Frenkel, Michael; Nickel, Christiane; Schmidt, Günter

Working Paper

Some shocking aspects of EMU enlargement

Research notes in economics & statistics, No. 99-4

Provided in cooperation with:
Deutsche Bank Research

RESEARCH NOTE RN-99-4

Some Shocking Aspects of EMU Enlargement

Michael Frenkel*, Christiane Nickel and Günter Schmidt

April 1999

Abstract

This paper uses a structural vector autoregression to examine differences in demand and supply shocks and the response to these shocks between EMU member countries and three other groups of countries. The first group includes non-EMU EU countries, the second group EFTA countries and the third group central and eastern European countries which seek EU membership over the next years. Our results suggest that, so far, EMU enlargement towards central and eastern European countries would involve significantly higher costs than EMU enlargement towards countries of the other two groups.

JEL: F33

Keywords: European Monetary Integration, International Monetary Arrangements and Institutions

Michael Frenkel is professor of economics at WHU Koblenz, Otto Beisheim Graduate School of Management, Burgplatz 2, D-56179 Vallendar, email: mfrenkel@whu-koblenz.de

Table of Contents

I. **Introduction**

Since EMU has become reality in Europe, the academic discussion on monetary integration in Europe shifts to the question of how the system can work best in the future. One aspect in this context is the challenge that EU enlargement creates for EMU. In principle, each new EU member is a potential candidate for EMU and, while it is not a necessary condition for EU members, the European Commission has repeatedly stressed that the full benefits of the common market can only be enjoyed with a common currency. In addition, the new Exchange Rate Mechanism (ERM II) aims at linking potential member countries close to the euro, also with a view to prepare them for EMU membership. In December 1997, the heads of the European governments announced at their summit in Luxembourg that the EU will open talks on membership with Cyprus plus five aspiring countries from central and eastern Europe (the Czech Republic, Estonia, Hungary, Poland, and Slovenia). Their membership could begin as early as 2002. Five other countries (Bulgaria, Latvia, Lithuania, Romania, and Slovakia) were given hopes that they could follow on a somewhat slower lane to membership. The summit did not include Turkey in the slower lane but confirmed Turkey's eligibility to join later.

With new EU members in the pipeline, the question arises how much these countries are already prepared for EMU membership. The objective of this paper is to shed some light on this question. One implication of monetary unification is that economies have to absorb shocks without using monetary policy or the exchange rate instrument. In addition, due to the stability pact, there are also limits on the extent to which fiscal policy can be used for macroeconomic stabilization. How serious these limitations are mainly depends on the type of occurring shocks, on the degree of similarity of the shocks in these countries with the shocks in the incumbent member countries and on the speed with which economies adjust to shocks.

We use a structural VAR model to analyze the response of different economies to shocks and to identify different types of shocks. We expand an approach initially applied by Bayoumi and Eichengreen (1993a) to study differences between 11 EU countries and eight regions of the United States. Bayoumi and Eichengreen (1993b) use this approach to compare

EFTA countries and EMS countries. Bayoumi and Taylor (1995) also adopt a VAR approach to compare EMS countries to several non-EMS OECD countries. Bergman, Hutchison and Cheung (1997) use a similar methodology to examine the four nordic countries in Europe and Funke (1997) presents results on a comparison of German regions and EU countries.[1] Our paper examines demand and supply shocks in EMU (Euroland) as established in 1999 and in 14 other countries which include current EU-Outs, EFTA countries and central and eastern European countries which may become EU members over the next few years.

The paper is structured as follows. Section II explains the theoretical basis of the analysis and the methodology. Section III presents some stylized facts. Section IV shows the results of the empirical investigation about the shocks in different countries and the response of these economies to supply and demand shocks. Section V contains the summary and conclusions.

