European Union Enlargement in 2004, Euro adoption and Trade Spillovers: A Near-Var Approach

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Abstract

This paper evaluates trade contagion before and after the accession of Central and Eastern European (CEE) countries to the European Union in 2004. A near-VAR model is used in order to capture both the direct and indirect shock transmissions via bilateral trade relationships. Empirical results reveal that CEE economies respond more strongly to a European shock after 2004 than before. Furthermore, we also find that trade spillovers increased mostly for CEE countries that have adopted the euro. Finally, transmission of shocks is mainly due to the biggest countries of the Euro area.

I. Introduction

The Treaty of Accession between Central and Eastern European (CEE) countries (Cyprus, the Czech Republic, Estonia, Hungry, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia[1]) and the European Union (EU) came into force on 1 May 2004. Before the accession of these countries to the EU, a lot of studies focused on the degree of business cycles synchronization between the Euro area and the CEE countries (see Fidrmuc and Korhonen (2006) for a survey). As stated by the Optimum Currency Area (OCA, Mundell (1961)) a high degree of synchronization is a condition of success for integration of new members. Nowadays, macroeconomic interdependencies of the Euro area and CEE countries are still at the center of many debates. Stanisic (2013) studies the comovements of CEECs' GDP and the euro area. Results show that there is no common CEE business cycle, although a synchronization trend is evident. Similarly, there is a strong trend of convergence of CEEC national business cycles toward that of the EA. In a recent paper, Di Giorgio (2016), using a Markov switching auto-regressive model, rejects the hypothesis of the independence of CEEC cycles from the EA cycle. Egger and Larch (2010) point out that trade agreements between EU members and CEE countries increase considerably bilateral trade between these regions. The increase of trade in the post-accession period is therefore expected to push the degree of correlation of aggregate output between these economies. Thus, this paper aims to assess the extent to which trade spillover effects transmitted from the Euro area to CEE economies increase after the largest enlargement of the European Union. Higher trade spillovers effects could explain the trend of convergence of CEEC national business cycles toward that of the EA observed by Stanisic (2013). Furthmore, according to the fact that some of the CEE countries have adopted the euro (Slovenia in 2007, Cyprus in 2008, Malta in 2008, Slovakia in 2009, Estonia in 2011, Latvia in 2014, and Lithuania in 2015), we disentangle trade spillovers from CEE-non euro countries to CEE-euro countries.

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[1]Eight Central and Eastern European countries (the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia), plus two Mediterranean countries (Malta and Cyprus)

International trade, one of the most important channels of the diffusion of output shocks, have positive effects on business cycles synchronization (Frankel and Rose, 1998, Clark and van Wincoop, 2001, Imbs, 2003, Baxter and Kouparitsas, 2003, 2005, Dées and Zorell, 2011). Literature also provide empirical evidence of effects of trade integration on business cycle synchronization between the Euro area and CEE countries. Maurel (2002) indicates a positive relationship between intra-industry trade and business cycle convergence. A similar conclusion is noted by Fidrmuc (2001, 2004). Siedschlag (2010) examines a sample of 171 pairs of countries of the Eurozone and CEECs over the period 1990-2003 and suggests that bilateral trade increases the similarity of business cycles. The effects of trade hence is crucial in explaining macroeconomic interdependencies for the EU and CEE countries.

Frenkel and Nickel (2005) extend the work of Frenkel et al. (1999) and find empirical evidence that shock adjustment processes of some CEE economies are similar to some euro area countries. Jimenez-Rodriguez et al. (2010) use a near-VAR model in order to investigate the impact of interest rate, commodity price and industrial production shocks on key macroeconomic variables in ten CEE economies over the period from the early 1990s to 2009. These authors suggest that some countries like Slovakia and Slovenia – already euro area members – react stronger to foreign industrial production shocks than other countries. IMF spillover report (2012) indicate a positive relation between real output in the Euro area and GDP fluctuations in Central, Eastern and Southeastern Europe region via trade channels. Backe, Feldkircher and Slacik (2013) conclude that spillovers transmitted via financial channels and via trade channel are similar by applying a GVAR model. The most recent work is Keppel and Prettner (2015) who develop a theoretical framework based on the structural vector error correction model to assess the effects to output, interest rates, exchange rate and relative prices on the Euro area and CEE countries. Their results show strong inter-regional spillovers of output shocks. However, there is no empirical work, in our knowledge, which specifically evaluates the effects of the accession of CEE countries to European Union on how output shocks spill over from the Euro area to CEE region via trade channels.

In contrast to the existing work, we focus on the changing in trade spillover effects by evaluating the responses of CEE economies to an industrial production shock to twelve initial members of the Euro area via bilateral trade relationships. A near-VAR model proposed by Rondeau and Tavéra (2005) is exploited to take into account the degree of trade integration. This near-VAR model allows us to capture both the direct and indirect spillover effects of trade. According to these authors, the propagation of an output shock via bilateral trade may be separated into two mechanisms:

+ Direct trade spillover effects from country i to country j via bilateral commerce between two countries.

+ Indirect trade spillover effects from country i to country j via bilateral commerce with the third countries.

The difficulty in modeling two shock propagation channels above is the high dimension of the matrix of parameters. By introducing the export share-weighted average of the output of trading partners as an independent variable to each country as well as imposing restrictions on coefficient matrix, the near-VAR model considerably reduces the number of estimated parameters. Structural breaks of coefficients in the model indicate that the estimation of near-VAR model should be realized on two sub-samples: before the expansion of the Europe (pre-accession period) and after that (post-accession period). Empirical results obtained reveal the differences in trade spillover effects and allow us to evaluate the effects of the adherence to European Union on reactions of CEE economies to an output shock to founder members of the Euro area.

Our main findings can be summarized as follows. Firstly, trade spillover effects are significantly larger after the accession than before. Trade integration and macroeconomic interdependancies of CEE countries with the Eurozone have increased over time. Secondly, we find that Estonia, Slovenia and Slovakia that have already adopted the euro react stronger to the output shock to economies of the Eurozone via the trade contagion. In other words, adopting the euro enhance significantly the trade spillover effects. This result is in line with Jimenez-Rodriguez et al. (2010). Thirdly, the paper enriches the empirical evidence that biggest economies in the Euro area diffuse the greater trade effects to CEE economies.

The remainder of this paper is divided into three sections. Section 2 presents the methodology, data and econometric specification. Section 3 describes and assesses the empirical results, and Section 4 concludes.

