Does trade integration contribute to synchronization of economic shocks in Europe?

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Abstract:
This paper examines two related issues: the convergence of shocks in NMS to their EU counterparts through time, and the effect of trade integration on the distributions of shocks. The decision to adopt the euro will be associated with higher implicit costs for new EU member states (NMS) with a more asymmetric shock structure. I employ the Kalman filter to calculate time varying regression coefficients relating previously identified structural shocks in NMS and the EU. Results in general show no convergence for shocks identified based on the Blanchard-Quah restriction. Supply and demand shocks do not become increasingly symmetric. Results suggest that the catching up process in NMS is slowing down. Additionally, there is no strong evidence suggesting that trade integration increased synchronization of shocks between the existing EU members and the newcomers. This is true also for the period after joining the union.

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

JEL classification: E5. E6. F4

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Does trade integration contribute to synchronization of business cycles in Europe?

1. Introduction

This paper asks whether the economic shocks in Eastern European EU members (NMS)[1] converge towards the shocks in the current members of the European Monetary and Economic Union (EMU). Additionally, I investigate whether trade contributes to synchronization of the shocks. Joining the European Union (EU) in 2004 and 2007, the new members are obliged to adopt the common European currency. At the beginning of 2007 the first one (Slovenia) adopted the euro, while another (Lithuania) was denied accession due to its failure to meet the Maastricht criteria (some details can be found in Table A in the appendix). Moreover, the potential costs of joining the EMU have sparked increasing political dissent over the accession in several NMS (for example, in Poland and Hungary).

Synchronization of the business cycle is one of the main determinants of the costs for accession to a monetary union and is therefore vital for countries about to enter. The optimum currency area (OCA) literature focuses on the distribution characteristics of shocks in two distinct economic areas to judge the relative costs associated with abandoning an independent monetary policy. Highly symmetric shocks in a monetary union and the potential member indicate relatively lower costs of joining. Costs are lower since the common monetary authority is likely to respond in order to stabilize the effects of the shocks shared by both the monetary union and the new member state. In contrast, asymmetric shocks imply high costs of joining a monetary union since the new member state will no longer be able to use monetary policy to respond to idiosyncratic shocks. Furthermore, the adjustment mechanism based on a flexible exchange rate will no longer be available. Given such shocks, this implies stronger fluctuations in output and therefore higher costs of joining a monetary union.

[1] Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovenia and Slovakia joined the EU in 2004 and Bulgaria and Romania in 2007.

Identified structural vector autoregression (SVAR) methodology has been employed in this context to extract structural demand and supply shocks and study their correlation.[2] Research focusing on the convergence of NMS to the EMU has yielded an array of contradicting results. In order to judge whether NMS shocks converge toward the EU, I follow the approach of Boone (1997),[3] who in turn built on Bayoumi and Eichengreen (1992), and apply the Kalman (1960) filter to study the correlation of structural shocks. Thus, I calculate the time varying regression coefficients that relate the shocks in an individual NMS to the corresponding shocks in the EU. Calculated standard errors for coefficients facilitate a formal judgment about convergence based on statistical criteria.

This paper departs from previous work in several important ways. First, I use the Kalman filter to calculate time varying correlations between previously identified structural shocks in the EU and in NMS. However, unlike Babetskii et al. (2004), I calculate the standard errors for time varying coefficients, which allows for a statistically more rigorous criterion of convergence. Second, several authors have 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 Korhnonen, 2001). I use the sample from 1993 – 2007 for most NMS. This sample thus excludes transitional recession and therefore some of the structural adjustments in these countries. Additionally, the longer sample period is relevant because the dynamics of inflation in the studied countries have recently changed, especially in Hungary and the Baltic states (almost 7% in Latvia in 2006 and over 9% recently in Hungary). Fourth, I expand my analysis comparing it to earlier enlargements of the EU in 1986 and 1995. Fifth, previous studies (including Horvath and Ratfai, 2004; Babetskii et al., 2004; Mikek, 2006; and others) used the common lag length in specification of all the countries studied, which may have affected the results. Therefore, I use statistical criteria to determine the individual lag length that is used in estimation for each country. To provide some measure of robustness for the results with respect to lag length, I compare the results for a series of possible lag length specifications.

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[2] The original methodology of Bayoumi and Eichengreen (1992) incorporated the Blanchard and Quah (1989) approach and was used by Horvath and Ratfai (2004), Frenkel and Nickel (2005), Funke (1997), and others. Fidrmuc and Korhonen (2006) offer a nice overview.

[3] Also followed by Babetskii et al. (2004).

Sixth, I additionally investigate two alternative hypotheses about the effect of economic/trade integration on the structure of shocks. The first is due to Franker and Rose (1989) and can be summarized as follows: more trade means that the economies of trading partners are becoming more and more similar and therefore experience increasingly similar shocks. The alternative is based on Krugman (1983) saying that trade facilitates and promotes specialization and therefore ever more different economic structure of trading partners. Such trading partners then experience less symmetric shocks.

After a brief review of previous research and the theoretical framework in Section 2, I provide some details on data and methodology in Section 3. In Section 4 I present empirical results for shock convergence based on the long run Blanchard Quah restriction. Section 5 is devoted to investigating the relationship between trade intensity and distribution of shocks. Finally, I briefly discuss the findings in Section 6.

2. Shock symmetry and optimum currency areas

The seminal paper of Mundell (1961) showed that it is symmetry of shocks that establishes the optimal currency area (OCA)[4] and is therefore the dominant factor in judging possible costs/benefits of entering a monetary union. His original work was extended in several directions incorporating the degree of openness (McKinnon, 1963), the importance of product diversification and intraindustry trade (Kennen, 1969; Fidrmuc, 2004), the possibility of endogeneity in business cycle correlations (Corsetti and Pesenti, 2002), and the relevance of political cohesion among members of a monetary union (Ingram, 1996; Goodhart, 1996).

Mundell considered two economic trading areas with distinct currencies. When both areas are hit symmetrically with the same shocks, then the adjustment through the exchange mechanism is of little need. However, the asymmetric shocks that hit one of the areas but not the other call for adjustments through changes in the exchange rate. A flexible exchange rate effectively separates both areas and therefore reduces the effect of the shock in one area on the other, thereby reducing or even completely eliminating the need for reaction of policy makers to such a shock in a partner country.

[4] Horvath (2006) is an example of the vast OCA literature overview.

Mundell's notion of OCA thus implies that for symmetrically distributed shocks there will be no need for an individual country to respond to such shocks and that overall adjustment in the monetary union will be sufficient. For idiosyncratic shocks, however, the national monetary policy would be called upon to counteract their undesirable effects. But the national monetary authority is transferred to a supra-national level in a monetary union and therefore cannot respond. Therefore, the lack of an exchange rate adjustment mechanism would be a major disadvantage for member countries with asymmetric distribution of shocks. Thus, the distribution of shocks across different countries will be a major determinant of the implicit costs of their forming a monetary union.

While one strand of empirical literature studying convergence toward a monetary union focused on changes in relative prices through the real exchange rate,[5] the other approach focused on time series behavior of data. A number of papers with a particular focus on time series in NMS include, among others, Kocenda et al. (2005), Kutan and Yigit (2004), Brada and Kutan (2001), and Kocenda and Valachy (2006).

Measuring the degree of shock symmetry, authors in some earlier studies judged the distribution of shocks by studying the correlation of the real output growth or real exchange rate.[6] Similarly, the Maastricht criteria, which set forth conditions for nominal stability in the countries bidding to join the EMU, focus on the outcomes, such as inflation and government debt (some details can be found in Table A in the appendix.)[7] While nominal stability embedded in the criteria is a necessary condition for real stability, it is by no means sufficient.[8] Additionally and more importantly, the focus on outcomes fails to distinguish between the shocks themselves and the adjustment to these shocks. Therefore, based on the outcomes that reflect both the shocks and

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

[6] For example, DeGrauwe and Vanhalberbeke (1991) or Cohen and Wyplosz (1989).

[7] Although in principle the criteria are not compatible with the catching up process in NMS (since productivity shocks may contribute to inflation rates higher than in the EU), empirical estimates render magnitudes consistent with fulfilling the criteria (e.g., Kovacs, 2002).