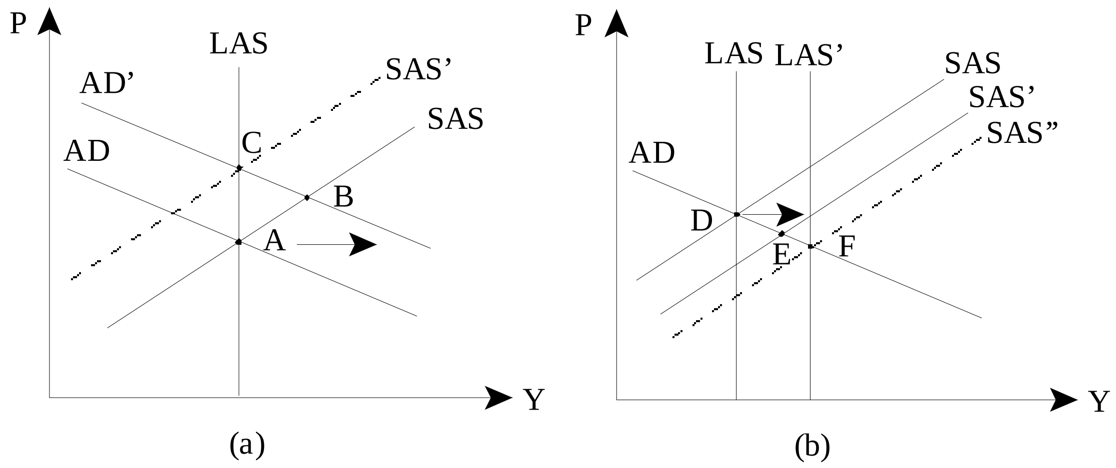
II. Theoretical considerations and estimation methodology

The incentive for individual countries to join EMU rests on the perceived benefits and costs of membership. The benefits are more obvious because they mainly reflect direct effects of monetary unification and take the form of a reduction in transaction costs and a stronger integration of markets for goods as well as for financial services. The costs of a monetary union are less transparent because they stem from more indirect effects. They result from possible disadvantages of giving up the exchange rate instrument and pursuing an independent monetary policy. This could present a significant limitation for policy makers if asymmetric shocks occur. In this case, economies have to absorb the shocks without the support of traditional government policies. Thus, it requires a higher degree of flexibility than without the limitations of a monetary union.

When EU enlargement becomes reality, it immediately leads to the question whether new members should also join EMU and whether, compared to the EU countries that are not

[1] Von Hagen and Neumann (1994) choose an alternative approach to examine shocks which may hit different economies. They examine real exchange rate shocks within Germany and between Germany and eight European countries as an indicator of the necessity to use the exchange rate instrument.

Figure 1: Short-run and Long-run Effects of Demand Shocks (a) and Supply Shocks (b)



yet EMU members, they are less well prepared for EMU membership. While the new European Exchange Rate Mechanism (ERM II) provides a framework for how the currencies of these economies could be linked to the euro before joining EMU, one could examine more fundamentally whether recent shocks in these economies are similar to the shocks which occurred in EMU countries. This is the issue of this paper. We look at a number of countries which may be candidates for EMU, although not all of them in the immediate future. They include industrial countries and transition economies. Following Bayoumi and Eichengreen (1993a, b), we distinguish demand and supply shocks and examine the correlation between the potential EMU candidates and EMU member countries.

The theoretical framework is the traditional aggregate demand and aggregate supply model (Figure 1). The aggregate demand curve (AD) is downward sloping since a decline in the price level increases the real stock of money, which, in turn, leads to lower interest rates and higher aggregate demand. The short-run aggregate supply curve (SAS) is upward-sloping reflecting the fact that higher prices increase producers' profitability and therefore lead to higher output. Clearly, this is the case as long as we can assume some price stickiness. In the long run, the aggregate supply curve (LAS) is vertical.

The aggregate-demand-aggregate-supply model predicts that a positive demand disturbance leads to higher prices and higher output in the short run as indicated by the movement from A to B in Figure 1(a). In the long run, wages respond to higher prices and the equilibrium moves from B to C. As a result, the demand shock increases prices but leaves output unchanged. The effects of an expansionary supply innovation are illustrated in Figure 1(b). When the shock occurs, SAS and LAS shift to the right to SAS' and LAS'. The short-run equilibrium moves from D to E. As wages gradually respond, the economy adjusts to its long-run equilibrium in F. This implies that supply shocks lead to positive output and negative price effects both in the short and in the long run.

