

## OUTPUT SPILLOVERS FROM TRADE AND FINANCIAL LINKAGES IN CENTRAL AND EASTERN EUROPEAN COUNTRIES: A PANEL ANALYSIS

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**ABSTRACT.** This paper studies the impact of international trade and foreign direct investments on economic growth in Central and East European countries using static and dynamic panel data estimation methods. The results mostly point towards a positive effect of trade and financial openness on economic growth, although the magnitude of the impact depends of the econometric method used. The paper also assesses the impact of trade and financial linkages on output comovements between regions. The measured influence of trade linkages is more reduced compared with the impact of financial linkages, especially during crisis periods. The empirical analysis identifies a significant negative effect of financial integration on output synchronization, conditional on global shocks. The impact of financial linkages on output synchronization during crises is changing compared to normal economic situations. During normal times, increased financial linkages generate higher output divergence since capital is flowing to the regions where it is most productive. In contrast, during the crisis period, regions which know a high degree of integration, especially through the banking system experienced a significant increase in their economic growth comovement. In order to safeguard the benefits of financial integration while reducing the negative effects stemming from financial crisis is of the utmost importance to implement better prudential oversight and policy coordination.

### 1. INTRODUCTION

The impact of openness on economic growth has been a subject of much interest in international macroeconomics literature. On the one hand, both trade and financial openness during normal economic conditions have a positive contribution on economic growth through productivity and technological innovations creating, at the same time, employment, and better living standards. On the other hand, trade and financial linkages play a significant role in international transmission of common or idiosyncratic shocks<sup>1</sup>. The global financial crisis initiated at the end of 2007, showed a significant comovement of world's economies and particularly of European Union countries. This could be the result of a common shock to world economy or the result of an idiosyncratic shock from U.S. asset markets transmitted to major economies through trade and financial channels. An interesting debate in the specific literature refers to the question whether economic growth comovement between different economies increased as a result of financial globalization during the last decades.

The correlation between financial integration and the synchronization of economic activity depends on whether financial shocks to the banking sector or collateral shocks to firms dominate.

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<sup>1</sup>Defined as shocks that are country-specific.

If the economies experience a higher financial integration and the firms operating in certain countries are hit by negative shocks to their collateral, domestic and foreign banks reduce the lending in affected countries and increase lending in the non-affected ones, amplifying this way the divergence of economic growth between these economies. However, if a negative shock is affecting the banking sector in a specific country with internationally operating banks, they will draw out capitals from all countries, transmitting the domestic banking shock internationally and generating a synchronized fall in output of all countries.

Preserving financial stability is essential in order to prevent synchronized GDP growth collapses regionally. The transmission mechanism of financial shocks on economic growth synchronization during normal periods is substantially different than during crisis. If during normal periods the capital flows are channelized towards emerging markets which offer greater yields determining output divergence between regions with strong financial linkages, during crisis the financial channels favours the propagation of shocks between financially linked regions contributing to output fall synchronization. That is why it is important to safeguard the benefits of financial integration through minimizing consequent risks by the instrumentality of better prudential oversight and policy coordination across the entire international financial system.

The research is structured on two distinct directions. First it provides empirical evidence of the impact of trade and financial openness on economic growth in case of a series of emerging economies from the Central and East Europe (CEE). Second, it illustrates the role of trade and financial linkages in international transmission of common and idiosyncratic shocks, revealing their significant role during crisis periods in generating synchronized output fall of emerging economies.

The paper is structured as follows: the next section presents the previous empirical works on how financial and trade linkages impact on economic growth. Section 3 describes data and methodology. Section 4 reports the panel estimates on the effect of financial and trade openness on economic growth. Section 5 and 6 analyse the role of financial and trade linkages in the transmission of shocks on output comovements. Section 7 concludes.

## 2. LITERATURE REVIEW

The contribution of financial and commercial openness to economic development is a very controversial issue in today's macroeconomic studies and no decisive conclusions has yet been achieved regarding this subject.

Most of the theoretical literature advocates that the degree of openness impacts economic growth in a positive manner. Romer (1993), Grossman and Helpman (1991) argue that countries that know a higher degree of openness catch more easily with developed ones. Also, Chang, Kaltani and Loayza (2009) state that open economies allocate their resources more efficiently compared to closed ones and that the effects of openness on economic growth are more efficient if additional reforms are undertaken

Nevertheless, there are also views asserting that the effects of openness on economic growth are questionable. Rodrik and Rodriguez (2001) argue that the impact of openness on economic growth may be even a negative one, highly dependent on the empirical and methodological framework. They carried out a critical analysis of some empirical studies and concluded that in many cases the openness indicators are not suitable measured or that the methodological sets have a strong impact on the results and therefore the conclusions of the authors regarding the benefits of economic openness are subject to much debate. Correcting weaknesses related to openness measures and empirical methods, Rodrik and Rodriguez obtained different results that questioned the positive correlation between the afore-mentioned variables.

Among the researchers examining the relationship between economic growth and openness, Gries and Redlin (2012) study a sample of 158 countries and conclude that over the long term, there is a positive effect from openness to economic growth while, in the short run, there may be a negative impact. Furthermore, Dar and Amirkhalkhali (2003) investigate 19 OECD countries and conclude that the influence of openness on economic growth varies across countries.

One major shortcoming of current related empirical literature is that too less attention is paid to examining the way financial openness and international trade impact economic growth in emerging economies, and particularly in case of CEE countries. This issue is especially important considering the need to investigate driving forces behind economic growth in case of emerging countries in the context of euro zone integration.

Large economies originating shocks significantly impact the economic activity in emerging markets through trade and financial channels, which played an important role in the transmission of these shocks during the global economic crisis from 2008 - 2009. For instance, Claessens, Tong, and Zuccardi (2012) show that financial shocks spread mostly through financial channels, while Auerbach and Gorodnichenko (2013) argue that for fiscal policy shocks transmission trade channels are more important than the other ones. Di Giovanni and Shambaugh (2008) claim that monetary policy shocks impact economic activity mostly through the interest rate channel.

Frankel and Rose (1998) show that over the long term the level of trade linkages is significantly and positively correlated with the degree of output comovements. The difficulty related to this evaluation consists in impossibility to separate this effect from those determined by a common border, a common currency or historical links, because countries related this way tend to trade more with each other.

Kalemli-Ozcan, Papaioannou, and Perri (2013) study the impact of financial globalization on business cycle synchronization using a proprietary database on banks' international exposure for industrialized countries for the time span between 1978 and 2006. Following a similar methodology the present paper runs a series of regressions, using quarterly and annual data, based on different measures for comovements between each CEE country and EU in order to test the effects of commercial and financial linkages on output synchronization and also to evaluate the relation between openness and economic growth.

