IMPACT OF INTEREST RATE AND INFLATION ON GDP IN BULGARIA, ROMANIA AND FYROM

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ABSTRACT

The influence of interest rates and inflation on GDP growth has been the subject of long debates and many research studies: from purely theoretical analysis of the channels through which this is accomplished, to empirical studies on a broad panel of countries. Because of these shared arguments about the impact of interest rates and inflation on GDP growth, as an area of investigation in this paper we took FYROM, Bulgaria and Romania. The first country is not part of the EU but the last two are, but all of them non-Eurozone members. The analysis aims to investigate the influence of these variables on GDP, on one hand in the country which is still on its way to enter the EU and on the other hand for the two countries that are expected to enter the common monetary area. The paper examines existing theory to create an analytical framework for the impact of interest rate and inflation on GDP, then to quantitatively evaluate the importance of these variables for the economic growth in the three countries. A cointegration analysis with three variables (interest rate, inflation and GDP growth) and a Granger causality analysis are implemented to examine the relations between these variables. Unit root tests will be applied in so as to examine the relationships among the respective data series. Our target period is from 2000 until present time, offering both a relatively positive first period until the arrival of the debt crisis by the end of the 2000s, leading to strict austerity and deflationary gaps in most countries. Our basic aim is to investigate the links between monetary and fiscal measures, especially for developing countries that strive for economic growth without having a strong home currency.

JEL Classification: E31, E43, O40

1. INTRODUCTION

The paper is focusing and analyzing three countries: FYROM, Bulgaria and Romania. The first country is not part of the EU and the last two are, but all of them non-Eurozone members. The analysis aims to investigate the influence of interest rates and inflation on GDP, in the country

which is still on its way to enter the EU(FYROM) and the other two countries that are expected to enter the common monetary area in the next period (Bulgaria and Romania).
Bulgaria has been experiencing a slow and painful transition to a market economy since the end of Communist rule. Bulgaria started accession talks with the EU in 2000, and signed an EU accession treaty in April 2005 and joined in January 2007. Today, it is an economy of 7.3 million people with a per capita income of $6,870. In the decade following up to EU accession, Bulgaria involved in difficult reforms to form macroeconomic stability and encourage growth. It built fiscal barriers by accruing fiscal surpluses between 2004 and 2008, and reduced public debt from over 70 % of GDP in 2000 to 18.5 % in 2012, the second lowest debt levels in the EU. During the years while IMF currency board was setting the monetary policy, Bulgaria fixed the lev to the deutschmark (and now also to the euro), and reduced inflation to 1%.
In the last 15 years, Romania has made considerable progress as a country that implement market economy as the basic economic system. Joining the European Union (EU) in 2007 was a critical point for the implementation of transformation and renovation. During the years of the economic crisis, Romania made a quick retrieval thanks managing reforms with support from the international financial institutions. The reforms consist of changes in education, the financial sector, public financial management, and public administration. Some of these directly affected the recovery from the crisis, and the other part influence the long-term recovery and growth. Packages of macro-stabilization and fundamental actions, supported by a multilateral program with the World Bank, International Monetary Fund and European Commission, helped the country pass the effects of the crisis by reestablishing macroeconomic stabilities and sustain with the economic growth. Since the international financial program, the exchange rate of the domestic currency with the euro has remained generally stable, with moderate changes in periods.
The Former Yugoslav Republic (FYR) of Macedonia has made great steps in reforming its economy over the last 15 years. The country has made important progress realizations, but additional steps in many areas are still needed in order to have more significant and needed economic growth and bigger living standards. The country is not part of the EU, but economy is associated to European countries which are the biggest source of investment and trade partners. Although the economy was stroked from the economic crisis in the euro zone, it maintained macroeconomic stability through by steering strict monetary policy, which keeps the domestic currency fixed against the euro. The countries is walking towards sustainable growth path, creating more and better jobs, and promote prosperity with GDP growth and fixed exchange rate.
The paper examines existing theory to create an analytical framework for the impact of interest rate and inflation on GDP, and to quantitatively evaluate the importance of these variables for the economic growth in the three countries. A cointegration analysis with three variables (interest rate, inflation and GDP growth) and a Granger causality analysis are implemented to examine the relations between these variables. Unit root tests will be applied in so as to examine the relationships among the respective data series. Our target period is from 2000 until present time, offering both a relatively positive first period until the arrival of the debt crisis by the end of the 2000s, leading to strict austerity and deflationary gaps in most countries.