[8] Nominal stability depends on fiscal policy (Mikek, 2006a). While small NMS show impressive fiscal outcomes, the large NMS showed hefty increases in debt during the 2002-2005 period (Poland 19%, Czech Republic 37%, and Hungary 58%). The numbers may even be underestimated (Kopits and Székely, 2003; Halpern and Nemenyi, 2001). Increasing political dissent over fiscal discipline further exacerbates the situation. Lewis (2007) finds exchange rate regime to be a determinant of fiscal performance.

reaction to them, one cannot separate the shocks from the policy measures taken in response to them. However, the shocks identified in a Structural Vector Autoregression (SVAR) allow for separating the shocks themselves from the outcomes.

The SVAR approach by Bayoumi and Eichengreen (1992), which studies the correlation of identified demand and supply shocks, was applied to NMS by Fidrmuc and Korhonen (2001), Horvath and Ratfai (2004), Frenkel and Nickel (2005), Mikek (2006), and Gilson (2006) among others. Their results on symmetry of shocks vary substantially. For example, while Horvath and Ratfai find a high level of symmetry, Fidrmuc and Korhonen (2001) and Frenkel and Nickel (2005) conclude the opposite. Fidrmuc and Korhonen (2006), Mikek (2006), and Horvath and Ratfai (2004) all report relatively low correlation coefficients for shocks between NMS and the EU. Low correlations are likely due to the noise in quarterly data, and several authors claim that these are of comparable magnitude to those within the EU.[9]

Additionally, studies of shock correlation dynamics through time also show mixed results. Artis et al. (2004) and Darvas and Szapary (2005) find that correlations for some countries increase through time while they decrease for others. Mikek (2006) uses two sub-periods and in general cannot reject the null of unchanged correlations over the two sub-periods. However, Babetskii et al. (2004) find that "supply shocks are not converging" and that "…demand shocks are becoming increasingly synchronized with the EU countries …" The literature thus suggests very mixed results.

The possibility of endogeneity of the shocks has been studied by Frankel and Rose (1989), Krugman (1983), Kennen (2001), Babetskii(2005), Fidermuc (2004) and others. Frankel and Rose (1898) suggested that trading partners with stronger trade ties are becoming gradually more similar and therefore experience more similar shocks. Fur such countries the costs of joining a monetary union would be smaller. Alternatively, Krugman's (1983) take on this was just the opposite. Trade encourages specialization and therefore the trading partners are becoming increasingly less similar. Thus, they are bound to experience less symmetric shocks. Kennen (2001) suggested that it actually depends on the nature of shocks. While Fidrmuc (2005) avoided

[9] For example, Fidrmuc and Korhonnen (2006), Frenkel and Nickel (2006), and Gilson (2006).

the problems of endogeneity of shocks by studying intra industry trade, Babetskii (2005) studies NMS and find some evidence supporting the Frankel and Rose's view. Zzzaddd Artis

In what follows, I use Blanchard Quah type long run restriction to identify shocks and calculate time varying correlations with the Kalman filter to assess the convergence of candidate countries (NMS and earlier newcomers) to the EU on the extended data set. Additionally, I expand on Babetskii et al. (2004) by studying the robustness of the results to alternative lag specifications and calculate standard errors to provide a statistical criterion in judging possible convergence. Finally I present some evidence on the endogeneity of shocks.

3. Methodology and data

The methodology for the present study consists of three steps. First, the shocks are recovered from a structural vector autoregression. Second, the series of these shocks is used to calculate time varying correlations by employing the Kalman filter. Third, the series of the time varying regression coefficients and the associated standard errors are studied to make a judgment on their possible convergence through time.

First, I follow the methodology of Bayoumi and Eichengreen (1992) and consider a two variable SVAR (inflation and output growth):

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

where X_t' =[y_t, π_t] includes real output growth (y) and inflation rate (π) and u_t'=[u_{st}, u_{dt}] includes an output growth shock (u_s) and an inflation shock (u_d), A is a compatible matrix of parameters and L is the lag operator. The equation is thus an infinite moving average representation of a VAR, and the shocks (u) are unobservable structural shocks. The variance covariance matrix of structural shocks is: **E(UU') = Ω**. For a given specified lag, the estimation of model (1) renders the vector of residuals e_t and the estimated variance covariance matrix: **E(ee') = Σ**. The variance/covariance matrices are related as follows:

$$\Sigma = A_0 \, \Omega \, A_0' \tag{2}$$

Thus I need four restrictions to recover the unobservable structural shocks. They will be based on Blanchard Quah (1989) long run restriction. Three restrictions are the same for both identifications. Two are normalizations of variances and the third one follows from the assumption of orthogonal shocks. This implies:[10]

$$\boldsymbol{\Sigma} = \mathbf{A_0}\ \mathbf{A_0}' \qquad (3)$$

The fourth restriction requires the following :

$$\sum_{i=0}^{\infty} a_{12i} = 0 \qquad (4)$$

This assumption identifies the supply shocks with permanent effects on both output and inflation dynamics and only transitory effects of demand shocks. The structural shocks can be recovered directly from the reduced form VAR parameters as follows:

$$e_t = A_0\ u_t \qquad (5)$$

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, after the structural shocks are extracted, I calculate time varying correlations between shocks in the EU and in NMS using the Kalman filter (Kalman, 1960). Consider the following equation, which relates shocks in NMS, the EU, and the rest of the world (Boone, 1997):

$$\mathbf{U_{NMS,i} - U_{EU} = a(t) + b(t)\ (U_{US} - U_{EU}) + e} \qquad (6)$$

The vector of supply and demand shocks recovered from VARs above U=[u_s, u_d] has index 'EU' for European, 'US' for American, and 'NMS,i' for shocks in individual NMS. Vector e=[e_s, e_d] contains random residuals. This is the measurement equation for the Kalman filter.[11] The equation explains the shock in NMS, which is in excess of the reference EU shock (left hand side of the equation), in terms of the rest of the world shock (US), which is in excess of the EU shock and a constant (measuring a possible persistent difference between EU and NMS shocks). In general, however, coefficient a(t) should be zero by construction since all shocks have zero mean

[10] As noted by Bayoumi and Eichengreen (1992).
[11] Further details can be found, for example, in Hamilton (1994) or Kalman (1960).

(Boone, 1997). I estimate equation (6), which has time dependent coefficients, for both supply and demand shocks in both regions. Unlike Mikek (2006), who split the sample into two subsamples and tested whether the correlations have changed, I employ here the Kalman filter (Kalman, 1960 or Hamilton, 1994). The latter is superior to splitting the sample since it can trace out the dynamics through time and does not require identifying/choosing a break point. The Kalman filter calls for additional assumptions about the coefficients (unobservable states). I assume they follow random walk, with ψ_i being white noise, giving the following transition equations:

$$\mathbf{a(t) = a(t\text{-}1) + \psi_0(t)}$$
$$\mathbf{b(t) = b(t\text{-}1) + \psi_1(t)} \qquad \textbf{(7)}$$

The approach can incorporate the possibility of endogenous correlations of demand shocks due to increasing monetary integration: correlations between the EU and NMS shocks would be increasing and therefore the corresponding coefficients a(t) and b(t) would be decreasing through time.

Third, I define the convergence in the following way: Unlike previous studies (e.g. Babetskii et al., 2004), I use statistical criteria to judge the convergence and for that purpose calculate the standard errors of the time varying coefficients. Controlling for the rest of the world, a(t) in equation (6) above approaching zero suggests convergence of the NMS shocks to their European counterparts. Similarly, given a(t), b(t) approaching 0 indicates progressively less important "rest of the world" and therefore convergence. However, in addition to the general direction of the coefficients through time, I formally test the hypotheses H_0: a(f)=0 and H_0: b(f)=0, where a(f) and b(f) are the regression coefficients in the final state.

Fourth, I then turn attention to the relationship of the measure of symmetry through time (coefficients b(t)) and the measure of trade flows between the two regions. I estimate the impact of trade flows on the symmetry of shocks prior to and after joining the EU for two sets of countries: NMS and those that joined the EU earlier, in 1986 or 1995. Finally, I use the pooled data to see whether the act of joining the EU itself changed the relationship between trade and the measure of symmetry.

This study includes NMS: (Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovenia and Slovakia) and countries joining the EU earlier (Portugal, Spain, Austria, Finland and Sweden). Additionally, the reference countries were the US and the three largest EU economies (Germany, France, and Italy). Thus, the EU variables were calculated as average values for Germany, France and Italy,[12] which represented over one half (52%)of the EU GDP in 2005. The data sources are the International Financial Statistics (IFS) and Direction of Trade (DOT) database by IMF. The quarterly data sample covers 1993q1 to 2007q1 for most NMS countries. However, for Bulgaria, Hungary, Lithuania, Poland, and Slovenia, the available data started in 1995q1 and for Romania in 1998q1. Additionally, the data sample for the countries joining earlier it covers 5 years prior to entry to 2007. While data for the large EU countries and the US were available already seasonally adjusted, the NMS data were not and therefore seasonal variables were included in VARs for the countries with seasonally unadjusted data..

