FINANCIAL SYSTEM DEVELOPMENT AND ECONOMIC GROWTH IN THE EASTERN EUROPEAN COUNTRIES

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Abstract: Economic theory suggests that an efficient financial system which channels capital to its most productive uses creates an advantageous climate for economic growth. Sound and efficient financial system is important for sustaining growth in developing Eastern European countries, because efficiency of investment will overshadow quantity of investment as a driver of growth in the region. Therefore, this paper examines the possible causal relationship between financial sector development and economic growth among Eastern European countries. Theoretical aspect points to presence of complex relationship between the financial system development and economic growth. Empirical evidence depends on the time period analyzed as well as the sub-samples of the possible correlation of the financial development with economic growth, which can be positive or negative. The annual data used indicate that the causality in Granger sense of this process can run one way or another, depending on the country in question.
Keywords: financial system, financial development, Granger causality test, economic growth

1. INTRODUCTION

The main objective of this paper is to perform an analysis in order to examine the potential relationship between financial system diversity and economic growth in the sample of Eastern European countries. To reach the specific purpose, the subsequent steps have to be taken: first, an analysis of the theoretical relationship between development of diversified financial sector and economic growth; second, empirical projection of the theoretical relationship.

According to Levine (2005), financial institutions and markets can promote economic growth through particular channels: (1) facilitation of the exchange of goods and services through decreasing provision of payment; (2) creating the pool of disposable savings from significant number of different investors; (3) using the savings of the enterprises for the realization of the most productive investment projects; (4) monitoring investment and implementation of corporate governance, and (5) diversification through increasing liquidity and decreasing intertemporal risk. Therefore, those functions have significant impact on savings and investment decisions and correspondingly to economic growth.

International capital inflows promote financial deeping through higher demand for financial services, which presents valuable instrument for financial sector development.

The key factors of permanently increasing depth of the internal financial sector in Eastern European countries are the following:

- Increased level of financial liberalization started in the late 1990s accompanied by the macroeconomic stabilization in EEC.
- Substantial foreign capital inflows due to continuous low domestic capital.
- Replacement of the weak legal and institutional financial sector infrastructure with enhanced legal framework which enables increased efficiency of the financial system in order to stimulate the financial deeping.
- Rising competion among internal commercial banks.
- Softening conditions in monetary policy as a cause for decreasing domestic interest rates.
- Sound and stable macroeconomic policies in order to enable long term growth of the financial sector.

In the study we examine the key aspects of the financial system diversity in eight EEC in the period 1995-2015 using vector error correction model. In order to achieve this goal we conduct a multivariate cointegration methodology established by Johansen (1988, 1991) as well as Johansen and Juselius (1990) to evaluate the relationships between financial system indicators and real output in the selected group of EEC. In addition, we test the time series in the period 1995-2015 to determine unit root presence in order to show integration of internal variables. Finally, for non-stationary series with a cointegrating relationship, the ,Granger-causality test has been applied, after the construction of vector error correction model (VECM).

2. THEORETICAL FRAMEWORK

Many studies have confirmed that the relationship between financial system development and economic growth is a controversial issue. Some economists, like Goldsmith (1969) and McKinnon (1973) emphasized the significant benefits of financial sector development and financial liberalization. In this regard, since the 1990s, evolving empirical literature highlights that financial sector development is significant factor for economic growth. On the other hand, at the moment when financial sector liberalization spread around the world, it has been noted diminishing influence of financial sector development on economic growth.

The estimation established in the empirical study by King and Levine (1993) comprises about 80 countries for the period from 1960 to 1989 and by using cross-country regression model, analysed the possible connection between certain indicators of size and relative importance of financial intermediaries and the accumulation of capital rate and the rise of productivity as the key factors of the economic growth. Their research found a positive and statistically significant relationship between several financial development indicators and GDP per capita growth.