2. LITERATURE REVIEW

There are significant research papers concerning the influence of interest rates and inflation rates on GDP. They are analyzing countries with different economic development and taking data sets with different duration and frequency.

According to Di Giovanni, McCrary and Wachter (2009), a repeated question in economics is the extent to which monetary policy involvements affect the real economy. This is a central research theme of numerous studies – for example Christiano, Eichenbaum and Evans (1999), Romer and Romer (1989) and Sims (1972, 1980), including work done by the 2011 Economic Nobel Prize winners, Sargent and Sims, who investigated the impact and causal relationships of unexpected shocks in the economy. These include, for example, the impact of an interest rate on GDP or inflation (Sargent and Sims 2011)

An increase in interest rates makes the cost of money more expensive, particularly when investments show a significant sensitivity to variations in interest rates. This could cause a decrease in aggregate demand, on one hand directly through investments and on the other indirectly through a lower wealth effect in the private sector and lower consumption. Also, higher interest rates could also initiate an increase in savings and could entice foreign inflows that could lead to a currency appreciation. This is especially true in a fairly small open economy, with a flexible exchange rate regime and relatively mobile capital (Briotti 2005).

Di Giovanni et al. (2009) found that interest rates lower quarterly real growth only moderately. Their results, using an ordinary least squares (OLS) methodology, show that a 1 percentage point increase in the interest rate in the Netherlands resulted in a 0.094 percentage point decrease in the real growth rate. A similar increase in the interest rate in France gave only a 0.015 percentage point decrease in the real growth rate. Their research shows an average interest rate effect of -0.043 on real growth across 12 European countries.

Research by the Organisation for Economic Co-operation and Development (OECD) (2008) shows that the impact on the US GDP (four to six quarters later) as a result of a 100 basis point increase in the real short-term interest rate is -0.09% (using reduced form estimation) and -0.06% (using a vector autoregression model). This research was done using quarterly data that covers the period 1990 (Q4) to 2007 (Q3).

According to research done by the European Central Bank (ECB) analysts (2002), the impact on real GDP as a result of a 100 basis point increase in the ECB repo rate is -0.34% after the first year and -0.71% after the second year, while the impact on consumer prices is -0.15% after the first year and -0.30% after the second year (see Table 1). The impact shown by the NCB (the ECB's macroeconometric model) is slightly lower, with a real GDP impact of -0.38% after year two and a reduction of -0.21% in the consumer prices. The NiGEM model shows a decrease of 0.47% in real GDP during year two.

Saymeh and Abu Orabi (2013) used regression analysis to estimate the impact of interest rates (among other variables) on real GDP for Jordan from 2000 to 2010. They found that a one period lagged interest rate had a significant impact on GDP, with a coefficient of -0.152. With a generalized autoregressive conditional heteroskedasticity (GARCH) regression, they estimated a lagged interest rate impact of -0.34 on real GDP.

Barro (1995) examines the issue and finds a significant negative relationship between inflation and GDP. The study contains a large sample data of more than 100 economies for the period 1960 to 1990 and to assess the effects of inflation on growth, a system of regression equations is used, in which many other determinants of growth are held constant. This framework is based on an expanded view of the neoclassical growth model as stated by Barro and Sala-i-Martin (1995). The study indicates that there is a statistically significant negative relationship between inflation and gross domestic product. More specifically, an increase in the average annual inflation by 10 percentage points per year lowers the real GDP growth by 0.2 to 0.3 percentage points per year.

Bruno and Easterly (1995) report the issue of inflation and growth and find no evidence of any consistent relationship between these variables up to a certain level of inflation. They evaluate that the growth falls during distinct high inflation crisis, above than 40 percent, and recovers after inflation falls. Their empirical analysis shows that there exists a sequential negative relationship between these two variables beyond 40 percent of inflation increase. They conclude that there is no significant influence to economic growth due to discrete high inflation crisis.

Using co-integration and error correction models, Malik and Chowdhury (2001) finds a long-run positive relationship between GDP growth rate and inflation for four South Asian countries. Concerning the results, they found that moderate inflation is helpful to faster economic growth and rise the GSP in a country. They recommend moderate inflation for growth of the economies of Bangladesh, India, Pakistan and Sri Lanka.