II. Methodology, Data and Empirical Specification

II.1. Model

A near-VAR model proposed by Rondeau and Tavéra (2005) is exploited to take into account the degree of trade integration. This near-VAR model allows us to capture both the direct and indirect spillover effects of trade.The model is summarized as follows:
Considering a sample with n economies which interact by bilateral trade relationships. The output of a country i is noted as:

$$Y_i = A_i + \sum_{j=1}^{n} X_{ij} - M_i \tag{1}$$

where Y_i denoting output of country i, A_i being domestic demand, M_i referring import of country i and X_{ij} being export from country i to country j.
Assuming that domestic demand and import depend on domestic output ($A_i = A_i(Y_i)$ and $M_i = M_i(Y_i)$ where $0 < \frac{\partial A_i}{\partial Y_i} < 1$ and $0 < \frac{\partial M_i}{\partial Y_i} < 1$), that exports of country i to country j in short-run depend on the output fluctuations of country j ($X_{ij} = X_{ij}(Y_j)$ where $\frac{\partial X_{ij}}{\partial Y_j} \geq 0$), equation (1) can be transformed to growth rate form:

$$\frac{\Delta Y_i}{Y_i} = a_i \varepsilon_{Y_i}^{A_i} \frac{\Delta Y_i}{Y_i} + \sum_{j=1}^{n} \theta_{ij} x_i \varepsilon_{Y_j}^{X_{ij}} \frac{\Delta Y_j}{Y_j} - m_i \varepsilon_{Y_i}^{M_i} \frac{\Delta Y_i}{Y_i} \tag{2}$$

where $a_i = \frac{A_i}{Y_i}$, $\theta_{ij} = \frac{X_{ij}}{X_i}$, $x_i = \frac{X_i}{Y_i}$, $m_i = \frac{M_i}{Y_i}$, and ε_H^G referring to elasticity of variable •G related to variable H.
Assuming also that export of country i has the same elasticity related to activity fluctuations in all countries j and it can be assimilated to the elasticity of exports related to the international demand addressed to this economy: $\varepsilon_{Y_j}^{X_{ij}} = \varepsilon_{Y_i^e}^{X_i}$ where Y_i^e being the international demand of country i's goods. Under these assumptions, equation (2) can be re-written as follow:

$$\frac{\Delta Y_i}{Y_i} = a_i \varepsilon_{Y_i}^{A_i} \frac{\Delta Y_i}{Y_i} + x_i \varepsilon_{Y_i^e}^{X_i} \sum_{j=1}^{n} \theta_{ij} \frac{\Delta Y_j}{Y_j} - m_i \varepsilon_{Y_i}^{M_i} \frac{\Delta Y_i}{Y_i}$$

or

$$y_i = \beta_i y_i^e \tag{3}$$

where $y_i = \frac{\Delta Y_i}{Y_i}$, $\beta_i = \frac{x_i \varepsilon_{Y_i^e}^{X_i}}{1 - a_i \varepsilon_{Y_i}^{A_i} + m_i \varepsilon_{Y_i}^{M_i}}$ and $y_i^e = \sum_{j=1}^{n} \theta_{ij} \frac{\Delta Y_j}{Y_j} = \sum_{j=1}^{n} \theta_{ij} y_j \ (i \neq j)$
Equation (3) constitutes a theoretical framework that provide the basis for developing a constrained

VAR model in order to estimate the transmission of shocks via bilateral export between countries. By adding a temporal dimension to the model, (3) is rewritten as a dynamic equation capturing both the adjustments of domestic GDP of country i and responses of export of country i to the fluctuations in the country j's output:

$$g_i(L)y_{i,t} = h_i(L)y^e_{i,t} + u_{i,t}$$

where $g_i(L) = 1 - g_{i,1}(L) - ... - g_{ip_i}(L^{p_i})$, $h_i(L) = h_{i,0} + h_{i,1}(L) + ... + h_{i,q_i}(L^{q_i})$, $y^e_{i,t} = \sum_{j=1}^{n} \theta_{ij} y_{j,t}$ $(i \neq j)$, $i = 1...n$, and $u_{i,t}$ referring to error term.

Grouping equations of all countries in analyzed sample, the model can be written in matrix form:

$$G(L)Y_t = H(L)Y^e + U_t = H(L)\Theta Y_t + U_t$$

where

$$G(L) = \begin{pmatrix} g_1(L) & 0 & 0 \\ 0 & \cdots & 0 \\ 0 & 0 & g_n(L) \end{pmatrix}, H(L) = \begin{pmatrix} h_1(L) & 0 & 0 \\ 0 & \cdots & 0 \\ 0 & 0 & g_n(L) \end{pmatrix} \text{ and } \Theta = \begin{pmatrix} \theta_{1,1} & \theta_{1,2} & \cdots & \theta_{1,n} \\ \theta_{2,1} & \theta_{2,2} & \cdots & \theta_{2,n} \\ \vdots & \vdots & \ddots & \vdots \\ \theta_{n,1} & \theta_{n,2} & \cdots & \theta_{n,n} \end{pmatrix}$$

$Y_t = (y_{1,t}, ..., y_{n,t})'$, $Y^e_t = (y^e_{1,t}, ..., y^e_{n,t})'$ and $U_t = (u_{1,t}, ..., u_{n,t})'$

The constrained VAR model is finally determined by imposing $n(n-2)$ restrictions on each coefficient matrix of VAR model:

$$\Phi(L)Y_t = U_t$$

where $\Phi(L) = G(L) - H(L)\Theta$, $\Phi(L) = \Phi_0 - \Phi_1(L) - ... - \Phi_p(L^p)$ and $p = max(p^i, q^i)$. Entries of the matrix $\Phi(L)$ are $\phi_{i,j}(L) = -b_i(L)\theta_{i,j}$ for $i, j = 1, 2, ..., n$ and $i \neq j$ and $\phi_{i,j}(L) = g_i(L)$ for $i = 1, ..., n$.

The impulse response functions are calculated from VMA form of the model:

$$Y_t = \Phi^{-1}U_t = \Psi(L)U_t$$

where $\Psi(L) = \Psi_0 + \Psi_1(L) + ...$ and $\Psi_{k,(i,j)} = \frac{\partial y_{i,t+k}}{\partial u_{j,t}}$

The matrix of cumulative multiplier effects in h periods ahead of an innovation shock to output variables is then obtained by:

$$M^h = \sum_{s=1}^{h} \Psi_s$$

By relying on this model, we evaluate the responses of seven CEE economies to output shocks in the initial members of the Euro area. We use the cumulative multiplier effects to see how CEE countries are exposed to the fluctuations of output in the Euro area. This model integrates all bilateral trade relationships between the members of the Euro area and CEE countries in the analyzed sample and therefore captures the direct and indirect transmissions of shocks. For example, an output shock to Germany not only impacts on GDP of Poland via direct bilateral trade between these two countries but also spills over to Poland by influencing economic activity of the rest of sample via bilateral trade between Germany and these third countries. This allows us to sufficiency model the trade spillover effects.

