

Long-term Interest Rates' Integration and Dynamics in Some CEE Countries on the Road to Eurozone

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Summary:

As most of the CEE countries are not yet participating as full members of the Economic and Monetary Union they are still obliged to enter the Euro area at some time in the future. Issue with raising importance tends to be the fulfillment of the convergence criteria and the problems relating to it in the context of the global financial crisis. This paper is focusing on the long-term interest rates, namely their co-integration as regard of some CEE countries towards the euro area as a whole. The center of the study includes also the most significant determinants of the long-term interest rates and their influence before, during and after the crisis. The results could be useful for recommending particular policies at different economic circumstances.

Key words: Long-term interest rates, CEE countries, co-integration, determinants, global financial crisis

JEL classification: E43, F36

1. Introduction:

The road to Eurozone goes through obligation to fulfill some criteria for nominal convergence, namely the Maastricht criteria for inflation, long-term interest rates, debt, deficit and exchange rate. In a pure economic and monetary union it is important for the countries to success such level of integration which makes it possible for them to realize low trade cost and similar business cycles for maintaining sustainable growth and economic stability.

This paper investigates the co-integration between the long-term interest rates of some Central and Eastern European countries with those of the euro area as a whole (EU 19) and tries to explain the most possible determinants and their influence for the deviations before, during and after the global financial crisis. As the global financial crisis deteriorate the common economic stance of the European continent, the convergence of the CEE countries to the Eurozone was severely deviated. An interesting issue is whether the long-term interest rates are still on their path of long-term relationship even when the investigation is including also the period after the crisis. Because of the crucial role of the crisis there is also interesting whether the most influencing factors of the dynamics of the long-term interest rates are changing their strength or not. This could be useful for focusing on particular policies to soften their negative influence.

Next sections are organized as follows: Chapter 2 presents literature review regarding co-integration of the long-term interest rates and the determinants influencing their dynamics. Chapter 3 is methodological explanation of the research procedure. Chapter 4 represents the results, and conclusions are summarized in the last Chapter 5.

2. Literature Review:

Since the appearance of the European Union the issues regarding the European integration are broadly concerned and discussed. In recent times, although very criticized each and together, the convergence criteria of Maastricht are in the field of view of economists, politicians and researchers. As in this report we are considering the long-term interest rates in some CEE countries on their road to euro zone, we are focusing on the literature in this narrower aspect of economic integration regarding the Maastricht convergence criteria.

Although by entering the Eurozone one can expect positive developments of the macroeconomic variables in regard of lower long-term interest rates, there are also important possible negative effects. Toporowski (2015) mentioned that after the global financial crisis lower interest rates could be a negative impulse for worsening growth perspectives due to the fact that the cheaper capital is not always used to finance investment, but also too often to finance consumption and wage growth. This could undermine the competitiveness of the CEE countries and also their efforts for further convergence. The moral hazard is one other also important problem of lower interest rates because it encourages risky investment, such as in the housing market, creating bubbles or macroeconomic imbalances.¹

Haug, MacKinnon and Michelis (1999) employs systems-based co-integration techniques to determine which European Union countries would form a successful Economic and Monetary Union, based on long-run behavior of the nominal convergence criteria laid down in the Maastricht treaty. They study the long-term interest rates using monthly long-term government bond yields for 11 countries and concluded that there is co-integration among eight countries: Belgium, Denmark, France, Germany, Ireland, Luxembourg, the Netherlands, and the UK.²

Meister (2002) investigates some CEE countries for *co-integration* of the Maastricht criteria with EMU countries using the Johansen co-integration method and VAR regression. The results show that the group of countries which entered the EU in

¹ Toporowski, P., 2015, A Post-Crisis Eurozone: Still an Attractive Offer for Central Europe, Policy Paper № 22 (124), PISM, July 2015

² Haug, A., MacKinnon, J., Michelis, L., 1999, European Monetary Union: A Co-integration Analysis, Revised: April, 1999

2004 (Czech Republic, Hungary, Latvia, Poland, Slovak Republic and Slovenia) are on their way to convergence. In contrast the later joined countries (Bulgaria and Romania) are lagging behind but showed positive development.³

Holz (2006) analyzes the 10-year government bond yields of 5 CEE countries, namely Czech Republic, Hungary, Poland, Slovakia and Latvia. His results show that there is a forming co-integration block between the three biggest CEE countries, namely Czech Republic, Hungary and Poland. A co-integration relationship vis-à-vis EMU can only be identified for Slovakia.⁴

