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Juillet 2009

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# **VULNERABILITIES IN CENTRAL AND EASTERN EUROPEAN COUNTRIES: DYNAMICS OF ASYMMETRIC SHOCKS**

**Aleksandra ZDZIENICKA<sup>1</sup>**

*March, 2009*

## **Abstract**

In this work, we use the VAR and space-state methodology to analyze how the recent developments in 20 European countries have modified the dynamics of structural shocks. Our results confirm a visible progress in (predominated output fluctuations) supply shocks convergence between the CEECs and the euro zone, but also corroborate a positive initial impact of EMU creation and EU enlargement supply shocks correlation. In particular, we find that Croatia, Poland, Slovakia and Slovenia are good candidates to the euro adoption under condition of greater fiscal policy alignment.

**JEL classification:** C32, F42

**Keywords:** Structural Shocks, CEECs, VAR model, Kalman filter, Euro Adoption

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## 1. Introduction

The financial and economic crisis that has spread across the world has brought in the foreground, once again, the discussion about the pros and cons of the euro adoption by Central and Eastern countries (CEECs hereafter). In particular, the vulnerabilities of CEECs during the current crisis has highlighted how to be part of European Monetary Union could be more favorable during period of severe downturns, in terms of monetary and financial stability. On the other hand, having an addition independent tool of policy (i.e. monetary policy) could be precious to face the current downturn. In the literature, the benefits and especially the costs of monetary integration have been widely discussed since the pioneering works of Mundell (1961), McKinnon (1963) and Kenen (1969). Indeed, one of the most important costs put forward by the literature is linked to the probability of asymmetric shocks occurrence when the monetary and exchange rate policies are no longer a national issue. So, in the case when a country is hit by asymmetric shocks, its exchange rate will no longer generate an adjustment in relative international prices to compensate for output losses and restore equilibrium (Mundell, 1961).

The occurrence of asymmetric shocks depends on factors such as similarity of production structure, economic openness, business cycles (as) synchronization, but also on the efficiency of other that exchange rate mechanism<sup>2</sup> to deal with idiosyncratic shocks (De Grauwe, 2005). Moreover, the susceptibility to asymmetric shocks changes over time. Monetary integration can lead to greater business cycles synchronization and therefore decreases incidence of asymmetric shocks or, *a contrario*, to greater sectoral specialization increasing the probability of asymmetric shocks. The first view is represented by the European Commission. According to it, the single market leads to greater trade integration

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<sup>2</sup> Such as prices and wages flexibility, labor force mobility, portfolios' diversification or fiscal and structural policies aliment.

and this structure of trade (intra-industry) to the situation where most shocks will have similar effects on aggregate demand, so to greater shocks symmetry<sup>3</sup>. The second view supported by Paul Krugman stipulates that trade integration leads to “regional concentration of industrial activities”, higher sectoral specialization and greater shocks asymmetry across a monetary union members<sup>4</sup>.

However, the usefulness of national monetary policy and in particular exchange rate is especially conditioned on the types of shocks affecting the economy and a flexible exchange rate is better suited to deal with real than nominal shocks (the Mundell-Fleming framework). Moreover, even if the ability of exchange rate mechanism to absorb the asymmetric shocks can be “weaker than the traditional (Keynesian) OCA theory has led us to believe<sup>5</sup>” (De Grauwe, 2005), national structural and institutional differences and divergence movement in national output and prices are not going to disappear with euro adoption. Indeed, the independent monetary and exchange rate policies will still be needed to assist in the national adjustments. So, to assess the cost of giving up monetary and exchange independence, we need to analyze the types of shocks hitting the economy and the degree of their – shocks and economic response to the shocks - asymmetry.

The main objective of this work is to study the abovementioned issues for the 11 CEECs during the 1995-2007 period. Indeed, we think that, even if this topic was relatively well explored at the beginning the 2000s, the recent *developments* make interesting a re-

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<sup>3</sup> This view is often associated with the “endogeneity” hypotheses of the Optimum Currency Area criteria stressing a strong relationship between economic (trade) integration and shocks correlation. See for example Frankel and Rose (1997); or recently Furceri and Karras (2008). See table 4 and A-2 (in Appendix) for business cycles and trade integration data.

<sup>4</sup> See for example Krugman (1991, 1993).

<sup>5</sup> According to the modern OCA theory, exchange rate is better suited to deal with temporary than permanent shocks since it has usually no permanent effect on output and unemployment. Thus, even in the case of temporary shock, the use of exchange rate can be costly in term of a higher long-term rate of inflation. Moreover, the independent monetary and exchange rate policies can become a source of asymmetric shocks since in an uncertain world exchange rate fluctuations are often driven by other than economic fundamentals (Mundell, 1973). For an analysis of exchange rate as shocks-absorber or source see Canzoneri (1996), Gros and Hobza (2003), Borghijs and Kuijs (2004) for the CEECs.

assessment of the asymmetric shocks' analysis. Moreover, compared to previous research, we dispose of a larger data span to conduct more detailed study on the subject. This let us to exclude the very first years of the CEECs' structural transformation that have a biasing impact on the estimations.

In details, the paper studies (i) the dynamics of the structural shocks convergence in the CEECs' economies taking into account the initial impact of EU adhesion<sup>6</sup>; (ii) and comparing<sup>7</sup> the CEECs' situation with the actual EMU countries before euro adoption (1990-1999); (iii) and finally, the effect of 10-years monetary integration on the shock asymmetry in the actual euro zone members, to derive some implications for the potential future euro zone members.

More precisely, our approach consists of three steps:

- (i) First, we identify three types of the structural shocks affecting the economies by using a conventional structural vector autoregressive (VAR) model and the Blanchard and Quah (1989) restrictions as developed by Clarida and Gali (1994).
- (ii) Secondly, we estimate a space-state model by applying the Kalman filter technique as initiated by Boone (1997) to obtain the dynamics of the shocks' convergence for two - CEECs' and EMU - areas.
- (iii) Finally, we estimate the impulse-response functions for each countries and euro zone to study their responses to symmetrical shocks and therefore their national peculiarities (the speed of adjustment to the shocks).

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<sup>6</sup> This is only possible for the 8 CEECs that jointed the EU in May 2004. For the remaining countries, except Croatia, we dispose only of four quarters to evaluate the impact of the EU adhesion that is why we consider the year 2004 as our "breaking point" for a whole analysis.

<sup>7</sup> The degree of structural shocks asymmetry such as others criteria of the OPA is a particularly difficult subject to deal with. Indeed, there is no universal threshold value that lets determine if a country can or cannot join the common currency area. The usual way to tackle this problem consists of comparison with the previous experiences of the monetary unions.

Our results confirm a visible progress in (predominated output fluctuations) supply shocks convergence between the CEECs and the euro zone, but also corroborate a positive initial impact and EU enlargement in May 2004 on almost all countries, even those that integrated the EU in January 2007. We also found significant similarity between the CEECs' economies and the EMU members' reactions to structural shocks. However since 2006, an increasing divergence in supply shocks could be noticed in some countries, especially for Bulgaria, the Czech Republic, Hungary and the Baltic Republics. But positive impact of monetary integration may accelerate convergence process at least in the case of supply shocks. Indeed, the EMU members still present, as is the case of the CEECs, a significant real shocks asymmetry that has not disappeared as nominal one with euro adoption.

In all, when the dynamics of structural shocks is analyzed, four of studied countries seem to be good candidates to euro adoption: Croatia (if EU adhesion increases supply shocks symmetry), Poland, Slovakia and Slovenia. However, for all countries a greater alignment of fiscal policy (greater real shocks symmetry) will be necessary to decrease the cost of economic adjustment<sup>8</sup>.

The rest of the paper is organized as follows. Section 2 reviews briefly the existing literature. Section 3 describes the empirical methodology and data used. Section 4 discusses the results and their implications. Section 5 concludes.

## **2. Literature Review on Structural Shocks (A) Symmetry in the CEECs.**

When we analyze studies on structural shocks (a) symmetry between the CEECs' economies and the euro zone, there is possible to distinguish at least two types of approaches. Following table (Table 1) regroups some of them.

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<sup>8</sup> On the impact of fiscal convergence on business cycle synchronization and stabilization costs see Darvas and Szapary (2004), Furceri (2009).

**Table 1: Selected works on structural shocks correlation between the CEECs  
and euro zone**

Authors/ Countries	Method	Data Frequency	Reference	Results
Horvath (2001), BG, CZR, ES, HU, LA, LI, PL, SR, SL	Real supply and nominal shocks correlation	Q1:1993- Q4:2000	EU-4(FR, GER, IT, UK)	High Correlation
Frankel and Nickel (2002) BG, CZR, ES, HU, PL, SR, SL	Real supply and nominal shocks correlation	Q1:1993- Q4:2001	EU-3(FR, GER, IT)	Low Correlation
Fidrmuc and Korhonen (2003), all CEECs except Croatia	Real supply and nominal shocks correlation, GDP and Inflation	Q1:1991- Q4:2000	Euro zone, GER, FRA, IT	High Correlation
Artis et al.(2004) CZR, HU, PL, SR, SL	Band-pass filter	M1:1993- M12:2002	Euro zone	Asymmetric business cycles except PL, HU
Darvas and Szapary (2004) CZR, HU, PL, SR, SL	Hodrick- Prescott, Band- pass filters	Q1:1993- Q4:2002	Euro zone	Symmetric business cycles except CZR, SR
Babeski et al., 2004, all CEECs except Croatia	Real supply and nominal shocks dynamic correlation	Yearly and Quarterly 1990-2002	Euro zone	Nominal shocks convergence, Real shocks divergence

**Source: adapted from Fidrmuc and Korhonen (2004), Ben Arfa (2009)**

The first group focuses on shocks (a) symmetry measuring business cycles correlation between two areas. Indeed, business cycles divergence indicates (temporary) shocks asymmetry (De Grauwe, 2005). The authors calculate therefore the correlation coefficients of (real) GDP and inflation (Fidrmuc and Korhonen, 2004), of industrial production and unemployment cyclical components obtained by filtering techniques (Hodrick-Prescott, Band-pass filter; Darvas and Szapary, 2004). Their results are sometimes mitigated but indicate, in general, a growing business cycles convergence between the CEECs and euro zone.

