

Symmetry of shocks in old and new EU members through time?

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Abstract

I investigate the convergence of demand and supply shocks in new EU member countries to those of the EU. High synchronization of the shocks would indicate relatively low costs of joining a monetary union. Applying the Kalman filter to demand and supply shocks recovered from SVAR, I calculate time varying coefficients in regression of shocks in individual countries versus the EU. For most countries, including the newest members Bulgaria and Romania, I find convergence of both demand and supply shocks. Convergence of supply shocks indicates a slowing down of the dynamic process of institutional adjustment and productivity shocks in these countries.

Keywords: structural VAR, optimum currency area, EMU accession, monetary union, Kalman filter, demand and supply shocks

JEL classification: E5. E6. F4

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1. Introduction

In this paper I study shock convergence in Eastern European EU member countries and ask whether the shocks become increasingly similar. The degree of similarity in shocks is one of the main factors influencing the costs of their potential accession to the European Economic and Monetary Union (EMU).

Joining the EU in 2004 and 2007, the new member states (NMS)¹ committed to future EMU accession. While Slovenia was the first one in the group to adopt the euro, Lithuania was denied accession (due to high inflation), and there is increasing political dissent in several other countries (such as Hungary and Poland) over meeting the Maastricht criteria. To better understand the relative costs of giving up monetary sovereignty, a number of authors have employed structural vector autoregression (SVAR) to recover the structural shocks and investigate their correlation with the European reference counterparts.² According to the optimum currency area (OCA) literature, a strong correlation of shocks between the potential member and the monetary union implies low costs of losing monetary independence and is therefore a favorable sign for accession. The common monetary authority is likely to respond adequately to the union-wide shocks that are also prevalent in individual new members. In contrast, low correlations indicate high costs since supra-national monetary policy is not likely to address country-specific economic shocks.

Motivation for the current study stems from the contradicting results found in previous work. To judge the possible convergence of shocks in NMS toward the EU, I follow the basic approach of Babetskii et al., 2004. Using the Blanchard and Quah (1989) long run restriction in SVAR, I extract the demand and supply shocks (Bayoumi and Eichengreen, 1992). Furthermore, applying the Kalman filter to these shocks, I can calculate the time varying regression coefficients that relate the shocks in an individual country to the corresponding shocks in the EU. The final judgment on convergence is then based on the asymptotics of the series of coefficients through time.

The paper departs from previous work in several important ways. First, previous studies (including Horvath and Ratfai, 2004; Babetskii et al., 2004; Mikek, 2006; and others) imposed a common lag length for all of the countries. However, I use individual lag lengths as determined by statistical tests. Second, several authors pointed to the limited reliability of earlier estimates due to the short time series available, which covered the initial structural adjustments in NMS (Campos and Coricelli, 2002; Fidrmuc and Korhonen, 2001). I use the sample from 1994 – 2005 for most countries. Thus, the sample excludes some of the initial structural adjustments in

¹ The member states (NMS) included in this study are Bulgaria, Czech Republic, Hungary, Poland, Romania and Slovakia. However, the group includes also Estonia, Latvia, Lithuania, Cyprus, Malta and Slovenia.

² The approach of Bayoumi and Eichengreen (1992) was employed by Horvath and Ratfai (2004), Frenkel and Nickel (2005), Funke (1997) and others. Fidrmuc and Korhonen (2006) offer a nice overview.

these countries. Third, I include in the analysis the newest members of the EU, Bulgaria and Romania.

2. Maastricht and optimal currency areas

The EU formalized its nominal stability condition for countries attempting to join the EMU in the Maastricht criteria. As Table 1 below shows, most of the NMS studied here did not manage to meet the criteria in 2006.³ The criteria do not allow for the catching up process in NMS where productivity shocks may be substantial and growth differential may contribute to inflation rates higher than in the EU. In practice, however, estimates of this contribution is of a magnitude consistent with fulfilling the criteria (Kovacs, 2002). Furthermore, the Balassa-Samuelson effect is gradually phasing out in most NMS (Mikek, 2007; Coricelli and Jazbec, 2001). Despite this and rather successful recent disinflation, several countries still do not meet the inflation criterion (set as the average of the three lowest inflation rates +1.5 percentage points). Bulgaria and Romania still exhibit rather high inflation rates, but these countries just joined the EU and are lagging behind the rest of the group in restructuring their economies. Poland has had very low inflation rates recently and it exhibited the lowest inflation rate in the EU for 2006. Similarly, the Czech inflation rates are low. Indeed, Czech Republic is the only of the group which currently meets all Maastricht criteria.