I measure output using real GDP and price level by GDP deflator. Several authors have worked with CPI instead. Fidrmuc and Korhonen (2006) report that the studies using CPI tend to find higher correlation coefficients for shocks in the two regions and therefore claim stronger convergence of NMS to EU shocks than those based on the deflator. Similarly, Gilson (2006), using CPI, finds relatively high correlation coefficients for both output and inflation shocks. However, the CPI includes the prices of goods consumed in home countries (including those imported) and in that sense directly transmits foreign price shocks or exchange rate shocks into the home economy. Since all of the NMS and the earlier newcomers are very open economies, the results based on CPI are likely to show shocks originating abroad. This would be particularly true for the NMS with consumption baskets looking increasingly like those in the EU. Admittedly, the approach here cannot clearly distinguish between the shocks originating in the home economy or abroad; however, the systematic incorporation of foreign shocks, such as through the CPI, is much less likely to provide reliable results. Additionally, equation (6) illustrates that I control for foreign or the rest of the world shocks.

[12] Similar to Frenkel and Nickel (2005), Funke (1997), Bayoumi and Eichengreen (1992) and others.

Different from previous work, the lag length in each VAR for an individual country was determined based on statistical criteria. Each VAR was thus estimated with an individually determined lag length. The following 4 criteria were used: the sequential exclusion likelihood ratio test at the 5% level (LR), final prediction error (FPE), the Akaike information criterion (AIC), and the Hannan-Quinn information criterion (HQ). The final number of lags chosen corresponds to the most frequently chosen lag length by these statistical tests. Additionally, I checked for robustness of the results with respect to alternative specifications of the lag length for NMS and calculated the coefficients through time for lags between 2 and 8.

4. Empirical results

Increasingly, more similar results in the outcomes between NMS and the EU have been widely documented (e.g., Mikek, 2006; Fidrmuc and Korhonen, 2006). However, the distinction between convergence in outcomes and convergence in shocks is conceptually important. Focusing on outcomes cannot distinguish between shocks and reactions to those shocks. While several elements in the country specific propagation mechanisms originate from policy actions, the shocks are exogenous. Thus, they are relatively more difficult to eliminate than the adjustments in policy and may pose more serious potential costs. For example: the adjustment based on country specific monetary policy or exchange rates disappears in a monetary union, thus the propagation mechanisms across the studied countries will become more similar as they join the monetary union. As such the propagation mechanism is relatively less important[13] and I focus on identifying the underlying shocks. The increasingly similar outcomes mentioned above are compatible with two possible scenarios: either the underlying shocks are highly positively correlated and the propagation mechanism is already very similar across the countries, or alternatively the shocks are independent and the country specific propagation mechanisms are such as to produce similar outcomes. The studied countries display many idiosyncratic characteristics, as is confirmed by the results below, and therefore assuming highly correlated shocks *a priori* does not seem warranted.

Therefore, ever more similar outcomes do not reveal the implied costs of giving up monetary independence. Instead, they hide the fact that the economy with asymmetric shocks has higher

[13] And its thorough analysis is beyond the scope of this paper.

adjustment costs to process the different shocks in a way that produces more similar outcomes. Thus, while the shocks push the outcomes in the same direction, the outcomes do not depend solely on the shocks. It is both the shocks and the adjustment mechanisms in the economy that determine final outcomes.

I conceptualize convergence in terms of the dynamics and final state of the coefficients a(t) and b(t) in equation (6) above. Convergence will reject the null for the final value at 5% significance. Thus, controlling for the rest of the world and given a(t), b(t) approaching zero would indicate that NMS shocks are increasingly approaching those of the EU, as opposed to the rest of the world. Literature with a wide spectrum of results as discussed above offers little guidance as to what may be expected.

4.1. Blanchard Quah identification: demand and supply shocks

The output and inflation shocks studied above may be due to major shifts in demand or supply. However, demand shocks may depend on monetary policy and therefore may disappear after a country joins the monetary union. At the same time, they could serve as a rough signal of alignment in monetary policy for individual NMS with that of the European central bank (ECB). On the other hand, supply shocks depend on productivity changes and are likely to persist after accession to the EMU. Thus, their asymmetry is likely to be a major ingredient in the implied costs of joining the EMU. Therefore, it is important to distinguish between these two types of shocks. I use the Blanchard-Quah identification scheme, which is based on the assumption that demand shocks have no long run effect on supply, but supply shocks have a lasting effect on demand (Bayoumi and Eichengreen, 1992). As before, I estimate equation (6) with the Kalman filter[14] for both demand and supply shocks separately.

The dynamics of coefficients merit closer inspection using Figure 2 and 3 below, which shows the coefficient b(t) through time and thus makes the dynamics much more clear. For most countries the b(t) for supply shocks show similar very dynamics: Substantial gains before 2001

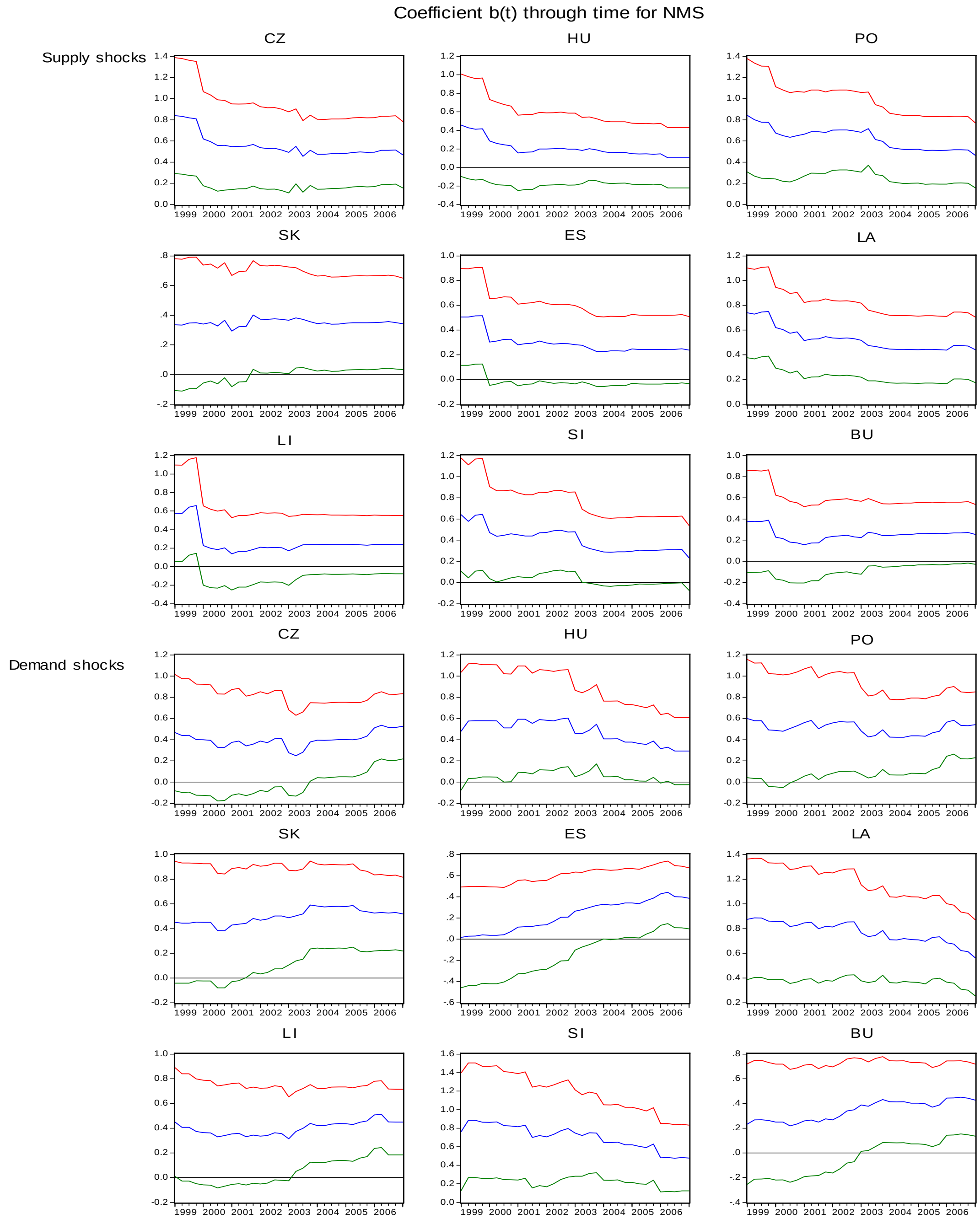
[14] While the Kalman filter allows for direct comparison with earlier work (Babetskii et al., 2004).