II.2. Data and empirical specification

The sample consists of seven CEE economies that are The Czech Republic, Estonia, Hungary, Lithuania, Poland, Slovakia and Slovenia (CEE-7) and twelve founding members of the Euro area that are Austria, Belgium, Finland, France, Germany, Greece, Ireland, Luxembourg, the Netherlands, Italy, Portugal, and Spain (EA-12) over the period from Jan 1996 to Sept 2015. The choice of sample is based on the data availability. To capture fluctuations in output of the rest of the World, we also introduce an exogenous variable which is computed as export share-weighted of output of the most important economies: China, Japan, Korea and India in Asia; United stated, Canada, Brazil and Mexico in America; Russia, Denmark, Norway, Sweden and United Kingdom in Europe in each equation of the model. In fact, we model from 75% (Slovenia) to 91% (Slovakia) of export of CEE-7 economies. Monthly industrial production index (IPI) which is collected from OECD database and Datastream is used as proxy for economic activity. The growth rate is calculated as the first difference of the logarithm of the IPI. The Dickey-Fuller tests indicate that these series are stationary[2]. Bilateral export-share is average of annual data over the studied period which are extracted from World Integrated Trade Solution database.

According to Rondeau and Tavéra (2005), lag length selection is based on Akaike Information Criterion (AIC) and lags are varied to specific variables in equation. Due to the lack of data, lags are fixed at twelve months as maximum. We also try to estimate the model based on Bayesian Information Criterion (BIC) with fixed or different lags to specific variables. These models, however, seem to be less adaptable to the data[3]. Jarque-Berra tests and Ljung-Box tests are realized to evaluate the normality and the auto-correlation, respectively, of residuals. Lag lengths are then adjusted to correct the residual auto-correlation issue. Because lag lengths in each equation of the system are different and because exogenous variables are weighted endogenous variables, the model is estimated by Seemingly Unrelated Regressions (SUR) method rather than OLS.

We first begin with estimating the model over the period from Jan 1996 to Sept 2015. As reported in appendix A, while the assumption of non auto-correlation of residuals are satisfied for all countries, only residual in equations of Germany, Netherlands, Portugal and Italy are normally distributed. We then perform Chow tests in order to determine whether structural breaks of coefficients exist in May 2004. As showed in table **??**, coefficients estimated in Poland and Estonia's equations are significantly changed due to their accession to European Union. Five other CEE countries in sample do not represent the changing of coefficients in our near-VAR model on this date. However, Jiménez-Rodríguez et al. (2010) employ the method proposed by Wang & Zivot (2000) to detect multiple structural breaks in industrial production of CEE economies over the period early 1990 to 2009. Their results highlight that the breaks occur in Aug 2005 for Poland, Feb 2002 for Estonia, Nov 2003 for the Republic Czech, Jan 2004 Slovakia and Aug 2001 for Slovenia. It seems that economic activity in CEE region are significantly impacted by their integration to European Union. The trade spillover effects from the Euro area to CEE countries are accordingly expected to change after the largest enlargement of the Europe. These results support our intention that the model should be estimated on two sub-periods pre- and post-accession.

We therefore realize the estimation of the near-VAR model over two sub-periods: from Jan 1996 to April 2004 and from May 2004 to Sept 2015. The estimated models are presented in appendix A. All residual series are not auto-correlated as indicated by Ljung-Box tests. Normal distribution assumption are not statistically rejected in most of economies. One of the most important tests in VAR model is cross-correlation of residuals test. Matrix of cross-correlations of residuals are presented in appendix B. Only 4% of correlations are greater than 30% in the pre-accession model. This number is 2.3% in the post-accession estimation. The hypothesis of non-correlation of residuals is finally tested by the Breusch-Pagan test of independence: $\lambda = n \sum_{k=1}^{n} \rho_k$ where ρ_k being correlations in ascending order, λ following chi-squared distribution and $1 \leq n \leq 171$

[2]Results are available upon request

[3]Results are available upon request

(maximum number of correlations in a model contained 19 dependent variables is 171). Results of the tests realized for all values possible of n indicate that only 11% of correlations are significantly non-different from 0 for both pre- and post-accession models. We finally perform many Chow tests for the introduction of the euro: Jan 2001 for Greece and Jan 1999 for other founding members of the Euro area; the dates that Slovenia, Slovakia, and Estonia adopt the euro: Jan 2007, Jan 2009, and Jan 2011, respectively; the dates denote the financial crisis in 2008-2009: Sept to Dec 2008; and finally sovereign debt crisis in Europe: Sept 2012. Results in table 1 reveal that the null hypothesis of no coefficient breaks is statistically accepted for all tested dates.

Table 1: *Chow tests for coefficient breaks in near-VAR models*

Country	Chow test's p-value										
	1996-2004		1996-2015	2004-2015							
	Dec-98	Dec-00	May-04	Jan-11	Jan-09	Jan-07	Sep-08	Oct-08	Nov-08	Dec-08	Sep-12
CZE			0.67				0.78	0.78	0.82	0.82	0.63
EST			**0.03**	0.99			0.72	0.71	0.59	0.94	0.99
HUN			0.44				0.97	0.97	0.97	0.95	0.31
POL			**0.03**				0.10	0.10	0.34	0.16	0.50
SVK			0.90		0.46		0.72	0.73	0.67	0.66	0.56
SVN			0.41			0.87	0.94	0.94	0.78	0.73	0.65
LTU			0.92				0.93	0.93	0.90	0.84	0.97
AUT	1.00		0.50				0.98	0.98	0.99	0.89	0.90
BEL	0.80		0.06				0.85	0.83	0.83	0.83	0.71
FIN	0.90		0.40				0.36	0.37	0.35	0.35	0.98
FRA	0.34		0.83				0.26	0.26	0.27	0.44	0.74
DEU	0.68		0.29				0.44	0.45	0.39	0.57	0.99
IRL	1.00		0.27				0.90	0.89	0.91	0.85	0.09
ITA	0.64		0.14				0.08	**0.05**	**0.05**	**0.05**	0.65
LUX	0.70		0.23				0.91	0.91	0.87	0.80	0.99
NLD	1.00		0.90				0.97	0.99	0.96	0.96	0.96
PRT	0.64		0.48				0.27	0.29	0.36	0.42	0.91
GRC		0.10	0.89				0.63	0.66	0.81	0.74	0.86
ESP	0.17		0.85				0.83	0.70	0.44	0.22	0.88

Note: AUT: Austria, BEL: Belgium, FIN: Finland, FRA: France, DEU: Germany, GRC : Greece, IRL: Ireland, ITA : Italia, LUX: Luxembourg, NLD: Netherlands, PRT: Portugal, ESP: Spain, EST: Estonia, HUN: Hungary, LTU: Lithuania, POL: Poland, CZE: Republic Czech, SVK: Slovakia, SVN: Slovenia.
In bold, the null hypothesis of no structural breaks can be rejected at significance level of **5%**.