Second group of studies concentrates on structural shocks correlation using the approach developed by Bayoumi and Eichengreen (1992) and then by Clarida and Gali (1994) for the actual EMU members. These approaches consist of VAR models estimations and

shocks identification to assess the degree of their (a) symmetry (Horvath, 2001; Frenkel and Nickel, 2002; Fidrmuc and Korhonen, 2004). In general, authors' findings suggest that smaller CEECs' economies are more affected by nominal shocks than the bigger countries. Their mostly static analyses confirm a significant shocks asymmetry for many of the CEECs. To our knowledge, there are only few studies treating structural shocks in the new EU countries from the dynamics point of view (Babecki et al., 2003). Their results show the progressive convergence in nominal shocks, but also the increase in supply asymmetry between the studied economies. Some elements of these last approaches are also used in this work.

### **3. Methodology**

#### **3.1. Identifying structural shocks**

To identify the types of the structural shocks, we apply the Blanchard and Quah (1989) long-term restrictions as developed by Clarida and Gali (1994) to estimate a trivariate VAR model which includes as variables: i) the real output; ii) the effective exchange rate; iii) and prices.

#### ***Theoretical model***

The method developed by Clarida and Galí (1994) is based on a stochastic version (Obstfeld, 1985) of the open macroeconomic model that presents the standard Mundell-Fleming-Dornbush results in the short-run and the characteristics of macroeconomic equilibrium in the long run.

In the short run when the prices are “sluggish”<sup>9</sup>, the demand determined level of output (1), difference between actual and market clearing price levels (2) and the ratio of price to foreign price levels (3) are written as follows:

$$y_t = y_t^s + (\eta + \sigma)v(1 - \theta)(v_t - z_t + \alpha\gamma\delta_t) \quad (1)$$

$$q_t = q_t^e + v(1 - \theta)(v_t - z_t + \alpha\gamma\delta_t) \quad (2)$$

$$p_t = p_t^e + (1 - \theta)(v_t - z_t + \alpha\gamma\delta_t) \quad (3)$$

And all three shocks<sup>10</sup> - supply ( $z_t$ ), real demand ( $\delta_t$ ) and nominal ( $v_t$ ) - influence contemporaneously the levels of all three of the system's variables – output ( $y_t$ ), the real exchange rate ( $q_t$ ), and prices ( $p_t$ ). However, because output, the real exchange rate, and prices are expected to converge to their flexible price equilibrium levels, the system is triangular in the long run. Only supply shocks influence the level of relative national outputs in the flexible price equilibrium, while both supply and real demand shocks affect the level of the real exchange rate<sup>11</sup>. Finally, all shocks influence the ratio of home to foreign price levels in the flexible price equilibrium<sup>12</sup>.

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<sup>9</sup>  $(1 - \theta)$  represents the degree of prices stickiness.

<sup>10</sup> Real supply shocks (AS) describes productivity and demographic shocks. Real demand shocks (IS) include shocks such as government-spending or changes in fiscal policy. Nominal demand shocks (LM) include monetary and financial shocks such as changes in money supply and in liquidity preferences, shifts in money velocity, in risk premia or financial liberalization or speculative currency attacks.

<sup>11</sup> The real exchange rate is defined as the relative price of non-tradables to tradables. So, for example, an increase in government spending (real demand shocks) that falls heavily on no-tradables, leads to an appreciation through its impact on the relative prices (Rogoff, 1992).

<sup>12</sup> According to the authors, these plausible restrictions should also hold in many other specifications of stochastic open macro equilibrium, for example in the cash-in-advance Arrow-Debreu open macro models pioneered by Lucas (1982).

### ***Structural VAR and shocks identification***

We can use the above-mentioned restrictions to identify structural shocks affecting the CEECs' economies<sup>13</sup>.

The structural VAR model used for this purpose can be represented as follows:

$$\begin{pmatrix} \Delta y_t \\ \Delta reer_t \\ \Delta p_t \end{pmatrix} = \begin{pmatrix} a_{11} & 0 & 0 \\ a_{21} & a_{22} & 0 \\ a_{31} & a_{32} & a_{33} \end{pmatrix} \begin{pmatrix} \varepsilon_{st} \\ \varepsilon_{dt} \\ \varepsilon_{mt} \end{pmatrix} \quad (4)$$

We assume that the natural logarithms of real GDP ( $y_t$ ), the real effective exchange rate ( $reer_t$ ) and consumer price index ( $p_t$ ) follow a stationary stochastic process responding to three orthogonal shocks: real supply ( $\varepsilon_{st}$ ), real demand ( $\varepsilon_{dt}$ ) and nominal demand ( $\varepsilon_{mt}$ ) shocks.

The theoretical model implies that variables are non-stationary in level and stationary in first differences, and that variables are not cointegrated.

The structural VAR model can be written as a moving average as follows:

$$X_t = A_0 \varepsilon_t + A_1 \varepsilon_{t-1} + \dots = \sum_{i=0}^{\infty} A_i \varepsilon_{t-i} = A(L) \varepsilon_t \quad (5),$$

where  $X_t$  represents a vector of difference of output, the real exchange rate and prices,  $\varepsilon_t$  is a vector of three orthogonal shocks and  $A_i$  is the matrices transmitting the effects of these shocks to the variables as indicated by the long-term restrictions above (4), and  $L$  is the

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<sup>13</sup> Indeed, another important advantage of the Blanchard-Quah approach is the fact that we can identify the shocks using their long term properties, and at the same time, the short- and medium term dynamics can be estimated. For example, in the short run positive supply and demand shocks increase relative output. A positive real demand shock increase relative demand and, since prices are sticky, appreciate real exchange rate. A positive nominal demand shocks lowers the domestic interest rate and depreciates exchange rate. In our VAR methodology these dynamics can be analyzed using variance decomposition and generating impulse response functions. See Section 3.

lag operator. Since, the variables are stationary it is possible to estimate the reduced form of the VAR model:

$$X_t = e_t + C_1 e_{t-1} + \dots = \sum_{i=0}^{\infty} C_i e_{t-i} = C(L) e_t \quad (6)$$

The following relationship can be established between the residuals of the structural and reduced forms of VAR models:  $e_t = A_0 \varepsilon_t$ . However, since the model (6) is under-identified it is not possible to estimate the matrix  $A_0$  and obtain  $e_t$  without additional restrictions. First restrictions are imposed on the structural shocks that are mutually orthogonal and each has unit variance ( $A_0 A_0' = \Omega$ ). The additional Blanchard-Quah “long-term” restrictions are then imposed on the matrix  $A_1$ . Knowing that  $A_1 = C_1 A_0$ , we can identify the structural matrix  $A_0$  and recover structural shocks to assess how the degree of asymmetry between them changes over time.

### 3.2. Estimating structural shocks convergence.

To analyze the structural shocks convergence, we estimate a dynamic space-state model using the Kalman filter technique (Boone, 1997). More precisely, we estimate the following measurement equation of the model:

$$(e_t^i - e_t^j) = \alpha_t + \beta_t (e_t^i - e_t^k) + \omega_t \quad (7),$$

where  $e_t$  represents the previously identified real and nominal structural shocks. Superscripts  $i$  denotes each of the CEECs,  $j$  denotes the euro zone and  $k$ - the rest of the world, approximated by the United States of America (USA).  $\alpha_t$  and  $\beta_t$  are time-varying coefficients, whose dynamics are described by the following transition equation of the model:

$$\alpha_t = \alpha_{t-1} + \mu_{1t} \quad (8)$$

$$\beta_t = \beta_{t-1} + \mu_{2t} \quad (9)$$

$\omega_t$  and  $\mu_t$  are independent and normally distributed error terms with zero mean ( $R$ ) and a constant variance ( $Q$ ).

We assume that shocks asymmetry between the CEECs and the euro zone decreases, i.e. there is a growing convergence between the shocks of two zones, if the coefficient  $\beta_t$  tends toward zero. In this case, shocks affecting the CEECs are entirely explained by shocks touching the euro zone. On the other hand, if the coefficient  $\beta_t$  tends toward one the asymmetry between two areas increases as shocks hitting the CEECs are more and more explained by shocks affecting the rest of the world<sup>14</sup>.

Moreover, to estimate the model, we establish two previous conditions. First, given that the starting value of the transition coefficients and those of the variance-covariance matrix of the transition equation are necessary, we perform the OLS estimation to assess them (Zhang et al., 2005).

Secondly, it is important to note that the “signal-to-noise ratio”, which is the ratio of the variance of residuals from the transition and measurement equations ( $Q/R$ ), has a great influence on the estimation results. So, its value must be set in such way as not to put too much of the explanatory power on unobservable variables ( $Q$  large) and to avoid estimating the time-varying coefficients as constants ( $Q$  small). Generally, the  $Q/R$  ratio is included between 0.1 and 0.4 (Boone, 2000). In doing so, the model equations fit rather well the real economic relations and the estimations of unobservable variables are relatively smooth. Testing different possibilities, we set the  $Q/R$  ratio at 0.1 for all countries<sup>15</sup>.

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<sup>14</sup> If the model is correctly specified, the time-varying coefficient  $\alpha_t$  should tend toward zero or remain stable at a low level. It should be noticed that we use a smoothing procedure in our estimations, which makes the estimates of  $\alpha_t$  less likely to be stationary (see also Cortinhas, 2006).

<sup>15</sup> The results are robust to different values and are available from the author upon request.