Munir et al. (2009) analyze the non linear relationship between inflation level and economic growth rate for the period 1970-2005 in the economy of Malaysia. Using annual data and applying new endogenous threshold autoregressive (TAR) models proposed by Hansen (2000), they find an inflation threshold value existing for Malaysia and verify the view that the relationship between inflation rate and economic growth is nonlinear. The estimated threshold regression model suggests 3.89 percent as the structural break point of inflation above which inflation significantly hurts growth rate of real GDP.

Khan and Senhadji (2001) examine effects of inflation on growth separately for industrial and developing countries. The data set covers 140 countries from both groups and non-linear least squares (NLLS) and conditional least squares methods are used. The empirical results show the presence of a threshold beyond which inflation exerts a negative effect on growth and GDP. The assessment of low inflation for sustainable growth is intensely supported by this study.

Another study done by Hobijn and Steindel (2009), shows that GDP can be seen as major dimension for economic activity because its movements on the short and long run are correlated with factors that influence the level of GDP, among which are inflation rate and income.

Ahmad and Mortaza (2005) assessed the idea that constant inflation rates encourage the development process of a country, and hence economic growth. Using annual data set on real GDP and CPI of Bangladesh for the period of 1980 to 2005, they demonstrate statistically significant long-run negative relationship between inflation and economic growth for the country as showed by a statistically significant long-run negative relationship between CPI and real GDP. Also as a threshold they suggested 6% of inflation above which inflation harmfully affects economic growth.

However, Johanson (1967) found no conclusive empirical evidence for either a positive or a negative association between the two variables. His view was that the effect of inflation on growth was not particularly important. Also Fischer and Modigliani (1978) suggest a negative and nonlinear relationship between the rate of inflation and economic growth through the new growth theory mechanisms (Malla, 1997). Fisher (1993) also found negative relation between inflation and growth for a large set of countries.

All of the above discussion shows different results. In some of them there is an existence of relationship between inflation, interest rates and GDP, and in others there is moderate influence of the first two variables to GDP in countries with different economic development and structure.

3. DATA COLLECTION

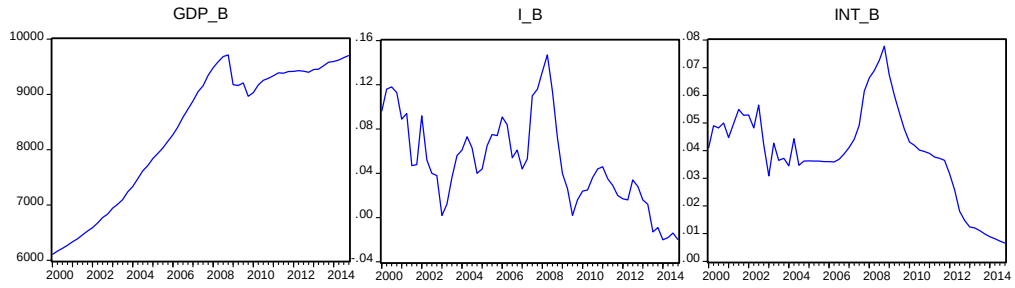
For the purpose of the study we take the data series from three countries, including gross domestic product (GDP), inflation rate and interest rates. In order to check impact of interest

rates and inflation on GDP in Bulgaria, Romania and FYROM, comprehensive data has been gathered for the period 2000-2014 with quarterly frequency of data values within each year. The data series were taken from different sources. We have consulted the State Statistical Offices in Bulgaria, Romania and FYROM, and also the rest of the data series were collected from the Central Banks of the three countries that are observed and analyzed and also from Eurostat.

4. ANALYSIS AND DISCUSSIONS

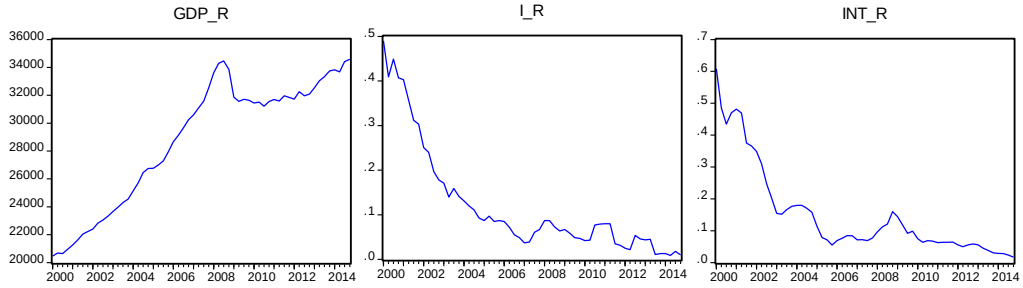
This chapter covers the estimation and analysis of data for the period 2000 - 2014 to check out the impact of inflation rate and interest rate to GDP in Bulgaria, Romania and FYROM. First, we present the movements graphically for the three variables: gross domestic product (GDP), inflation rate (I) and interest rate (INT) for the three countries.
After that, in the subsequent parts we cover analysis based on correlation, presenting the correlation matrixes, and unit root tests, performing and analyzing Augmented Dickey-Fuller (ADF) test. After that we analyze the cointegration as an econometric technique for testing the correlation between non-stationary time series variables. Here we use Johansen model for analysis. And at the end we implement the Granger Causality tests, analyzing the causality between specific variables in three different countries.