### 3. DATA AND METHODOLOGY

**3.1. Data.** The data sample includes a series of Central and Eastern European (CEE) countries that present similarities regarding their economic evolutions in the last decade: Czech Republic, Poland, Hungary, Romania, Bulgaria, Slovakia and Lithuania. To these is added the European Union, which is the main financial and trading partner of the CEE economies. Data for these countries regarding economic growth, foreign direct investments and intra-EU trade volumes were collected from Eurostat database at quarterly and annual frequencies. The share of inward FDI stock to GDP comes from the UNCTAD 2008 database. The data sample covers the interval between 1991 and 2013 for the annual analysis and from Q1 2004 to Q2 2014 for quarterly research. Due to data limitations in case of some variables, which are included successively in the empirical study, the data span is reduced to more recent periods. For the same reason Lithuania is excluded from the analysis in some empirical estimates.

The degree of trade openness can be measured through several indicators that are divided into two different categories: trade volume and trade restrictions measures. The last one being more difficult to quantify as it includes taxes on international trade or measures of trade barriers, it is better to use volume trade measures quantified for example by the share of exports plus imports to GDP, indicator known as trade openness. Following the approach of Cieslik and Tarsalewska (2008), the share of FDI stock to GDP is used instead of the ratio of FDI flows to GDP as a financial openness measure due to the fact that spillovers may not be related to the current FDI inflows but to the ones which have accumulated along years. However, for the quarterly frequency empirical analysis, due to the data availability limitations in case of CEE countries, the flows of FDI to GDP ratio are used.

The main explanatory variables are the ratios of trade to GDP and inward FDI stock to GDP, to which add some other control variables, such as real effective exchange rate and external demand, which play a significant role in emerging economies economic evolution. The dependent variables are the economic growth and different measures for the degree of synchronization between each CEE country and EU that are described in the next sections.

The impact of financial and trade linkages on output synchronization between CEE countries and EU is assessed using a balanced panel of seven pairs consisting of each CEE country included in the analysis and EU over the period between Q1 2004 and Q2 2014. The panel estimates gauge how the output synchronization is affected via trade and financial channels by common or idiosyncratic shocks both during normal and crisis periods of time.

**3.2. Methodology.** First methodological step before estimating the relationship between the degree of openness and economic growth consists in testing the variables for stationarity. Two frequently used panel unit root tests are the IPS test proposed by Im, Pesaran, and Shin (2003) and a Fisher type test created by Maddala and Wu (1999).

The tested equation has the following form:

$$\Delta y_{i,t} = \mu_i + \beta_i \cdot y_{i,t-1} + e_{i,t} \quad (3.1)$$

Both tests have the null hypothesis that each cross section series included in the data panel has an unit root, while the alternative is that at least one cross section in the data panel is stationary. The results of the tests are reported in the Appendix.

Going further, in order to evaluate the influence of trade openness on economic growth, static and dynamic panel data estimations are employed. These methods have the advantage that both time series and cross sectional dimensions of the data can be analysed. The equation to be estimated has the following form:

$$\Delta GDP_{i,t} = c_{it} + a_1 \cdot trade_{i,t} + a_2 \cdot fdi_{i,t} + a_3 \cdot control_{i,t} + e_{i,t} \quad (3.2)$$

In equation (3.2), the dependent variable is represented by the growth rate of real GDP while the main explanatory variables are the ratios of FDI and trade to GDP and some control variables expected to have an influence on economic growth. The estimation method considers both fixed and random effects in order to control for individual country specific characteristics. To check the robustness of the results and discriminate between fixed and random effects the Hausman test is used. The null hypothesis of the test is that the random effects estimator is more efficient, while the alternative one is that only the fixed effects estimator is consistent and needs to be included. The difference between fixed and random effects models is largely attributed to their assumption regarding how the heterogeneity is captured and also to the estimation method which is best suited: fixed effects models require OLS, while random effects models require GLS.

The Hausman statistics has the following form:

$$H = \left[ \hat{\beta}_{FE} - \hat{\beta}_{RE} \right]' \cdot \left[ Var \left( \hat{\beta}_{FE} - \hat{\beta}_{RE} \right) \right]^{-1} \cdot \left[ \hat{\beta}_{FE} - \hat{\beta}_{RE} \right]$$

In this formula,  $\hat{\beta}_{FE}$  and  $\hat{\beta}_{RE}$  are the estimators corresponding to the fixed and random effects models, respectively. The statistics have the null hypothesis that the random effects estimator is more efficient. A large value of the statistic points toward the rejection of the null hypothesis. Still, the random effects model may also be evaluated individually by running the Breusch Pagan Lagrange multiplier test with the null hypothesis that the variances across entities is zero, therefore there is no need for including random effects.

The potential time-invariant country fixed effects validated by the Hausman test are subsequently removed by using the first differenced generalized method of moments developed by Arrelano and Bond (1991). This method deals with any endogeneity problem that may appear due to measurement errors and omitted variable and has become very popular in all the research studies related to economic growth. One endogeneity issue may appear due to the fact that, although the present empirical study analyses to what extent openness influences economic growth, one needs to acknowledge that this influence may run in both directions, namely, from GDP growth to trade and foreign direct investments. Admitting the causality

may run in both directions, the regressors may be correlated with the errors term, violating the OLS assumptions, and therefore the GMM approach deals with this possible issue. The GMM estimator mostly relies on differencing regressions in order to account for unobserved effects.

Silaghi, Jude, Alexa and Litan (2012) argue that this method may exhibit poor finite sample properties and the use of weak instruments may raise concerns in case of time persistent variables. Therefore, the instruments are validated using the Sargan test of over-identifying restrictions.

In order to analyse the effects that financial and trade linkages have on GDP synchronization, a slightly different methodology is employed. The evaluation of the role of financial and trade linkages in transmitting the shocks originated during the economic global crisis period is performed based on regressions of different correlation measures of output growth between each analysed country and the EU on the financial and trade linkages between them.

The economic growth rate of each country is assumed being influenced by a combination of shocks in the following way:

$$y_{i,t} = \varepsilon_t + \varepsilon_{i,t} + \sum_j \rho_{i,j,t} \cdot \varepsilon_{j,t} \tag{3.3}$$

in which  $y_{i,t}$  denotes real economic growth in country  $i$ ,  $\varepsilon_t$  denotes common shocks,  $\varepsilon_{i,t}$  represents domestic idiosyncratic shocks,  $\varepsilon_{j,t}$  denotes specific shocks originated in the other regions, and  $\rho_{i,j,t}$  quantifies the correlation within each analysed pair including each CEE country and EU. Within this framework, the analysis focuses on linkages between different regions through financial and trade channels.