Table 1: Maastricht values for NMS in 2006

	Inflation	Government deficit	Public debt
Reference value	3.06	-3.0	60.0
Bulgaria	7.4	3.3	22.8
Czech Republic	2.1	-2.9	30.4
Hungary	4.0	-9.2	66.0
Poland	1.3	-3.9	47.8
Romania	6.6	-1.9	12.4
Slovakia	4.3	-3.4	30.7

Source: EUROSTAT (2007). Shaded cells indicate a value that exceeds the reference.

In general the countries have low public debt, but deficits are fluctuating. In Czech Republic the deficit reached almost 7% in 2003, but was slightly lower than 3% in 2006. Additionally, the dynamics of the debt shows substantial changes since 2000. While the debt fell in Romania (by 44%), Slovakia (by 39%) and most impressively in Bulgaria (by 69%), it grew in Czech Republic (by 69%), Poland (by 29%) and in Hungary (by 20%). Debt is expected to stabilize in Czech Republic and in Poland; however, the level of debt in Hungary already exceeds the reference value, and it may be underestimated (Halpern and Nemenyi, 2001). Evident political discord about prudent fiscal management is likely to make it worse. However, the appropriate fiscal regime is essential for disinflation (Mikek, 2006a). Furthermore, for several NMS the exchange rate seems to be the dominant determinant of their fiscal performance (Lewis, 2007).

³ Slovenia joined the EMU at the beginning of 2007 and is therefore not referenced here.

While satisfying the nominal criteria may be a necessary condition, it is not sufficient for convergence. I will clearly specify convergence below, but convergence reaches far beyond the merely nominal outcomes. Indeed, I will distinguish between convergence in outcomes and convergence of shocks. The latter will be the focus of this study.

The basic conceptual framework for my analysis is rooted in the OCA literature. Symmetry of shocks is the fundamental criterion for establishing the optimal currency area (Mundel, 1961)⁴ and the basis for cost benefit analysis of accession to a monetary union. In a monetary union the overall adjustment will suffice for symmetrical shocks, but the idiosyncratic shocks present substantial costs for individual economies since the monetary policy is no longer independent and cannot react to them. Additionally, the lack of exchange rate mechanism is a serious disadvantage with such shocks.

While one line of empirical literature focuses on changes in relative prices through the real exchange rate,⁵ the other approach focuses on time series behavior of data in NMS.⁶ The third approach is based on structural VAR (Bayoumi and Eichengreen, 1992) studying the correlation of identified demand and supply shocks. The approach has been applied to NMS by Fidrmuc and Korhonen (2001), Horvath and Ratfai (2004), Frenkel and Nickel (2005), and Mikek (2006) among others. However, their results on symmetry of shocks show a variety of opposing conclusions. While Horvath and Ratfai find a high level of symmetry between shocks in NMS and in the EU, Fidrmuc and Korhonen (2001), and Frenkel and Nickel (2005) conclude the opposite.

Focusing on the time dimension in the correlation of shocks in NMS reveals opposing conclusions as well. While Artis et al. (2004) and Darvas and Szapary (2005) find increasing coefficients, Mikek (2006) cannot reject the null of unchanged coefficients over two sub-periods. Furthermore, Babetski et al. (2004) find that supply shocks are not converging, but demand shocks are increasingly synchronized with EU shocks. In what follows, I adjust the approach of Babetskii et al. (2004) by incorporating an alternative lag structure. Then by applying the Kalman (1960) filter, I study the dynamics of the time dependent regression coefficients to assess the convergence of NMS to the EU.

3. Methodology and data

There are three steps involved in the present analysis: recovering the structural shocks from SVAR, calculating time varying correlations by means of the Kalman filter, and studying the dynamics of the coefficients through time to judge whether they converge to their counterparts.

First, to recover the structural shocks I apply the approach of Bayoumi and Eichengreen (1992), who study a two variable SVAR. The variables included are real output growth and inflation rate. While the shocks to the first are the aggregate supply shocks, the assumption of transitory

⁴ Horvath (2003) is an example of the OCA literature overview. Many extensions include, among others, McKinnon, 1963; Kennen, 1969; Corsetti and Pesenti, 2002; and Goodhart, 1996.

⁵ Including DeBroeck and Slok (2001) and DeGrauwe and Vanhalberbeke (1991).