Graph 1: GDP, inflation and interest rates of Bulgaria 2000-2014 (quarterly)



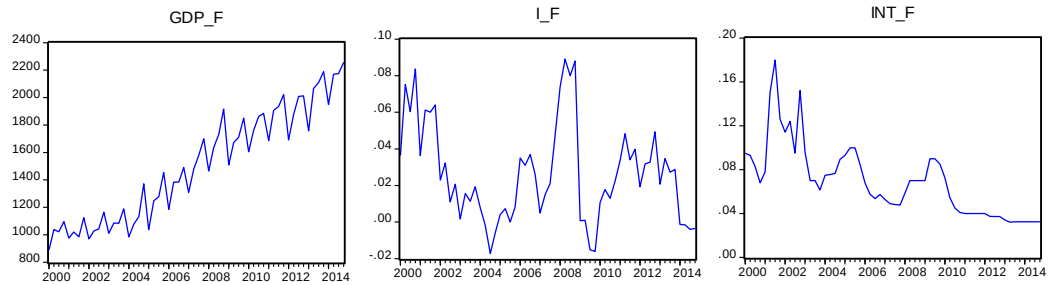
Source: State Statistical Office in Romania, Central Bank of Bulgaria

Graph 2: GDP, inflation and interest rates of Romania 2000-2014 (quarterly)



Source: State Statistical Office in Bulgaria, Central Bank of Romania

Graph 3: GDP, inflation and interest rates of FYROM 2000-2014 (quarterly)



Source: State Statistical Office in FYROM, Central Bank of FYROM

4.1. Correlations

Correlation is used as statistical technique to measure and describe the strength and direction of the relationship between two variables.In our analysis we use correlation matrixes for the three countries in order to measure the correlation (strength and direction) between the different variables for each country.

Table 1: Correlation matrix Bulgarian GDP, inflation and interest rates

	GDP_B	I_B	INT_B
GDP_B	1.000000		
I_B	-0.375706	1.000000	
INT_B	-0.255018	0.671215	1.000000

Concerning Bulgaria, both inflation and interest rates have a small negative correlation against the GDP of the country, showing a negative relationship among the variables. In addition, inflation and interest rates have a positive correlation of 0.67, as expected, revealing a relatively strong relationship between the two variables, in accordance with basic monetary policy.

Table 2: Correlation matrix Romanian GDP, inflation and interest rates

	GDP_R	I_R	INT_R
GDP_R	1.000000		
I_R	-0.874799	1.000000	
INT_R	-0.847793	0.977172	1.000000

Likewise, inflation and interest rates in Romania have a negative correlation against GDP but at significantly larger values than Bulgaria, i.e. -0.87 and -0.85, respectively. Equally strong is the correlation between interest rates and inflation, which reaches almost the perfect positive correlation level, i.e. 0.98. This could be a sign of a monetary policy that follows closely the changes of the price levels in the country during the period 2000-2014.

Table 3: Correlation matrix Macedonian GDP, inflation and interest rates

	GDP_F	I_F	INT_F
GDP_F	1.000000		
I_F	-0.074665	1.000000	
INT_F	-0.728305	0.106115	1.000000

In this case, inflation to GDP correlation in FYROM is relatively non-existent, having a marginally negative value of -0.75, revealing a very weak relationship between the two

variables. On the contrary, interest rates to GDP have a negative correlation of -0.73 proving a strong negative relationship between these two variables. As a result of the above fact, the interest rates and inflation are weakly correlated, i.e. 0.11, showing that the monetary policy of the country does not closely monitor changes in the prices levels.