In a simple framework, denoting with  $(h)$  and  $(f)$  home and, respectively, the foreign country, the growth rates are driven by common shocks ( $e_c$ ) that impact both countries, and specific shocks, ( $e_h$ ) and ( $e_f$ ), that affect one country:

$$y_h = e_c + e_h + c_1 \cdot y_f$$

$$y_f = e_c + e_f + c_2 \cdot y_h$$

Suppose each idiosyncratic shock has a variance  $\sigma_i^2, i = h, f$ , the common shock has a variance  $\sigma_c^2$  and both  $c_1$  and  $c_2$  are lower than 1, considering that domestic output normally responds less than one per cent to a one per cent shock in external demand.

The presence of common shocks and the cross-border effects of specific shocks involve that the economic growth rates will be positively correlated. If the variance of the common shock is decreasing than the variance of economic growth would decrease in each economy as well as the covariance. The covariance would decrease proportionally more than variance, implying that the correlation would also fall. The decrease in covariance is doubled by a lower correlation when the decline in variance is due to reduction of the variance of common shocks.

When the variance of both countries' specific shocks is reducing, the variance of each output and the covariance between them are reducing due to spillovers. However, in this case, the correlation between the two countries' economic growth is increasing due to the fact that the share of variation that is common rises on the back of the reduction in both idiosyncratic variation and the total variance. When the linkages between economies (measured through  $c_1$  and  $c_2$ ) is increasing / decreasing, keeping the variances constant, the variance, covariance and correlation increase / decrease simultaneously.

Under this framework, the correlation between economic growth rates across regions is determined by the existence of common shocks and of spillover effects stemming from idiosyncratic shocks. Common shocks can increase in importance or becoming more frequent relative to idiosyncratic shocks, determining spikes in output correlations. Also, it is possible that the financial and trade linkages between regions can change during crisis periods amplifying the negative effects on output growth.

Following Kalemli-Ozcan, Papaioannou, and Perri (2013) are run a series of regressions, using quarterly data, based on different measures for comovements between each CEE country and the EU. The general form of the regression is as following:

$$\begin{aligned} Comv_{i,EU,t} = & c_{i,EU} + \alpha_0 \cdot fin_{i,EU,t-1} + \beta_0 \cdot trade_{i,EU,t-1} + crisis_t + \\ & \alpha_1 \cdot fin_{i,EU,t-1} \cdot crisis_t + \beta_1 \cdot trade_{i,EU,t-1} \cdot crisis_t + \varepsilon_{i,EU,t} \end{aligned} \quad (3.4)$$

in which  $Comv_{i,EU,t}$  is the economic growth rate correlation between country  $i$  and the EU in period  $t$ ,  $fin_{i,EU,t-1}$  and  $trade_{i,EU,t-1}$  denote the lagged financial and trade linkages respectively between country  $i$  and the EU and  $crisis_t$  is a dummy variable which equals 1 during the crisis period and 0 during normal times. The dummy variable account for the effects of global crisis shocks on both output patterns and trade and financial integration. Also, the specification includes country pair fixed effects  $c_{i,EU}$ . These account for non-measurable factors such as strategic coordination of EU countries, cultural ties or other unobservable factors, all of which may have a significant effect on output comovement between regions.

The results of different version of the regression tested using the quarterly data for the sample from Q1 2004 to Q2 2014 are in line with those reported by Kalemli-Ozcan, Papaioannou, and Perri (2013) and International Monetary Fund (2013) for world economy. The effect of financial shocks in normal state of the economy is negative, but it becomes positive during crisis periods.

The sample included in the analysis, spanning the period between Q1 2004 and Q2 2014, comprising the global financial crisis period between Q3 2008 and Q2 2009. The remaining of the time interval is characterized by normal economic conditions. The effects of financial and trade linkages are allowed to differ across the normal and crisis periods, since the shocks that affect the economic growth in each period are of different nature. During crises common shocks are more likely to manifest while during normal times the idiosyncratic shocks are more frequent. That is why, a dummy variable that takes value one during the crisis period and zero for normal times is considered. Based on dummy variables it is possible to test whether the trade and financial channels work contrarily during the two different state of the nature.

#### 4. THE RELATIONSHIP BETWEEN ECONOMIC GROWTH AND OPENNESS

Most of the recent macroeconomic literature sustains that emerging countries should encourage foreign direct investments and international trade benefitting in time from higher economic growth and therefore close the gap with respect to developed economies.

The CEE countries have the potential to grow at a faster rate than developed countries, being involved in a catch-up process. To this process contribute the significant amount of import of capital and high commercial and financial integration. As part of the EU integration process these countries have adopted reforms and policies in order to liberalize their commercial and financial sectors. Thus, the present analysis also focuses on the main drivers of the economic growth in CEE countries in order to better understand the catching-up process specific to these economies.

Tabel 1 reports the main results of the estimation of different versions of equation (3.2), using static panel data methods. To begin with, simple static panel regressions are conducted in order to analyse the effects of trade openness on economic growth using both fixed and random effects estimators. In the beginning of the analysis the only explanatory variable included is the degree of openness measured as the ratio of imports and exports to GDP, along with a dummy variable for 2008 and 2009 in order to capture the effects of the financial crisis. The estimation results of the model 1 indicate that both the coefficient of the trade variable and the constant term are positive and statistically significant, although the magnitude of the impact of commercial openness on economic growth is a small one. In order to check the robustness of the results the Hausman test is computed and it seems to favour the fixed effects model estimator. Also, the Breusch Pagan test shows that there are no evidences of significant differences across countries; therefore there is no need to take into account possible random effects. Consequently, Table 1

contains only the estimations results from the fixed effects models, as neither Breusch Pagan nor the Hausman test did indicate the need of considering random effects.