⁶ Including among others Kocenda et al. (2005), Kutan and Yigit (2004), and Brada and Kutan (2001).

effects of the shocks to inflation allows interpreting it as aggregate demand shocks. The SVAR can be written as an infinite moving average:

$$X_t = \sum_{i=0}^{\infty} L^i A_i u_t \quad (1)$$

where $X_t' = [\Delta y_t, \pi_t]$ is a vector that includes real output growth (Δy) and inflation rate (π). $u_t' = [u_{st}, u_{dt}]$ is a vector of supply shock (u_s) and demand shock (u_d), L is the lag operator and the variance covariance matrix of unobservable structural shocks is:

$$E(UU') = \Omega \quad (2)$$

For a specified lag, the estimation of the model (1) gives the vector of residuals e_t and the estimated variance covariance matrix:

$$E(ee') = \Sigma \quad (3)$$

Both variance/covariance matrices are related in the following manner:

$$\Sigma = A_0 \Omega A_0' \quad (4)$$

Four restrictions are needed to identify the system and recover the unobservable structural shocks u_t . Two restrictions are normalizations of variances. The third is an assumption of orthogonality of supply and demand shocks that there are two orthogonal shocks: demand shock and supply shock. The final restriction (Blanchard and Quah, 1989) is an assumption of no permanent effect of demand shocks on real output:

$$\sum_{i=0}^{\infty} a_{12i} = 0 \quad (5)$$

In this setting the vector of estimated residuals e_t is a linear combination of underlying structural shocks. I collect the structural shocks u_t from this estimation and use them to study their correlation through time.

Second, the extracted structural shocks are input in the Kalman filter (Kalman, 1960; Hamilton, 1994). To obtain the time varying coefficients, I estimate the following equation for both supply and demand shocks (Babetskii et al., 2004):

$$U_{NMS,i} - U_{EU} = a(t) + b(t) (U_{US} - U_{EU}) + \psi_0(t) \quad (6)$$

U_j is the vector of recovered structural shocks where $j = s, d$. Index 'NMS,i' stands for shocks to individual NMS, 'EU' for European and 'US' for the United States. $\psi_0(t)$ is a well-behaved error term. The equation explains the difference between the shocks in NMS and in the EU with the excess of the 'rest of the world' shock over the EU shock. The time dependent coefficients describe the dynamics of correlations between the shocks in NMS and the reference country. I model the dynamics of the coefficients (unobservable states) through time as random walk, with ψ_i being white noise:

$$a(t) = a(t-1) + \psi_1(t)$$

$$\mathbf{b}(t) = \mathbf{b}(t-1) + \psi_2(t) \quad (7)$$

Third, my definition of convergence is based directly upon estimates of coefficients in (6). There are two conditions. First, if coefficients $a(t)$ are stable and close to zero, this would indicate that there is no persistent difference between NMS and EU shocks that are not explained by the rest of the world shocks. Additionally, $b(t)$ approaching 0 indicates decreasing importance of the rest of world for shocks in individual NMS. Thus, it shows convergence of NMS shocks towards the EU shocks. Indeed, both $a(t)$ and $b(t)$ equal to 0 would indicate on average identical shocks in NMS and the EU. To summarize, coefficients $a(t)$ close to zero and $b(t)$ approaching zero will indicate decreasing differences in the distribution of shocks in this framework.

The data set includes 6 Eastern European members of the EU: Bulgaria, Czech Republic, Hungary, Poland, Romania and Slovakia. Baltic countries are relatively small, and Slovenia already adopted the euro at the beginning of 2007. The data for Germany, France, Italy and the US serve to calculate information for reference countries. The first three countries are the largest European economies and represent more than half of Europe's GDP. Most of the data are from International Financial Statistics (IFS - 2007); however, a few additional sources include Eurostat (2007) and statistical agencies and central banks of individual countries. The data set for quarterly observations depends on data availability, but for most countries spans 1995 to 2005. The data for Romania start in 1998, for Slovakia in 1993, and for Bulgaria and Czech Republic in 1994. Real GDP is the measure of real output, and CPI measures the price level. Where data were not seasonally adjusted, I added the season dummies in VAR. The number of lags used in estimation was determined using statistical criteria: the Akaike information criterion, the Schwarz information criterion, the Hannan-Quinn information criterion, the likelihood ratio test at 5%, and final prediction error. I employed the number of lags that was chosen by most of these tests. Table A in the appendix provides the number of lags for individual countries. This is a point of departure from previous literature, which usually imposed uniform structure of lags.