Bellas, Papaioannou and Petrova (2010) analyses the determinants of emerging market sovereign bond spreads by examining the short and long-run effects of fundamental (macroeconomic: risk-free rate, the stock of debt, gross domestic product, *fiscal balance*) and temporary (financial market) factors on these spreads. Analysis through fixed-effects model and pooled mean group model indicate that in the long run, fundamentals are significant determinants of emerging market sovereign bond spreads, while in the short run, financial volatility is a more important determinant of spreads than fundamental indicators.⁵

Dumičić and Ridzak (2011) analyze the determinants of the changes in sovereign bond spreads in emerging European markets before and during the recent global financial crisis. Using least squares and controlling for serial correlation the authors found that the dynamics of spreads can be explained by both market sentiment indicators (equity prices volatility index) and macroeconomic fundamentals (real GDP growth, *inflation rate*, exchange rate, general *government debt*, external debt, short-term external debt, international reserves, current account balance), with external imbalances

³ Meister, I., 2002, Is Eastern Europe Ready for the Euro? A Co-integration Analysis for the Maastricht Criteria, Research Memorandum WO no 699, De Nederlandsche Bank, September 2002

⁴ Holz, M., 2006, Interest Rate Convergence in CEE Countries Towards EMU Levels, Bond Market Performance and the Perspective of EMU Membership, January 2006

⁵ Bellas, D., Papaioannou, M., Petrova, I., 2010, Determinants of Emerging Market Sovereign Bond Spreads: Fundamentals vs Financial Stress, IMF Working Papers, WP/10/281, December 2010

not exerting any discernible effect on spreads prior to the crisis, but became increasingly significant as the crisis broke out.⁶

Moinescu (2012) investigates the mechanism by which lending to private sector may induce risks to the long-term interest rates convergence process in the new EU Member States and the empirical assessment highlights the importance of the sovereign risk premium transmission channel to long-term interest rate, with *approximately two thirds of the CDS rate contributing to the level of government bonds long-term yields*.⁷

⁶ Dumičić, M., Ridzak, T., 2011, Determinants of Sovereign Risk Premia for European Emerging Markets, Croatian National Bank, Zagreb, Financial Theory and Practice, 35 (3) 277-299 (2011)

⁷ Moinescu, B., Credit Accelerator, CDS Rate and Long Term Yields: Empirical Evidences From the CEE Economies, JAQM, Vol. 7, No. 3, Fall 2012

3. Methodology:

For the purpose of our analysis the econometric softwares JMulTi⁸ and SPSS⁹ are used.

The examined countries are: *Bulgaria, Czech Republic, Hungary, Poland and Romania*. They are members of the EU and have an obligation to enter also the Euro area. The investigation period is a 10-year period between June 2005 and first half of 2015 (*2005 M6 to 2015 M6*).

For the first part of the analysis *the Johansen co-integration method* is applied in order to illustrate if there is a co-movement between the long-term interest rates of the above mentioned Central and Eastern European countries with those of the euro area. Data for Euro area is represented as a benchmark for the analysis. The time series of the long-term interest rates are presented on a monthly basis. Initially a test for non-stationarity is implemented with Johansen trace test following.

For the second part of the analysis an *OLS regression* is used in order to explain the influence of the most crucial reasons for the deviations during the global financial crisis. The period could be divided into three sub periods, which represents the pre-crisis period, the period of the global financial crisis and conditional post-crisis period¹⁰. Because of the different timing of the available data the analysis is implemented with three separated models, namely:

- Long-term interest rates and debt and deficit – quarterly data;
- Long-term interest rates and inflation – monthly data;
- Long-term interest rates and CDS spreads – daily data.

All abovementioned data is extracted from Eurostat, except the CDS spreads which are from HSBC database.

8 JMulTi is an interactive open-source software designed for univariate and multivariate time series analysis.

9 SPSS – Statistical Package for Social Sciences

10 The economics of the all EU countries are not yet reached their levels before the crisis.

4. Results

To start with the analysis we first conducted a test for non-stationarity. The Augmented Dickey-Fuller test is applied to all time series of the long-term interest rates. The tests are done including a constant and without trend. It is important that the time series are integrated of order 1 for the co-integration analysis to be reliable.