### 3.3. Data, variables and estimation periods

We use quarterly data provided by the IMF's International Financial Statistics. A common strategy used in the literature is to use of annual data to iron out short-term cyclical fluctuations, but our estimation periods for the CEECs is too short. Indeed, the analysis covers<sup>16</sup> the period 1990 (Q1) - 1997 (Q4) for the 9 euro zone countries and the period 1995 (Q1) - 2007 (Q4) for the 11 CEECs. The euro zone countries include: Austria, Belgium, Finland, France, Germany, Italy, the Netherlands, Portugal and Spain, and the CEECs include: Bulgaria, Croatia (estimation period starts in first quarter 1997), the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania (estimation period starts in first quarter 1997), Slovakia and Slovenia.

The variables are pre-tested for the presence of unit roots, applying the Augmented-Dickey-Fuller and Perron-Phillips tests<sup>17</sup>, which fail to reject the null hypothesis of a unit root in levels, while reject the null of a unit root in first differences. The cointegration (Johansen procedure) tests indicate that the null hypothesis of no cointegration cannot be rejected at any conventional level of significance. We chose two lags estimation for the CEECs and fourth lags estimations for the actual euro zone countries on the basis of the lag length tests using Akaike and Schwarz information criteria and for the homogeneity reason.

The data are expressed in logarithmic terms and the model is estimated in fourth differences to avoid seasonality. Following the literature we focus our analysis on standard

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<sup>16</sup> Since sources of nominal asymmetry tend to disappear with the monetary integration, the dynamics of nominal shocks is analyzed far as a country does not become member of the EMU (Table 4 in Appendix for the evolution of the CEECs' exchange rate regimes)

<sup>17</sup> The unit root, cointegration and lag length tests are not reported here, but available from the author upon request.

variables such as the real GDP, the consumer price index and real effective exchange rate. Real GDP is computed using the GDP deflator provided by the IFS database<sup>18</sup>.

## **4. Results**

### **4.1. CEECs: Dynamics of asymmetric shocks**

The following figures (Figure 1) report the evolution of structural shocks convergence between the euro zone and CEECs.

#### ***Supply shocks***

When looking at the CEECs' supply shocks convergence toward the euro zone, a general increasing trend can be remarked over the 1999-2005/2006 period, with a stabilization phase in 2003 and in 2007. This is particularly visible after the initial growing divergence between the two zones during the second half of the 1990's.

From the individual country point of view, some interesting evolution can be noticed. For example, Croatian supply shocks have shown the most persistence divergence over the 2001- 2006 (Q2) period. In Estonia, a visible increasing divergence can be remarked during the first semester of 2000 and since the beginning of 2003. In Hungary, after the years of increasing convergence toward the EMU level, supply shocks have started to diverge since the second quarter of 2005. For all countries except Croatia and Poland, an increase in

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<sup>18</sup> We decide not to transform the original data into relative variables to capture asymmetric shocks for the obvious reason that the former do not take into account propagation mechanism and individual country reaction to each shocks.

shocks' divergence or at least more stable pattern has been visible since the beginning of 2006 and during 2007<sup>19</sup>.

### ***Real demand shocks***

In the first period under study, it is possible to distinguish two phases: (i) increasing convergence between 1997-1999/2000, (ii) heterogeneous divergence after 2001. However, after 4 years of growing asymmetry, the real demand shocks convergence between the CEECs and the euro zone has been increasing since the second or third quarter of 2004 until the end of 2006. Since then the convergence pattern has remained stable or lightly decreased. It is worth to notice that, since 2003, Hungarian real demand shocks have been more affected by the rest of the world than the EMU, but also that Polish real demand shocks have shown the most visible convergence with those of the EMU countries. In all, real demand shocks are more asymmetric than the real supply ones.

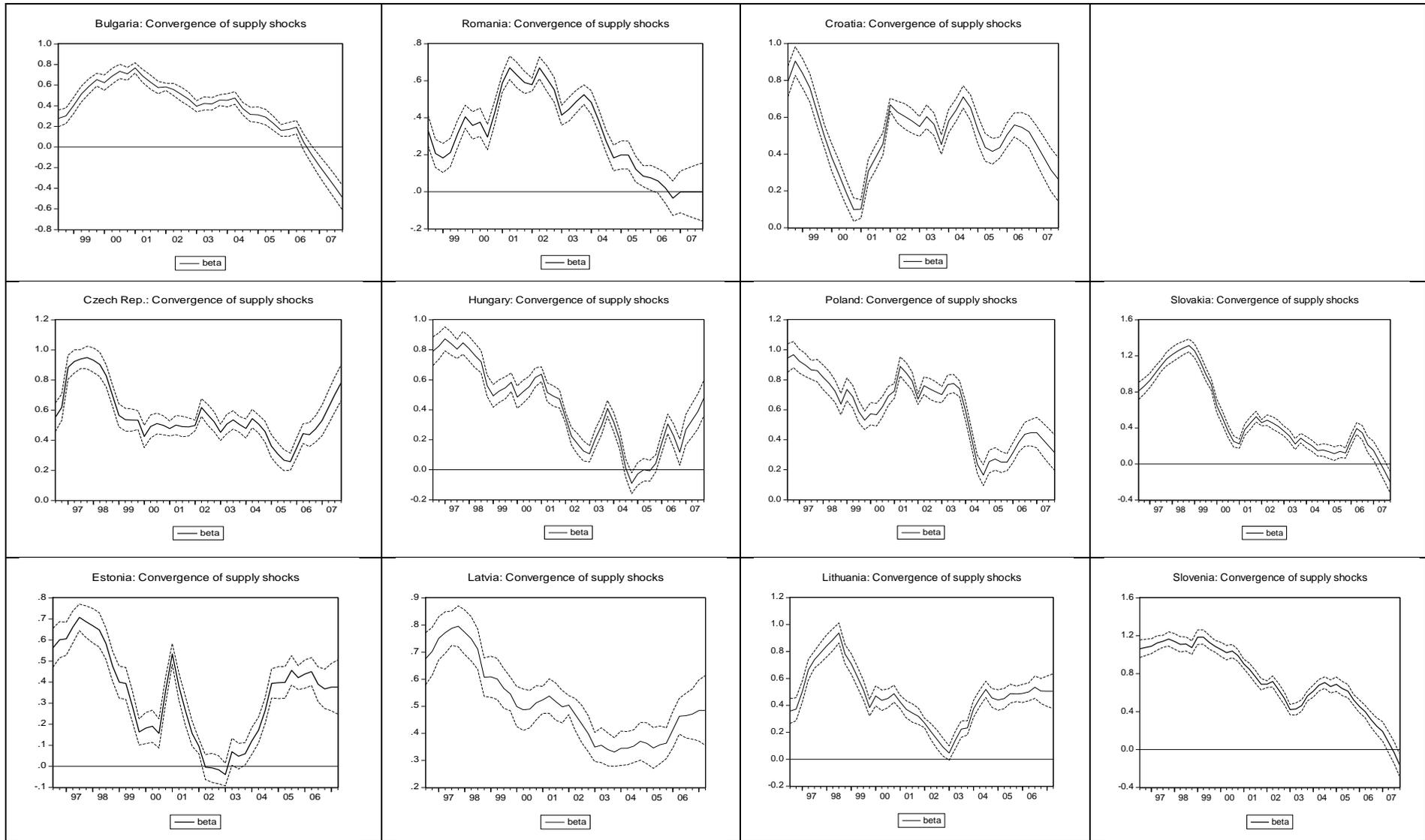
### ***Nominal demand shocks***

In general, the convergence of the CEECs' nominal demand shocks toward those of the euro zone has been increasing over the period of study (Figure 3). In particular, it is possible to notice a visible acceleration in the CEECs' nominal shocks convergence since the beginning of 1998 (for some countries since the beginning of 2002), but also a visible deceleration since 2005/2006. Looking more into details, three different patterns can be distinguished: (i) growing and persistent convergence (the coefficient beta has remained close to zero) with stabilization phase for Estonia, Hungary, Lithuania and Latvia; (ii) growing convergence following an increase in divergence since 2004/2005 for Bulgaria, Croatia, Poland, Romania and Slovakia; (iii) and an increase in divergence since 2000 for the Czech Republic and Slovenia.

