the U.S. dollar from the gold standard and controlled the salaries and the prices. Our results for Romania are consistent with the conclusion of Florea (2014) that showed also a positive relationship between inflation and unemployment in Romania on long-run due for age group 20-24 years, because of the recent economic crisis and of policy interventions. It seems that Phillips curve is valid only on short-run.

We checked if there is any causality between inflation and unemployment rate in both countries. Granger causality must be checked only of stationary data series. Therefore, we tested the presence of unit roots in our data sets. According to ADF test, the data series for both variables in both countries are stationary in first difference at 5% level of significance (Appendix 3). Therefore, we checked for Granger causality for the data series in first difference. For both countries, we got that there is not any type of causality between absolute changes in inflation and unemployment rate in Romania and Serbia (appendix 4). Johansen test was employed to verify if there is any cointegration relationship between variables with data series in level (appendix 5). We obtained that inflation rate and unemployment rate are cointegrated of order 1 at 5% level of significance. So, a long-run correlation between inflation and unemployment rate exists in both countries, but it is a positive one.

5. CONCLUSION

It is developing a growing interest in predicting inflation, keeping in mind that the proper management of inflation is considered the primary objective of macroeconomic policies, especially monetary policy. This is especially important when one considers that the Republic of Serbia on the road to EU accession and thereby seeks to maintain inflation within the permitted limits. The paper presents the different manifestations and causes that move the understanding of the Phillips curve.

The tested hypothesis has confirmed the initial assumption that there is no trade-off between inflation and unemployment in Serbia and Romania in nowadays. Reality has shown that economic policy in Serbia is focused on inflation targeting policy rather than a policy of unemployment. Given the fact that inflation can never be neutralized, it is necessary to keep it under control. In the case of Romania, situation is a little different, they consider both policy: unemployment is controlled and inflation is in limits last two years. This work gave scientifically valid and practically useful empirical contribution to the understanding of the relationship of inflation and unemployment. If the Phillips curve presented a concept come to life and was widely applied in practice, the monetary authorities could more effectively predict the rate of inflation. Results of the research are showed that Phillips curve well describes the dynamics of inflation, and can be used as an effective tool for predicting inflation. Whether the New Keynesian linear, hybrid or curve that includes marginal costs, they all come down to relationships inflation and unemployment and in particular their predictions. In this paper, we used GDP deflator as presenter of inflation considering the most literature. Data for inflation can (for example HICP) but the essence of their relationship is shown in the final result with Phillips curve.

Limitations of this model are reflected in the fact that inflation and unemployment are influenced by many other factors, and that there is no correlation only between these two macroeconomic variables so their changes can cause other variables of economic policy, such as exchange rates, interest rates, etc. However, this model represents a simplified picture of reality and makes certain conclusions for policy makers. This model gives a framework of monetary authorities to better manage and anticipate inflation.

From the analysis of the movement of the inflation rate and the unemployment rate in the observed period, it be said that in addition to selected long term necessary to analyse and shorter periods of time in order to see a short-term movement of inflation and unemployment, which may be recommendations for future research. For future research it would also be interesting to complement the analysis of Phillips curve models for forecasting inflation and inflationary risks, such as Monte Carlo simulation.

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Appendix 1

The relationship between inflation rate and unemployment rate in Serbia using Bayesian linear regressions and BVAR model

The dependent variable is
The regressor us
A constant is added to X.

```
  ,Coeff.'    ,Post. mean'    ,Post. std'
  ,C(0)'      [   11.9280]    [   9.9198]
  ,C(1)'      [    0.4121]    [   0.6506]
  ,s^2'       [  690.4879]    [ 224.0287]
```

The regressor is
The regressor us
Constant

```
 6.2953    6.3728
```

Posterior Phi1 coefficients

```
  0.49    0.03
 -0.02    0.67
```

Posterior covariance matrix of the VAR system

```
 313.89   -8.57
  -8.57    3.48
```

Appendix 2

The relationship between inflation rate and unemployment rate in Romania using Bayesian linear regressions and BVAR model

The dependent variable ir is
The regressor ur
A constant is added to X.

```
  ,Coeff.'    ,Post. mean'    ,Post. std'
  ,C(0)'      [    4.8723]    [   9.8390]
  ,C(1)'      [    2.6743]    [   1.7099]
  ,s^2'       [  837.2592]    [ 260.6157]
```