Appropriate lag length is chosen by considering Akaike, Hannan-Quinn and Schwarz criteria and also the Ng and Perron procedure, described below.

BG	1%	5%	10%
	-3.43	-2.86	-2.57
	value of test statistic: -0.9862		

optimal number of lags (searched up to 10 lags of 1. differences):

Akaike Info Criterion: 3

Hannan-Quinn Criterion: 3

Schwarz Criterion: 0

For Bulgaria the value of test statistic – 0,9862 is greater than the critical value - 2,57 at 10%, hence one can accept the null hypothesis and conclude that there is a unit root and the time series for this country is *non-stationary*. As regard of the optimal lag length, Akaike and Hannan-Quinn are pointing at 3. Although it is better to use 0 according to Schwarz criterion, because it's the smallest (the smaller the lag length, the more reliable results), we are choosing Akaike Info Criterion by following Ng and Perron¹¹. According their recommendations we set an upper bound for the optimal lag length and run the ADF test. If the absolute value of the t-statistic for testing significance of the last lagged difference is greater than 1.6, then one should set the max value and perform the unit root test. Otherwise, one should reduce the lag length by one and repeat the process. JMulTi suggests maximum number of lags to be 10, so we chose 10 and repeat the process until reaching the optimal number of lags. For Bulgaria it's 3,

¹¹ Ng and Perron “Unit Root Tests in ARMA Models with Data-Dependent Methods for the Selection of the Truncation Lag”, JASA, 1995

which match the Akaike and Hannan-Quinn criteria. The same procedure is applied to all other countries.

CZ	1%	5%	10%
	-3.43	-2.86	-2.57

value of test statistic: 0.1098

optimal number of lags (searched up to 10 lags of 1. differences):

Akaike Info Criterion: 2

Hannan-Quinn Criterion: 2

Schwarz Criterion: 2

The same is true for the Czech Republic, where the value of test statistic is also greater than the critical value at 10%. The time series is *non-stationary* and considering all information criteria the optimal lag length is 2. The result according Perron's procedure is 8, which is too large, so we choose the optimal lag length of 2.

HU	1%	5%	10%
	-3.43	-2.86	-2.57

value of test statistic: -0.7500

optimal number of lags (searched up to 10 lags of 1. differences):

Akaike Info Criterion: 2

Hannan-Quinn Criterion: 2

Schwarz Criterion: 2

Hungary's time series is *non-stationary* too with optimal lag length of 2 according to all three information criteria and Perron's procedure. The value of test statistic -0,7500 is greater than the critical value -2,57 at 10%.

PL	1%	5%	10%
	-3.43	-2.86	-2.57

value of test statistic: -0.3968

optimal number of lags (searched up to 10 lags of 1. differences):

Akaike Info Criterion: 3

Hannan-Quinn Criterion: 2

Schwarz Criterion: 1

Poland's time series also has a unit root which can be seen as the value of test statistic -0,3968 is greater than the critical value -2,57 at 10%. Here we choose the optimal lag length to be 2 according to Hannan-Quinn Criterion, the procedure of Perron is pointing the same.

RO	1%	5%	10%
	-3.43	-2.86	-2.57

value of test statistic: -1.0200

optimal number of lags (searched up to 10 lags of 1. differences):

Akaike Info Criterion: 0

Hannan-Quinn Criterion: 0

Schwarz Criterion: 0

Non-stationarity characterizes also the time series of Romania. Here Perron's procedure is not followed because it's result of 8 is too large. All information criteria are pointing that there is no optimal lag length, i. e. the optimal lag length is 0.

EA	1%	5%	10%
	-3.43	-2.86	-2.57

value of test statistic: -1.3749

optimal number of lags (searched up to 10 lags of 1. differences):

Akaike Info Criterion: 8

Hannan-Quinn Criterion: 1

Schwarz Criterion: 1

Finally, for the euro area there is also acceptance of the null hypothesis of existence of a unit root, which is proved by the value of test statistic -0,7241 greater than the critical value -2,57. Again it is better to choose the smaller lag length and according to all information criteria and Perron's procedure it is 1.

As all time series are non-stationary we could proceed to implement the co-integration analysis using the Johansen Trace Test.