Model	1	2	3	4	5	6
Constant (standard error)	3.41 (1.51)**	2.73 (0.73)*	3.83 (1.59)**	1.78 (1.59)	1.13 (0.86)	2.87 (1.54)***
Trade Openness (standard error)	0.01 (0.01)***	-	-0.02 (0.02)	0.01 (0.02)	-	-0.025 (0.02)
Dummy*Trade Openness (standard error)	-0.02 (0.01)*	-	0.04 (0.02)***	-0.03 (0.01)*	-	0.034 (0.02)
Dummy*Financial Openness (standard error)	-	-0.07 (0.02)*	-0.15 (0.05)*	-	-0.076 (0.02)*	-0.139 (0.05)*
Financial Openness (-1) (standard error)	-	0.02 (0.02)	0.038 (0.25)***	-	0.04 (0.02)*	0.062 (0.02)*
External Demand (-1) (standard error)	-	-	-	0.45 (0.18)**	0.53 (0.17)*	0.5 (0.17)*
Time effects	No	No	No	No	No	No
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Breusch Pagan tests for random effects (prob>chi2)	0.99 0.32	0.68 0.47	0.3 0.59	0.01 0.96	1.6 0.66	1.11 0.29
R-sq	0.15	0.19	0.21	0.18	0.27	0.25
F test / Wald test	5.92	9.99	5.81	6.34	10.46	7.06
Prob>F/chi2	0.0	0.0	0.0	0.0	0.0	0.0
Number of observations	96	96	96	96	96	96

Notes: \*significant at 1 per cent level, \*\*significant at 5 per cent level, \*\*\*significant at 10 per cent level.

Including into the analysis the FDI to GDP ratio as a measure of financial openness, which replaces the trade share, as in the model 2, the results are slightly different. Specifically, although the constant and the dummy variable are still significant, the coefficient corresponding to the financial variable, although positive, is statistically insignificant.

Further on, in order to offer a more complete image of the degree of openness, FDI and exports plus imports to GDP ratios are included in the static panel data estimation. It must be pointed that in all 6 models, the foreign direct investments stock is included with one lag, taking into considerations that the spillovers related to the FDI stock impact economic activity with some delay and the commercial openness as well considering the lags in influencing economic growth. In this case (model 3), the coefficient of the financial variable is positive and statistically significant at 10 per cent level, while the one of the commercial variable is slightly negative and also insignificant. The dummy variables and the constant coefficients are statistically significant.

Moreover, other control variables are added to the equation in order to better explain real GDP growth, specifically the real exchange rate and a measure of external demand. The real exchange rate determines insignificant coefficients and did not bring additional relevant information to the model as R-squared did not improve; for that reason it is excluded from all specifications and not reported in the table.

Static panel estimation is applied for the extended model and then the Hausman and Breusch Pagan tests are computed. The external demand is proxied by the economic growth in the euro area and is being included in the equation with one lag. Model 4 includes the trade share and the external demand together with a dummy variable. The coefficient corresponding to the trade share is positive but statistically insignificant, while external demand has a positive and statistically significant coefficient of 0.45. When the financial openness indicator replaces

the trade share in model 5 the estimated coefficients are both statistically and economically significant. The coefficient corresponding to financial openness is positive (equal with 0.04), while external demand still has a positive impact, being higher compared with model 4, as can be observed from Table 1. In model 6 reported in the same table, both measures of the degree of openness along with the external demand are included. The financial openness has a positive and significant at 1 per cent level impact of 0.06, while the trade share has a negative and statistically insignificant coefficient.

The dynamic panel data estimated coefficients obtained applying the Arellano and Bond (1991) method with one period lag are reported in Table 2. As previously mentioned, the Hausman test indicates the necessity of using the dynamic panel data estimator. Admitting the existence of time invariant characteristics (i.e. fixed effects) it might be the case that these effects may be correlated with the explanatory variables.

Model	1	2	3	4	5	6
Economic growth (-1) (standard error)	0.43 (0.074)*	0.44 (0.06)*	0.45 (0.07)*	0.35 (0.10)*	0.35 (0.09)*	0.34 (0.09)*
Trade Openness (standard error)	0.011 (0.003)*	-	0.001 (0.01)	0.01 (0.004)*	-	-0.002 (0.01)
Financial Openness (-1) (standard error)	-	0.02 (0.008)*	0.02 (0.02)	-	0.03 (0.008)*	0.03 (0.02)
External Demand (-1) (standard error)	-	-	-	0.17 (0.16)	0.23 (0.17)	0.25 (0.18)
Wald test	47.8	50.09	49.83	48.41	52.14	52.09
Prob>chi2	0	0	0	0	0	0
Number of instruments	98	98	99	99	99	100
Sargan test	105.7039	107.97	106.7385	107.0591	109.6	109.37
p value	0.234	0.19	0.2131	0.2069	0.1619	0.1656
Number of observations	102	102	102	102	102	102

Notes: \*significant at 1 per cent level, \*\*significant at 5 per cent level, \*\*\*significant at 10 per cent level.

The fixed effects may be comprised by the error term in equation (3.1) that usually incorporates the unobserved country specific effects. By applying the first order difference to the equation the fixed effects country specific are removed taking into account that these effects do not vary with time. Consequently, equation (3.2) is transformed as follows:

$$\Delta GDP_{i,t} = \alpha_1 \cdot \Delta trade_{i,t} + \alpha_2 \cdot \Delta fdi_{i,t} + \alpha_3 \cdot \Delta control_{i,t} + \Delta \varepsilon_{i,t} \quad (4.1)$$

The fixed effects are enclosed by  $\varepsilon_{i,t}$  that comprises the unobserved country specific effects, namely  $\nu_i$  and the specific errors of the observations,  $u_{i,t}$ .

$$\varepsilon_{i,t} = \nu_i + u_{i,t} \quad (4.2)$$

When differencing for the Arellano Bond estimator the fixed effects are removed and equation (3.2) becomes:

$$\varepsilon_{i,t} - \varepsilon_{i,t-1} = u_{i,t} - u_{i,t-1} \quad (4.3)$$

Table 2 reports the results of the dynamic panel data estimation including one lag for all six models previously described. It can be observed that even though, in the case of static panel estimations some specifications indicate negative coefficients for the degree of openness, using the dynamic estimator, most of the models indicate positive effects of both trade share and financial openness. Nevertheless, in model 6 the corresponding coefficients are statistically insignificant.



The magnitude of the commercial variable is somewhere near 0.01 like model 1 and 4 show, while the share of FDI in GDP has a higher impact on GDP growth reaching 0.03 in model 5. The validity and robustness of the results are checked using the Sargan test which helps to validate the instruments. The instruments are valid in case of all models.

Like in the static panel estimations, the external demand is included as a control variable so as to provide a better fit for the dynamics of real GDP (see models 4 to 6 in Table 2). Both measures of the degree of openness have positive and statistically significant coefficients when used one by one along with the external variable, while the impact of the latter is no longer statistically significant.