The regressor ir
The regressor ur
Constant

```
 -0.0755    5.4923
```

Posterior Phi1 coefficients

```
  0.55    1.42
 -0.01    0.22
```

Posterior covariance matrix of the VAR system

```
 524.54   -5.33
  -5.33    0.31
```

Appendix 3

Unit root tests for unemployment and inflation rate data series in Serbia and Romania
Unemployment rate and inflation rate data series in Serbia in first difference

Null Hypothesis: D(US) has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.052745	0.0012
Test critical values:	1% level	-3.920350	
	5% level	-3.065585	
	10% level	-2.673459	

Null Hypothesis: D(US) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 2 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.818915	0.0077
Test critical values:	1% level	-4.667883	
	5% level	-3.733200	
	10% level	-3.310349	

Null Hypothesis: D(US) has a unit root
Exogenous: None
Lag Length: 2 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.522684	0.0002
Test critical values:	1% level	-2.717511	
	5% level	-1.964418	
	10% level	-1.605603	

Null Hypothesis: D(IS) has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.858257	0.0019
Test critical values:	1% level	-3.959148	
	5% level	-3.081002	
	10% level	-2.681330	

Null Hypothesis: D(IS) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 3 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.347325	0.0036
Test critical values:	1% level	-4.728363	
	5% level	-3.759743	
	10% level	-3.324976	

Null Hypothesis: D(IS) has a unit root
Exogenous: None
Lag Length: 1 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.903431	0.0006
Test critical values:	1% level	-2.708094	
	5% level	-1.962813	
	10% level	-1.606129	

Unemployment rate and inflation rate data series in Romania in first difference

Null Hypothesis: D(UR) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.928423	0.0000
Test critical values:	1% level	-3.857386	
	5% level	-3.040391	
	10% level	-2.660551	

Null Hypothesis: D(UR) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.868458	0.0002
Test critical values:	1% level	-4.571559	
	5% level	-3.690814	
	10% level	-3.286909	

Null Hypothesis: D(UR) has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.084353	0.0000
Test critical values:	1% level	-2.699769	
	5% level	-1.961409	
	10% level	-1.606610	

Null Hypothesis: D(IR) has a unit root
Exogenous: None
Lag Length: 3 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.788394	0.0088
Test critical values:	1% level	-2.728252	
	5% level	-1.966270	
	10% level	-1.605026	

Null Hypothesis: D(IR) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-19.12253	0.0001
Test critical values:	1% level	-4.571559	
	5% level	-3.690814	
	10% level	-3.286909	

Null Hypothesis: D(IR) has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on SIC, maxlag=4)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.832031	0.0018
Test critical values:	1% level	-3.920350	
	5% level	-3.065585	
	10% level	-2.673459	

Appendix 4

Granger causality for inflation and unemployment rate in Serbia and Romania

Pairwise Granger Causality Tests
Sample: 1996 2015
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
D_IS does not Granger Cause D_US	17	0.59446	0.5673
D_US does not Granger Cause D_IS		0.07320	0.9298

Pairwise Granger Causality Tests
Sample: 1996 2015
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
D_IR does not Granger Cause D_UR	17	1.89565	0.1926
D_UR does not Granger Cause D_IR		0.70274	0.5145

Appendix 5

Johansen cointegration test for inflation and unemployment rate in Serbia and Romania

Serbia
Included observations: 18 after adjustments
Trend assumption: Linear deterministic trend
Series: IS US
Lags interval (in first differences): 1 to 1
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.707069	25.53189	15.49471	0.0011
At most 1	0.173552	3.431140	3.841466	0.0640

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.707069	22.10075	14.26460	0.0024
At most 1	0.173552	3.431140	3.841466	0.0640

Romania
Included observations: 18 after adjustments
Trend assumption: Linear deterministic trend
Series: IR UR
Lags interval (in first differences): 1 to 1
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.863818	39.72968	15.49471	0.0000
At most 1 *	0.192199	3.841901	3.841466	0.0500

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.863818	35.88778	14.26460	0.0000
At most 1 *	0.192199	3.841901	3.841466	0.0500