Calderȯn (2002) used the Geweke decomposition test (Geweke, 1982) on unit data of 109 developing and industrial countries in the period 1960-1994 with aim to examine the trend of causality between financial development and economic growth and adopted the following conclusions:

(1) Financial development induces the economic growth;
(2) Coexistence of both opposite relations, such as: the Granger causality from financial development to economic growth and vice versa;
(3) Financial diversity provokes more to the causality relations in the developing countries;
(4) The longer interval of the sample contributes for more significant effect of financial development on economic growth;
(5) Financial diversity stirs economic growth through intensive capital accumulation and growth of productivity.

Winkler (2009) analyses the process of rapid financial diversification and coherent risks for Southeastern European countries and concludes that is impossible to guarantee financial stability through the rising entry of foreign banks.

3. ECONOMETRIC MODEL

With the aim to examine the effects of the financial diversification on the economic growth in eight EEC, we evaluate a vector error correction model (VECM). The paper applies a multivariate cointegration methodology established by Johansen (1988, 1991) and Johansen and Juselius (1990) to evaluate the possible relationship between financial depth indicators and real output of selected group of Eastern European countries. This method is based on a vector autoregression model (VAR) of order *p* (lags) to analyze the long run relationships that may exist among representative non-stationary variables:

$$Y_t = \mu + A_1 Y_{t-1} + A_2\, Y_{t-2} + \ldots + A_p\, Y_{t-p} + \varepsilon_t \qquad (1)$$

where Y_t is a $n \times 1$ vector of endogenous variables that are integrated of order one – commonly denoted I(1), μ is a $n \times 1$ vector of the constants, A_i are $n \times n$ polynomial variance-covariance matrix, $\varepsilon_{t} \sim N_n\ (0, \Sigma_\varepsilon)$ is a $n \times 1$ normalized vector of innovations (exogenous shocks).

In the case when at least two variables are cointegrated of the order one (I(1)), the VAR in the previous equation can be rewritten by deducting Y_{t-1} to the vector error correction model:

$$\Delta Y_t = \mu + \Pi\, Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_1\, \Delta\, \mathrm{Y}_{t-1} + \varepsilon_t \qquad (2)$$

where $\Delta\, Y_t$ is a $n \times 1$ vector of the first differences of stochastic variables Y_t, $\Pi = \sum_{i=1}^{p} A_i - I$, $\Gamma_t = -\sum_{j=i+1}^{p} A_j$, I is $n \times n$ identity matrix.

The VECM model comprises information on short-term and long-term adjustments to changes in Y_t, enclosed in projected Γ and Π appropriately. Γ represents the dynamic of the model in the short run, respectively adjustments to changes in Y_t, while Π represents the long run relationship among the variables included in the vector Y_t. Therefore, the matrix Π determines the number of error correction terms in the model and is called impact matrix. Π can be decomposed as follows:

$$\Pi = \alpha\beta' \quad (3)$$

where the elements of α represent adjustment parameters in the vector error correction model, while each column of β is the cointegrating vector. The variable *r* is the number of cointegrating relationships. If the coefficient matrix Π has reduced rank *r<n*, there exist *n x r* matrices α and , each with rank *r* such that $\Pi = \alpha\beta'$ and $\beta' y_t$ is stationary. VECM requires presence of at least one cointegrating relationship.

Johansen recommends two different likelihood ratio tests of significance of respective canonical correlations and thereby the reduced risk of the Π matrix: the trace test and maximum eigenvalue test, shown in the following equations respectively.

$$\lambda_{trace}(r) = -T\sum_{i=r+1}^{n}\ln(1-\hat{\lambda}) \quad (4)$$

$$\lambda_{max}(r, r+1) = -T\ln(1-\hat{\lambda}_{r=1}) \quad (5)$$

where *T* is the sample size and $\hat{\lambda}_i$ is the *i:*th largest canonical correlation. The trace test tests the null hypothesis of *r* cointegrating vectors against the optional hypothesis of *n* cointegrating vectors. On the other hand, the maximum eigenvalue test, tests the null hypothesis of of *r* cointegrating vectors against the optional hypothesis of *r+1* cointegrating vectors.

The next step before projecting the model is related with testing the time series for stationarity. According to the study of Engle and Granger (1987) is required that all variables within the cointegration relationship have to possess the same order of integration.