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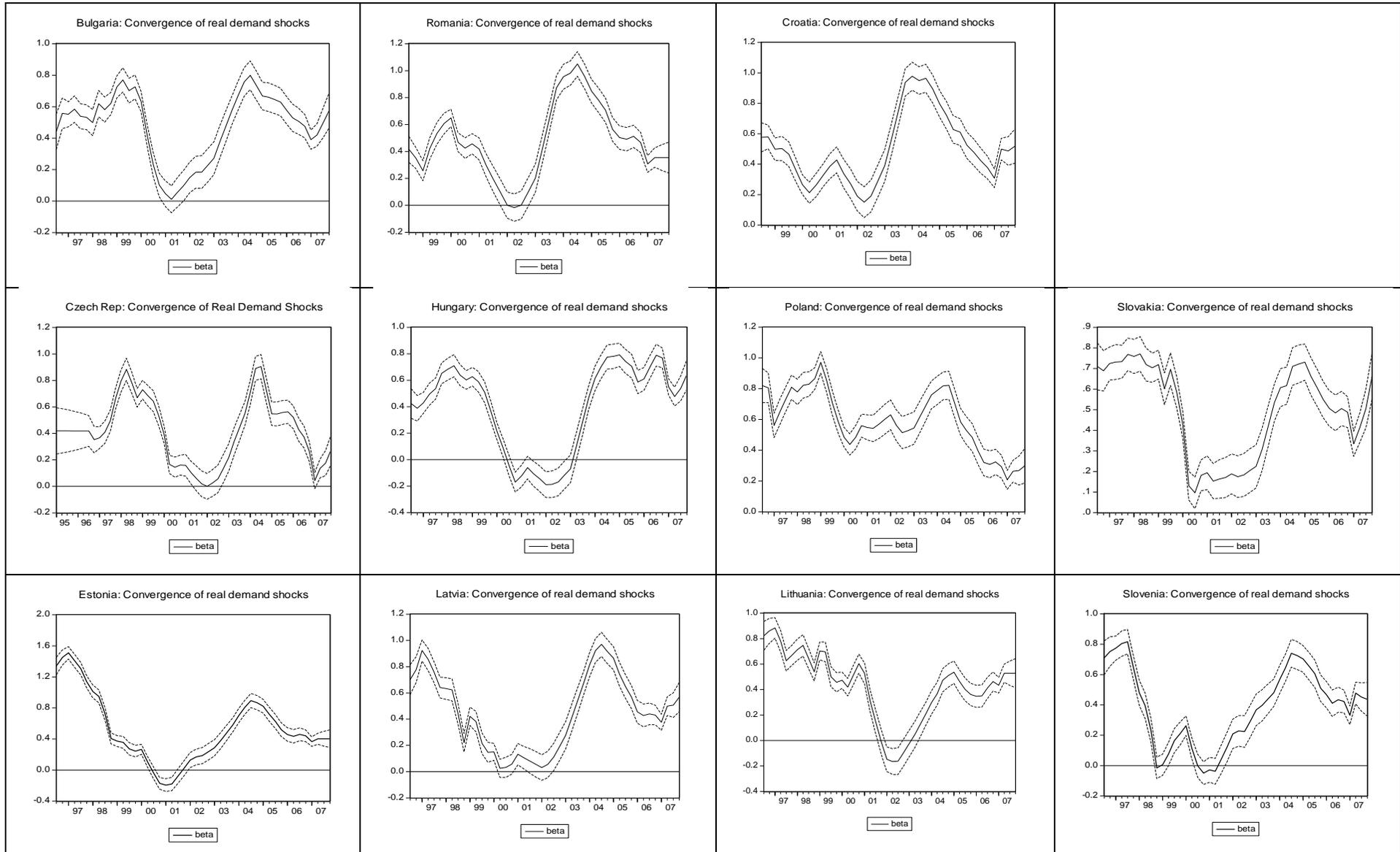
<sup>19</sup> The individual time-varying coefficients of structural shocks are presented in Appendix (Table A-3).

**Figure 1: Convergence of Supply Shocks toward the Euro Zone as opposed to the USA: CEECs**



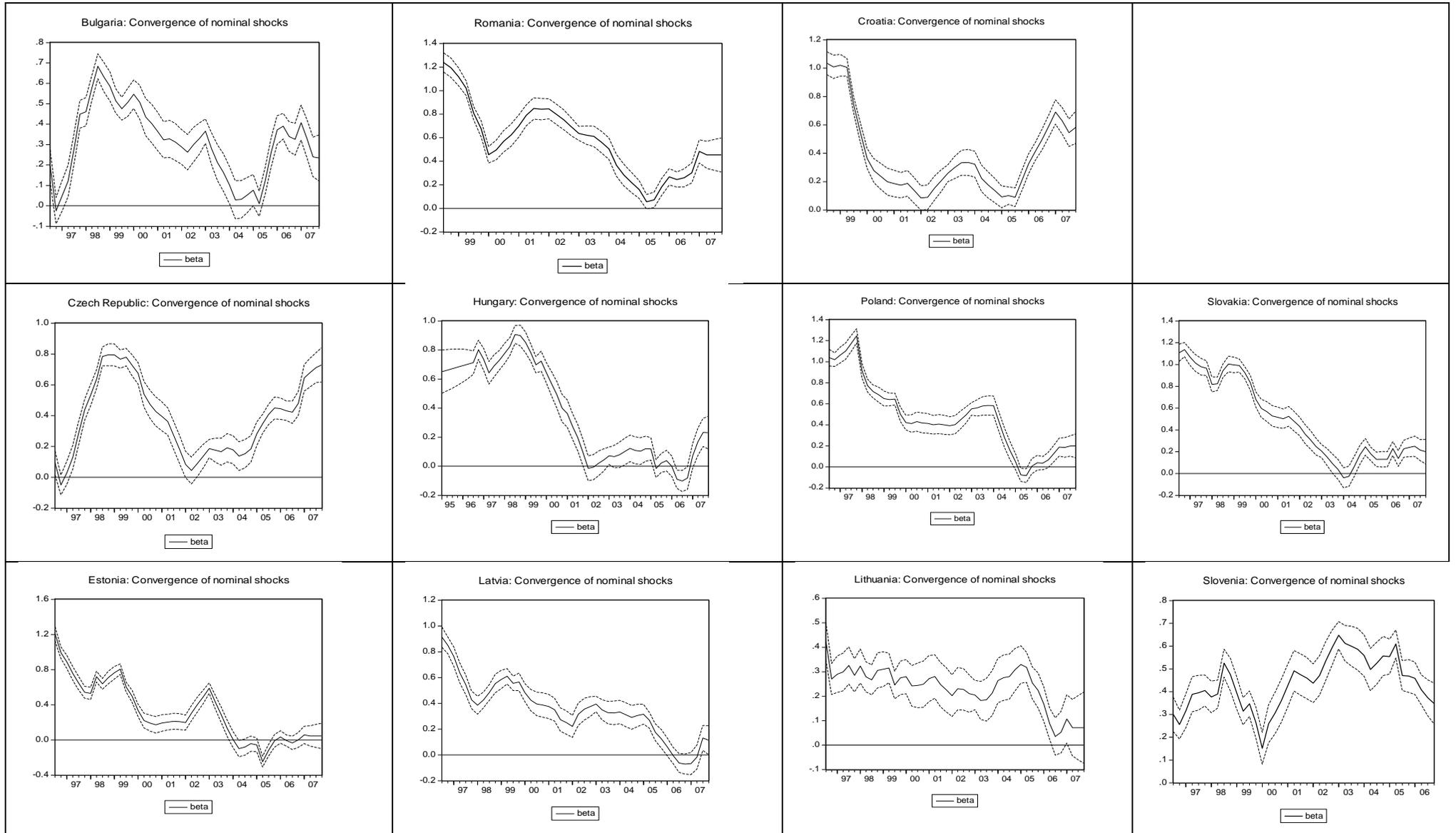
**Source: Author's estimations**

**Figure 2: Convergence of Real Demand Shocks toward the Euro Zone as opposed to the USA: selected CEECs**



Source: Author's estimations

**Figure 3: Convergence of Nominal Shocks toward the Euro Zone as opposed to the USA: CEECs**



Source: Author's estimations

### *Types of shocks affecting the CEECs' economies*

The following table (Table 2) reports the variance decomposition of output, the real exchange and prices at the 10-quarters horizon that can be attributed to each structural shocks.

For all countries, the variability in output (first line) is explained in large part by real supply shocks (AS). Their shares in total variance vary from 52 percent in Bulgaria and Poland to 98 percent in Latvia. For the other countries, supply shocks explain about 80 percent of the variability in output. Demand –nominal and real – shocks explain usually a small part in total output variation.

**Table 2: Variance Decomposition for the CEECs' economies**

	<b>Bulgaria</b>	<b>Croatia</b>	<b>Czech Rep.</b>	<b>Estonia</b>	<b>Hungary</b>	<b>Latvia</b>
Shocks	<i>AS IS LM</i>	<i>AS IS LM</i>	<i>AS IS LM</i>	<i>AS IS LM</i>	<i>AS IS LM</i>	<i>AS IS LM</i>
Real GDP	52 19 29	93 2 5	87 2 11	84 9 7	84 3 12	98 1 1
REER	48 19 17	52 45 3	15 72 13	87 10 3	7 93 0	77 21 2
Prices	71 12 17	29 25 46	80 10 9	1 21 78	25 5 70	97 0 2
	<b>Lithuania</b>	<b>Poland</b>	<b>Romania</b>	<b>Slovakia</b>	<b>Slovenia</b>	<b>Euro Zone</b>
Shocks	<i>AS IS LM</i>	<i>AS IS LM</i>	<i>AS IS LM</i>	<i>AS IS LM</i>	<i>AS IS LM</i>	<i>AS IS LM</i>
Real GDP	80 4 7	53 39 8	88 6 6	82 4 14	92 3 5	91 2 6
REER	36 53 11	33 66 1	4 95 2	9 72 19	6 91 3	3 58 39
Prices	17 24 59	50 5 45	75 16 9	23 31 47	83 6 11	4 54 42

*AS describes Real Supply Shocks, IS – Real Demand Shocks, and LM –Nominal Demand Shocks*

**Source: Authors' estimations**

However, some exceptions can be remarked. For example, in Bulgaria the role of nominal shocks is relatively more important (29 percent) than in the other CEECs (5-14 percent). In Poland, the real demand shocks explain 39 percent of output fluctuation comparing to 2-6 percent for the other countries. These last findings are particularly interesting when we compare them with the dynamics of structural shocks. For example, it is possible to notice a visible convergence in real supply shocks in the case of Poland and Slovenia (until 2007). However, while Slovenian economy is in large part affected by supply shocks (92 percent), Polish economy is much less (53 percent). Indeed, real demand shocks account for 39 percent of the variation in Polish output. Fortunately, Polish real demand shocks show a growing convergence with these of the euro zone. In the opposite

case, it could become rather problematic since the frequency of fiscal policy shocks contrary to nominal ones is not going to disappear with the euro adoption.