4.2 Unit Root Tests

We use unit root test to find whether a time series variable is non-stationary. A stationary time series is one whose statistical properties such as mean, variance, autocorrelation, etc. are all constant over time. If there is a unit root then series are non-stationary.
For the purpose of this study, we have performed the Augmented Dickey-Fuller (ADF) test. This test is an augmented version of the Dickey-Fuller test for a larger and more complicated set of time series models for testing I (1) versus I (0). The null hypothesis here is H_0: Data series have a unit root.
The testing procedure for the ADF test is applied to the model:

$$\Delta y_t = \alpha + \beta_t + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + \ldots + \delta_{p-1} \Delta y_{t-p+1} + \varepsilon_t$$

The logic of the test is that if the series is not integrated then the lagged level of the series $(y_t - 1)$ will provide no relevant information in predicting the change in yt besides the one obtained in the lagged changes (Δy_{t-k}). In that case the y=0 null hypothesis is not rejected.

The next tables are presenting the Dickey-Fuller test for the three different variables for Bulgaria

Table 4: Dickey-Fuller test for Bulgarian GDP – I(1)

Null Hypothesis: GDP_B has a unit root Exogenous: Constant Lag Length: 0 (Automatic based on SIC, MAXLAG=10)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.115470	0.2395
Test critical values:	1% level	-3.546099	
	5% level	-2.911730	
	10% level	-2.593551	
*MacKinnon (1996) one-sided p-values.			

Performing the Dickey-Fuller test for the unit root in case for GDP in Bulgaria (I(1)), we do not reject the null hypothesis and series have a unit root, they are non-stationary.

Table 5: Dickey-Fuller test for Bulgarian GDP – I(0)

Null Hypothesis: D(GDP_B) has a unit root Exogenous: Constant Lag Length: 2 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.272554	0.1842
Test critical values:	1% level	-3.552666	
	5% level	-2.914517	
	10% level	-2.595033	
*MacKinnon (1996) one-sided p-values.			

Here I(0), we also do not reject the null hypothesis , and series and non-stationary.

Table 6: Dickey-Fuller test for Bulgarian Inflation – I(1)

Null Hypothesis: I_B has a unit root Exogenous: Constant Lag Length: 4 (Automatic based on SIC, MAXLAG=10)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.261877	0.6410
Test critical values:	1% level	-3.555023	
	5% level	-2.915522	
	10% level	-2.595565	
*MacKinnon (1996) one-sided p-values.			

Concerning the Inflation rate in Bulgaria, we do not reject the null hypothesis and the series again are non-stationary.

Table 7: Dickey-Fuller test for Bulgarian Inflation – I(0)

Null Hypothesis: D(I_B) has a unit root Exogenous: Constant Lag Length: 3 (Automatic based on SIC, MAXLAG=10)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.557541	0.0000
Test critical values:	1% level	-3.555023	
	5% level	-2.915522	
	10% level	-2.595565	
*MacKinnon (1996) one-sided p-values.			

Here, for I(0), the probability is below 5%, so we reject the null hypothesis and the data series are stationary.

Table 8: Dickey-Fuller test for Bulgarian Interest rate – I(1)

Null Hypothesis: INT_B has a unit root Exogenous: Constant Lag Length: 0 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.383911	0.9047
Test critical values:	1% level	-3.546099	
	5% level	-2.911730	
	10% level	-2.593551	

*MacKinnon (1996) one-sided p-values.

Performing the Dickey-Fuller test for the unit root in case of interest rates in Bulgaria (I(1)), we do not reject the null hypothesis and series have a unit root, they are non-stationary.

Table 9: Dickey-Fuller test for Bulgarian Interest rate – I(0)

Null Hypothesis: D(INT_B) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.407087	0.0000
Test critical values:	1% level	-3.548208	
	5% level	-2.912631	
	10% level	-2.594027	

*MacKinnon (1996) one-sided p-values.

For I(0), the probability is below 5%, so we reject the null hypothesis and the data series are stationary.

The next tables are presenting the Dickey-Fuller test for the three different variables for Romania

Table 10: Dickey-Fuller test for Romanian GDP – I(1)

Null Hypothesis: GDP_R has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.414280	0.5692
Test critical values:	1% level	-3.548208	
	5% level	-2.912631	
	10% level	-2.594027	

*MacKinnon (1996) one-sided p-values.

In the case of GDP of Romania, we do not reject the null hypothesis and series have a unit root, they are non-stationary.

Table 11: Dickey-Fuller test for Romanian GDP – I(0)

Null Hypothesis: D(GDP_R) has a unit root

Exogenous: Constant
Lag Length: 0 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.439321	0.0007
Test critical values:	1% level	-3.548208	
	5% level	-2.912631	
	10% level	-2.594027	

*MacKinnon (1996) one-sided p-values.