The key point of our study is connected to testing the direction of the causality linkages between financial depth indicators and real output using linear Granger causality test defined by the equation:

x_t is said not to Granger–cause y_t, if

$$E(y_{t+p} \mid \Omega_t) = E(y_{t+p} \mid \Omega_t - x_t) \qquad (\forall_p > 0) \quad (6)$$

where x_t and y_t are two time series, *E* denotes the conditional distribution and $\Omega_t - x_t$ is all the information in the universe except series x_t. Therefore, x_t is said to not $\text{Granger} - \text{cause}\ y_t$, if X cannot help predict future Y.

Applying the projected VECM, the dynamic responses of the internal variables to the money stock, domestic bank deposits and domestic bank loans one standard deviation shocks are computed for any country from the group of EEC.

4. DATA AND EMPIRICAL RESULTS

In our paper, we used annual data ranging from 1995 to 2015 (21 observations) for the financial depth indicators (presented by the participation of broad money stock M2 (*m*), domestic bank deposits (*d*) and domestic bank loans (*l*) to GDP), GDP (*y*), inflation (*p*) represented by the adjusted domestic consumer price index, nominal effective exchange rate (NEER) (*e*) and short-term interest rates (*i*).

Time series for broad money stock (monetary aggregate) M2, domestic bank deposits, domestic bank loans and GDP are seasonally adjusted and with NEER are indicated as indexes with base line year 2010. From the other side, inflation rate and interest rate are estimated as an annual percentage change of adjusted consumer price index indicated on the quarterly base.

First of all, before computing the model, we test the time series for stationarity. To ascertain the order of integration of different variables we use augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests. Namely, ADF test use a parametric autoregressive structure to capture serial correlation (trend-stationary) while PP test use non-parametric corrections based on estimates of the long-run variance of Δy_t (difference-stationary). Those tests were used to test the endogenous variables for the existence of the unit roots.

When all the endogenous variables order of integration is identified, it is necessary to test the time series for cointegration by Johansen cointegration test. The Johansen test and estimation strategy makes it possible to estimate all cointegrating vectors when there are more than two variables.

Accordingly to the results of the unit root tests and cointegration tests, we apply Granger causality test and calculate the model using first differences of the variables. Toward assessment the responses of the real output (GDP) to the money stock, domestic deposits and domestic loans, we evaluate following three models for separate country from the group of EEC – model A ($Y_t = [m_{t,} y_{t,} p_{t,} e_{t,} i_t]$), model B ($Y_t = [d_{t,}\ y_t, p_t,\ e_{t,} i_t]$) and model C ($Y_t = [l_{t,} y_{t,} p_{t,} e_{t,} i_t]$) for each of the individual country from the group of EEC.

A. Unit root Test

The obtained results of ADF and PP tests for unit roots presence in the endogenous variables are exposed in the Table 1.

[Insert Table 1 here]

Both tests show that the variables are non-stationary on the values i.e. the null hypothesis of a unit root presence can't be unadopted for any of the series. On the other hand, testing variables oh the first differences shows the stationarity of the time series. Therefore, all variables in the paper can be tested for cointegration.

B. Cointegration Test

In order to test endogenous variables that contain a unit root on the values for cointegration, we use the Johansen cointegration test. The results of the test divided eight EEC in two groups.

[Insert Table 2 here]

Both trace statistics and maximum eigenvalue statistics (both at 0.05 level) indicate the existence of two cointegration equation in Slovenia (model A), Slovak Republic (model B) and Latvia (model B). Mixed results of cointegration analyses indicate both tests in Bulgaria (model A and B), Czech republic (model A), Hungary (model A and C), Romania (model C) and Slovenia(model B). Namely, the trace test statistics denotes that there is no cointegration among the analysed variables.

C. Granger Causality Test

In order to test for evidence of causality between variables we employ Granger causality test. One variable is Granger-caused by another, if the second variable enables to predict the first one, or if the coefficients on the lagged are statistically significant.