## 5. ECONOMIC GROWTH COMOVEMENT IN CEE COUNTRIES

In order to measure comovements between CEE countries and EU there are used some different methodologies based on quarterly real GDP measured in local currency prices. The simplest measure of output comovements is based on the correlation of economic growth between every analysed economy and EU, which is the main trading partner of CEE economies. Rolling window of two or five years long time period and an instantaneous measure are used in order to measure the correlation of GDP growth between CEE countries and the EU. The economic growth rates correlations had been reduced as level in the years before the crisis but increased considerably during the crisis time. This phenomenon impacted globally, not being specific only to advanced economies where financial crisis originated. Since 2010 the comovement in case of different countries and regions have fallen back considerably, suggesting that the global economic evolution, including emerging economies, have returned to a normal state of nature. The understanding of the factors that drove the changes in comovements is important in order to anticipate if this phenomenon could repeat again in case of different regions or even globally. The increase in output growth correlations could be the result of unfavourable shocks, such as a unexpected intensification of financial uncertainty or an alteration in the investors' perceptions regarding portfolio risks (Acharya and Schnabl (2010); Bekaert, Campbell and Lundblad (2011); Fratzscher (2009, 2012)) which affected simultaneously many economies. International Monetary Fund (2013) suggested that the cause of these developments could be the output spillovers<sup>2</sup> that amplified because of the strengthening of trade and financial linkages.

Another measure of comovement is represented by the correlations in detrended output, which requires the choice of a filtering method. With this respect a series of methods were compared including a Hodrick-Prescott (1997) filter, which withdraw low-frequency long term trends from the GDP series, the band-pass filter of Baxter and King (1999), which retains output fluctuations with frequencies between 6 and 32 quarters and the random walk filter of Christiano and Fitzgerald (2003). The correlations based on detrended output point to similar conclusions although they are even larger than those computed based on quarterly GDP growth rates.

The third method follows Giannone, Lenza, and Reichlin (2010), who measure business cycle synchronization as the negative of divergence in economic growth rates, computed annually as the absolute value of the difference between real GDP growth in each CEE country and EU:

$$SYNCH_{i,EU,t} = - |(lnY_{i,t} - lnY_{i,t-1}) - (lnY_{EU,t} - lnY_{EU,t-1})| \quad (5.1)$$

Unlike to the other correlation measures this indicator is simple and it does not contain estimation errors. Moreover, it is insensitive to filtering methods that have been criticized by Canova (1998) among others or to the time length of the rolling window used in the computation. This index of synchronization doesn't reflect the volatility of economic growth directly and, therefore, it allows the identification of the impact of financial and trade integration on the covariation of real GDP growth as in Kalemli-Ozcan, Papaioannou and Peydro (2009).

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<sup>2</sup>This phenomenon is characterized by the transmission of country specific shocks to other economies with effects on economic growth regionally or even globally.

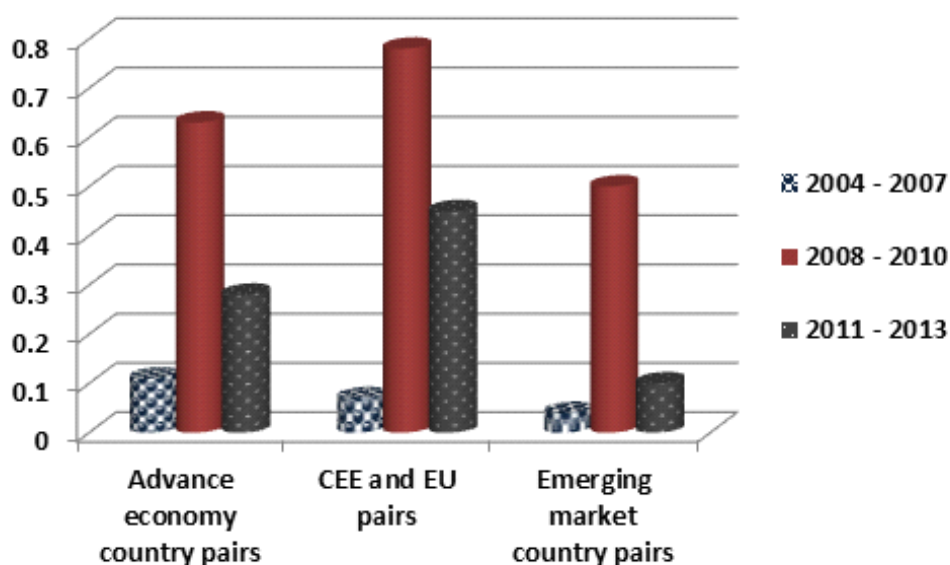


FIGURE 1. Growth rate correlations. Source: Eurostat Database; IMF, World Economic Outlook; Organization for Economic Cooperation and Development; and authors' calculations.

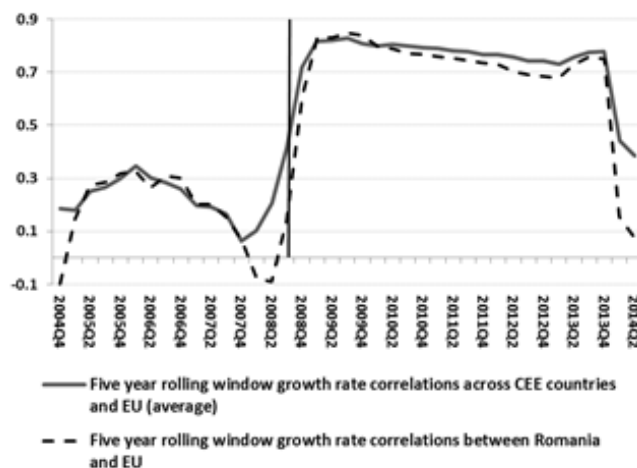


FIGURE 2. The five-year moving average growth rate correlations. Source: Eurostat and authors' calculations

The five-year rolling window economic growth correlations, computed as arithmetic means, across each EEC and rest of the EU pair remained contained below 0.5 from the 2000 Q1 until 2008 Q2. The five-year moving average growth correlations spiked sharply starting with 2008 Q3 concurrently with the developing of the global financial crisis (Figure 2). Following the onset of the global crisis in September 2008, there was a severe and synchronized collapse in outputs in case of a majority of world economies, in 2008 Q4 and 2009 Q1. This event steered to a significant increase in output correlations, towards values around 0.8 for all country pairs included in the analysis, with the highest values observed among pairs formed between Lithuania, Hungary, Romania and Czech Republic on one side and the rest of EU on the other