III. Empirical Results

III.1. Effect of the accession to European Union

Estimation of near-VAR model on two sub-periods before and after the accession to Union European allows us to assess the changing in the impulse responses of CEE-7 economies when facing an output shock in twelve initial members of the Euro area. We calculate multiplier effects as cumulative impulse responses in 24 months ahead that are exhibited in appendix C. The graphs of cumulative impulse responses are also displayed in appendix D. In general, two main conclusions may be inferred from these results:
Firstly, all impulse responses of CEE region estimated over both two sub-periods are positive. This result is in line with Rondeau and Tavéra (2005) and indicates that the transmission of demand is consistently captured by the model. Furthermore, whereas most of reactions in industrial production of CEE-7 economies disappear in 8 to 10 months during the pre-accession period, it is more persistent following the adherence. The effects exist, on average, in 20 to 24 months in this

period. During the pre-accession period, we obtain a maximum multiplier effect of 1.71% when Lithuania reply to an output shock to Germany and a minimum of 0.03% when The Republic Czech react to a shock to Finland. These numbers are 6.92% and 0.14% obtained from the near-VAR model estimated over the period from May 2004 to Sept 2015. These are the reactions of Slovakia to a shock to Germany and of Lithuania to a shock in Luxembourg, respectively. We also build an error bands of 16% and 84% as suggested by Sims and Zha (1999) from 5000 Monte Carlo simulations[4]. Results reveal that cumulative impulse responses are statistically different from 0.
Secondly, multiplier effects increase significantly in the period succeeding the adherence into European Union and adequately correlate with trade intensity. Table **??** reports the changing in multiplier effects and trade intensities over two periods. R_{M24} denote the ratio of multiplier effect estimated over the post-accession period to multiplier effect obtained from the pre-accession period: $R_{M24} = \frac{post-accession\ M24}{pre-accession\ M24}$. Trade intensity is calculated as $TI_{ij} = \frac{X_{ij}+M_{ij}}{Y_i}$ where X_{ij} denoting average of export of country i to country j, M_{ij} referring to average of import of country i from country j, Y_i being the average of output of country i over the analyzed sample. Country i denote the CEE countries and country j refer to the initial members of the Euro area. Data on GDP is extracted from World Bank database. This variable of trade intensity represents percentage of bilateral trade with country j on output of country i and therefore measures the degree of trade integration of country i to country j. Similar to R_{M24}, R_{TI} in table 2 is a ratio that measure the changing in trade intensity between each CEE country with the Euro area members after the enlargement of Union European in 2004: $R_{TI} = \frac{post-accession\ TI_{ij}}{pre-accession\ TI_{ij}}$.

Table 2: *Changing in Multiplier effect and Trade intensity*

Country	CZE		EST		HUN		POL		SVK		SVN		LTU	
	R_{M24}	R_{TI}	R_{M24}	R_{TI}	R_{M24}	R_{TI}	R_{M24}	R_{TI}	R_{M24}	R_{TI}	R_{M24}	R_{TI}	R_{M24}	R_{TI}
AUT	*2.53*	*0.98*	*4.08*	*0.98*	0.71	0.82	2.26	1.39	4.57	1.12	2.58	1.27	*0.79*	*1.11*
BEL	2.86	1.22	4.24	1.07	0.87	0.90	2.46	1.18	5.21	1.19	2.85	1.32	*0.78*	*1.57*
FIN	7.94	1.07	*10.38*	*0.64*	*2.39*	*0.62*	6.84	1.00	14.44	1.21	7.80	1.02	*2.77*	*0.98*
FRA	3.52	1.36	5.12	1.07	1.09	1.14	3.05	1.29	6.41	2.15	*3.40*	*0.88*	*0.94*	*1.05*
DEU	6.29	1.10	*9.57*	*0.92*	1.97	1.05	5.51	1.24	11.54	1.32	6.19	1.00	*1.78*	*0.90*
IRL	2.41	1.05	*3.49*	*0.60*	0.74	0.72	2.17	1.52	4.59	1.53	2.47	1.19	0.66	0.78
ITA	3.52	1.19	*5.20*	*0.81*	*1.10*	*0.90*	3.08	1.13	6.38	1.10	3.39	1.05	*0.97*	*1.14*
LUX	2.09	1.22	3.04	1.84	*0.66*	*1.26*	1.85	1.63	3.91	1.44	2.15	1.37	*0.59*	*1.02*
NLD	4.78	1.39	*7.14*	*0.78*	1.46	1.20	4.12	1.31	8.89	1.59	4.77	1.31	1.31	1.45
PRT	2.64	1.89	*3.82*	*0.69*	0.81	0.99	2.26	1.23	4.82	2.56	2.63	2.11	*0.72*	*1.34*
ESP	4.47	1.64	6.52	1.24	1.41	1.46	3.93	1.55	8.32	1.90	4.41	1.43	1.22	1.54
GRC	2.48	1.03	3.59	1.13	*0.79*	*1.38*	2.18	1.58	4.61	2.13	2.50	1.54	0.68	0.54
EA-12	3.41	1.15	*5.14*	*0.78*	1.05	1.02	2.97	1.25	6.23	1.36	3.33	1.07	*0.95*	*1.07*

Notes: Output shocks are originated from country in row. EA-12 refer to a common shock in all twelve economies of the Euro area. Country code: AUT: Austria, BEL: Belgium, FIN: Finland, FRA: France, DEU: Germany, GRC : Greece, IRL: Ireland, ITA : Italia, LUX: Luxembourg, NLD: Netherlands, PRT: Portugal, ESP: Spain, EST: Estonia, HUN: Hungary, LTU: Lithuania, POL: Poland, CZE: Republic Czech, SVK: Slovakia, SVN: Slovenia.

On the one hand, The Republic Czech, Estonia, Poland, Slovakia, and Slovenia enhance significantly the macroeconomic integration with the Euro area via trade channels in comparison with the pre-accession period. These economies react more strongly and persistently to the economic fluctuations in the monetary union after becoming European Union members. All R_{M24} of these countries are greater than 1 which denote the increase in multiplier effects. The greatest raise which is 14.44 times is the cumulative impulse response in 24 months ahead of Slovakia to an

[4]Results are available upon request

output shock in Finland. On the other hand, Lithuania also responds more strongly to an output shock to Germany, Netherlands, Spain and Finland but trade spillover effects from France to this economy do not change. Moreover, multiplier effects decrease when facing a shock in other EA-12 members. Similarly, Hungary reacts more greatly to a shock to the leading economies in the Euro area like Germany, France, Italy, Netherlands and Spain whereas multiplier effects decrease when output shocks occurred in other EA-12 economies.
We also simulate a common output shock occurred contemporaneously in all twelve members of the Euro area. Six of seven CEE countries reacts more strongly to this shock after 2004. The response of Slovakia to such a shock increase 6.23 times in comparison with the pre-accession period whereas it seems that Lithuania reacts equally to such a shock in two sub-periods.
Results in table 2 also reveal that most of increases in multiplier effects go with the raises in trade intensity. There are 24% of pairs are inverse. This phenomena, however, mainly occurs for Estonia and Lithuania. The enhancing trade intensity after the accession in European Union increase significantly trade spillover effects. CEE region integrate more and more to the Euro area by changing the way how these economies are exposed to exogenous shock via trade channels.