Johansen Trace Test for: BG CZ EA HU PL RO

sample range: [2005 M7, 2015 M6], T = 120

included lags (levels): 1

dimension of the process: 6

intercept included

response surface computed:

r0	LR	pval	90%	95%	99%
0	93.67	0.1958	98.98	103.68	112.88
1	56.66	0.6191	72.74	76.81	84.84
2	32.48	0.8293	50.50	53.94	60.81
3	14.21	0.9625	32.25	35.07	40.78
4	6.28	0.9302	17.98	20.16	24.69
5	1.06	0.9289	7.60	9.14	12.53

OPTIMAL ENDOGENOUS LAGS FROM INFORMATION CRITERIA

sample range: [2006 M4, 2015 M6], T = 111

optimal number of lags (searched up to 10 lags of levels):

Akaike Info Criterion: 3

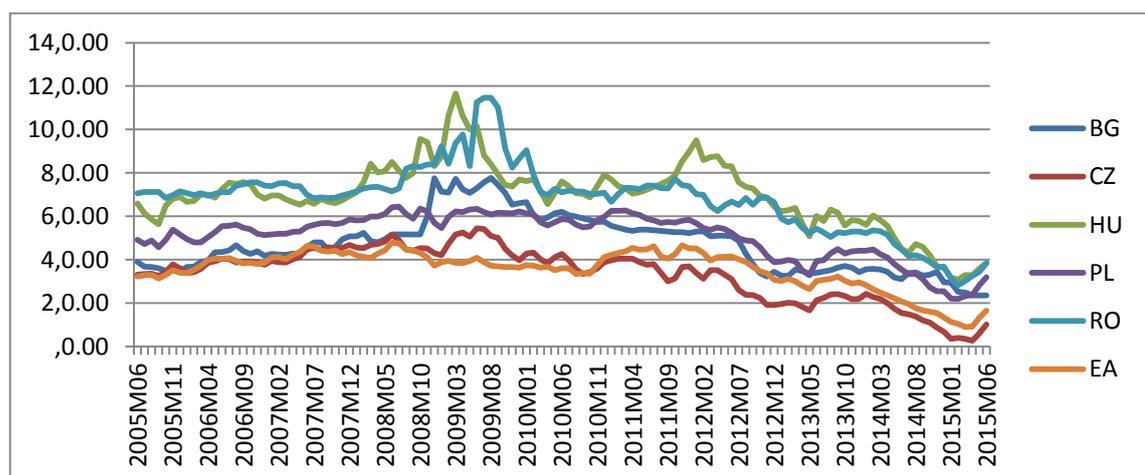
Hannan-Quinn Criterion: 1

Schwarz Criterion: 1

Regarding Dwyer (2014)¹² the Johansen test makes it possible to estimate all co-integrating vectors when there are more than two variables. If there are three variables each with unit roots, there are two possible co-integrating vectors. More generally, if there are n variables, there are n-1 possible co-integrating vectors.

As results show there are 5 co-integration vectors of these 6 cases which is a confirmation of a long-run relationship between the long-term interest rates of Bulgaria, Czech Republic, Hungary, Poland and Romania towards the countries already members of EMU.

Let's proceed with the second part of the analysis.



As the graph shows there is significant deviation from the path of pre-crisis convergence. We suggest and obviously that is due to the global financial crisis and the problems related to it. So we proceed with examining the impact of some suggested indicators which could be directly linked with the long-term interest rates, namely through the global financial crisis. There are many papers which investigate the determinants of long-term interest rates but this paper build up with investigating whether these determinants are eligible also for the so called in this paper post-crisis

¹² Dwyer, G. ,The Johansen Tests for Cointegration, Lecture, April 2014

period. It is interesting whether they are strengthening or loosening their influence after the crisis. We included in the analysis the following variables: the global financial crisis, represented by the CDS spreads, also the budget deficit and government debt, both represented as a share of GDP, and inflation, represented as a HICP.

This methodology allows to make a direct link between the long-term interest rates and the other convergence criteria, thus showing their importance and mutual interconnectivity in the process of euro zone entry despite that they are very criticized.

For this purpose we use the methodology of OLS.

Debt and deficit / quarterly data

Pre-Crisis Model	Coefficients	
	B	Std. Error
1 (Constant)	5,012	,390
Dbt	,009	,011
Def	-,061	,035

Crisis Model	Coefficients	
	B	Std. Error
1 (Constant)	5,191	,369
Dbt	,019	,008
Post-Crisis Model	Coefficients	
	B	Std. Error
1 (Constant)	2,296	,536
Dbt	,027	,011
Def	-,056	,097

carefully.