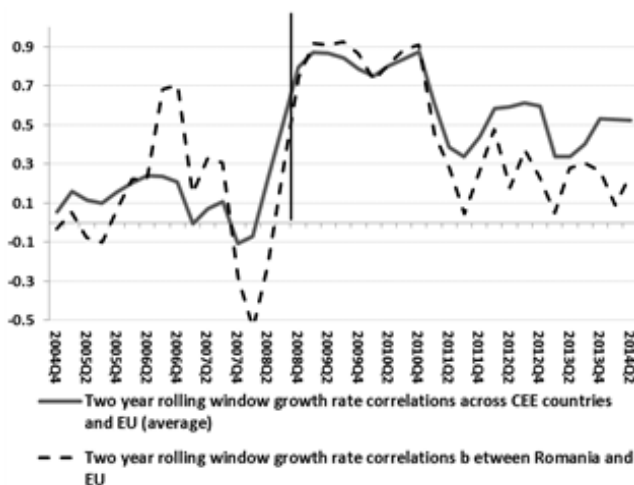


FIGURE 3. The two-year moving average growth rate correlations. Source: Eurostat and authors' calculations.

one. The correlations based on output gap measures, interpreted as proxies for business cycle positions, show even higher increases during the financial crisis.

The analysis based on the five-year rolling window correlations indicates that output synchronization remained high a longer period of time (i.e. until end-2013, as long as first quarter of 2009 remained within the rolling window), but if the output comovement is computed using a shorter-window or an instantaneous measure of correlation it can be observed that it decreased earlier. In case of two-year rolling window average correlation there is a substantial reduction in output comovements in 2011 Q1 (Figure 3). This fall corresponds to the moment when the first quarter of 2009 exits out of the two-year rolling window. Moreover, an instantaneous measure of correlation is used to test whether the output comovements fall simultaneous compared to the peak of the global financial crisis. The instantaneous measure of correlation is defined as:

$$\frac{(\Delta y_{i,t} - \overline{\Delta y_i}) \cdot (\Delta y_{j,t} - \overline{\Delta y_j})}{s_i \cdot s_j}$$

This instantaneous measure of correlation, unlike to a normal correlation index, it is not bounded between -1 and 1. If the GDP growth rates for two countries/regions are both far away from their respective means, as occurred during the peak of the global financial crises, the instantaneous correlation measure can significantly exceed 1.

As it can be observed from Figure 4, the economic growth instantaneous correlations have fallen close to pre-crisis levels after 2009 Q3, despite of the intensification of the sovereign debt crisis in Europe during that period of time.

## 6. OUTPUT SPILLOVERS. TRANSMISSION OF SHOCKS THROUGH TRADE AND FINANCIAL CHANNELS

The way in which trade and financial linkages determines the transmission of shocks on output comovements is analysed based on the panel model described in equation (3.4). The Hausman test indicates the use of fixed effects model estimator.

The main estimation results show that in normal times, an increase in financial flows between different regions tends to reduce comovements between them (Table 3, models 2 to 4). The coefficient related to the financial channel is statistically and economically significant. The coefficient is negative implying that increased financial flows determine a decreasing of output

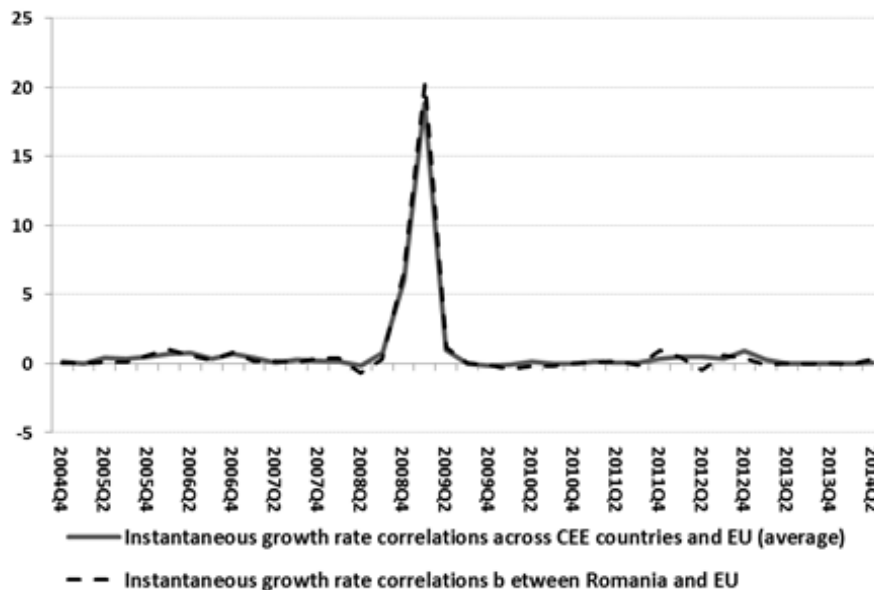


FIGURE 4. The instantaneous growth rate correlations. Source: Eurostat and authors' calculations.

comovement during normal times. If the economy operates in normal conditions and the financial channel is active, investors diversify their portfolio placements looking for the places where the capital is more productive.

Model	1	2	3	4	5
Dummy variable for crisis period	-1.6 (-6.60)*	-0.65 (-2.27)*	-2.21 (-2.81)*	-0.7 (-2.10)**	-1.78 (-6.39)*
Trade Linkages	0.01 (2.78)*		0.015 (1.93)**	0.01 (6.36)*	0.01 (3.06)*
Trade Linkages X Dummy	0.02 (2.58)*		0.09 (1.55)***		
Financial Linkages		-0.027 (-2.77)*	-0.02 (-1.64)***	-0.01 (-2.55)*	
Financial Linkages X Dummy		0.10 (0.80)***	0.13 (0.41)***		
Fixed Effects	YES	YES	YES	YES	YES
Observations	252	252	252	252	252
R Squared	0.25	0.21	0.25	0.21	0.22

*Notes:* This table reports panel (six pairs of EU with CEE countries) fixed-effect estimates for the period 2004 Q1 – 2014 Q2. Slovakia was excluded from the panel due to data availability issues regarding direct investments quarterly flows having as partner EU27 countries. The dependent variable is represented by the output comovement between each CEE country and EU proxied by the instantaneous synchronization index. The results are not changing sensible when the comovement measure is replaced with different alternatives presented in the paper. The crisis dummy variable equals one during 2008 Q3 and 2009Q2 interval and zero elsewhere. Trade linkages are measured by the bilateral share of real exports and imports of each country with EU to real GDP. Financial linkages are measured by the bilateral share of real foreign

direct investments flows of each country with EU to real GDP. In parenthesis are reported T statistics.