### *Adjustment to structural shocks*

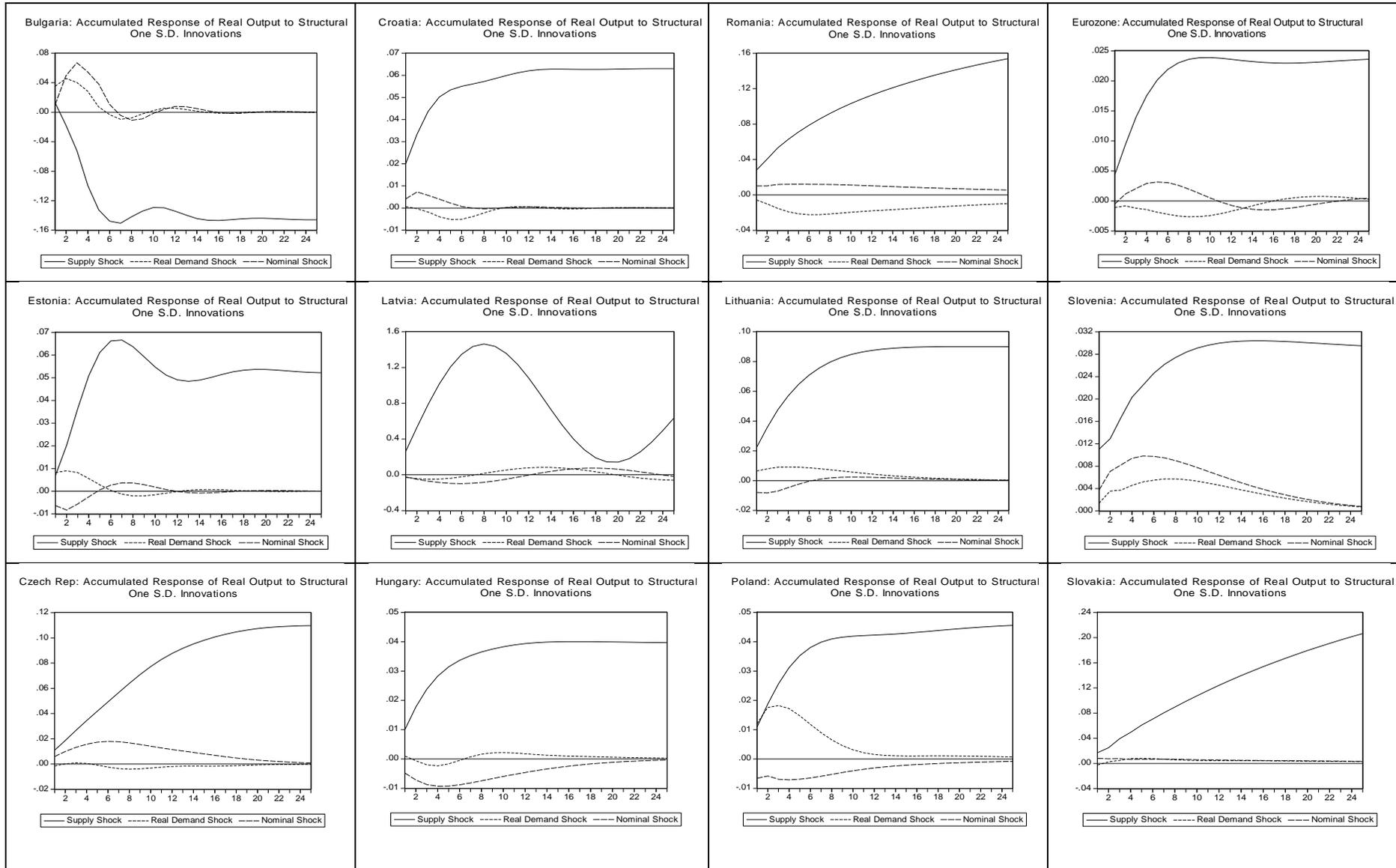
Another necessary criterion to determine whether a country can give up its monetary and exchange rate policies is the speed with which the economy adjusts to common structural shocks. The estimation of impulse-response functions (Figure 4) shows a rather similar adjustment pattern of the CEECs economies and the euro zone to real supply shocks (except Bulgaria).

More precisely, the adjustment of output to a supply shock is similar or even faster in Croatia, Hungary, Lithuania and Poland. Indeed, almost 80 to 90 % of long term level of aggregate response to a supply shocks<sup>20</sup> is archived after 4 periods. In the case of the Czech Republic, Romania, Slovakia and Slovenia adjustment to a supply shock is much slower (less that 50% after 4 quarters). For the remaining countries, Estonia and Latvia, the output response to a supply shocks is much more volatile. The adjustment to demand shocks is comparably slow in almost all studied countries, except Croatia, Estonia, Lithuania and Slovakia, where the long-term (zero) level is reached after 10 or 14 periods.

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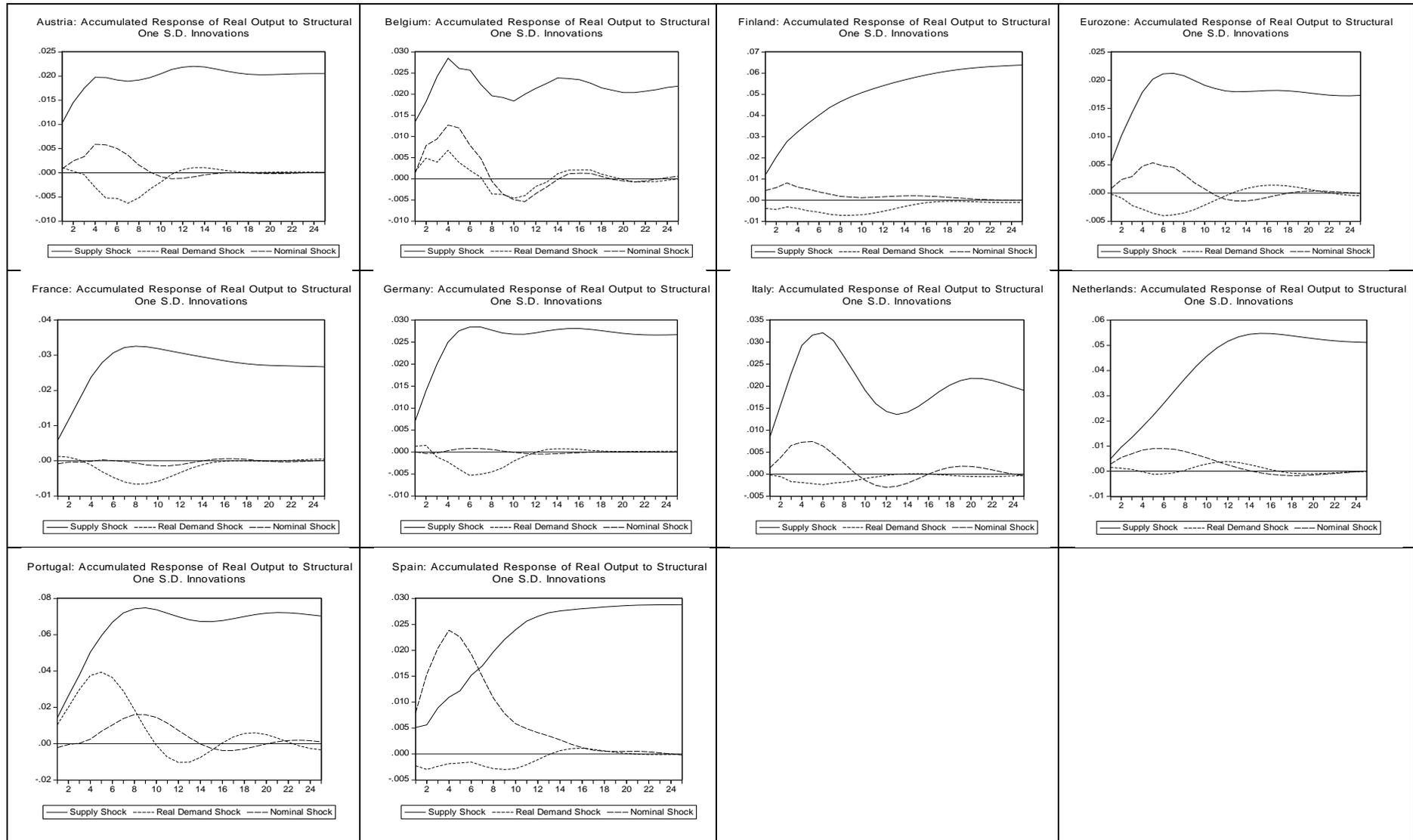
<sup>20</sup> Bayoumi and Eichengreen (1992) proposed this measure, i.e. the value of aggregated impulses after some period of time in comparison to the long-run level of the responses, to decide whether response of a economy to common shocks is appropriate for the members of a currency union.

**Figure 5: The Impulse-Response Functions: the CEECs and the Euro Zone**



Source: Author's estimation

**Figure 6: The Impulse-Response Functions: the actual EMU members and the Euro Zone**



Source: Author's estimations

Despite some differences in the adjustment of output to structural shocks, the response of the CEECs follow more similar pattern to that of the euro zone, especially when comparing to some of the actual EMU members (Figure 5). For example, in the case of the Netherlands and Spain, the adjustment of output to a supply shocks is slower than in the case of other members. Moreover, Spanish output is dominated more by nominal than by supply shocks.

In the next two sections, we compare the correlation of the shocks for the CEECs with the actual EMU members in the period before the euro adoption, first from the static then from dynamic point of view. This analysis can shed some light on how well prepared (in terms of stabilization costs) are CEECs countries compared with the actual EMU members.

#### **4.2. Are the CEECs ready for the euro?**

In the following table (Table 3) we present the correlation of the three types of shocks for the EMU countries during the period 1990-1998 and the CEECs during the period 1998-2007. Focusing first on supply shocks (second column) we can see that the CEECs showed, except Poland and Slovenia, similar or even more important correlation than some of the EMU countries<sup>21</sup>. Looking at real demand shocks (third column) we can observe more asymmetric development. Indeed, correlation coefficients between the CEECs and euro zone are in general negative, except in Croatia, Hungary and Slovenia, while in the EMU countries only Finish and Spanish real demand shocks were asymmetric during the pre-adhesion phase. Finally, a different pattern emerges for nominal demand shocks (fourth column).

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<sup>21</sup> However, it is worth to remind that despite these positive correlation coefficients, convergence of supply shocks has decreased for the Baltic countries and Hungary, and increased for Poland and Croatia. See 3.1.