The results of Granger causality tests are shown in Table 3.

[Insert table 3 here]

There is no causality between financial depth indicators and real output in Bulgaria, Czech Republic, Slovak republic and Slovenia.

On the other hand, we obtained mixed results for Hungary, Latvia, Poland and Romania. In Hungary Granger causality test indicate domestic loans foster economic growth. On the other hand, in Poland domestic deposits granger economic growth. Our observation shows that money stock affect real economic activity in Romania.

From the estimated results per country, we may summarized that causality between economic growth and financial depth indicators doesn't seem very clear for the whole group of EEC.

5. CONCLUSION

In the paper we have examine the key aspects of the financial diversification in eight EEC in the period 1995-2015. We have used a multivariate cointegration methodology to estimate the relationship between financial diversification indicators and real output in selected EEC. To find the order of integration of endogenous variables, we have used ADF and PP tests. To assess the rank of cointegration, we have implemented Johansen cointegration test. We have tested the direction of the causality links between financial diversification indicators and real output using Granger causality test.

We may summarize our findings as follows: (1) countries with lower GDP per capita seem to benefit from financial diversification, as the financial diversification indicators affects real economic activity with higher intensity in the short-run and Granger cause real output in the long-run; (2) Whilst short-run effects of financial diversification indicators' on the real output development differs in intensity and durability, overall positive impact is clear in all EEC.

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Appendix A

Table 1. *Tests for Unit Roots*

Bulgaria

		M2_BG		D_BG		L_BG		GDP_BG		INF_BG		NEER_BG		IR_BG	
		ADF	PP	ADF	PP	ADF	PP	ADF	PP	ADF	PP	ADF	PP	ADF	PP
model A	values	1.533	1.533					-1.25	-1.577	4.018*	-3.363**	-10.25**	-18.38**	-3.678**	3.638**
	1.dif.	-3.198**	3.198*					3.477*	-1.039	3.897*	-3.897**	-3.435**	-8.399**	-11.08**	9.553**
model B	values			-1.506	-1.506			-1.25	-1.577	4.018*	-3.363**	-10.25**	-18.38**	-3.678**	3.638**
	1.dif.			-1.449	-1.449			3.477*	-1.039	3.897*	-3.897**	-3.435**	-8.399**	-11.08**	9.553**
model C	values					-2.027	-1.946	-1.25	-1.577	4.018*	-3.363**	-10.25**	-18.38**	-3.678**	3.638**
	1.dif.					3.284*	-2.946	3.477*	-1.039	3.897*	-3.897**	-3.435**	-8.399**	-11.08**	9.553**

Czech republic

		M2_CZ		D_CZ		L_CZ		GDP_CZ		INF_CZ		NEER_CZ		IR_CZ	
		ADF	PP	ADF	PP	ADF	PP	ADF	PP	ADF	PP	ADF	PP	ADF	PP
model A	values	0.396	1.076					-0.446	-0.505	3.258*	-3.172**	-1.036	-1.044	-2.192	-1.947
	1.dif.	-2.887	-2.922					-2.794	-2.795	-3.008	-2.887	-3.912**	-3.911**	-2.02	3.612**
model B	values			0.225	0.643			-0.446	-0.505	3.258*	-3.172**	-1.036	-1.044	-2.192	-1.947
	1.dif.			7.077*	6.804*			-2.794	-2.795	-3.008	-2.887	-3.912**	-3.911**	-2.02	3.612**
model C	values					-1.223	-2.084	-0.446	-0.505	3.258*	-3.172**	-1.036	-1.044	-2.192	-1.947
	1.dif.					6.463*	6.439*	-2.794	-2.795	-3.008	-2.887	-3.912**	-3.911**	-2.02	3.612**