4 Empirical results

I will focus on the convergence of shocks and not the convergence of outcomes. Focusing on outcomes hides high adjustment costs for a country with idiosyncratic shocks. Shocks do push the outcomes in the same direction; however, the outcomes are not determined only by the shocks but also by the way in which the economic system processes these shocks. First, I will present the information about coefficients a . For my broad definition of convergence, they should be close to zero or broadly approaching zero.

In Table 2 I provide information for coefficients a in Equation (6) for both demand and supply shocks. The reference EU shocks are recovered from estimating a SVAR based on average values for three large EU countries in terms of GDP: Germany, France and Italy.⁷ Means and standard deviations for the coefficients through time show that the coefficients are not significantly different from zero for several countries: Bulgaria, Romania and Slovakia for the supply shock equation, and Hungary and Romania for the demand shock equation. For these countries the first criterion for convergence is met.

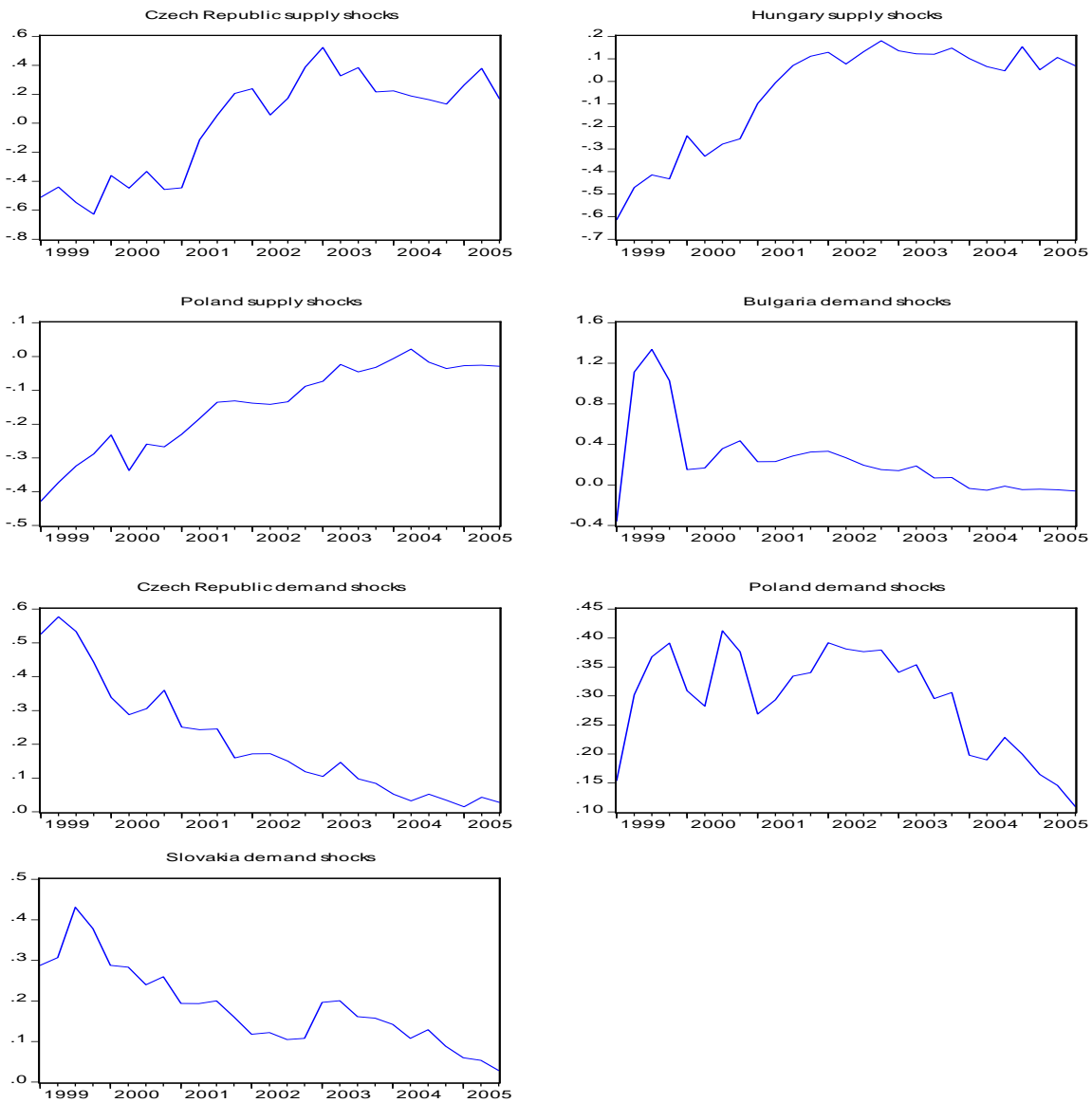
⁷ Technically the UK is larger than France or Italy; however, it accounts for a smaller share in trade with NMS.