To answer the question that which economy in EA-12 influences most significantly on CEE region in both pre- and post-accession period, we simulate a common shock in all founding economies of the Euro area and impose restrictions on the near-VAR coefficients that each country in the Euro area has no export and import with other countries in the sample. The degree of diffusion is then calculated as follow:

$$\widetilde{R}_{M24j} = \frac{\widetilde{M24}_j}{M24}$$

where $M24 = \sum_{i=1}^{7} MC24_i * GDP_i$ and $\widetilde{M24}_j = \sum_{i=1}^{7} \widetilde{MC24}_{ij} * GDP_i$ where $MC24_i$ referring to cumulative impulse response in 24 months ahead of CEE country i to a common shock occurred in the Euro area, $\widetilde{MC24}_{ij}$ being the cumulative impulse response of CEE country i to a common shock in the Euro area when export and import of founding member •j of the Euro area are imposed to be 0, GDP_i denoting the GDP share of country i in CEE region. The more $\widetilde{R}_{M24j}$ is small, the more degree of propagation of output shock of this country is great.
As presented in table **??**, the more the economy in the Euro area is large, more the trade spillover effects are importants. Germany, France, Italy ans Spain, the leader economies in the Euro area, impact considerably on CEE regions over the period 2004-2015. Excluding bilateral trade of Germany from the model induce a decrease of 88% and 89% of the average of multiplier effects of CEE region to a common shock in the Euro area over the pre-2004 and post-2004 periods, respectively. These numbers are 69% and 71% if we impose international trade of France to be zero. We also find that Netherlands and Belgium play an important role in propagating the output shock to CEE countries during the period before 2004. Excluding bilateral trade of these two countries engender a decrease of 53% and 75% of trade spillover effects. These numbers, however, decline to 40% and 44% after 2004. The smallest economies in the Euro area, like Luxembourg, Greece, Ireland and Finland have negligible impacts.
To sum up, The Republic Czech, Estonia, Poland, Slovakia, and Slovenia are more and more integrated to the Eurozone since their adhesion into European Union in 2004. The impulse response of Lithuania and Hungary, however, only increase when output shocks come from largest economies in EA-12. The largest founding economies of the Euro area have a high degree of diffusion of output shock over CEE region, specially after the enlargement of Union European in 2004.

Table 3: *Degree of shock diffusion*

Country	GDP share (%)		$\widetilde{R}_{M24}$		Rank	
	Pre-2004	Post-2004	Pre-2004	Post-2004	Pre-2004	Post-2004
DEU	28.41	27.83	0.12	0.11	1	1
FRA	19.74	19.97	0.31	0.29	3	2
ITA	19.24	17.77	0.57	0.31	6	3
ESP	11.59	12.58	0.52	0.47	5	4
BEL	3.53	3.66	0.25	0.56	2	5
NLD	6.14	6.30	0.47	0.60	4	6
AUT	2.89	3.00	0.57	0.67	7	7
PRT	2.48	2.36	0.88	0.81	10	8
FIN	1.65	1.77	0.84	0.83	9	9
GRC	2.63	2.66	0.89	0.93	11	10
LUX	0.32	0.38	1.00	0.94	12	11
IRL	1.38	1.73	0.64	0.98	8	12

Note: AUT: Austria, BEL: Belgium, FIN: Finland, FRA: France, DEU: Germany, GRC : Greece, IRL: Ireland, ITA : Italia, LUX: Luxembourg, NLD: Netherlands, PRT: Portugal, ESP: Spain.

III.2. Effect of adopting the euro

In this section, we dtermins which CEE country is significantly impacted by output shocks in EA-12 members and if adopting the euro matters for trade spillover effects. To exhibit the average impulse response of seven CEE economies to twelve members of the Euro area, we use an index as follow:

$$M24_{GDP-weighted\ average} = \sum_{j=1}^{12} M24_{ij} GDP_j$$

where GDP_j being the GDP share of country j in the EA-12 region, $M24_{ij}$ is the multiplier effects of CEE country i to an output shock in country j. Results are reported in table **??**.

Table 4: *Effect of adopting the euro*

Country	GDP Share (%)		$M24_{GDP-weighted\ average}$ (%)		Rank	
	Pre-EU	Post-EU	Pre-EU	Post-EU	Pre-EU	Post-EU
SVK	7.41	8.05	0.36	3.27	7	1
EST	1.89	2.04	0.40	2.98	6	2
SVN	3.89	3.62	0.49	2.37	4	3
CZE	19.13	18.21	0.43	2.16	5	4
POL	47.84	49.55	0.49	2.13	3	5
HUN	15.99	14.24	1.02	1.58	2	6
LTU	3.86	4.30	1.05	1.45	1	7
Total	100	100				

Note: CZE: Republic Czech, EST: Estonia, HUN: Hungary, LTU: Lithuania, POL: Poland, SVK: Slovakia, SVN: Slovenia.

We note that the way how CEE countries are exposed to an output shock is different between the two sub-periods: before the accession to European Union, Lithuania, Poland and Hungary are more significantly impacted via trade channels whereas the smaller economies respond more significantly during the post-accession period. Three euro-adopted economies including Slovakia, Estonia and Slovenia react more strongly to an output shock in the Euro area members. The cumulative impulse responses of these economies are 0.36%, 0.40% and 0.49%, respectively, during the pre-2004 period compared to 3.27%, 2.98% and 2.37% during the subsequent period. These empirical results provide evidence that the euro adoption enhance significantly macroeconomic interdependencies between CEE countries and the initial members of the Euro area. The euro-effects on trade attract the attention of many research. Herwartz and Weber (2013) point out that trade between Eurozone countries gradually increases compared to European countries that are not members of the Euro area. This conclusion is consistent with the raise in trade intensity of Slovenia and Slovakia with the Euro area. An increase in trade intensity induce the increase in trade spillover effects. Jiménez-Rodríguez et al. (2010) also highlight that Slovakia and Slovenia react stronger to foreign industrial production shocks than other economies. Estonia represent a decrease in trade integration with the Euro area but an increase in multiplier effect as indicated in table 2. Our result also reveal that whereas Lithuania react greatly before, this economies integrate slowly into the Euro area after the accession to European Union.

IV. Conclusion

Considered as future candidates for adopting the euro, CEE countries are at the center of many debates with regarding to the macroeconomic interdependencies and the Euro area. In particular, the question of how are CEE economies exposed to output shocks in the initial members of the Euro area via trade channels is particularly raised. The fact that these economies become European Union members in 2004 is expected to enhance trade intensity between two regions and therefore increase the degree of synchronization of business cycle via trade spillover effects. This paper thus aims to evaluate the impact of this largest enlargement of Union European on the way how CEE economies react to an output shock in the Euro area.