Hungary

		M2_HU		D_HU		L_HU		GDP_HU		INF_HU		NEER_HU		IR_HU	
		ADF	PP	ADF	PP	ADF	PP	ADF	PP	ADF	PP	ADF	PP	ADF	PP
	values	0.231	0.17					-1.33	-1.272	-1.807	-3.138**	-5.197**	-4.575**	-4.175**	6.973**
model A	1.dif.	-3.182**	-3.184					-2.936	-2.925	-1.605	-1.428	-2.244	-5.523**	-2.02	6.973**
	values			-1.13	-1.13			-1.33	-1.272	-1.807	-3.138**	-5.197**	-4.575**	-4.175**	6.973**
model B	1.dif.			4.117*	4.106*			-2.936	-2.925	-1.605	-1.428	-2.244	-5.523**	-2.02	6.973**
	values					-1.106	-1.074	-1.33	-1.272	-1.807	-3.138**	-5.197**	-4.575**	-4.175**	6.973**
model C	1.dif.					-5.13**	5.197*	-2.936	-2.925	-1.605	-1.428	-2.244	-5.523**	-2.02	6.973**

Latvia

		M2_LT		D_LT		L_LT		GDP_LT		INF_LT		NEER_LT		IR_LT	
		ADF	PP	ADF	PP	ADF	PP	ADF	PP	ADF	PP	ADF	PP	ADF	PP
	values	-0.268	-0.182					-1.07	-1.195	-0.567	-0.941	-4.411**	-2.267	-2.466	-2.466
model A	1.dif.	-1.24	-1.097					3.652*	-2.284	-2.645	-2.658	-4.481**	-2.51	-5.237**	5.242**
	values			-1.64	-1.64			-1.07	-1.195	-0.567	-0.941	-4.411**	-2.267	-2.466	-2.466
model B	1.dif.			3.218*	3.194*			3.652*	-2.284	-2.645	-2.658	-4.481**	-2.51	-5.237**	5.242**
	values					-1.791	-1.278	-1.07	-1.195	-0.567	-0.941	-4.411**	-2.267	-2.466	-2.466
model C	1.dif.					-1.812	-1.835	3.652*	-2.284	-2.645	-2.658	-4.481**	-2.51	-5.237**	5.242**