\*, \*\*, \*\*\*, denote significance at the 1 per cent, 5 per cent and 10 per cent levels, respectively.

The main results are in line with relevant literature (Bekaert, Campbell and Lundbad (2006, 2011); Kose, Prasad, and Terrones (2009) or Kalemli-Ozcan, Sorensen, and Yosha (2001, 2003)), which indicate that financial integration increases risk sharing and have a tendency to decrease the volatility in consumption and output. However, during crisis times the way in which the financial channel operates is changing fundamentally due to the fact that financial shocks are transmitted through financial linkages.

Regions characterized by an increased degree of integration, particularly through the banking system, knew a major increase in output comovement during the global financial crisis period. Even though the financial channel allows efficient capital allocation in normal economic conditions, during crisis periods it facilitates the transmission of the financial shocks across regions. Although the total effect of financial linkages on output comovement, for the entire time span included in the analysis, is negative its impact during the crisis period from 2008 to 2009 is strongly positive, as the sign of the coefficient corresponding to financial linkages multiplied with dummy variable indicate (models 2 and 3). The financial crisis weakened the negative relationship between financial integration and output comovement as the total effect is still negative but reduced as value compared with the pre-crisis period.

The crisis dummy variable captures a significant part of the spike in output synchronization, indicating that there are some other factors, apart from the trade and financial linkages, which determined the spreading of the negative effects of the crisis and synchronized output fall in the CEE economies. Bacchetta and van Wincoop (2013) suggested that among other factors the global panic and self-fulfilling expectations contributed to a great extent to the spread of the negative effects of the global financial crisis.

The effect of trade linkages on output comovement is significantly smaller compared with the impact of financial linkages due to the limited time variation in quarterly trade data relative to financial data (see model 5 for example). It seems that during global crisis from 2008 – 2009, trade channel played a less important role in shock spreading across countries compared with financial channel.

## 7. CONCLUSION

A vast majority of recent macroeconomic literature analyses the effects of financial and commercial openness on economic growth. However, limited empirical research concentrate on the analysis of link between openness and economic growth in CEE countries.

The present paper contributes to this literature by analysing the relationship between economic growth and the degree of openness in seven emerging economies from Central and Eastern Europe using both static and dynamic panel data estimation methods. On one hand, the main findings suggest the existence of a positive contribution of economic openness, materialized in international trade and foreign direct investments, to economic growth. Nevertheless, as other empirical studies show, the removal of commercial and financial barriers needs to be complemented by the completion of reforms in order to enhance economic growth in the long run.

On the other hand, trade and financial linkages may significantly contribute to the spread of negative shocks originated in advanced economies towards emerging countries and to a synchronized GDP fall across regions. The main findings show that increased financial integration has a tendency to reduce output comovement during normal states of the economy while during crises periods, those regions that are financially linked to each other experience a high degree of output synchronization and are sometimes hit by adverse shocks.

During normal periods of time, the impact of financial shocks on output synchronization across regions is significantly different compared with crisis periods of time. During normal states of the economy, the capital flows are directed towards emerging markets, which offer

higher yields and determine output divergence across regions characterized by solid financial linkages. Nevertheless, during crisis period the financial channel favours the propagation of adverse shocks and contributes to a synchronized output fall across financially integrated regions. In conclusion, it is highly important to safeguard the benefits of financial integration through diminishing ensuing risks by the instrumentality of better prudential oversight and policy coordination across the whole international financial system.

Reduced capital controls favoured the flows of speculative funds towards savings-poor but opportunity-rich economies impacting their financial sectors. For example, the capital flows can fuel borrowing booms in countries with a poorly developed financial system, contributing to overwhelming busts when the capitals flow out. That is why, nowadays, a large majority of world economies and international institutions, as is the case of International Monetary Fund (IMF), support capital controls in the form of taxes on certain types of flows or different reserve and liquidity requirements for foreign funds, in general market-based measures, in order to limit the volatility of capital flows. Such measures become even more relevant taking into account that cross-border bank lending is significantly more volatile than other capital flows such as direct investments or equities. Hills and Hoggart (2013) argue that cross-border bank lending can have considerable benefits, by diversifying the available sources of borrowing and increasing banking competition but these kind of flows can also amplify risks in times of stress due to the fact that lending by foreign banks tend to be more cyclical than by domestic banks. Rey (2014) argues that whenever capital is freely mobile, the global financial cycle rules out an independent monetary policy regardless of the exchange rate regime. However, such capital controls do have significant microeconomic effects, being administratively demanding, requiring the political decider maker to discriminate across types of credit or encouraging evasion. Also, reduced financial linkages force the countries which suffer domestic shocks to bear more of the resulting consequences by itself. Moreover, financial fragmentation reduces banking competition and, further, the efficiency. The best way to preserve the benefits of financial globalisation without threatening emerging market economies' macroeconomic stability would be increased cooperation across regulators. This is the direction in which the Financial Stability Board (FSB)<sup>3</sup> is working, by trying to ensure the uniform implementation of financial standards across European countries and to create a European banking union.

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#### REFERENCES

- [1] Acharya, Viral V. and P. Schnabl, 2010, "Do Global Banks Spread Global Imbalances? Asset-Backed Commercial Paper during the Financial Crisis of 2007-09," IMF Economic Review, Vol. 58, No. 1, pp. 37-73.
- [2] Arellano, M. and S. Bond, (1991), Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations, The Review of Economic Studies, Vol. 58, No. 2, pp. 277-97.
- [3] Auerbach, A. and Y. Gorodnichenko, 2013, "Output Spillovers from Fiscal Policy," American Economic Review, Vol. 103, Issue 3 (May), pp. 141-46.
- [4] Bacchetta, P. and E. van Wincoop, 2013, "Sudden Spikes in Global Risk," Journal of International Economics, Vol. 89, No. 2, pp. 511-21.
- [5] Baxter, M. and R. G. King, 1999, "Measuring Business Cycles: Approximate Band-Pass Filters For Economic Time Series," The Review of Economics and Statistics, MIT Press, vol. 81(4), pages 575-93, November.
- [6] Bekaert, G., H. R. Campbell and C. Lundblad, 2006, "Growth Volatility and Financial Market Liberalization," Journal of International Money and Finance, Vol. 25, pp. 370-403.
- [7] Bekaert, G., H. R. Campbell, and C. Lundblad, 2011, "Financial Openness and Productivity," World Development, Vol. 39, No. 1, pp. 1-19.