and only very limited decreases or even increases (for Lithuania or Bulgaria) after 2001. This seems to suggest slower catching up in productivity in NMS. b(t) coefficients for demand shocks separate countries into two groups: those with seemingly converging coefficients (such as Hungary, Poland and Slovenia) and those with either increasing or unclear dynamics (including Estonia and Czech Republic). Figure 3 shows dynamics of b(t0 for the earlier newcomers prior to their entry in the EU. For Spain and Portugal we cannot reject the null for the final value and for both supply and demand shocks. Similarly the dynamics for Sweden 's supply shocks is favorable. However, final values for Austria, Finland and Sweden for demand shocks clearly reject the null and thus indicate relatively higher potential costs of joining a monetary union. Joining the EU long before the launch of the euro, these countries had a much longer period of adjustment before the introduction of euro. They had a lot of time to build their economic system and performance to be compatible with the rest of the EU countries. Additionally, their institutional framework was already at the starting point very similar to the rest of the EU. Therefore, their situation is not completely comparable to that in NMS with regard to potential costs of joining a monetary union.

A comparison of coefficients b(t) with Portugal and Spain prior to EU entry[15] reveals that, in general, the countries studied here have similar magnitudes for both shocks. Most exhibit a comparable mean of b(t) for supply shock . While this points toward similar costs of adjustments after accession, it is misleading. Spain and Portugal did not need to go through the final stages of transition to a market economy at the time of entry and they already had economic systems more compatible with the EU. On the contrary, NMS are both transforming their economic and social systems, broader institutional framework, and working on joining both the EU and EMU. While the results suggest substantial progress towards this goal, the process is by no means complete.

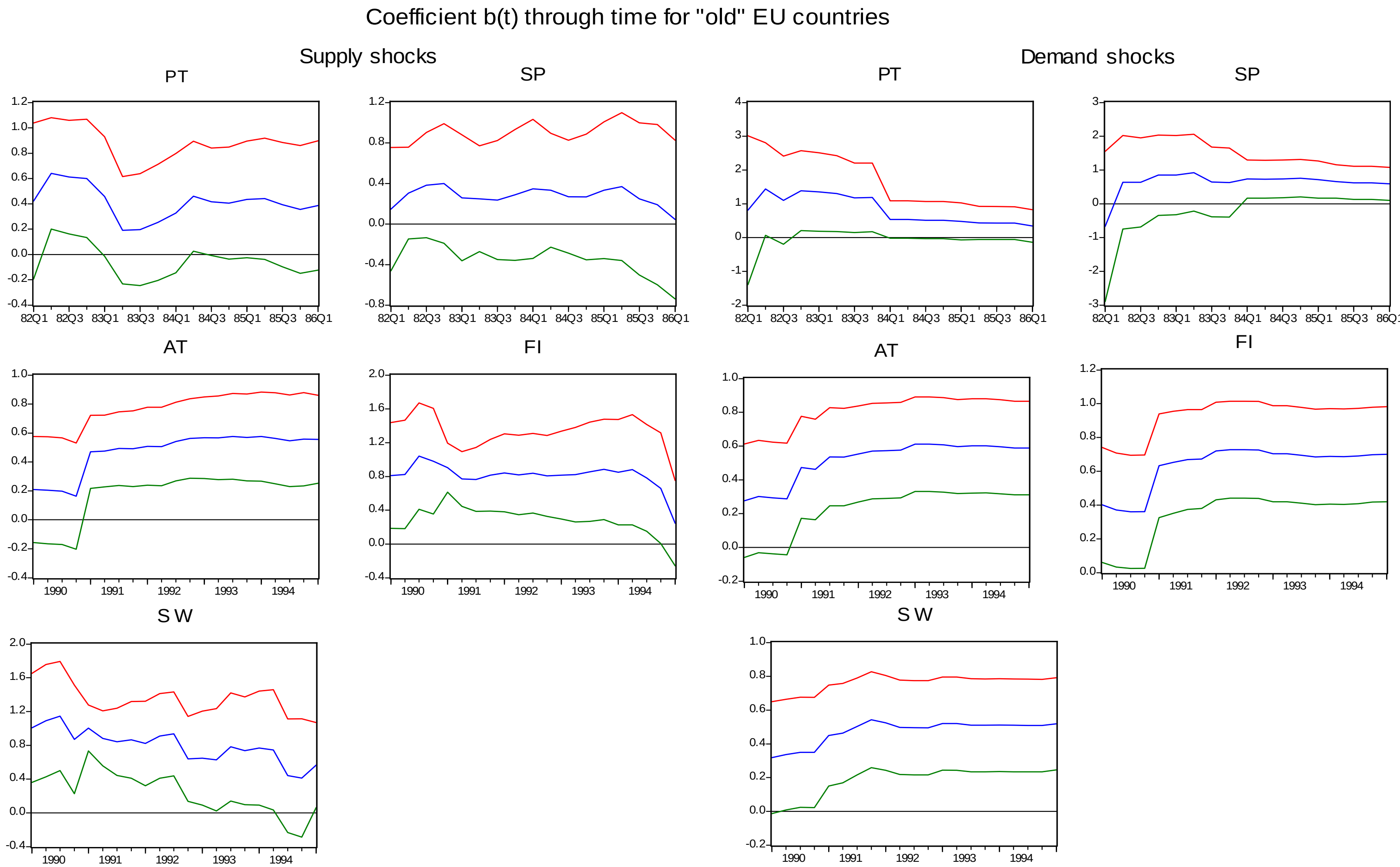
[15] As reported in Babetskii et al. (2004).

Figure 1: Dynamics of b(t) coefficients through time estimated by Kalman filter[16]



[16] Country abbreviations are: pt – Portugal, sp – Spain, at – Austria, fi – Finland, sw – Sweden, cz- Czech Republic, es –Estonia, hu – Hungary, la – Latvia, li – Lithuania, po- Poland, si – Slovenia, sk – Slovakia, bu – Bulgaria and ro – Romania.

Figure 2: Dynamics of b(t) coefficients through time estimated by Kalman filter



Many previous papers imposed a uniform structure of lags on different countries (for example, Horvath and Ratfai, 2004 and Gilson, 2006 impose two lags for all countries), I use statistical criteria to specify the lags for individual countries. In particular, the joint null hypothesis of zero coefficients at given lag (t-l) is tested sequentially - H_0: $\beta_{i,t-l} = \beta_{j,t-l} = 0$ for l = 8 ,7, …,1. The test results for lag exclusion are given in Table D in the appendix. However, Babetskii (2005) points out the low robustness of the estimated correlations for shocks in various studies, despite the same methodology. To address this, I check for robustness of the results to alternative lag specifications. I calculated the series of the b(t) coefficients for BQ specification and the Kalman filter for l = 2, …,8. The results are given in Figure A in the appendix and illustrate two points. First, they show relatively weak sensitivity to the lag choice for individual countries (as long as at least 4 lags are included). Clearly two lags are inadequate. Second, there is no justification for imposing a uniform lag structure across countries (especially if this includes only a few lags). This is clearly visible on the graphs for Estonia, Latvia and the Czech Republic.

Has the symmetry of shocks in NMS increased within the group (Horvath and Ratfai, 2004)? In order to answer this question, I estimated the following:[17]

$$\mathbf{U_{NMS,i} = a(t) + b(t) * U_{avg}} \qquad \mathbf{(8)}$$

$U=[u_s, u_d]$ is a vector of structural supply and demand shocks. Index 'NMS' indicates individual NMS and 'avg' marks the average for NMS. The coefficients a(t) and b(t) follow an AR(1) process given in equation (7) above. Convergence in this setting would require a(t) approaching zero and b(t) approaching 1. However, similar to Fidrmuc and Korhonen (2003), I find that none of the countries displayed this tendency for either demand or for supply shocks.[18] The demand shocks may be induced by policy, such as a disinflation program. However, despite disinflation programs in these countries, there seems to be no synchronization of demand shocks, which is probably due to different timing of disinflation. This suggests that the NMS have not been experiencing similar shocks, and it implies that we should not treat the group as homogeneous. Indeed, differences between individual NMS countries are substantial.