In regard of the deficit factor, there is increasing influence during the crisis, but it is slightly easing after the crisis. The reason could be the relatively calmed economic circumstances. It should be mentioned that results show a negative link between the deficit levels and the long-term interest rates. These strange results are caused by the insignificant regression coefficients of the deficit factor in all three models.

The results show that the influence of the debt factor is statistically insignificant in the pre-crisis model. This could be explained with the good economic circumstances of prosperous growth, which is a sign of not focusing on the debt ratio. However, the debt factor is increasing its influence during the crisis and also after the crisis. Perhaps that is due to the increasing importance of the fiscal discipline, erasing from the Greek debt crisis, which has very deep impact in the market expectations. The fear from country bankruptcy has sharpened the perceptions of market participants and they are more

However, the deficit factor tends to be influencing the long-term interest rates because of the threshold of 3% which could be easily violated in times of economic crisis. Besides is also the trend to structural reforms in the EU, which requires a significant amount of resources.

Inflation / monthly data

Pre-crisis Model	Coefficients	
	B	Std. Error
1 (Constant)	4,571	,208
Inflation	,197	,040

Crisis Model	Coefficients	
	B	Std. Error
1 (Constant)	4,749	,202
Inflation	,330	,040

Post-crisis Model	Coefficients	
	B	Std. Error
1 (Constant)	2,983	,129
Inflation	,462	,062

The inflation factor tends to be very strong and to increase its influence throughout the crisis and after the crisis. It's strongly linked to the long-term interest rates than the factors debt and fiscal balance. The price stability objective is in the heart of the monetary policy of the ECB, determining all its operations. The low inflation objective is crucial for the level of interest rates in short- and long-term period. The Fisher's effects is widely known and explains the positive link between the inflation rate and nominal interest rates. The results maintain Fisher's conclusions of the importance of the inflation rate for the interest rate level.

CDS / daily data

Pre-crisis Model	Coefficients	
	B	Std. Error
1 (Constant)	4,399	,040
CDS spread	,044	,001

Crisis Model	Coefficients	
	B	Std. Error
1 (Constant)	3,946	,052
CDS spread	,009	,000

In the case of CDS spreads the regression coefficients show that the influence of CDS spreads is decreasing throughout the crisis and slightly increasing after the crisis, but significantly below the level before the crisis, which is strange. Although the sharpened market sentiments and the fear of second crisis appearance are very strong, the model appears to show conflicting results at a

Post-crisis Model	Coefficients	
	B	Std. Error
1 (Constant)	1,418	,051
CDS spread	,016	,000

first sight.

However, in peaceful times the CDS spreads are very crucial indicator for determining coming fluctuations in the economic circumstances. When the crisis begin it is obvious that the economy is recessive and finally when the growth is back on its positive path the CDS is becoming again an indicator with significant importance.

5. Conclusions

In times when the global financial crisis has eased its unfavorable influence on the CEE economies the long-term interest rates of Bulgaria, Czech Republic, Hungary, Poland and Romania are still on their path of long-term relationship with the members of the euro area. This shows the positive convergence process even after the severe crisis.

The investigation of the most important determinants of the long-term interest rates presents their influence before, during and after the crisis. The factors debt, deficit, inflation and CDS spreads influence in a different way and in a different direction throughout the period. Inflation is the most influencing factor and is increasing its influence throughout and after the crisis. This shows the importance of the *monetary policy of price stability irrespectively of the economic stance*.

The *fiscal discipline* is also important but the results show less significant influence, and even insignificant in the case of the deficit factor. One can conclude that despite the low regression coefficients they influence the level of long-term interest rates and that the influence is most pronounced in crisis times. This *conflicting situation* is hardly solving because exactly during crisis periods the fiscal balance is almost always deteriorated and the debt levels tends to vastly rise.

CDS spreads appear to be crucial in calm economic situation where one could receive from them information about possible negative shocks and likely near recession. They tend to ease their influence when the economy enters the real crisis period.

So even that the long-term interest rates of the investigated CEE countries didn't fall out from the convergence path and continue to integrate each other and with the euro area member states, there are indicators which should be bear in mind and greatly considering in order not to lose the positive direction from the EU and EMU participation and integration.

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