Table 2: Convergence of NMS to the EU

	Coefficients a for supply shocks		Coefficients a for demand shocks		No. obs.
	Mean	SD	Mean	SD	
Bulgaria	-0.002	0.345	0.178*	0.173	28
Czech Republic	-0.130*	0.423	0.256*	0.192	39
Hungary	-0.192*	0.477	-0.217	3.023	42
Poland	-0.242*	0.258	0.374*	0.229	39
Romania	0.359	0.228	0.018	0.130	24
Slovakia	-0.027	0.539	0.178*	0.173	46

Coefficients a defined in Equation (6) above. * indicates significance at the 5% level.

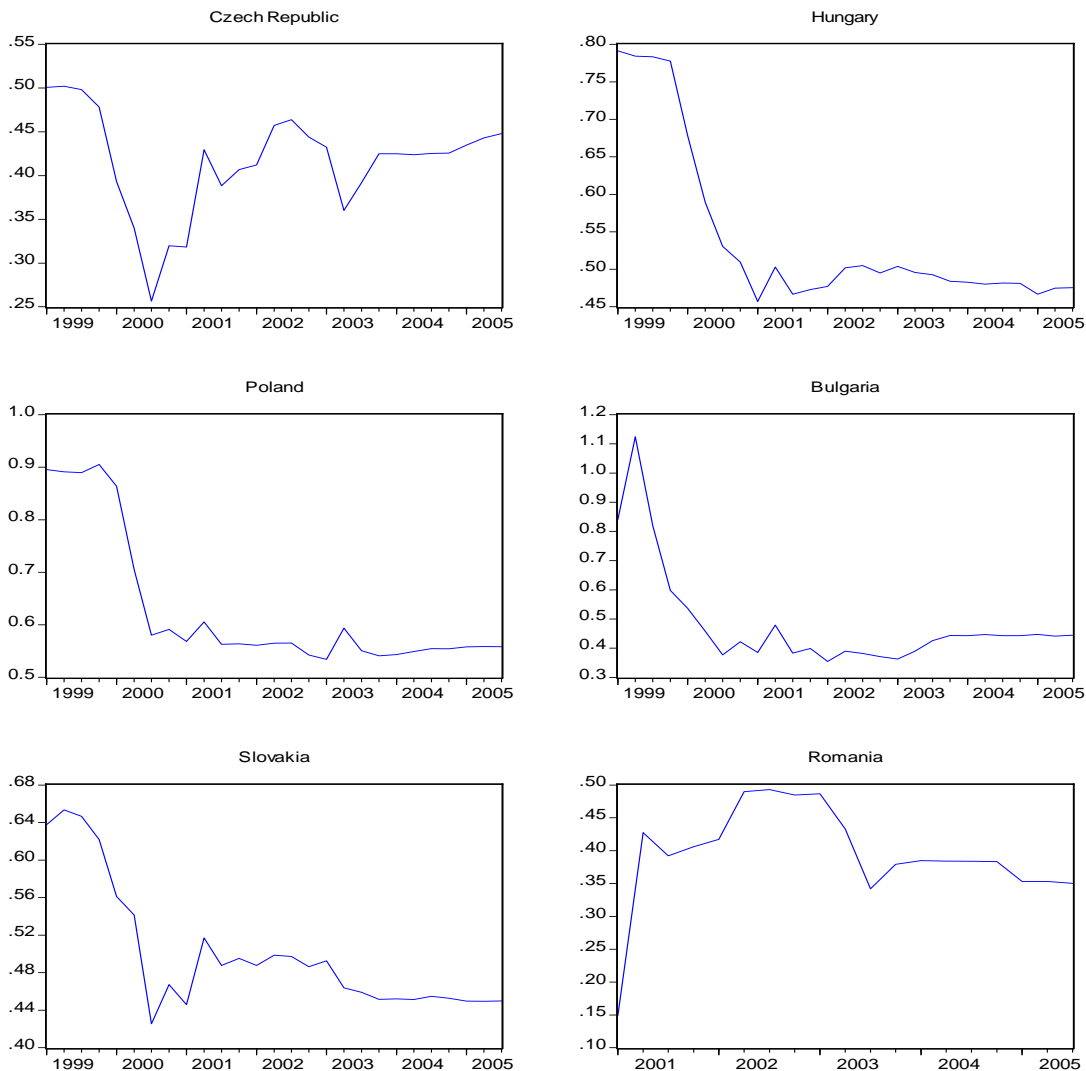
Figure 1: Dynamics of coefficients a for cases significant in Table 1