**Table 3: Shocks Correlation during the pre-adhesion period:  
the EMU members and CEECs**

<b>Q1 :1990-Q4 :1998</b>	<b>Real Supply Shocks</b>	<b>Real Demand Shocks</b>	<b>Nominal Demand Shocks</b>
Austria	0.16	0.15	0.34
Belgium	0.16	0.44	0.43
Finland	0.09	-0.07	0.36
France	0.17	0.25	0.04
Germany	0.51	0.14	0.59
Italy	-0.02	0.12	0.35
Netherlands	0.18	0.03	0.22
Portugal	0.09	0.36	0.08
Spain	-0.03	-0.18	0.32
<b>Q1 :1995-Q4 :2007</b>	<b>Real Supply Shocks</b>	<b>Real Demand Shocks</b>	<b>Nominal Demand Shocks</b>
Bulgaria	0.10	-0.08	0.19
Croatia	-0.05	0.23	0.11
Czech Rep.	0.05	-0.35	0.10
Estonia	0.43	0.06	-0.16
Hungary	0.26	0.12	-0.04
Latvia	0.08	-0.20	0.19
Lithuania	0.31	-0.04	0.53
Poland	-0.25	-0.03	0.20
Romania	0.17	-0.26	-0.05
Slovakia	0.05	-0.07	-0.12
Slovenia*	-0.37	0.17	0.27

\*Q1 :1995-Q4 :2006

**Source: Author's calculations**

In particular, nominal shocks are highly correlated for Lithuania, but also for Bulgaria, Latvia and Poland. For the other CEECs, especially Estonia, Hungary, Romania and Slovakia, correlation coefficient are low and negative. In general, nominal shocks in the CEECs are less correlated than in the EMU countries before the euro adoption.

### ***Impact of the EU enlargement on shocks correlation***

In the following table (Table 4, lower part) we report the correlation coefficients before and after the EU enlargement in May 2004.

**Table 4: Impact of the euro adoption and the EU enlargement on shocks<sup>22</sup> correlation: the EMU members and the CEECs' economies.**

	Real GDP Growth		Real Supply Shocks		Real Demand Shocks	
	Q1:1990- Q4:1998	Q1:1999- Q4:2007	Q1:1990- Q4:1998	Q1:1999- Q4:2007	Q1:1990- Q4:1998	Q1:1999- Q4:2007
Austria	0.69	0.58	0.16	0.34	0.15	0.50
Belgium	0.46	0.76	0.16	0.63	0.44	0.67
Finland	-0.22	0.81	0.09	0.48	-0.07	-0.48
France	0.53	0.85	0.17	0.57	0.25	0.62
Germany	0.75	0.90	0.51	0.56	0.14	0.33
Italy	0.49	0.93	-0.02	0.56	0.12	0.51
Netherlands	0.35	0.93	0.18	0.62	0.03	0.17
Portugal	0.72	0.59	0.09	0.15	0.36	0.44
Spain	0.57	0.69	-0.03	0.45	-0.18	-0.28
	Real GDP Growth		Real Supply Shocks		Real Demand Shocks	
	Q1:1995- Q2:2004	Q3:2004- Q4:2007	Q1:1995- Q2:2004	Q3:2004- Q4:2007	Q1:1995- Q2:2004	Q3:2004- Q4:2007
Bulgaria	0.22	-0.27	0.03	0.31	-0.01	0.36
Croatia	-0.42	0.54	-0.01	-0.18	0.13	0.19
Czech Rep.	0.37	0.34	0.11	0.15	-0.27	0.17
Estonia	-0.34	0.46	0.45	0.01	-0.03	0.00
Hungary	0.21	-0.22	0.10	0.27	0.28	-0.16
Latvia	-0.32	0.08	0.17	-0.17	-0.16	-0.22
Lithuania	-0.67	-0.07	0.34	-0.19	-0.11	-0.19
Poland	0.27	0.80	-0.34	0.02	0.06	0.71
Romania	-0.38	0.15	0.05	0.59	-0.28	-0.01
Slovakia	0.34	0.58	-0.40	-0.48	0.22	0.20
Slovenia	-0.41	0.39	-0.08	0.11	-0.11	-0.53

Source: Author's calculations

The shocks of EU adhesion has decreased the correlation coefficients in the Baltic countries, but increased in Hungary, Poland and Slovenia. In the Czech and Slovak Republic, the supply shocks correlation has shown only small changes. It is interesting to notice that supply shocks have become more correlated in the “future” new EU countries – Bulgaria and Romania, but the opposite can be remarked for a country that did not enter to the EU in 2007 – Croatia. A similar, i.e. heterogeneous, pattern emerges for real demand shocks. Indeed, even if the impact of the EU

<sup>22</sup> The real GDP growth correlation is reported here as a proxy for business cycles correlation between two zones. In general, growth correlation coefficients are higher than these of supply shocks, but the similarity in both correlation coefficients development are often put in advance (Fidrumc and Korhonen, 2003).

enlargement is less visible, their correlation has increased in the case of the Czech Republic and Poland and decreased in Hungary and Slovenia. When looking at the nominal shocks correlation, we can notice a general decrease in the correlation coefficients. This is undoubtedly due to monetary policy reaction on the EU enlargement shock. Indeed, this temporary increase in “fiscal” and “monetary” policies shocks can also be notice when the dynamics of demand shocks is analyzed (Figure 2 - 3).

In all, the impact of EU enlargement on the shocks, especially real shocks, correlation is rather mitigated: negative in the case of the Baltic countries, positive in Poland and Slovenia. For the other CEECs, namely the Czech and Slovak Republic, the impact of EU enlargement is more difficult to depict. Data span is too short to measure the initial impact of the euro adoption in Slovenia. However, we can try to assess the impact of monetary integration on shocks correlation.

### **4.3. Can monetary integration increase shocks correlation?**

While from a theoretical point of view it is not clear that EMU integration has increased the similarity of the shocks among its participant<sup>23</sup>, previous empirical evidence has pointed out that with the birth of the EMU business cycle synchronization has increased. In this paragraph, we re-examine this issue, from static and dynamic point of views, with most recent data and disentangling between types of shocks.

Starting with supply shocks<sup>24</sup> (Table 4, upper part), we remark general increase in these shocks correlation for all actual EMU countries, except Germany where supply shocks correlation was already significant (0.51) before the euro adoption. When we look at real demand shocks, a

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<sup>23</sup> See Introduction.

<sup>24</sup> We analyze especially the impact of monetary integration on real structural shocks, since the frequency of nominal disturbances is going to progressively disappear among the member of currency union.

similar pattern can be noticed for all studied countries except Finland and Spain. However, the impact of EMU creation on real demand shocks is less significant.

From a dynamics point of view, it is possible to notice a general increase in supply shocks convergence (Figure 4) toward the common European level during the first phase of monetary integration (1992-1993) and since at least the beginning of the EMU in 1999. For some countries, this second increase in convergence has started earlier (Finland in 1995, Spain in 1996, the Netherlands in 1997), for others, such as Italy or Portugal, latter, i.e. after 2001.

However, some cyclical increase in shock divergence could be noticed for example in 2003 and 2005, undoubtedly because of the impact of the EU enlargement to the East.

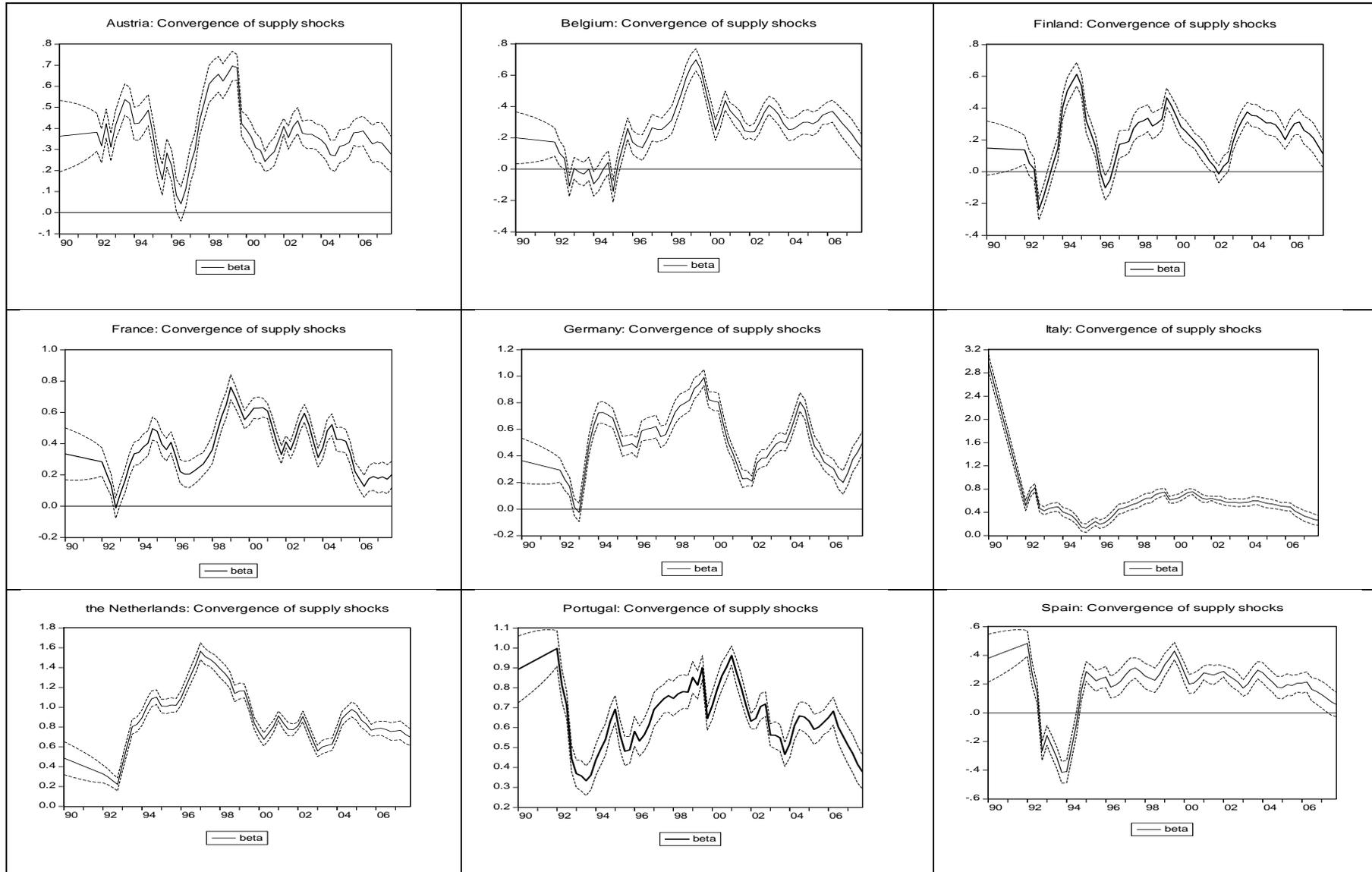
In the case of real demand shocks (Figure 5), it is possible to remark a general convergence trend between all studied countries except Italy and the Netherlands. However, this increasing convergence is also linked to economic fluctuation and progress in political integration in Europe. For example, we notice a general divergence in real demand shocks pattern over the 1994-1997 period and a general convergence since the introduction of the Stability and Growth Pact (SGP) until at least the end of 2000. Moreover, since 2001, especially in the second semester of 2003 and 2005, real shocks convergence increased with the recovery of European growth.