[17] In fact, I investigated several alternative specifications to control for EU shocks and for shocks in the rest of the world (US).

[18] To save space these results are not displayed here.

5. Does trade matter?

In what follows I consider the b(t) coefficients as a measure of shock symmetry. I study whether the measure depends on the trade flows between the two regions. Trade flows are measured by trade intensity (Frankel and Rose, 1989), which is calculated as

$$TI = (EX+IM) / (WEX+WIM)+(EUWEX+EUWIM)$$

Where TI – trade intensity, EX – exports of a country to EU, IM – imports from the EU, WEX – total exports of a country, WIM – total imports for the country, EUWEX – total exports of the EU and EUWIM total imports of the EU. Thus it is a share of bilateral trade in the sum of total trade for both partners.

Figures 3 to 5 below show scatterplots between trade intensity and the b(t) coefficients. In particular, Figure 3 limits its time span to several years prior to the EU entry. While trade seems to have increased the symmetry of supply shocks before entry for the earlier newcomers (Portugal, Spain, Austria, Finland, and Sweden), there is no evidence that that is in general true for the NMS (Slovakia and Bulgaria seem to be exceptions).

Demand shocks in Figure 4 also show that in most cases higher trade intensity is associated with less (and not more) shock symmetry. This is true for most NMS and even for a couple of the earlier newcomers (Finland and Sweden). Thus scatter plots do not offer much of a unified picture for the relationship between trade and symmetry of shocks. Perhaps one may dare to claim that the earlier newcomers in general exhibit a slightly more favorable relationship; however, the sample is so small that this should be taken with caution.

Figure 5 below shows the scatter graphs for the earlier newcomers for the period after their entry to the EU. While graphs may be less convincing than numbers, a clear picture is clearly not there. While demand shocks for Portugal, Spain and Sweden (and supply shocks for Finland and Sweden) are decreasing (indicating that trade integration was associated with more symmetric shocks), we see just the opposite for Spanish supply shocks and Finish demand shocks.

Figure 3:

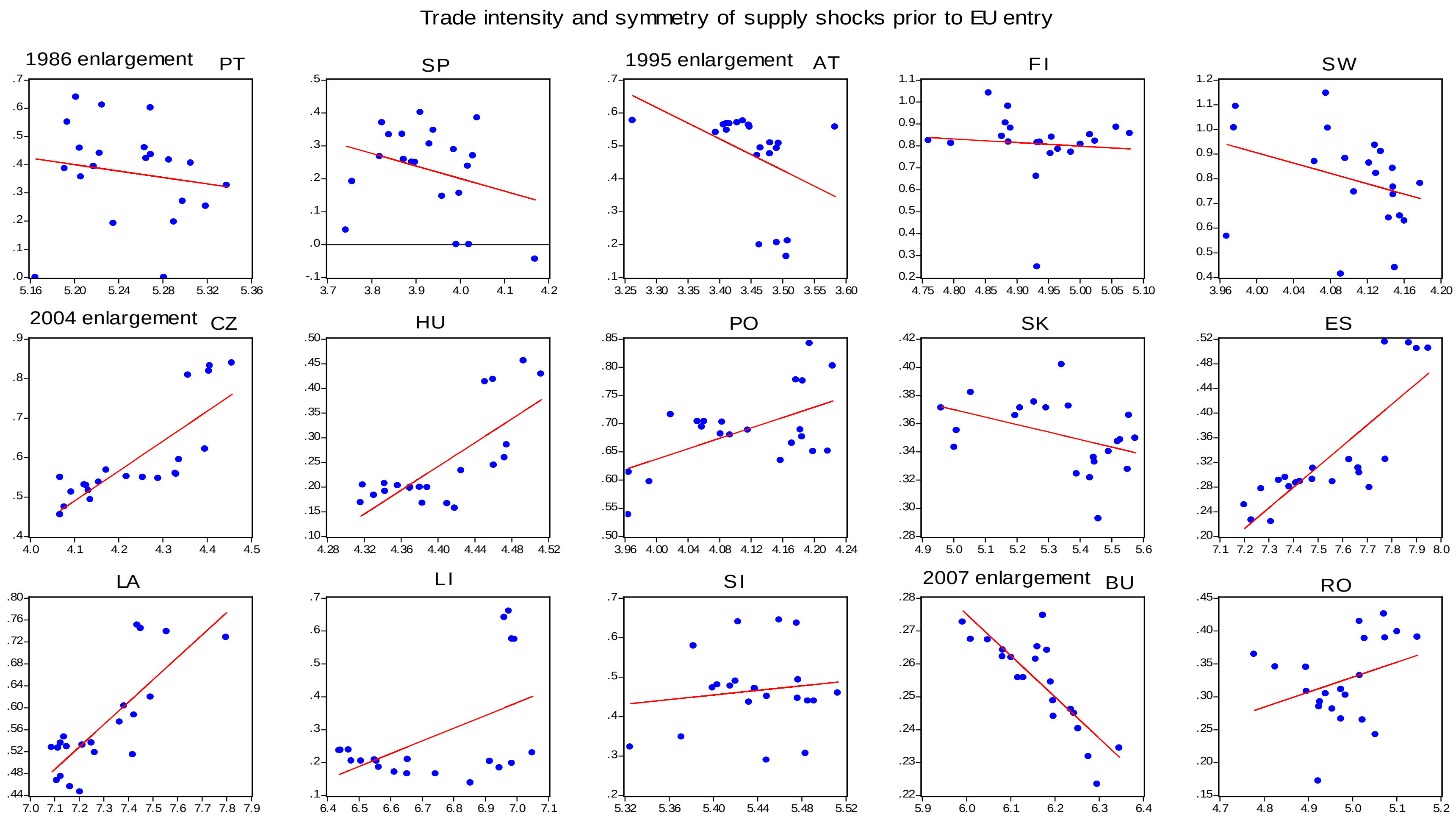
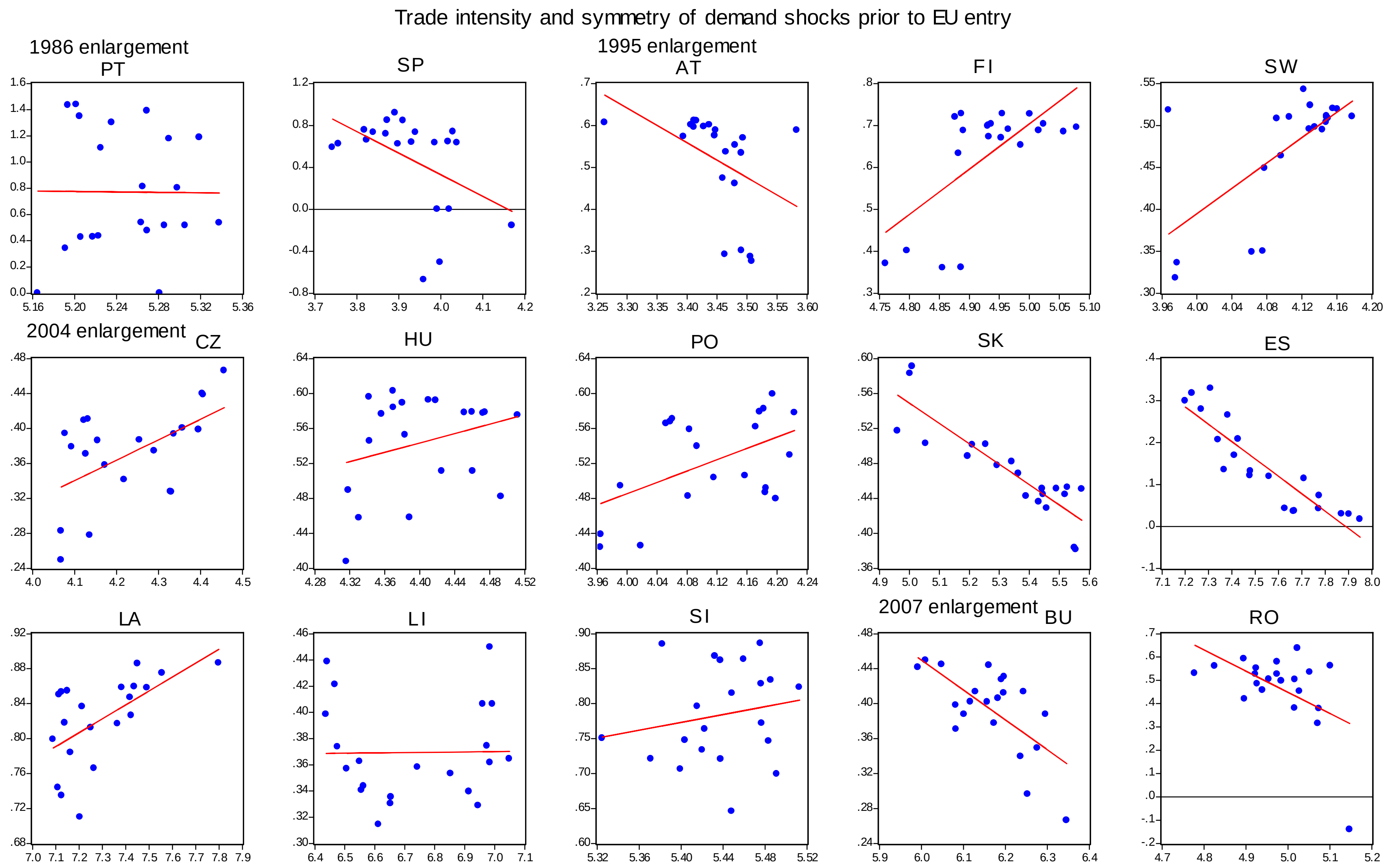
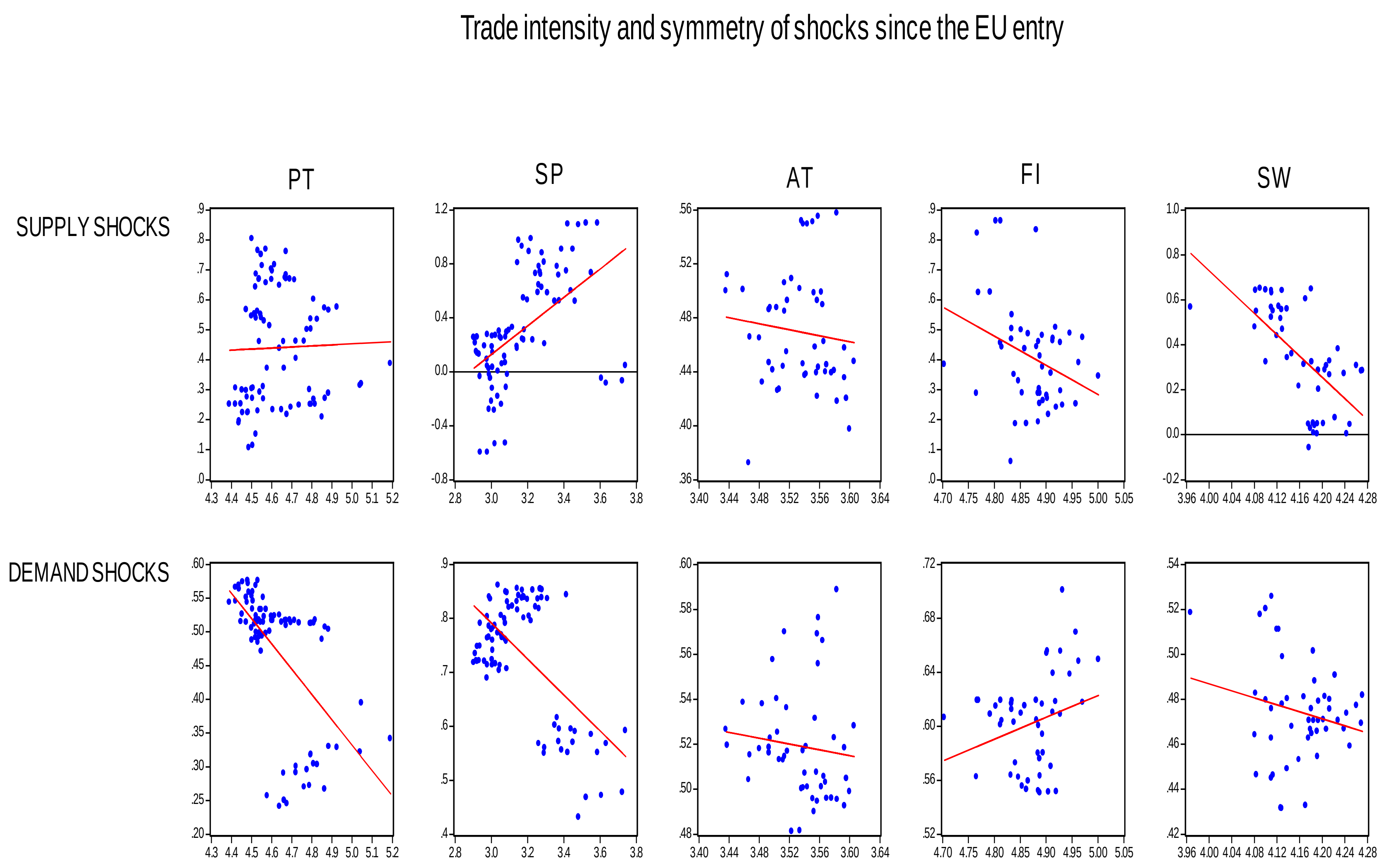