Relying on a near-VAR model to capture all bilateral trade relationships of all economies in studied sample, our empirical results indicate that the adherence to European Union has the significant impact on trade spillover effects between the Euro area and CEE countries. We also find that economies have adopted the euro integrate more rapidly to the Euro area. We also enrich the existing literature that the biggest economies in the Euro area diffuse greater trade effects to CEE region.

References

[1] Backé, P., Feldkircher, M., & Slacík, T., 2013. "Economic spillovers from the Euroarea to the CESEE region via the financial channel: A GVAR approach". Focus on European Economic Integration, 4/2013.

[2] Baxter, Marianne & Kouparitsas, Michael A., 2005. "Determinants of business cycle comovement: a robust analysis," Journal of Monetary Economics, Elsevier, vol. 52(1), pages 113-157, January.

[3] Clark, Todd E. & van Wincoop, Eric, 2001. "Borders and business cycles," Journal of International Economics, Elsevier, vol. 55(1), pages 59-85, October.

[4] Di Giorgio C., 2016. "Business Cycle Synchronization of CEECs with the Euro Area: A Regime Switching Approach". Journal of Common Market Studies, Vol. 54(2), pages 284–300.

[5] Dées, Stéphane & Zorell, Nico, 2011. "Business cycle synchronisation: disentangling trade and financial linkages,". Working Paper Series 1322, European Central Bank.

[6] Egger, Peter & Larch, Mario, 2011. "An assessment of the Europe agreements' effects on bilateral trade, GDP, and welfare," European Economic Review, Elsevier, vol. 55(2), pages 263-279, February.

[7] Fidrmuc, Jarko, 2001. "The endogeneity of the optimum currency area criteria, intraindustry trade, and EMU enlargement". Discussion paper No. 106/2001. Centre for Transition Economics, Katholieke Universiteit, Leuven.

[8] Fidrmuc, Jarko, 2004. "The endogeneity of the optimum currency area criteria, intra-industry trade, and EMU enlargement". Contemporary Economic Policy 22, 1–12.

[9] Fidrmuc, Jarko, Korhonen Iikka , 2006. Meta-Analysis of the Business Cycle Correlation between the Euro Area and the CEECs, CESifo Working Paper Series 1693, CESifo Group Munich.

[10] Frankel, Jeffrey A & Rose, Andrew K, 1998. "The Endogeneity of the Optimum Currency Area Criteria," Economic Journal, Royal Economic Society, vol. 108(449), pages 1009-25, July.

[11] Frenkel, Michael & Nickel, Christiane & Schmidt, Günter, 1999. "Some shocking aspects of EMU enlargement,". Research Notes 99-4, Deutsche Bank Research.

[12] Frenkel, M., & Nickel, C. (2005). How symmetric are the shocks and the shock adjustment dynamics between the euro and Central and Eastern European Countries? Journal of Common Market Studies, 43, 53–74.

[13] Hájek J. & Horváth R., 2015. The Spillover Effect of Euro Area on Central and Southeastern European Economies: A Global VAR Approach. Open Economies Review, Volume 27, Issue 2 , pp 359-385.

[14] Keppel, Catherine & Prettner, Klaus, 2015. "How interdependent are Eastern European economies and the Euro area?," The Quarterly Review of Economics and Finance, Elsevier, vol. 58(C), pages 18-31.

[15] Imbs, Jean, 2003. "Trade, Finance, Specialization and Synchronization," CEPR Discussion Papers 3779, C.E.P.R. Discussion Papers. IMF. (2012). Spillover Report. In IMF Policy Papers.

[16] Iulia SIEDSCHLAG, 2010. "Patterns and determinants of business cycle synchronization in the enlarged European Economic and Monetary Union," Eastern Journal of European Studies, Centre for European Studies, Alexandru

[17] Ioan Cuza University, vol. 1, pages 21-44, June. Marianne Baxter & Michael A. Kouparitsas, 2003. "Trade Structure, Industrial Structure, and International Business Cycles," American Economic Review, American Economic Association, vol. 93(2), pages 51-56, May.

[18] Maurel, Mathilde, 2002. On the way of EMU enlargement towards CEECs: What is the appropriate exchange rate regime? Discussion paper No. 3409. CEPR, London.

[19] Mundell, Robert A., 1961. A theory of optimum currency area. American Economic Review 51, 657–665.

[20] Rebeca Jimenez-Rodriguez & Amalia Morales-Zumaquero & Balazs Egert, 2010. "The effect of Foreign Shocks in Central and Eastern Europe". Journal of Policy Modeling 32 (2010) 461–477

[21] Rondeau Fabien et Tavéra Christophe, 2005. «Interdépendance macroéconomique des pays européens et propagation des chocs conjoncturels d'activité», Economie & prévision, 2005/3-4-5 n° 169-170-171, p. 25-39.

[22] Stanisic N., 2013. "Convergence between the business cycles of Central and Eastern European countries and the Euro area," Baltic Journal of Economics, Baltic International Centre for Economic Policy Studies, vol. 13(1), pages 63-74, July.

Appendix A. Model estimations

Country	Jan 1996-Sept 2015				Pre-accession model				Post-accession model			
	LAGs	**LB**	**JB**	**AIC**	**LAGs**	**LB**	**JB**	**AIC**	**LAGs**	**LB**	**JB**	**AIC**
CZE	(2,2,7)	0.36	**0.03**	-463.10	(1,2,2)	0.46	0.18	-238.36	(3,1,11)	0.19	0.82	-363.61
EST	(2,2,7)	0.38	**0.03**	-396.00	(1,1,1)	0.11	0.90	-221.80	(8,3,5)	0.93	**0.02**	-299.65
HUN	(2,3,8)	0.94	**0.00**	-502.82	(2,3,1)	0.06	0.41	-271.76	(2,1,7)	0.43	**0.00**	-372.33
POL	(1,1,1)	0.08	**0.00**	-571.99	(2,3,3)	0.55	0.28	-277.70	(2,1,7)	0.42	0.55	-468.57
SVK	(1,1,1)	0.71	**0.00**	-350.76	(3,1,5)	0.27	0.22	-256.14	(2,1,7)	0.17	**0.02**	-258.18
SVN	(8,5,11)	0.05	**0.00**	-542.21	(3,3,1)	0.42	**0.00**	-306.86	(2,2,5)	0.53	**0.00**	-397.06
LTU	(7,1,1)	0.99	**0.00**	-87.65	(3,4,1)	0.29	0.87	-60.52	(10,6,1)	0.74	**0.00**	-164.00
AUT	(5,5,11)	0.50	**0.00**	-669.48	(12,3,3)	0.60	**0.01**	-320.20	(2,2,9)	0.74	0.96	-472.35
BEL	(4,3,4)	0.87	**0.00**	-576.11	(2,3,7)	0.71	**0.00**	-340.90	(3,4,7)	0.39	0.93	-399.44
FIN	(2,3,8)	0.11	**0.00**	-612.06	(6,6,3)	0.42	0.48	-350.13	(2,1,7)	0.66	**0.00**	-399.34
FRA	(3,3,12)	0.59	**0.02**	-826.19	(6,2,1)	0.53	**0.00**	-431.70	(2,2,9)	0.39	0.23	-537.94
DEU	(2,3,8)	0.74	0.77	-751.54	(4,1,5)	0.05	0.62	-416.51	(1,3,1)	0.32	0.12	-475.01
IRL	(3,1,10)	0.14	**0.00**	-105.91	(3,2,10)	0.55	0.44	-149.49	(3,5,7)	0.21	**0.00**	-109.49
ITA	(2,3,8)	0.44	0.39	-822.26	(1,3,2)	0.83	0.07	-463.94	(3,3,2)	0.20	0.44	-531.01
LUX	(3,2,11)	0.25	**0.00**	-304.83	(6,2,5)	0.60	**0.00**	-187.54	(2,2,9)	0.56	**0.00**	-245.11
NLD	(3,3,12)	0.16	0.16	-541.36	(3,4,12)	0.74	0.46	-317.86	(1,1,1)	0.13	0.81	-368.08
PRT	(3,3,12)	0.78	0.98	-529.89	(2,2,5)	0.95	0.06	-308.49	(2,1,3)	0.19	0.76	-398.43
GRC	(10,4,1)	0.06	**0.00**	-477.86	(2,2,5)	0.62	**0.00**	-285.99	(4,0,1)	0.11	0.39	-358.25
ESP	(6,3,8)	0.11	**0.00**	720.66	(2,2,5)	0.55	**0.01**	-410.04	(1,1,2)	0.08	0.38	-524.90