However, averages might obscure the information on dynamics of these shocks. This merits closer inspection using Figure 1 below. It provides more detailed information for countries that had means significantly different from zero in Table 2. The figure clearly shows the coefficients approaching zero for all considered cases. Even the dynamics of coefficients a for supply shocks in Czech Republic and in Hungary cross zero and then move back towards zero. The final values for coefficients a in Czech Republic is 0.17 and for Hungary 0.07, confirming convergence towards zero. Thus, I can conclude that coefficients a approach 0 and that all countries studied satisfy the first condition for convergence of shocks.

The second criterion for convergence of shocks to EU reference values pertains to coefficients $b(t)$. If these are approaching 0, the shocks in individual NMS are becoming increasingly similar to those in the EU. I will first show the results for supply shocks and then proceed to those for demand shocks. Figure 2 below shows the dynamics of coefficients $b(t)$ through time.

Figure 2: Convergence of supply shocks – b coefficient through time



All countries except Czech Republic exhibit a high level of convergence in supply shocks towards their European counterparts. Even Romania's supply shocks converge towards their European counterparts after 2002. Czech Republic is the only country clearly showing divergence. Coordination of policy reduces uncertainty, encourages trade and improves the correlation of idiosyncratic supply shocks (Frankel and Rose, 1996). Offsetting this is the fact that higher integration promotes specialization and therefore reduces the correlation of shocks (Krugman, 1993). These offsetting factors contribute to the diverging results for Czech Republic. However, other current EMU members had diverging supply shocks at the time of entry (Babetskii et al., 2004).

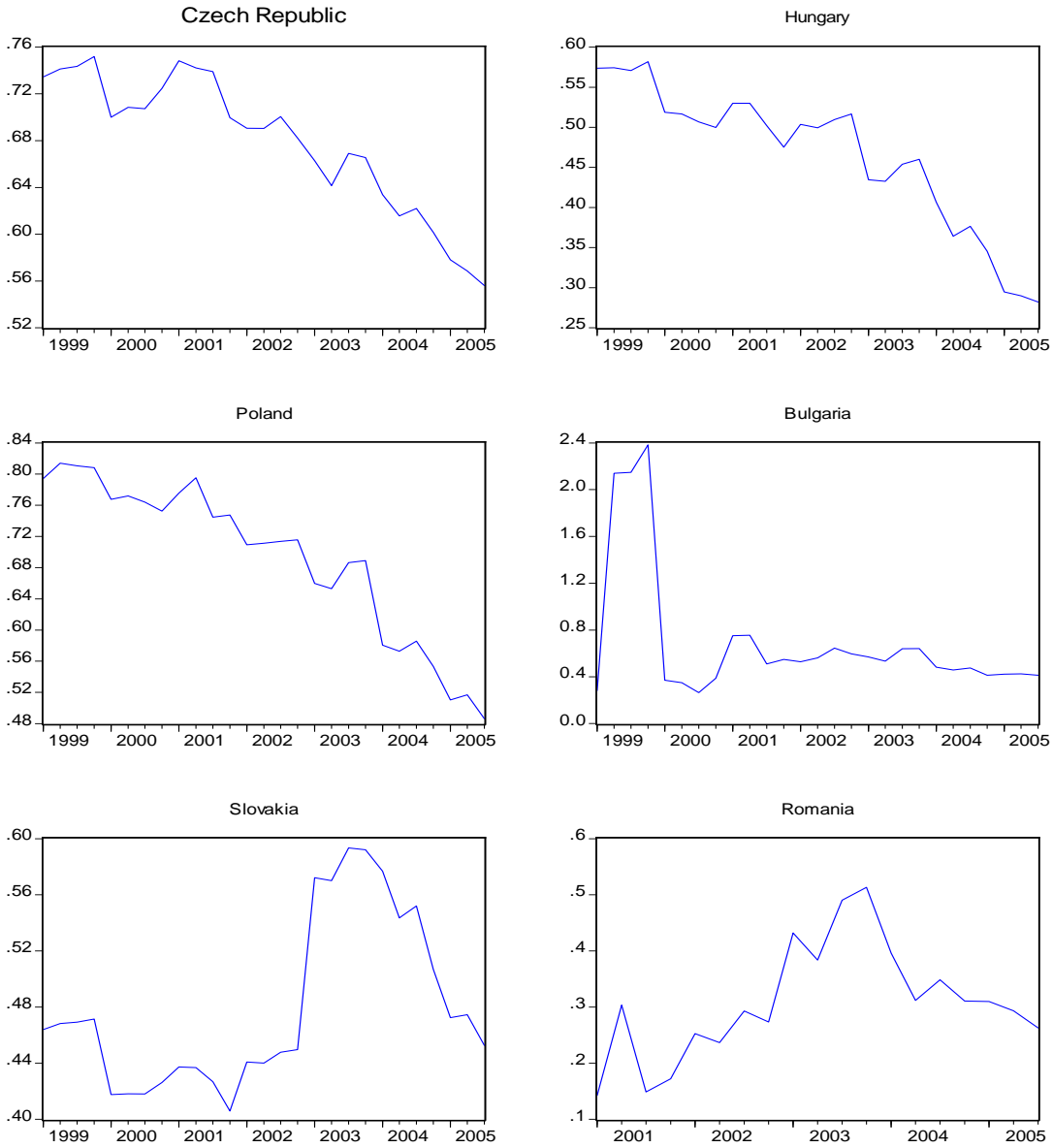
First, these results are different from previous studies (e.g., Babetskii, 200; Mikek, 2006), which found no convergence of supply shocks. Indeed, the lack of convergence was not a surprise and was explained by the dynamic catch-up process with strong productivity shocks in the early nineties. However, the results here seem to suggest that the process is slowing down and the Balassa-Samuelson effect is becoming weaker (Mikek, 2007).