Trade intensity and symmetry of supply shocks prior to EU entry
1986 enlargement
PT
SP
1995 enlargement
AT
FI
SW
2004 enlargement
CZ
HU
PO
SK
ES
LA
LI
SI
2007 enlargement
BU
RO

Figure 4:



Trade intensity and symmetry of demand shocks prior to EU entry
1986 enlargement
PT
SP
1995 enlargement
AT
FI
SW
2004 enlargement
CZ
HU
PO
SK
ES
LA
LI
SI
2007 enlargement
BU
RO

Figure 5:


Trade intensity and symmetry of shocks since the EU entry
PT
SP
AT
FI
SW
SUPPLY SHOCKS
DEMAND SHOCKS

One can draw similar conclusions from Tables A and B in the appendix. They show estimates for the following equation in individual countries:

$$\mathbf{b(t) = \beta_0 + \beta_1 TI + \beta_2 t + \varepsilon} \tag{9}$$

where t is time and ε is white noise. Table A gives the information for the time prior to entry and Table B after EU entry.

A negative coefficient would indicate that more trade means more symmetry shocks (smaller b(t)). However, the Swedish coefficient for demand shocks is the only significantly negative coefficient. All others are either positive or not significant at 5%. This means that Frankel and Rose's (1989) hypothesis is not supported by the findings here. This is true for both the period prior to EU entry with intensive preparation in the new countries, including adjustments in the institutional environment, and after they joined the club. Even after joining the EU, the symmetry of shocks did not reflect trade integration in the sense of Frankel and Rose. Instead it seems that Krugman's conjecture about stronger specialization and more asymmetric shocks was equally, or perhaps even more, likely.

Table 1: Symmetry of shocks as dependent on trade intensity

	Supply			Demand		
	beta	time	Dummy - after entry	beta	time	Dummy – After entry
Prior	0.226			-0.175		
t-value	4.298			-2.100		
Prior time	0.056	-0.006		-0.035	0.005	
t-value	0.858	-4.222		-0.334	2.142	
Whole period	0.055		-1.35E-16	-0.041916		-1.35E-16
t-value	1.894		3.51E-15	4.482		-3.20E-15

This is further confirmed by Table 1 above. It shows the results of an estimation based on the pooled data, where I combined the shocks and trade intensities across countries. While for the period before entry to the EU the coefficient for supply shocks is significant, it is positive. Additionally, adding the time trend renders it insignificant. Examining the graphs above, it seems that the Spanish supply shocks and the Swedish demand shocks changed their relationship after

EU accession. To examine this I provide results for adding a dummy that indicates the period after entry. For both demand and supply shocks the dummy variable coefficient is not significant and tiny. Thus there was no significant overall change between periods prior to and after EU entry for the earlier newcomers.

6. Discussion

The results here are different from previous studies (e.g., Horvath and Ratfai, 2004; Babetskii, 2004), which found convergence for demand. However, like previous research, I find no evidence of convergence for supply shocks.