Concerning the I (0), we reject the H_0 , and series are stationary, with no unit root.

Table 12: Dickey-Fuller test for Romanian Inflation – I(1)

Null Hypothesis: I_R has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.309717	0.0000
Test critical values:	1% level	-3.555023	
	5% level	-2.915522	
	10% level	-2.595565	

*MacKinnon (1996) one-sided p-values.

Concerning the Inflation in Romania, there is no unit root and series are stationary.

Table 13: Dickey-Fuller test for Romanian Inflation – I(0)

Null Hypothesis: D(I_R) has a unit root
Exogenous: Constant
Lag Length: 6 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.925531	0.3184
Test critical values:	1% level	-3.562669	
	5% level	-2.918778	
	10% level	-2.597285	

*MacKinnon (1996) one-sided p-values.

In this case of inflation rate in Romania (I (0)), we do not reject H_0, which means that there is a unit root problem.

Table 14: Dickey-Fuller test for Romanian Interest rates – I(1)

Null Hypothesis: INT_R has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic based on SIC, MAXLAG=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.218455	0.2021
Test critical values:	1% level	-3.548208	
	5% level	-2.912631	
	10% level	-2.594027	
*MacKinnon (1996) one-sided p-values.			

Performing the Dickey-Fuller test for the unit root in case of interest rates in Romania (I(1)), we do not reject the null hypothesis and series have a unit root, they are non-stationary.

Table 15: Dickey-Fuller test for Romanian Interest rates – I(0)

Null Hypothesis: D(INT_R) has a unit root Exogenous: Constant Lag Length: 0 (Automatic based on SIC, MAXLAG=10)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.476381	0.0000
Test critical values:	1% level	-3.548208	
	5% level	-2.912631	
	10% level	-2.594027	
*MacKinnon (1996) one-sided p-values.			

In case of I(0), there is no unit root and series are stationary.

The next tables are presenting the Dickey-Fuller test for FYROM for the three different variables.

Table 16: Dickey-Fuller test for Macedonian GDP – I(1)

Null Hypothesis: GDP_F has a unit root Exogenous: Constant Lag Length: 4 (Automatic based on SIC, MAXLAG=10)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.750534	0.9922
Test critical values:	1% level	-3.555023	
	5% level	-2.915522	
	10% level	-2.595565	
*MacKinnon (1996) one-sided p-values.			

Performing the Dickey-Fuller test for the unit root in case for GDP in FYROM (I(1)), we do not reject the null hypothesis and series have a unit root, they are non-stationary.

Table 17: Dickey-Fuller test for Macedonian GDP – I(0)

Null Hypothesis: D(GDP_F) has a unit root

Exogenous: Constant Lag Length: 3 (Automatic based on SIC, MAXLAG=10)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.067974	0.0023
Test critical values:	1% level	-3.555023	
	5% level	-2.915522	
	10% level	-2.595565	
*MacKinnon (1996) one-sided p-values.			

Concerning I(0), we have probability below 5%, so we reject the null and the data series are stationary.

Table 18: Dickey-Fuller test for Macedonian Inflation – I(1)

Null Hypothesis: I_F has a unit root Exogenous: Constant Lag Length: 2 (Automatic based on SIC, MAXLAG=10)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.937183	0.0033
Test critical values:	1% level	-3.550396	
	5% level	-2.913549	
	10% level	-2.594521	
*MacKinnon (1996) one-sided p-values.			

Implementing the test for the inflation rates in FYROM, we can see from the probability that we reject the null hypothesis and can conclude that the data series are stationary, there is no unit root.

Table 19: Dickey-Fuller test for Macedonian Inflation – I(0)

Null Hypothesis: D(I_F) has a unit root Exogenous: Constant Lag Length: 0 (Automatic based on SIC, MAXLAG=10)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.814947	0.0000
Test critical values:	1% level	-3.548208	
	5% level	-2.912631	
	10% level	-2.594027	
*MacKinnon (1996) one-sided p-values.			

There is no unit root for I(0) in case of inflation rate in FYROM.

Table 20: Dickey-Fuller test for Macedonian Interest rate – I(1)

Null Hypothesis: INT_F has a unit root Exogenous: Constant

Lag Length: 8 (Automatic based on SIC, MAXLAG=10)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.739774	0.8271
Test critical values:	1% level	-3.565430	
	5% level	-2.919952	
	10% level	-2.597905	
*MacKinnon (1996) one-sided p-values.			