Notes: LB, JB denote p-value of Ljung-Box test and Jarque-Berra test, respectively. LAGs represent lags of national output (y), international output (y^e) and rest of the Word's output. AIC refer to Akaike Information Criterion. Country code: AUT: Austria, BEL: Belgium, FIN: Finland, FRA: France, DEU: Germany, GRC : Greece, IRL: Ireland, ITA : Italia, LUX: Luxembourg, NLD: Netherlands, PRT: Portugal, ESP: Spain, EST: Estonia, HUN: Hungary, LTU: Lithuania, POL: Poland, CZE: Republic Czech, SVK: Slovakia, SVN: Slovenia.

Appendix B. Residual analysis

	CZE	EST	HUN	POL	SVK	SVN	LTU	AUT	BEL	FIN	FRA	DEU	IRL	ITA	LUX	NLD	PRT	GRC	ESP
CZE		-0.01	0.21	0.38	-0.05	0.15	0.06	0.06	-0.19	0.07	-0.13	-0.10	0.07	0.18	0.21	0.18	0.17	-0.11	0.01
EST	0.01		-0.03	-0.02	0.05	0.18	0.29	0.00	-0.20	-0.25	0.22	-0.21	-0.13	-0.05	0.04	0.17	0.11	0.22	0.05
HUN	0.03	0.05		0.19	0.11	0.12	0.18	-0.04	-0.14	-0.13	-0.14	0.10	-0.12	0.10	-0.17	-0.19	-0.04	0.07	0.07
POL	-0.01	0.07	0.27		-0.06	0.21	0.01	-0.09	-0.02	-0.09	-0.18	-0.01	-0.13	0.13	0.24	0.04	0.00	-0.05	-0.13
SVK	0.03	-0.09	-0.17	0.13		0.26	0.08	-0.17	-0.06	-0.05	-0.11	0.32	-0.29	-0.14	0.04	-0.23	-0.01	-0.20	0.18
SVN	-0.08	-0.19	0.06	-0.06	0.05		0.01	-0.13	-0.20	-0.16	0.09	0.15	-0.04	0.01	0.08	0.17	-0.08	-0.08	0.08
LTU	0.12	-0.12	0.01	-0.23	-0.05	0.04		-0.09	0.02	-0.09	0.13	-0.18	-0.04	-0.08	-0.03	0.15	-0.03	0.00	-0.07
AUT	-0.02	0.01	0.09	0.16	0.06	-0.06	-0.01		0.11	-0.06	0.20	-0.47	-0.02	0.08	0.14	0.26	0.08	-0.01	-0.30
BEL	-0.19	0.09	0.03	0.16	-0.04	-0.24	-0.02	-0.01		-0.01	-0.34	-0.15	-0.09	-0.01	-0.04	-0.19	-0.05	-0.13	-0.07
FIN	0.11	-0.37	-0.04	0.06	0.27	0.10	-0.06	-0.21	-0.08		-0.04	0.08	0.05	-0.13	0.01	0.16	0.24	-0.12	-0.03
FRA	0.29	0.13	-0.09	-0.13	-0.01	0.09	0.23	0.03	-0.11	-0.07		-0.33	0.01	-0.13	0.03	0.39	0.00	-0.14	-0.21
DEU	-0.32	0.12	-0.05	-0.21	-0.35	0.15	-0.06	-0.12	-0.11	-0.14	-0.24		-0.01	-0.26	-0.23	-0.27	-0.13	-0.23	0.20
IRL	0.02	-0.07	0.11	-0.04	-0.09	0.02	0.08	-0.13	-0.18	0.07	-0.01	0.01		-0.04	0.11	0.12	-0.12	0.10	-0.03
ITA	-0.09	0.15	-0.01	0.22	-0.04	-0.13	-0.08	-0.05	0.06	0.05	-0.19	-0.18	-0.10		0.12	0.03	-0.07	0.01	-0.31
LUX	-0.04	-0.01	0.01	-0.13	0.08	0.25	0.00	-0.14	-0.25	0.08	0.07	0.04	0.06	-0.05		0.14	-0.03	-0.12	-0.21
NLD	0.06	0.06	0.03	-0.13	0.08	0.08	0.15	-0.02	-0.10	0.05	0.37	-0.09	0.06	-0.06	0.10		0.02	-0.12	-0.24
PRT	-0.12	0.08	-0.01	0.10	0.13	0.08	-0.10	-0.06	0.04	-0.07	-0.21	0.11	0.12	0.07	-0.13	-0.23		-0.24	-0.04
GRC	0.13	-0.08	-0.04	0.08	0.16	-0.08	-0.11	0.08	-0.17	0.05	-0.04	-0.29	0.08	-0.02	0.20	0.02	-0.25		0.15
ESP	-0.03	-0.13	0.04	-0.05	0.12	0.04	0.11	0.01	0.01	0.07	0.10	-0.08	0.20	-0.22	0.14	0.13	-0.12	0.15	