First, the Kalman filter reveals that the coefficients are not approaching zero through time. Trends are extremely weak and final values for supply shocks are between 0.28 and 0.58. This suggests that the supply shocks in NMS are in general not similar to their European counterparts. The asymmetric supply shocks are not surprising and have been widely documented (e.g. Horvath and Ratfai, 2004: Frenkel and Nickel, 2005). The asymmetry in supply shocks arises from the dynamic restructuring of institutional framework and productivity shocks induced by the catching up process in NMS.

Second, the results indicate that, while still present, the catching up in productivity is slowing down, as can be seen in rather stable coefficients for supply towards the end of the studied period (the first two rows in Figures 1 and 2 above) and in small trend coefficients. In other words, the NMS have in general almost caught up with the rest of the EU in terms of productivity. Nevertheless, approaching a non zero value indicates that the supply shocks remain rather asymmetric. This may be due to institutional framework, market structures or other remaining idiosyncratic rigidities in individual NMS. Furthermore, it seems that NMS process shocks from the rest of the world differently from the current EMU members.

Third, the results for demand shocks here are in contrast with previous findings of convergence. Different from previous studies (e.g. Horvath and Ratfai, 2004 or Babetskii et al., 2004), in general I found no convergence for demand shocks in NMS, including, for example, the Czech Republic or Estonia. The dynamics of the coefficient b(t) for demand shocks in Czech Republic are a surprise since inflation was quite low during the observed period. However, as mentioned above, the dynamics of inflation (outcome) are not determined solely by the shocks, but also by the way the economic system processes these shocks. Thus, the results suggest relatively high costs of adjusting to the shocks in Czech Republic. In contrast, the dynamics for Hungary are not a surprise since inflation in Hungary recently increased substantially. It would require information beyond the sample studied here to sort out whether the recent inflation in Hungary, as high as 9%, is due to changing demand shocks or some other factor. Hungary and Poland are especially interesting cases. Despite the lack of political consensus on joining the EMU, coefficients in both countries decrease over some portion of the observed period. However, while Hungary, Poland, and Slovenia show somewhat stronger dynamics towards more symmetric demand shocks, they still fail the test of zero null. The results thus suggest that NMS in general do not exhibit a pattern of synchronized demand shocks. Additionally, further work on individual countries (not as a group) is needed to better understand the dynamics of the demand shocks.

Fourth, while the results are relatively robust to the choice of lag length as long as sufficiently many are included (check Figure B in the appendix), they may not be robust with respect to the time period studied and the data source. Several authors (including Campos and Coricelli, 2002 and Fidrmuc and Korhonen, 2003) cautioned that some earlier studies are less reliable since they included transitional recession. The sample used here excludes the early stages of transition before 1993/1994, which was characterized by abrupt, large structural adjustments in NMS. These likely contributed to larger demand shocks (both directly and through the Balassa-Samuelson effect) and therefore played a role in identifying stronger convergence than found here. Besides excluding the transitional recession, the sample covers recent years and therefore captures the new dynamics in output and particularly inflation after 2002 (e.g., in Estonia, Latvia or Hungary). Differences across the observed periods may also stem from various other factors, such as different policies in place (for example, disinflation efforts) or increasingly similar consumption preferences due to high trade integration between the economies (Frankel and Rose, 1996).

Fifth, the diverging results for demand shocks might be partly due to shocks originating in monetary policy itself. If that is the case, giving up monetary authority would eliminate those shocks. In contrast, diverging supply shocks indicate relatively high costs of joining the EMU as these would persist in a monetary union. Babetskii et al. (2004) found that Spain and Portugal also had diverging supply shocks up to the time of their entry to the EU. They point out that a higher level of integration in capital markets allows for better diversification of asset portfolios to handle idiosyncratic risks. However, divergent supply shocks are likely to render a common monetary policy not optimal for at least some members of the monetary union and would certainly increase the cost of entering such a union.[19]

Sixth, two offsetting factors may have contributed to the dynamics of coefficients seen above during the period of ever stronger integration of NMS and the EU. Frankel and Rose (1996) point out that coordination of policy decreases uncertainty and promotes trade and foreign direct investment, which in turn increases covariance of country-specific supply shocks through spreading productivity adjustments. This would explain the decreasing of coefficients in the earlier part of the observed period, characterized by a dynamic catching up process. In contrast, higher trade integration promotes more specialization and therefore less synchronization of supply shocks (Krugman, 1993). Since it offsets the productivity spreading effect, this seems to be compatible with relatively little change in the supply shock coefficients in the second part of the sample. Thus, while productivity spreading was dominant in the past, specialization seems to have gained momentum in recent years. The latter mitigates productivity spreading and is thus compatible with very little change in the coefficients observed.[20]

Seventh, studying the effect of trade integration on the symmetry of shocks did not provide support for either of the alternative possible explanations. Neither the Frankel and Rose suggestion nor Krugman's claims were supported by the data. This casts doubt on the findings of Babetskii (2005) for NMS. There may be several reasons for this, including (but not limited to) the need for further disaggregating of shocks. Alternatively, the evidence that NMS still have strong idiosyncratic economic structures and dynamics might have played a role. However, I am inclined to think that both effects are clearly there and they are balanced in a way that prevents

[19] In fact, it may even be undesirable for the union itself since it complicates monetary policy, creating a trade-off for the central bank in the sense of Clarida et al. (2000).
[20] This is not at odds with the claim of slowing down the productivity catching up process since trade integration of the NMS is also likely to be slowing down as they become "almost mature".

their easy detection in data. Previous studies based their reasoning on the outcomes and interpreted the synchronization in GDP or inflation as the consequence of stronger trade ties. However, as discussed above the outcomes incorporate both the shocks and the adjustment mechanism. Therefore it seems that some further analysis of the adjustment mechanism might reveal more about the relationship. In particular, including additional regressors measuring contributions of labor market rigidities, financial integration and differences in fiscal policy is likely to prove fruitful.

7. Conclusion

The costs of giving up the ability to respond to idiosyncratic shocks through monetary policy could be very high. The magnitude depends on the degree of symmetry in the distribution of shocks in the monetary union and the individual country. For countries with an asymmetric shock structure with respect to the EMU (such as Estonia or Czech Republic), keeping flexible exchange rates a little longer would be most beneficial. They at least partially isolate their economies in the face of idiosyncratic shocks. Thus, these countries would not find a common monetary policy a welcome stabilization instrument since the costs of joining the EMU are likely to be substantial.[21] In line with this, 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 the exchange rate regime is the most important determinant of fiscal outcomes in NMS. This confirms that NMS trying to stabilize the exchange rate are actually using their fiscal policy to respond to idiosyncratic shocks. Furthermore, this already reveals some hidden costs of giving up monetary independence (in the form of participation in ERM2, a currency board or other non-flexible exchange rate arrangement). Most of the NMS have implemented either inflation targeting, a currency board, or some other formal mechanism to prepare for EMU entry. However, if they experience asymmetric shocks, as suggested by the results above, the costs of their entry might be relatively high.

[21] Sanchez (2006) finds countries with flatter output-inflation tradeoff and larger country size would show a preference for a flexible exchange rate.

To summarize, different from previous studies, my results show no evidence of convergence for either demand or supply shocks in NMS. Formally testing the null for final values and time trends for both alternative estimation methods and both identification schemes, results seem to suggest rather asymmetric shocks. Coefficients b(t) approaching a non zero value indicate that NMS respond to the shocks from the rest of the world in a different way from their EU counterparts. Relatively stable coefficients toward the end of the observed period for supply shocks indicate that the dynamic process of productivity shocks due to catching up in NMS has been slowing down. Additionally, the NMS as a group have not been experiencing increasingly similar shocks. In fact, the countries are rather different and therefore cannot be treated as a homogenous group. This calls for further inquiry into (primarily demand) shocks for individual countries. The distinction between convergence in outcomes and convergence in shocks becomes obvious for several countries (such as Czech Republic or Estonia), where we see divergence in shocks and some convergence of outcomes. This implies relatively high costs of processing shocks for such economies in order to produce outcomes similar to those in the EU. The dynamics of coefficients in the earlier part of the observed period were primarily in line with the productivity spreading explanation of Frankel and Rose (1996). However, in recent years specialization due to high trade integration (Krugman, 1993) with the EU most likely mitigated this influence and contributed to relatively stable coefficients.

Current results suggest the need for further analysis in three directions: first, exploring the sources of (primarily) demand shocks focusing on individual NMS (establishing additional robustness tests for the present results); second, studying causes of asymmetries focusing on the propagation mechanism in individual NMS; and third, confronting alternative possible explanations and determining the level of possible endogeneity in shock distribution due to integration. Further research is likely to be fruitful as the longer time series become available and the transition towards fully fledged market economies is nearing its completion in NMS. I found no clear support for either of the alternative hypotheses explaining the relationship between trade intensity and symmetry of the shocks.