During the period preceding the EMU creation, nominal demand shocks dynamics was very heterogeneous. Indeed, despite a visible progress in shocks convergence until the second half of 1995, stabilization phase and growing divergence since the first quarter of 1997, it is rather impossible to find a common pattern of nominal shocks correlation. The year 1996, when the greatest progress in nominal shocks correlation was made, can be considered as an exception. These findings confirm the thesis that monetary policies of the member states were actively used during the phases of preparation, especially the last one, to complete monetary integration<sup>25</sup>. Moreover,

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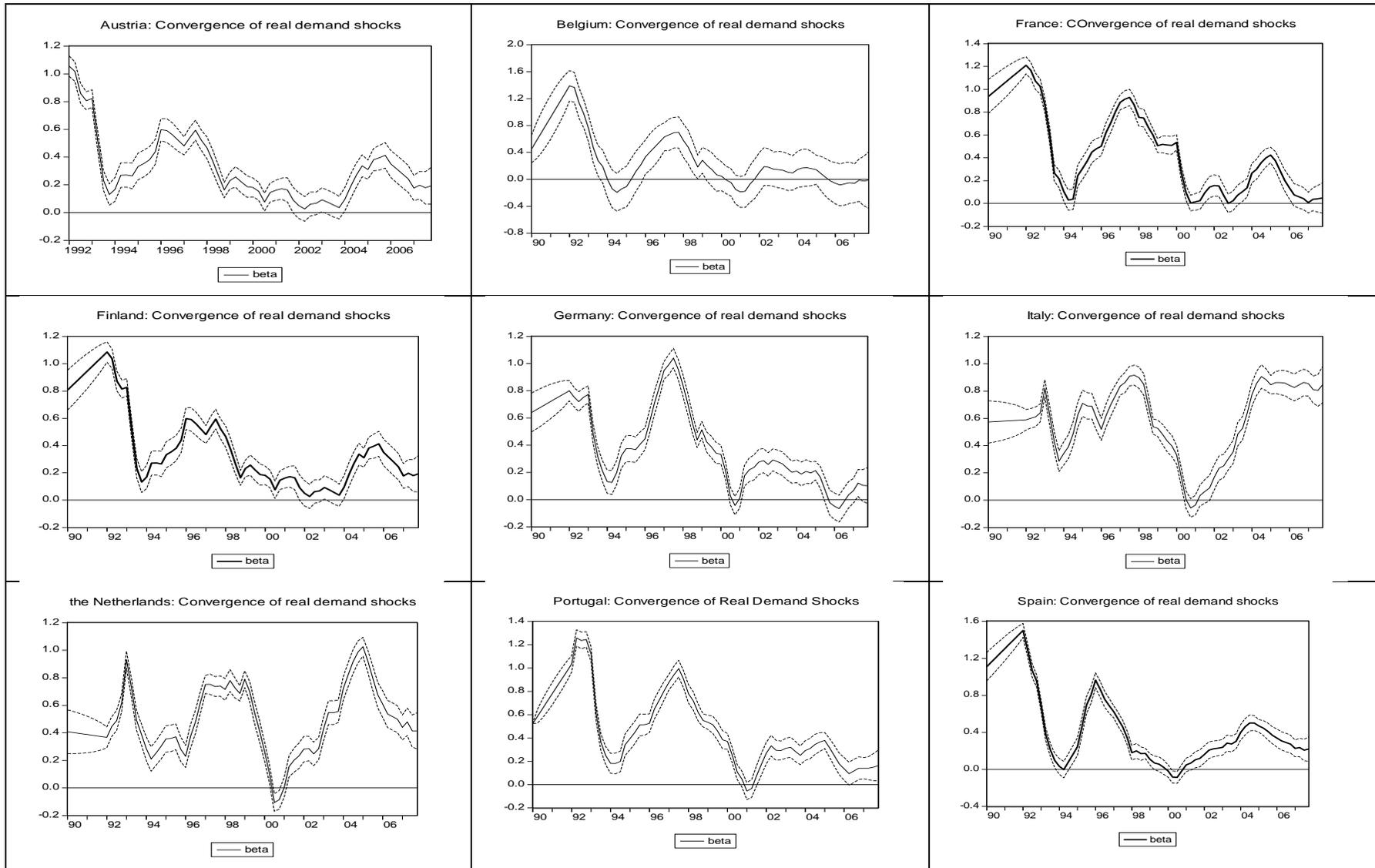
<sup>25</sup> We notice a similar pattern in the case of Slovenia (Figure 3).

**Figure 7: Convergence of Supply Shocks toward the Euro Zone as opposed to the US: the actual EMU members**



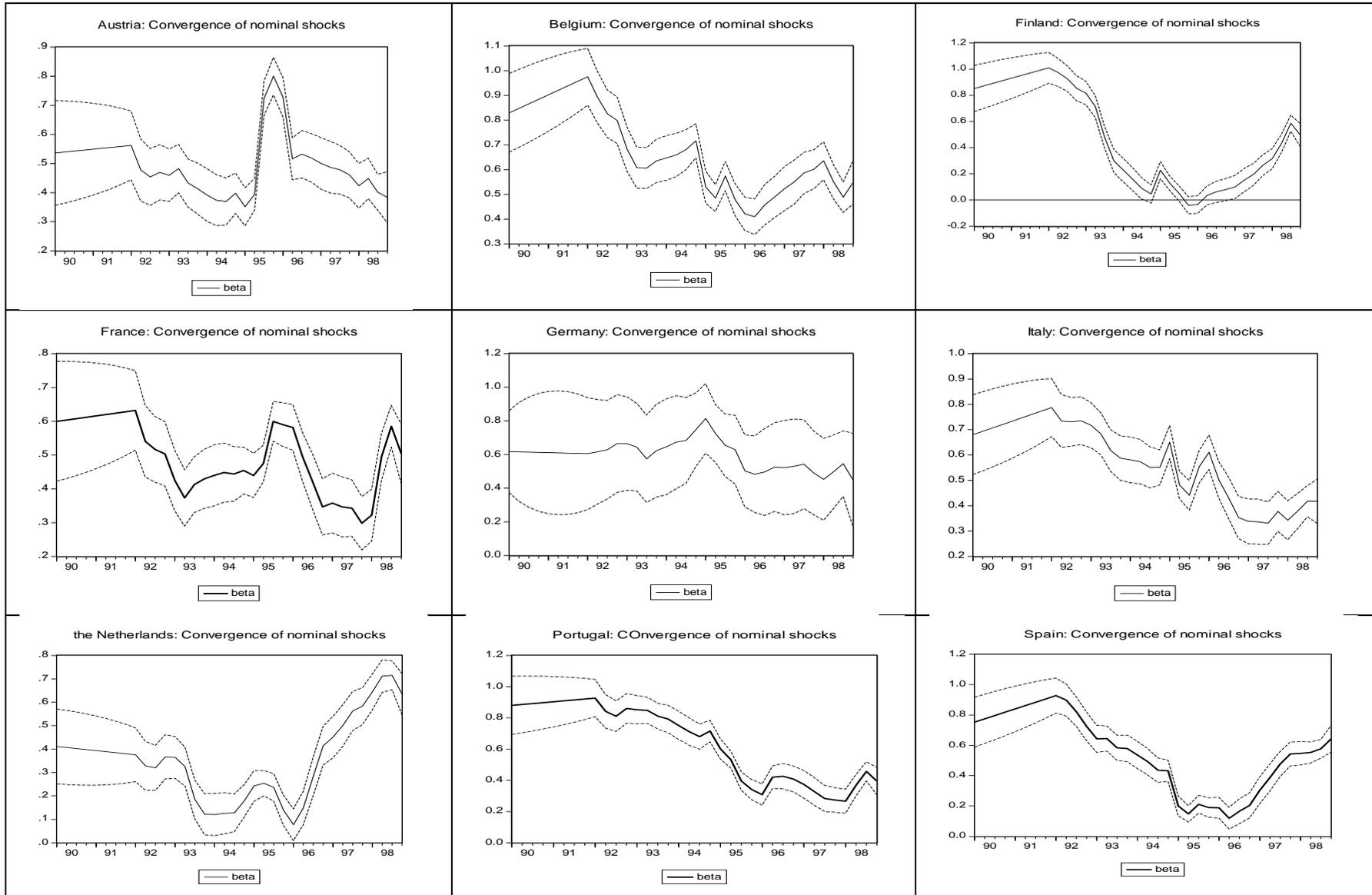
Source: Author's estimations

**Figure 8: Convergence of Real Demand Shocks toward the Euro Zone as opposed to the US: the actual EMU members**



Source: Author's estimations

**Figure 9: Convergence of Nominal Shocks toward the Euro Zone as opposed to the US: the actual EMU members**



Source: Authors' estimations

positive or highly positive correlation coefficients for almost all countries<sup>26</sup> over the 1990-1998 period, corroborates the fact about the existing considerable symmetry of these economies.