When we analyze the interest rates, we can see that there is unit root, we do not reject the null hypothesis, so the data sets are non-stationary.

Table 21: Dickey-Fuller test for Macedonian Interest rate – I(0)

Null Hypothesis: D(INT_F) has a unit root Exogenous: Constant Lag Length: 7 (Automatic based on SIC, MAXLAG=10)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.809142	0.0002
Test critical values:	1% level	-3.565430	
	5% level	-2.919952	
	10% level	-2.597905	
*MacKinnon (1996) one-sided p-values.			

We cannot conclude the same for I(0), which means that there is stationarity.

4.3 Cointegration

Cointegration is an econometric method for testing the correlation between non-stationary time series variables. If two or more series are themselves non-stationary, but a linear combination of them is stationary, then the series are said to be cointegrated. For example, a stock index and the price of its associated futures contract move through time, each roughly following a random walk. Testing the hypothesis that there is a statistically significant connection between the future price and the spot price could now be done by finding a cointegrating vector. If such a vector has a low order of integration it can signify an equilibrium relationship between the original series, which are said to be cointegrated of an order below one.

If we have two non-stationary time series X and Y that become stationary when differenced (these are called integrated of order one series, or I(1) series; random walks are one example) such that some linear combination of X and Y is stationary (I(0)), then we say that X and Y are cointegrated. In other words, we can think of cointegration as describing a particular kind of long-run equilibrium relationship.

Cointegration is an equilibrium relationship between time series that individually aren't in equilibrium and it's useful because it allows us to incorporate both short-term dynamics (deviations from equilibrium) and long-run expectations (corrections to equilibrium).

The superior test for cointegration is Johansen's test. This is a test which has all desirable statistical properties. This test permits more than one cointegrating relationship.

In case of Bulgaria, all variables that are level stationary.

Table 22: Johansen's test for Bulgarian variables

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.363788	34.92906	29.79707	0.0117
At most 1	0.132905	8.700090	15.49471	0.3939
At most 2	0.007367	0.428881	3.841466	0.5125
Trace test indicates 1 cointegrating eqn(s) at the 0.05 level				

After performing the Johansen test, we can conclude that the variables seem to be cointegrated at the 5% significance level, revealing the existence of a long-term relationship among the variables.

Romania, on the other hand , has only GDP and Interest Rate series that are stationary at levels, so we can run a cointegration test for the two.

Table 23: Johansen's test for Romanian variables

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.144309	14.36918	15.49471	0.0733
At most 1 *	0.087802	5.330112	3.841466	0.0210
Trace test indicates no cointegration at the 0.05 level				

Results show that there is no cointegration between the two variables.

Taking into analysis FYROM, variables that are level stationary are GDP and Interest Rates.

Table 24: Johansen's test for Macedonian variables

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**

None	0.218693	14.47317	15.49471	0.0708
At most 1	0.002747	0.159525	3.841466	0.6896

Trace test indicates no cointegration at the 0.05 level

Results show that there is no cointegrating vector between the GDP and the Interest Rates.

4.4. Granger Causality

Granger causality is a statistical model of causality that is based on forecast. Conferring to Granger causality, if a indicator X_1"Granger-causes" a indicator X_2, then past values of X_1 should contain information that helps predict X_2 above and beyond the information contained in past values of X_2 alone. All Granger Causality tests are run at 5% significance level and have as H_0: Variable X does not Granger cause Variable Y.

We use the Granger Causality statistical model for the three countries.
The Granger causality test for Bulgaria is implemented for GDP, Inflation and Interest rates.

Table 25: Granger Causality statistical model for Bulgaria

Null Hypothesis:	Obs	F-Statistic	Probability
I_B does not Granger Cause GDP_B	58	4.47401	0.01602
GDP_B does not Granger Cause I_B		1.77320	0.17971
INT_B does not Granger Cause GDP_B	58	1.74676	0.18422
GDP_B does not Granger Cause INT_B		4.13078	0.02152
INT_B does not Granger Cause I_B	58	1.30687	0.27925
I_B does not Granger Cause INT_B		7.13381	0.00180

The Granger Causality test in case of Bulgaria shows that there is only one-way causality from Inflation to GDP and interest rates, and also from GDP to interest rates.