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<sup>3</sup>The FSB has been established to coordinate at the international level the work of national financial authorities and international standard setting bodies and to develop and promote the implementation of effective regulatory, supervisory and other financial sector policies.

- [8] Canova, F., 1998, "Detrending and Business Cycle Facts," *Journal of Monetary Economics*, Vol. 41, No. 3, pp. 475-512.
- [9] Chang, R., L. Kaltani and N. Loayza, 2009, "Openness is good for economic growth: The role of policy complementarities", *Journal of Developed Economics*, vol.90, pp. 33-49.
- [10] Christiano, L. J., and T. J. Fitzgerald, 2003, "The Band Pass Filter," *International Economic Review*, Vol. 44, No. 2, pp. 435-65.
- [11] Cieslik, A. and M. Tarsalewska, 2008, "Trade, foreign direct investment and economic growth: Empirical evidence for CEE countries", Warsaw University, Department of Economics working paper.
- [12] Claessens, S., H. Tong and I. Zuccardi, 2012, "Did the Euro Crisis Affect Non-financial Firm Stock Prices through a Financial or Trade Channel?" IMF Working Paper No. 11/227 (Washington: International Monetary Fund).
- [13] Dar, A. and S. Amirkhalkhali, 2003, "On the impact of trade openness on growth: further evidence from OECD countries", *Applied Economics*, Vol. 35, pp. 1761-1766.
- [14] di Giovanni, J. and J. C. Shambaugh, 2008, "The Impact of Foreign Interest Rates on the Economy: The Role of the Exchange Rate Regime," *Journal of International Economics*, Vol. 74, No. 2, pp. 341-61.
- [15] Frankel, J. and A. Rose, 1998, "The Endogeneity of the Optimum Currency Area Criteria," *Economic Journal*, Vol. 108, No. 449, pp. 1009-25.
- [16] Fratzscher, M., 2012, "Capital Flows, Push versus Pull Factors and the Global Financial Crisis," *Journal of International Economics*, Vol. 88, No. 2, pp. 341-56.
- [17] Fratzscher, M., 2009, "What Explains Global Exchange Rate Movements During the Financial Crisis?" *Journal of International Money and Finance*, Vol. 28, No. 8, pp. 1390-407.
- [18] Giannone, D., M. Lenza, and L. Reichlin, 2010, "Did the Euro Imply More Correlation of Cycles?" in *Europe and the Euro*, ed. by Alberto Alesina and Francesco Giavazzi (Chicago: University of Chicago Press), pp. 141-67.
- [19] Gries, T. and M. Redlin, 2012, "Trade openness and economic growth: A Panel Causality Analysis", Center for International Economics Working Paper Series, No. 2011-06.
- [20] Grossman, G. M. and E. Helpman, 1991, "Trade, knowledge spillovers and growth", NBER Working Paper 3485.
- [21] Hills, B. and G. Hoggarth, 2013, "Cross-border bank credit and global financial stability", *Quarterly Bulletin* 2013 Q2, Bank of England.
- [22] Hodrick, R. and E. Prescott, 1997, "Postwar U.S. Business Cycles: An Empirical Investigation", *Journal of Money, Credit and Banking*, Vol. 29, No. 1, pp. 1-16.
- [23] Im, K.S., M. H. Pesaran, and Y. Shin, (2003), "Testing for unit roots in heterogeneous panels", *Journal of Econometrics*, Vol. 115, No. 1, pp. 53-74.
- [24] International Monetary Fund, 2013, "World Economic outlook october 2013 Transitions and Tensions".
- [25] Kalemli-Ozcan, S., B. E. Sorensen and O. Yosha, 2001, "Economic Integration, Industrial Specialization and the Asymmetry of Macroeconomic Fluctuations," *Journal of International Economics*, Vol. 55, No. 1, pp. 107-37.
- [26] Kalemli-Ozcan, S., B. E. Sorensen and O. Yosha, 2003, "Risk Sharing and Industrial Specialization: Regional and International Evidence," *American Economic Review*, Vol. 93, No. 3, pp. 903-18.
- [27] Kalemli-Ozcan, S., E. Papaioannou, and F. Perri, 2013, "Global Banks and Crisis Transmission," *Journal of International Economics*, Vol. 89, pp. 495-510.
- [28] Kalemli-Ozcan, S., E. Papaioannou, and J. L. Peydro-Alcalde, 2009, "Financial Integration and Risk Sharing: The Role of Monetary Union," in *The Euro at Ten: Fifth European Central Banking Conference*, ed. by Bartosz Maćkowiak, Francesco Paolo Mongelli, Gilles Noblet, and Frank Smets (Frankfurt: European Central Bank).
- [29] Kose, M. A., E. Prasad and M. E. Terrones, 2009, "Does Openness to International Flows Contribute to Productivity Growth?", *Journal of International Money and Finance*, Vol. 28, No. 4, pp. 549-738.
- [30] Maddala, G.S. and S. Wu, (1999), "A Comparative Study of Unit Root Tests with Panel Data and a New Simple Test", *Oxford Bulletin of Economics and Statistics*, Vol. 61, No. 1, pp. 631-52.
- [31] Rey, H., (2014), "Dilemma not Trilemma: The global financial cycle and monetary policy independence", paper presented at the Jackson Hole Symposium, August 2013.
- [32] Rodriguez, F. and D. Rodrick, 2001, "Trade Policy and economic growth: A Skeptic's Guide to the Cross-National Evidence", *NBER Macroeconomics Annual* 2000, Vol.15, MIT Press, pp. 261-325.
- [33] Romer, D., 1993, "Openness and inflation. Theory and evidence", *Quarterly Journal of Economics* 108 (November), 869-903.
- [34] Silaghi, M., C. Jude, D. Alexa and C. Litan, (2012), "Do business and public sector research and development expenditure contribute to economic growth in Central and Eastern European Countries? A dynamic panel estimation", Kingston University London, Economics Discussion Papers.

## APPENDIX

<b>Table A: Unit root tests</b>			
Variable	Deterministic	IPS	Fisher
Economic growth	Constant	-3.84 (0.00)	120.47 (0.00)
	Constant and trend	-3.96 (0.00)	93.22 (0.00)
Trade openness	Constant	-1.14 (0.000)	24.54 (0.02)
	Constant and trend	-2.60 (0.00)	17.07 (0.09)
Foreign direct investments	Constant	-4.13 (0.000)	81.22 (0.000)
	Constant and trend	-4.52 (0.00)	53.42 (0.00)
External demand	Constant	-2.80 (0.000)	59.96 (0.000)
	Constant and trend	-3.72 (0.00)	46.35 (0.00)