## 5. Conclusion

In this work we tried to determine how the degree of asymmetry between the CEECs' and euro zone economies has changed over the recent period taking into account the initial impact of EU enlargement and the potential impact of monetary integration. We focused especially on structural shocks affecting these economies analyzing the dynamic of their correlation, but also study the response of the CEECs' economies to symmetric shocks. To this purpose, we estimated VAR models imposing the long-term restrictions and carried out a space-state model using the Kalman filter technique.

Our estimation results corroborate the usual findings about progress in supply shocks convergence between the CEECs and the euro zone, but also confirm a positive initial impact of the EU enlargement in May 2004 on almost all countries. However since 2006, an increasing divergence in supply shocks could be noticed in some countries (especially for Bulgaria, the Czech Republic, Hungary and the Baltic economies). We found a similar development in the case of nominal demand shocks, namely a general increase of shocks convergence during the majority of studied period, but also recent (since 2005/2006) growing divergence for almost all countries, which should disappear with the euro adoption. In the case of real demand shocks, we found however more heterogeneous pattern of convergence and weaker correlation between two zones.

When compared to the previous experience, we found that monetary integration has a positive impact on the real supply shocks correlations, which confirms that in the case of the CEECs, supply shocks convergence and symmetry can increase with the euro adoption. The past

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<sup>26</sup> Except Portugal and Spain until the end of 1996; results not reported here but available from the author upon request.

experience however did not let confirm the same evolution about real demand shocks. Indeed, even if these shocks symmetry seemed to increase with fiscal integration within the monetary union, real demand shocks have stayed less weakly correlated than supply ones and their divergence seems to be more affected by cyclical fluctuations.

In all, we found that Croatia, Poland, Slovakia and Slovenia can be considerate as good candidates to the euro adoption. Indeed, even if all CEECs' economies are affected in the greatest part by real supply shocks, these countries supply shocks have shown the most visible increase in convergence toward the euro zone level. Moreover, once the shock of EMU adhesion (and in the case of Croatia, EU adhesion) absorber, the supply shocks correlation will probably increase as in the case of the actual EMU members. However, all these countries should increase coordination of their fiscal policies (real demand shocks symmetry).

In the case of the other countries and especially Hungary and the Baltic Republics, the euro adoption should be postponed to the achievement of greater shocks correlation. Indeed, it seems that their economies are touched by asymmetric shocks and some independence of monetary policies is still required.

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## Appendix

**Table A-1: Exchange Rate Regimes in the CEECs**

Bulgaria	Managed Floating since Feb 1991 Currency Board peg to Euro (DM) since July 1997
Croatia	Fixed Peg since 1992 Managed Floating since Oct 1993
Czech Rep.	Managed Floating since May 1997
Estonia	Currency Board peg to euro (DM) since Jan 1996 ERM 2 since June 2004
Hungary	Fixed Exchange Rate to the Basket of Currencies since Dec 1991 Crawling peg/band to basket (+/- 2.25% bands) since Mar 1995 To Euro since Jan 2000, +/- 15% bands since May 2001 Floating since the end of 2003
Latvia	Fixed Exchange Rate peg to SDR since 1994 (+/-1%) Peg to euro since Jan 2005, ERM 2 since May 2005
Lithuania	Currency Board peg to USD since Apr 1994 Peg to Euro since Feb 2002, ERM 2 since Jun 2004
Poland	Fixed Exchange Rate peg to basket since May 1991 Crawling peg/band to basket since Oct 1991 Bands widened since Mar 1995 (+/-2.0%) to Mar 1999 (+/-15%) Free Floating since Apr 2000
Romania	Managed Floating since Aug 1992
Slovakia	Fixed Exchange Rate peg to basket since Jan 1991 Bands widened since Jan 1996 (+/-3%) and since Jan 1997 (+/- 7%) Managed Floating since Oct 1998, ERM 2 since Nov 2005 Euro adoption Jan 2009
Slovenia	Managed Floating since Oct 1991 ERM 2 since Jun 2004, Euro adoption Jan 2007

**Source: IMF, National Central Bank**

**Table A-2: Openness Rate\* among the EU countries**

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
<b>Austria</b>	51.7	56.7	59.4	59.0	61.2	64.3	63.3	64.3	66.8	65.9
<b>Belgium</b>	102.4	116.3	119.4	121.5	119.1	123.4	129.4	133.7	135.6	137.6
<b>Finland</b>	38.1	42.7	39.0	37.9	37.0	37.2	39.1	42.2	42.0	40.1
<b>France</b>	29.4	33.1	32.0	30.2	30.0	30.3	29.6	30.9	30.2	29.9
<b>Germany</b>	31.2	35.2	35.8	35.1	36.3	38.4	40.3	44.0	46.3	46.5
<b>Italy</b>	24.6	26.7	26.4	25.32	24.8	25.4	25.7	27.3	27.5	26.6
<b>Netherlands</b>	72.2	79.2	74.9	72.1	71.0	74.5	78.9	84.7	87.1	89.1
<b>Portugal</b>	42.0	44.6	43.1	41.5	40.4	39.6	41.7	43.0	44.0	43.9
<b>Spain</b>	27.8	32.6	31.7	30.2	29.6	29.8	28.8	28.7	29.5	25.5

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
<b>Bulgaria</b>	40.8	48.9	53.2	51.9	54.9	58.3	61.1	65.6	72.7	68.9
<b>Czech Rep.</b>	74.9	86.3	90.4	82.6	86.8	105.9	103.6	109.8	114.3	106.6
<b>Estonia</b>	80.6	103.1	89.5	83.3	80.8	90.9	100.4	99.4	95.7	91.8
<b>Hungary</b>	85.8	93.5	89.6	80.4	79.5	85.7	88.3	101.4	102.0	101.0
<b>Latvia</b>	49.3	49.6	50.8	52.5	55.4	60.9	64.9	65.9	61.8	55.8
<b>Lithuania</b>	44.2	48.4	53.1	55.5	52.4	62.5	65.5	70.3	71.3	67.3
<b>Poland</b>	33.0	34.7	33.8	36.3	42.2	50.3	48.3	52.7	54.5	51.8
<b>Romania</b>	37.6	42.9	46.8	48.8	49.8	51.5	45.2	45.0	46.7	45.7
<b>Slovakia</b>	85.9	96.2	104.5	101.7	106.6	112.5	114.4	125.3	126.6	n.a.
<b>Slovenia</b>	64.0	71.4	70.8	67.2	66.2	75.9	81.9	89.0	93.4	90.7

*\*Openness rate is computed as follows: Intra-union exports+ Intra-union imports/ GDP*

**Source: Eurostat, Author's calculations**

**Table A-3: The space-state model estimation results (mean values)**

	Real Supply Shocks <sup>1</sup>		Real Demand Shocks		Nominal Demand Shocks <sup>2</sup>	
	$\alpha$	$\beta$	$\alpha$	$\beta$	$\alpha$	$\beta$
Austria	-0.17*	0.28***	-0.09*	0.19***	-0.15**	0.38***
Belgium	-0.19***	0.14***	-0.03*	-0.01*	-0.42***	0.55***
Finland	-0.18*	0.11**	-0.09*	0.19***	-0.28***	0.50***
France	0.35***	0.20***	0.17***	0.05*	-0.36***	0.50***
Germany	0.7	0.50***	-0.13**	0.10*	-0.09	0.45***
Italy	0.36***	0.26***	0.23***	0.85***	-0.46***	0.42***
Netherlands	0.25***	0.70***	-0.56***	0.41***	0.33***	0.63***
Portugal	0.12*	0.38***	-0.05	0.16**	-0.43***	0.39***
Spain	0.01	0.05*	-0.03	0.22***	-0.85***	0.64***
	Real Supply Shocks		Real Demand Shocks		Nominal Demand Shocks	
	$\alpha$	$\beta$	$\alpha$	$\beta$	$\alpha$	$\beta$
Bulgaria	-0.18***	-0.49***	0.52***	0.57***	-0.45***	0.23***
Croatia <sup>3</sup>	-0.50***	0.26***	0.19***	0.52***	-0.35***	0.58***
Czech Rep.	-0.14**	0.78***	0.43***	0.27***	0.17***	0.73***
Estonia	0.20***	0.38***	0.21***	0.40***	-0.11	0.04*
Hungary	0.13*	0.48***	-0.02	0.64***	0.77***	0.23***
Latvia	0.35***	0.48***	-0.06	0.57***	-0.38***	0.11*
Lithuania	0.17***	0.51***	0.14*	0.53***	-0.32***	0.07*
Poland	0.32***	0.31***	-0.27***	0.02***	0.70***	0.20***
Romania <sup>3</sup>	0.44***	-0.00*	-0.19**	0.35***	0.20**	0.45***
Slovakia <sup>4</sup>	-0.35***	-0.20***	0.30***	0.66***	0.36***	0.20***
Slovenia	0.77***	-0.17***	-0.16***	0.44***	0.33***	0.34***

<sup>1</sup> the Q1:1990-Q4:2007 estimation period

<sup>2</sup> Q1:1990-Q4:1998

<sup>3</sup> Q1:1997-Q4:2007

<sup>4</sup> Q1:1995 –Q4: 2006 for nominal shocks

\*\*\*/\*\*/\* siginificant resectively at the 1, 5, 10% level

Source: Author's estimations