The Granger Causality test for Romania is showing slightly different results

Table 25: Granger Causality statistical model for Romania

Null Hypothesis:	Obs	F-Statistic	Probability
I_R does not Granger Cause GDP_R	58	3.38263	0.04144
GDP_R does not Granger Cause I_R		0.29220	0.74781

INT_R does not Granger Cause GDP_R	58	3.57278	0.03503
GDP_R does not Granger Cause INT_R		0.88314	0.41948
INT_R does not Granger Cause I_R	58	0.98248	0.38109
I_R does not Granger Cause INT_R		12.0055	5.0E-05

The Granger Causality test shows that there is only one-way causality between the variables. In particular, in Romania, there seems to be one-way causality from inflation to GDP and interest rates, and interest rates to GDP.

Granger Causality test for FYROM is showing the following results

Table 25: Granger Causality statistical model for FYROM

Null Hypothesis:	Obs	F-Statistic	Probability
I_F does not Granger Cause GDP_F	58	0.65327	0.52448
GDP_F does not Granger Cause I_F		1.13920	0.32779
INT_F does not Granger Cause GDP_F	58	0.67209	0.51494
GDP_F does not Granger Cause INT_F		4.25464	0.01934
INT_F does not Granger Cause I_F	58	0.12973	0.87861
I_F does not Granger Cause INT_F		3.35523	0.04246

There is no case of two-way Granger causality between any of the variables. However, there seems to be one-way causality between specific variables, in particular: GDP and interest rates (GDP Granger causes rates) and inflation and interest rates (inflation leads rates).

4.5 Conclusion

The three countries that we analyze in this paper are not part of the Euro zone. Bulgaria and Romania are part of the European Union, and FYROM is still in the negotiation process. They have significant economic improvements during the period that we are covering in the paper (2000 – 2014), with significant lag behind other European developed countries part of the EU and Eurozone. Concerning their national currencies, Bulgaria fixed the lev to the deutschmark (and now also to the euro). The exchange rate of the domestic currency with the euro in Romania has remained generally stable, with moderate changes in periods. FYROM has the domestic currency which exchange rate is fixed to European currency.
From the correlation matrixes we can conclude that in Bulgaria, both inflation and interest rates have a small negative correlation against the GDP of the country. Inflation and interest rates in this country have a positive correlation revealing a relatively strong relationship between the two variables, in accordance with basic monetary policy. Inflation and interest rates in Romania have a negative correlation against GDP but at significantly larger values than Bulgaria. Equally strong is the correlation between interest rates and inflation, which reaches almost the perfect positive correlation level which could be a sign of a monetary policy that follows closely the changes of the price levels in the country during the period 2000-2014. Inflation to GDP correlation in FYROM is relatively non-existent, revealing a very weak relationship between the two variables. On the contrary, interest rates to GDP have a negative correlation. The interest

rates and inflation in this country are weakly correlated, showing that the monetary policy of the country does not closely monitor changes in the prices levels.

We use unit root test to find whether a time series variable is non-stationary. For the purpose of this study, we have performed the Augmented Dickey-Fuller (ADF) test. From the test performed for the three countries, we can conclude that in case of Bulgaria, we do not reject the null hypothesis and series have a unit root, they are non-stationary for the three variables GDP, inflation and interest rates. In case of Romania, there is a stationarity just with inflation, and other two variables (GDP and interest rate) and non-stationary. The same conclusion as for Romania about the stationarity can be implemented in FYROM.

We used Johansen's test to investigate the cointegration for the variables that are level stationary. From the test we can conclude that in case of Bulgaria, the variables seem to be cointegrated at the 5% significance level, revealing the existence of a long-term relationship among the variables. Concerning Romania and FYROM, there is no cointegrating vector between GDP and interest rates for both countries.

The Granger Causality test in case of Bulgaria shows that there is only one-way causality from Inflation to GDP and interest rates, and also from GDP to interest rates. In particular, in Romania, there seems to be one-way causality from inflation to GDP and interest rates, and interest rates to GDP. Implementing the same test for FYROM variables, there seems to be one-way causality between GDP and interest rates and inflation and interest rates.

Further analysis in the future could take into consideration the special characteristics of each country's variables as well as the different monetary and fiscal policies used. To this effort, additional variables could also be introduced to the analysis, such as net exports or individual GDP figures (C, I, G) in order to reveal more detailed patterns in the relationships of these variables to interest rates and inflation. Furthermore, since the statistical tests applied (ADF, Johansen and Granger causality) are lag-sensitive, a further experimentation with various time lags could probably discover different patterns.

5. BIBLIOGRAPHY

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