Poland															
		M2_PL		**D_PL**		**L_PL**		**GDP_PL**		**INF_PL**		**NEER_PL**		**IR_PL**	
		ADF	PP	ADF	PP	ADF	PP	ADF	PP	ADF	PP	ADF	PP	ADF	PP
model A	values	0.396	1.076					-0.445	-0.505	3.258*	-3.172**	-1.036	-1.044	-2.192	-1.947
	1.dif.	-2.887	-2.922					-2.794	-2.795	-3.008	-2.887	-3.912**	-3.911**	-2.02	3.612**
model B	values			0.225	0.643			-0.445	-0.505	3.258*	-3.172**	-1.036	-1.044	-2.192	-1.947
	1.dif.			7.076*	6.804*			-2.794	-2.795	-3.008	-2.887	-3.912**	-3.911**	-2.02	3.612**
model C	values					1.223	-2.084	-0.445	-0.505	3.258*	-3.172**	-1.036	-1.044	-2.192	-1.947
	1.dif.					6.463*	6.439*	-2.794	-2.795	-3.008	-2.887	-3.912**	-3.911**	-2.02	3.612**
Romania															
		M2_RO		**D_RO**		**L_RO**		**GDP_RO**		**INF_RO**		**NEER_RO**		**IR_RO**	
		ADF	PP	ADF	PP	ADF	PP	ADF	PP	ADF	PP	ADF	PP	ADF	PP
model A	values	-0.483	0.055					0.06	-0.128	3.919*	-1.659	-13.31**	-24.56**	-1.004	-0.952
	1.dif.	-3.234**	-1.736					3.105*	3.095*	-1.196	-1.543	-29.11**	-4.248**	-6.004**	6.004**
model B	values			-1.924	3.456*			0.06	-0.128	3.919*	-1.659	-13.31**	-24.56**	-1.004	-0.952
	1.dif.			4.999*	5.015*			3.105*	3.095*	-1.196	-1.543	-29.11**	-4.248**	-6.004**	6.004**
model C	values					-1.714	-1.47	0.06	-0.128	3.919*	-1.659	-13.31**	-24.56**	-1.004	-0.952
	1.dif.					-2.766	-2.733	3.105*	3.095*	-1.196	-1.543	-29.11**	-4.248**	-6.004**	6.004**
Slovak republic															
		M2_SK		**D_SK**		**L_SK**		**GDP_SK**		**INF_SK**		**NEER_SK**		**IR_SK**	
		ADF	PP	ADF	PP	ADF	PP	ADF	PP	ADF	PP	ADF	PP	ADF	PP
model A	values	0.894	1.025					0.096	-0.096	-2.991	-2.311	-0.968	-0.586	-1.791	-2.834
	1.dif.	-1.626	-1.626					3.561*	-3.54**	-2.127	-2.044	-2.433	-2.433	-1.459	-1.929
model B	values			0.251	0.477			0.096	-0.096	-2.991	-2.311	-0.968	-0.586	-1.791	-2.834
	1.dif.			3.157*	-2.614			3.561*	-3.54**	-2.127	-2.044	-2.433	-2.433	-1.459	-1.929
model C	values					-1.812	-1.805	0.096	-0.096	-2.991	-2.311	-0.968	-0.586	-1.791	-2.834
	1.dif.					4.708*	4.853*	3.561*	-3.54**	-2.127	-2.044	-2.433	-2.433	-1.459	-1.929
Slovenia															
		M2_SI		**D_SI**		**L_SI**		**GDP_SI**		**INF_SI**		**NEER_SI**		**IR_SI**	
		ADF	PP	ADF	PP	ADF	PP	ADF	PP	ADF	PP	ADF	PP	ADF	PP
model A	values	0.166	0.446					-1.748	-1.686	-4.52**	-4.52**	-3.884**	-6.892**	-0.204	-0.298
	1.dif.	-2.715	-2.896					3.169*	3.133*	-1.285	-1.213	-4.119**	-4.119**	-2.315	-2.194
model B	values			-1.38	-1.374			-1.748	-1.686	-4.52**	-4.52**	-3.884**	-6.892**	-0.204	-0.298
	1.dif.			4.279*	4.279*			3.169*	3.133*	-1.285	-1.213	-4.119**	-4.119**	-2.315	-2.194
model C	values					4.434*	4.434*	-1.748	-1.686	-4.52**	-4.52**	-3.884**	-6.892**	-0.204	-0.298
	1.dif.					4.104*	18.14*	3.169*	3.133*	-1.285	-1.213	-4.119**	-4.119**	-2.315	-2.194

Source: Authors calculations

Note: Data represents the results of t-statistics. Null hypothesis can be rejected at 1% level of confidence (*), 5% level of confidence (**), 10% level of confidence (***)

Appendix B

Table 2. *Johansen and Juselius cointegration rank tests*

Hypothesized No. of CE(s)	Bulgaria						Czech Republic					
	model A		model B		model C		model A		model B		model C	
	trace stat	max eigvalue stat	trace stat	max eigvalue stat	trace stat	max eigvalue stat	trace stat	max eigvalue stat	trace stat	max eigvalue stat	trace stat	max eigvalue stat

r=0	150.2871	76.32474	118.4506	59.13967	120.6897	56.74097	116.0025	42.42710	159.9676	76.76795	130.3431	57.89594
r≤1	73.96238	31.31320	59.31093	23.49856	63.94877	33.23015	73.57535	35.92360	83.19969	51.64523	72.44720	36.07253
r≤2	42.64917	18.71189	35.81237	17.65714	30.71863	18.64721	37.65176	21.09268	31.55446	18.19444	36.37467	24.42572
r≤3	23.93729	15.12778	18.15523	13.30015	12.07142	7.770807	16.55908	12.53239	13.36003	13.09270	11.94895	9.362091
r≤4	8.809501	8.809501	4.855076	4.855076	4.300611	4.300611	4.026688	4.026688	0.267330	0.267330	2.586858	2.586858