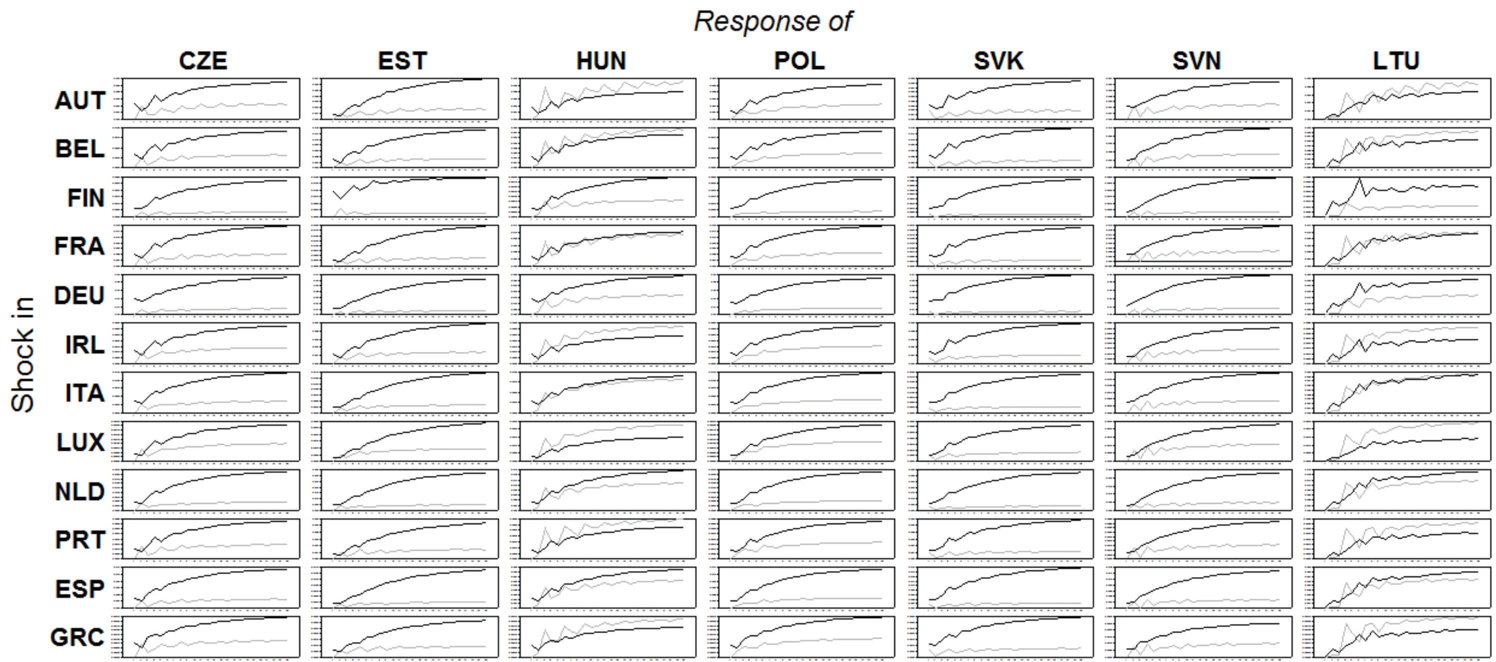
Notes: Lower triangular matrix consists of correlations of residuals from the post-accession model. Upper triangular matrix consists of correlations of residuals from the pre-accession model. Country code: AUT: Austria, BEL: Belgium, FIN: Finland, FRA: France, DEU: Germany, GRC : Greece, IRL: Ireland, ITA : Italia, LUX: Luxembourg, NLD: Netherlands, PRT: Portugal, ESP: Spain, EST: Estonia, HUN: Hungary, LTU: Lithuania, POL: Poland, CZE: Republic Czech, SVK: Slovakia, SVN: Slovenia.

Appendix C. Multiplier effects before and after the accession (%)

Country	CZE		EST		HUN		POL		SVK		SVN		LTU	
	Pre-EU	Post-EU	Pre-EU	Post-EU	Pre-EU	Post-EU	Pre-EU	Post-EU	Pre-EU	Post-EU	Pre-EU	Post-EU	Pre-EU	Post-EU
AUT	0.22	0.55	0.17	0.70	0.57	0.41	0.23	0.52	0.19	0.85	0.25	0.65	0.43	0.34
BEL	0.32	0.92	0.31	1.33	0.76	0.67	0.37	0.91	0.27	1.39	0.35	1.00	0.82	0.64
FIN	**0.03**	0.27	0.14	1.45	0.08	0.20	0.04	0.28	0.03	0.42	0.04	0.29	0.11	0.30
FRA	0.39	1.38	0.38	1.94	0.93	1.01	0.45	1.38	0.33	2.12	0.46	1.56	1.01	0.95
DEU	0.73	4.60	0.65	6.19	1.70	3.35	0.82	4.52	0.60	**6.92**	0.80	4.95	**1.71**	3.03
IRL	0.14	0.33	0.14	0.49	0.32	0.24	0.15	0.33	0.11	0.49	0.14	0.36	0.36	0.24
ITA	0.35	1.22	0.33	1.71	0.82	0.91	0.40	1.23	0.30	1.89	0.43	1.47	0.86	0.83
LUX	0.10	0.21	0.09	0.28	0.23	0.15	0.11	0.20	0.08	0.31	0.11	0.23	0.24	**0.14**
NLD	0.45	2.15	0.46	3.26	1.08	1.57	0.52	2.16	0.37	3.28	0.49	2.32	1.16	1.53
PRT	0.14	0.38	0.14	0.53	0.34	0.28	0.17	0.38	0.12	0.58	0.16	0.42	0.36	0.26
ESP	0.26	1.16	0.25	1.65	0.61	0.86	0.30	1.16	0.21	1.78	0.29	1.29	0.66	0.80
GRC	0.09	0.22	0.09	0.32	0.21	0.17	0.10	0.22	0.07	0.34	0.10	0.25	0.22	0.15

Notes: This table presents the cumulative impulse response in 24 months ahead of country in column to a shock originated in country in row. Country code: AUT: Austria, BEL: Belgium, FIN: Finland, FRA: France, DEU: Germany, GRC : Greece, IRL: Ireland, ITA : Italia, LUX: Luxembourg, NLD: Netherlands, PRT: Portugal, ESP: Spain, EST: Estonia, HUN: Hungary, LTU: Lithuania, POL: Poland, CZE: Republic Czech, SVK: Slovakia, SVN: Slovenia.

Appendix D. Accumulated impulse responses



Notes: Thin lines are accumulated impulse responses estimated over the post-accession period. Dashed lines are accumulated impulse responses estimated over the pre-accession period. Country code: AUT: Austria, BEL: Belgium, FIN: Finland, FRA: France, DEU: Germany, GRC : Greece, IRL: Ireland, ITA : Italia, LUX: Luxembourg, NLD: Netherlands, PRT: Portugal, ESP: Spain, EST: Estonia, HUN: Hungary, LTU: Lithuania, POL: Poland, CZE: Republic Czech, SVK: Slovakia, SVN: Slovenia.