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Appendix

Table A: Maastricht values for NMS in 2006

	Inflation	Interest rate	Government deficit	Public debt
Czech Republic	2.2	3.8	-3.5	30.9
Slovakia	4.3	4.3	-3.4	33.0
Poland	1.2	5.2	-2.2	42.4
Hungary	3.5	7.1	-10.1	67.6
Slovenia	2.5	3.8	-1.8	29.9
Estonia	4.3	n.a.	2.5	4.0
Latvia	6.7	3.9	-1.0	11.1
Lithuania	3.7	4.0	-0.5	18.9
Reference value	**2.8**	**6.2**	**3.0**	**60.0**

Source: Convergence report (2006) values for Slovenia and Lithuania are from EUROSTAT (2007) and the Convergence report (2006a). Only Poland and Slovenia met the criteria in 2006. The latter successfully adopted the euro in January 2007.

Table B: Relationship between symmetry of the shocks and trade intensity (b(t)= f(IT)) prior to EU entry

	Supply				Demand			
	beta	t value	time	t value	beta	t value	time	t value
PT	0.591	0.713	0.006	0.992	0.014	0.006	-0.021	-1.215
SP	0.022	0.055	0.008	1.206	0.211	0.175	0.042	2.094
AT	0.432	1.321	0.017	5.184	0.367	1.472	0.015	6.027
FI	-0.630	-1.380	-0.017	-2.885	-0.597	-1.919	0.010	2.575
SW	0.081	0.200	-0.027	-6.565	-0.518	-3.586	0.007	4.496
CZ	0.208	0.374	-0.021	-1.782	-0.101	-0.260	-0.003	-0.351
HU	-0.223	-0.294	-0.010	-1.357	0.720	1.126	-0.010	-1.626
PO	0.494	1.299	-0.014	-2.689	-0.179	-0.494	-0.002	-0.426
SK	0.009	0.145	0.002	0.822	0.269	4.033	-0.001	-0.598
ES	-0.197	-1.083	-0.005	-0.794	-0.154	-1.995	0.022	7.696
LA	-0.100	-1.197	-0.012	-4.603	0.048	0.793	-0.008	-4.282
LI	0.595	1.373	-0.037	-2.388	0.082	0.655	-0.003	-0.709
SI	0.139	0.440	-0.013	-5.648	-0.013	-0.054	-0.008	-4.631
BU	0.125	3.657	0.000	0.026	0.051	0.380	0.005	2.632
RO	-0.308	-1.304	0.002	0.463	0.582	1.098	0.006	0.827

The countries are listed in order as they joined the EU.

Table C: Relationship between symmetry of the shocks and trade intensity (b(t)= f(IT)) since EU entry

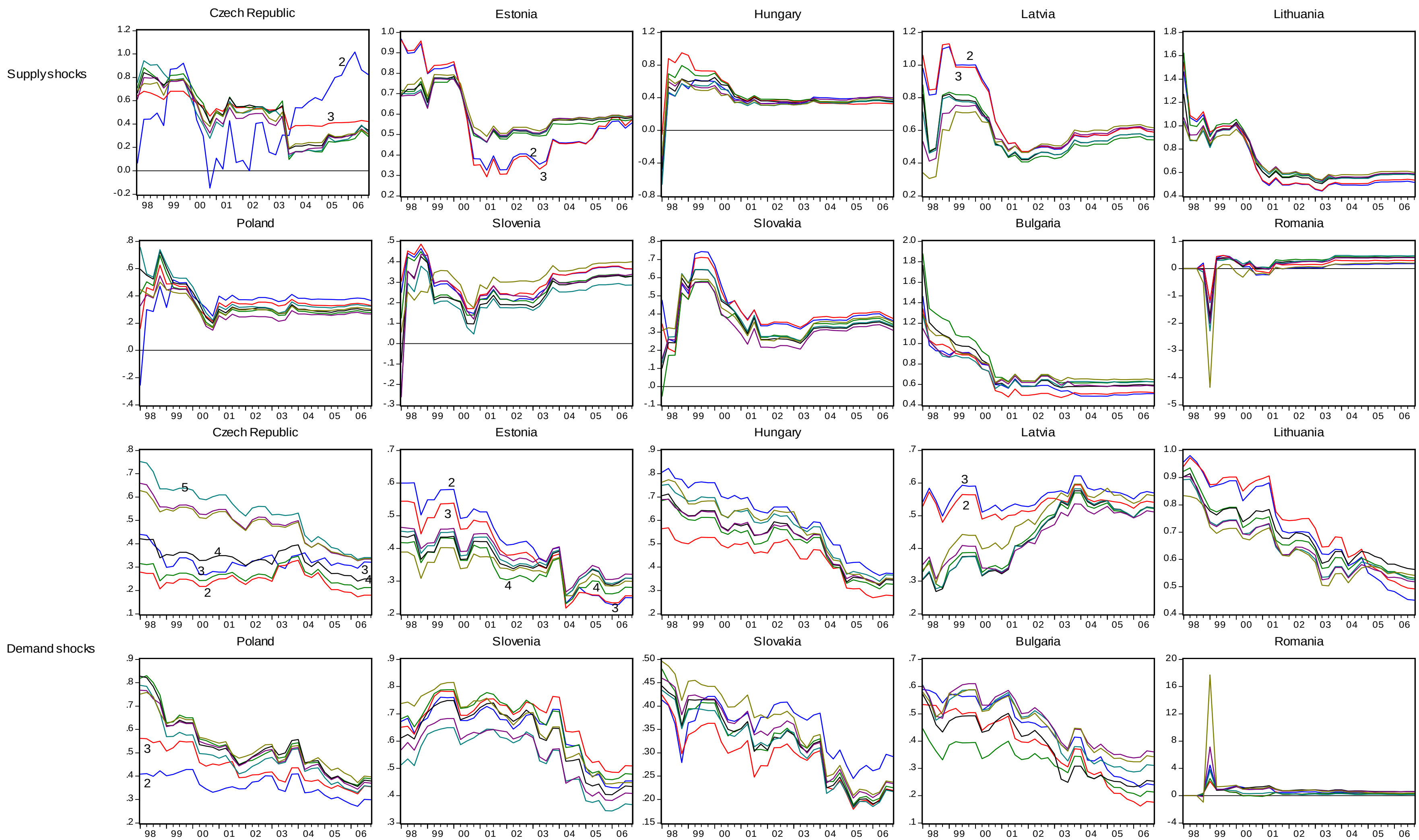
	Supply				Demand			
	beta	t value	time	t value	beta	t value	time	t value
PT	0.283	2.478	-0.005	-7.098	0.227	5.068	0.002	8.337
SP	-0.049	-0.118	-0.009	-2.744	0.592	5.714	-0.002	-2.787
AT	0.495	2.825	-0.001	-3.391	0.329	3.462	-0.001	-4.317
FI	1.500	4.012	-0.007	-4.385	0.014	0.322	-0.002	-12.442
SW	0.372	0.870	-0.012	-6.680	0.009	0.116	-0.000	-1.338

Table D: The lags chosen by different criteria

	LR	FPE	AIC	HQ	Chosen
Bulgaria	4	6	6	6	6
Czech Republic	6	1	7	0	4
Estonia	4	5	5	4	4
Hungary	4	4	8	4	4
Latvia	7	0	0	0	4
Lithuania	8	8	8	8	8
Poland	4	4	4	4	4
Romania	8	8	8	8	8
Slovenia	8	8	8	1	8
Slovakia	4	5	5	4	4

Table B gives the number of lags for the following 4 criteria: 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-k) is tested sequentially - $\mathbf{H_0: \beta_{i,t-k} = \beta_{j,t-k} = 0}$ for k = 8 ,7, …,1. The final number of lags chosen corresponds to the most frequently chosen lag length, except for Czech Republic and Latvia, where the choice by statistical criteria was not clear. However, several alternative lags were investigated for each country and the results are given in Figure B below.

Figure A: Robustness of the results with respect to chosen lag length



The numbers on selected graphs indicate number of lags included in estimation of the particular series of b(t) coefficients. In general, the series are not very sensitive to specification of lags as long as at least 4 lags are included. The graphs here are based on the Kalman filter and Blanchard-Quah long run restriction.