Hypothesized No. of CE(s)	Hungary						Latvia					
	model A		model B		model C		model A		model B		model C	
	trace stat	max eigvalue stat	trace stat	max eigvalue stat	trace stat	max eigvalue stat	trace stat	max eigvalue stat	trace stat	max eigvalue stat	trace stat	max eigvalue stat
r=0	142.2313	71.76857	129.0596	59.26213	155.2941	77.41658	121.9107	53.46440	100.7744	45.37966	139.6918	56.40570
r≤1	70.46272	36.37979	69.79748	36.45872	77.87754	39.69182	68.44632	37.36053	55.39469	30.95154	83.28613	47.31539
r≤2	34.08293	16.22710	33.33876	18.66588	38.18572	17.24675	31.08579	19.58936	24.44315	11.04017	35.97074	20.36879
r≤3	17.85583	11.70058	14.67288	9.942837	20.93897	15.37785	11.49643	6.000347	13.40298	7.581290	15.60194	12.54568
r≤4	6.155251	6.155251	4.730043	4.730043	5.561123	5.561123	5.496085	5.496085	5.821687	5.821687	3.056269	3.056269

Hypothesized No. of CE(s)	Poland						Romania					
	model A		model B		model C		model A		model B		model C	
	trace stat	max eigvalue stat	trace stat	max eigvalue stat	trace stat	max eigvalue stat	trace stat	max eigvalue stat	trace stat	max eigvalue stat	trace stat	max eigvalue stat
r=0	181.8360	76.79366	197.3861	101.6355	154.7323	80.26326	173.8283	86.67569	179.1771	103.3105	169.5422	91.00107
r≤1	105.0423	54.48179	95.75067	65.35682	74.46906	44.24335	87.15263	37.07468	75.86660	37.15839	78.54109	37.97352
r≤2	50.56052	36.56685	30.39385	16.30680	30.22571	20.27241	50.07795	29.00625	38.70821	20.64604	40.56757	18.18332
r≤3	13.99367	8.205750	14.08705	9.894776	9.953296	8.766841	21.07170	15.19273	18.06217	15.70110	22.38425	16.02523
r≤4	5.787922	5.787922	4.192275	4.192275	1.186455	1.186455	5.878965	5.878965	2.361074	2.361074	6.359015	6.359015

Hypothesized No. of CE(s)	Slovak Republic						Slovenia					
	model A		model B		model C		model A		model B		model C	
	trace stat	max eigvalue stat	trace stat	max eigvalue stat	trace stat	max eigvalue stat	trace stat	max eigvalue stat	trace stat	max eigvalue stat	trace stat	max eigvalue stat
r=0	136.8194	69.53168	114.7842	65.16095	94.63536	42.19685	143.8417	80.06975	113.5945	46.56442	119.9918	47.85104
r≤1	67.28777	34.92983	49.62327	28.00603	52.43851	25.91764	63.77190	43.11321	67.03008	32.13029	72.14075	38.17254
r≤2	32.35793	19.13287	21.61724	14.42845	26.52087	13.32841	20.65869	10.49935	34.89979	18.03074	33.96820	18.49746
r≤3	13.22506	6.875364	7.188789	7.110796	13.19246	8.910139	10.15934	7.352148	16.86905	11.71955	15.47075	8.643782
r≤4	6.349697	6.349697	0.077993	0.077993	4.282323	4.282323	2.807193	2.807193	5.149497	5.149497	6.826967	6.826967

Appendix C

Table 3. *Granger Causality Tests*

Bulgaria

null hypothesis		lags	obs	prob	decision
model A	M2_BG does not Grainger cause GDP_BG	3	18	0.1663	do not reject
	GDP_BG does not Grainger cause M2_BG	3	18	0.5472	do not reject
model B	D_BG does not Grainger cause GDP_BG	3	18	0.8272	do not reject
	GDP_BG does not Grainger cause D_BG	3	18	0.5686	do not reject
model C	L_BG does not Grainger cause GDP_BG	3	17	0.6472	do not reject
	GDP_BG does not Grainger cause L_BG	3	17	0.3233	do not reject