Second, there are two elements here that depart from previous studies: CPI as a measure of price level and different lag specification. Several authors (e.g. Horvath and Ratfai, 2004 or Gilson, 2006) for different reasons uniformly imposed 2 lags in their estimation. I use statistical criteria to choose the lag lengths. The joint null of zero coefficient at given lags ($t-1$) is tested sequentially: $H_0: \beta_{i,t-1} = \beta_{j,t-1} = 0$ for $l = 8, 7, \dots, 1$. The lag length that was chosen most frequently by these tests was then used in the estimation. Details are given in Table A in the appendix. Moreover, the CPI includes prices of imports and therefore contributes to higher correlation coefficients for shocks (Fidrmuc and Korhonen, 2006; Gilson, 2006).

Next, I turn my attention to the demand shocks. They also show some variation of the results, as can be seen in Figure 3 below. The figure overwhelmingly suggests that there is convergence of demand shocks in NMS to the European ones. However, this is not the case for Slovakia and Romania. It seems that some convergence has taken place since 2003.

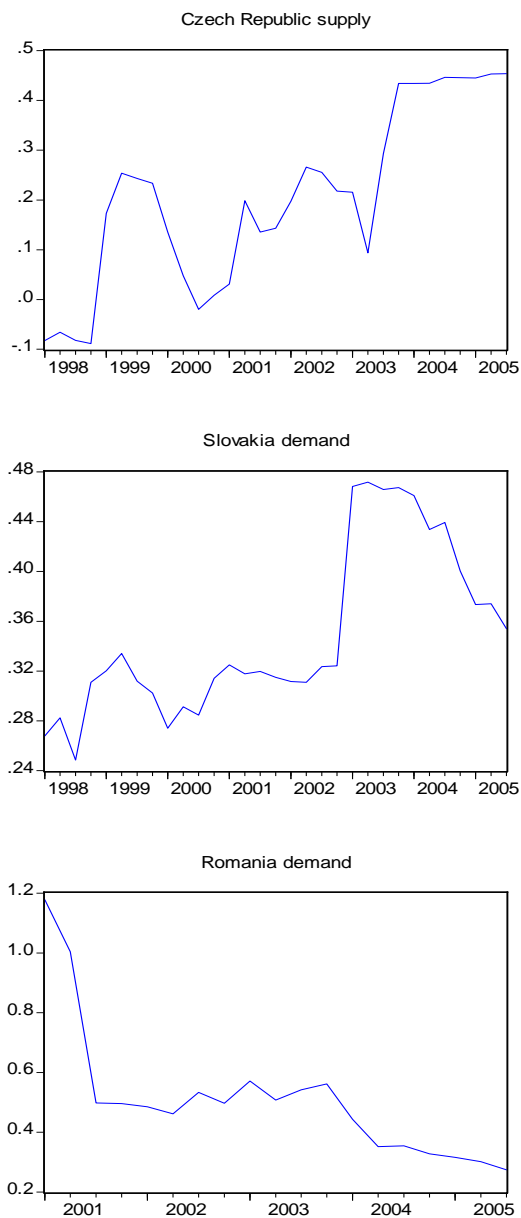
The results are in general comparable to previous results. However, some differences exist. First, I am not aware of previous studies of the kind for Bulgaria. Second, unlike Babetskii et al. (2004) I find no evidence of convergence of demand shocks for Slovakia and Romania prior to 2003. It is rather surprising not to find a more clear indication of demand shock convergence for these two countries since I am using CPI, which tends to show a higher level of country specific shocks. I conjecture that the difference for these two countries stems from different lag specification. Furthermore, some differences over different time periods might be due to increasingly similar consumption patterns resulting from higher trade integration (Frankel and Rose, 1996). Despite similarities, the NMS cannot be treated as a homogenous group since they show a lot of country specific behavior (Mikek, 2007).

Figure 3: Convergence of demand shocks – b coefficients through time



To further investigate the synchronization of shocks in NMS, I calculate coefficients of Equation (6) for cases not showing convergence with respect to their main trading partners. In particular, Germany is by far the largest trading partner for Czech Republic and Slovakia (CSO, 2007; SOSR, 2007), while both Germany and Italy are important for Romanian trade (NIS, 2007). Figure 4 thus shows coefficients $b(t)$ for Czech Republic supply shocks versus Germany, for Slovakian demand shocks versus Germany, and for Romanian demand shocks versus the trade-weighted average of Germany and Italy.

Figure 4: Convergence of shocks in selected NMS versus main trading partners



While the results indicate convergence of Romanian demand shocks toward the country's trading partners, the demand shocks in Slovakia and supply shocks in Czech Republic do not. Slovakia again may be changing after 2003. The Czech case is particularly interesting. While the country meets all Maastricht criteria, as shown in Table 1 above, it clearly has a lot of country-specific supply shocks that are not aligned with those in the EU. Therefore, it may be best served by postponing accession to the EMU for a later time after further synchronization of shocks is obtained.

5 Conclusion

An exchange rate regime that allows some flexibility may be most advantageous for the countries with divergent shocks (for example, Czech Republic for supply shocks). Such an arrangement allows the national monetary authority to respond to country-specific shocks. Angeloni et al. (2007) find that the exchange rate regime affects the speed of convergence and therefore conclude that "exchange rate flexibility may still serve as a useful shock absorber." Moreover, Lewis (2006) reports that exchange rate regime is the most important determinant of fiscal outcomes in NMS. Thus, countries trying to stabilize the exchange rate are using their fiscal policy to respond to idiosyncratic shocks. This shows potential costs for some NMS should they decide to give up entirely their monetary independence in the near future.

In summary, I find that in general both the supply and demand shocks in NMS are increasingly similar to those of their EU counterparts. However, there are some exceptions, including Czech Republic for supply shocks and Slovakia for demand shocks. This does not change even when they are compared only with their main trading partner, Germany. Supply shock coefficients are in general quite stable for most countries, indicating weaker shocks due to Balassa-Samuelson's effect. The distinction between convergence in outcomes and convergence in shocks becomes obvious for the case of Czech Republic, where we clearly see divergence in shocks and convergence of outcomes. Such increasingly similar outcomes indicate high adjustment costs in the presence of divergent shocks.

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Appendix

Table A gives the number of lags for the following 4 criteria: for the likelihood ratio test at the 5% level (LR), final prediction error (FPE), Akaike information criterion (AIC), and Hannan-Quinn information criterion (HQ). The joint null hypothesis of zero coefficients at a given lag ($t-l$) is tested sequentially - $\mathbf{H}_0: \beta_{i,t-l} = \beta_{j,t-l} = \mathbf{0}$ for $l = 8, 7, \dots, 1$.

Table A: The lags chosen

	LR
Bulgaria	7
Czech Republic	8
Hungary	1
Poland	4
Romania	7
Slovakia	5