Czech republic

null hypothesis		lags	obs	prob	decision
model A	M2_CZ does not Grainger cause GDP_CZ	3	15	0.8578	do not reject
	GDP_CZ does not Grainger cause M2_CZ	3	15	0.3479	do not reject
model B	D_CZ does not Grainger cause GDP_CZ	3	18	0.5361	do not reject
	GDP_CZ does not Grainger cause D_CZ	3	18	0.2194	do not reject
model C	L_CZ does not Grainger cause GDP_CZ	3	18	0.5504	do not reject
	GDP_CZ does not Grainger cause L_CZ	3	18	0.3479	do not reject

Hungary

null hypothesis		lags	obs	prob	decision
model A	M2_HU does not Grainger cause GDP_HU	3	18	0.2556	do not reject
	GDP_HU does not Grainger cause M2_HU	3	18	0.0861	do not reject
model B	D_HU does not Grainger cause GDP_HU	3	18	0.3375	do not reject
	GDP_HU does not Grainger cause D_HU	3	18	0.0354	reject
model C	L_HU does not Grainger cause GDP_HU	3	18	0.0035	reject
	GDP_HU does not Grainger cause L_HU	3	18	0.0009	reject

Latvia

null hypothesis		lags	obs	prob	decision
model A	M2_LT does not Grainger cause GDP_LT	3	18	0.7875	do not reject
	GDP_LT does not Grainger cause M2_LT	3	18	0.3661	do not reject
model B	D_LT does not Grainger cause GDP_LT	3	18	0.2888	do not reject
	GDP_LT does not Grainger cause D_LT	3	18	0.3881	do not reject
model C	L_LT does not Grainger cause GDP_LT	3	18	0.1861	do not reject
	GDP_LT does not Grainger cause L_LT	3	18	0.0358	reject

Poland

null hypothesis		lags	obs	prob	decision
model A	M2_LT does not Grainger cause GDP_LT	3	17	0.2459	do not reject
	GDP_LT does not Grainger cause M2_LT	3	17	0.2193	do not reject
model B	D_LT does not Grainger cause GDP_LT	3	16	0.0021	reject
	GDP_LT does not Grainger cause D_LT	3	16	0.5105	do not reject
model C	L_LT does not Grainger cause GDP_LT	3	17	0.1974	do not reject
	GDP_LT does not Grainger cause L_LT	3	17	0.5721	do not reject

Romania

null hypothesis		lags	obs	prob	decision
model A	M2_RO does not Grainger cause GDP_RO	3	12	0.0168	reject
	GDP_RO does not Grainger cause M2_RO	3	12	0.6731	do not reject
model B	D_RO does not Grainger cause GDP_RO	3	18	0.4689	do not reject
	GDP_RO does not Grainger cause D_RO	3	18	0.004	reject
model C	L_RO does not Grainger cause GDP_RO	3	18	0.5743	do not reject
	GDP_RO does not Grainger cause L_RO	3	18	0.0597	do not reject

Slovak republic

null hypothesis		lags	obs	prob	decision
model A	M2_SK does not Grainger cause GDP_SK	3	6		
	GDP_SK does not Grainger cause M2_SK	3	6		
model B	D_SK does not Grainger cause GDP_SK	3	18	0.0659	do not reject
	GDP_SK does not Grainger cause D_SK	3	18	0.6193	do not reject
model C	L_SK does not Grainger cause GDP_SK	3	18	0.4062	do not reject
	GDP_SK does not Grainger cause L_SK	3	18	0.4868	do not reject

Slovenia

null hypothesis		lags	obs	prob	decision
model A	M2_SI does not Grainger cause GDP_SI	3	9	0.8899	do not reject
	GDP_SI does not Grainger cause M2_SI	3	9	0.5959	do not reject
model B	D_SI does not Grainger cause GDP_SI	3	18	0.6441	do not reject
	GDP_SI does not Grainger cause D_SI	3	18	0.2893	do not reject
model C	L_SI does not Grainger cause GDP_SI	3	18	0.9083	do not reject
	GDP_SI does not Grainger cause L_SI	3	18	0.7457	do not reject

Authors own calculations