This framework is applied to EMU countries and a number of potential new member countries.[2] The methodology used here to separate short-run and long-run effects and to identify supply and demand shocks was first suggested by Blanchard and Quah (1989) who investigate the effects of supply and demand shocks on output and employment.[3] As Bayoumi (1992) and Bayoumi and Eichengreen (1993a, b), we focus on price and output effects of demand and supply shocks. Starting from these theoretical considerations, changes in output in any period ()y_t) can be written as a function of contemporaneous changes in prices and lagged changes of output and inflation. Using a corresponding functional form for price changes ()p_t) and restricting the system to one lag, we get the simple bivariate system[4]

$$\Delta y_t = b_{10} + b_{11}\Delta p_t + b_{12}\Delta y_{t-1} + b_{13}\Delta p_{t-1} + \varepsilon_{dt}$$
$$\Delta p_t = b_{20} + b_{21}\Delta y_t + b_{22}\Delta y_{t-1} + b_{23}\Delta p_{t-1} + \varepsilon_{st}\ .$$

---

[2]Mélitz and Weber (1996) use an alternative framework in their study of the macroeconomic effects of monetary unification. Based on an open economy version of the IS-LM framework they apply a structural VAR model to examine the effects of identical monetary policy on output and inflation movements in Germany and in France.

[3]A modification of their study can be found in Gamber and Joutz (1993).

[4]The absolute term can be interpreted as a trend.

One restriction of this first-order VAR model is that we need to assume that both y_t and p_t are stationary. We come back to this issue later. The two error terms ε_{dt} and ε_{st} reflect demand and supply shocks and are assumed to be white-noise with variances Φ_d^2 and Φ_s^2. The two shocks are also assumed to be uncorrelated. Since)p_t affects)y_t and)y_t affects)p_t in the same period, both types of shock impact on output and prices in the same period. Hence, as required in any VAR model, an identical number of endogenous variables and shocks is used.

The two equations yield the reduced form

$$\begin{pmatrix} 1 & -b_{11} \\ -b_{21} & 1 \end{pmatrix}\begin{pmatrix} \Delta y_t \\ \Delta p_t \end{pmatrix} = \begin{pmatrix} b_{10} \\ b_{20} \end{pmatrix} + \begin{pmatrix} b_{12} & b_{13} \\ b_{22} & b_{23} \end{pmatrix}\begin{pmatrix} \Delta y_{t-1} \\ \Delta p_{t-1} \end{pmatrix} + \begin{pmatrix} \varepsilon_{dt} \\ \varepsilon_{st} \end{pmatrix}. \tag{1}$$

Simplifying this system by multiplying the system with the inverse of the coefficient matrix on the left hand side of system (1) yields

$$\begin{pmatrix} \Delta y_t \\ \Delta p_t \end{pmatrix} = \begin{pmatrix} a_{10} \\ a_{20} \end{pmatrix} + \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix}\begin{pmatrix} \Delta y_{t-1} \\ \Delta p_{t-1} \end{pmatrix} + \begin{pmatrix} e_{1t} \\ e_{2t} \end{pmatrix}, \tag{2}$$

where the elements a_{ij} as well as the new error terms e_{1t} and e_{2t} are derived from rearranging (1). For the latter, we assume expected values of zero, i.e., $E(e_{1t}) = E(e_{2t}) = 0$. Since the vector with the elements e_{1t} and e_{2t} is derived from the product of the vector $(\varepsilon_{dt}, \varepsilon_{st})$N and the inverse of the coefficient matrix on the left hand side of (1), both e_{1t} and e_{2t} are composites of the shocks ε_{dt} and ε_{st}.

Estimating system (2) yields values for the error term, which can be decomposed into demand and supply shocks. To see this, we first solve (2) by iterating to get the vector moving average representation

$$\begin{pmatrix} \Delta y_t \\ \Delta p_t \end{pmatrix} = \begin{pmatrix} \Delta \overline{y}_t \\ \Delta \overline{p}_t \end{pmatrix} + \sum_{i=0}^{\infty} \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix}^i \begin{pmatrix} e_{1t} \\ e_{2t} \end{pmatrix}. \tag{3}$$

In terms of the underlying supply and demand shock terms ε_{dt} and ε_{st} (3) can be written as

$$\begin{pmatrix} \Delta y_t \\ \Delta p_t \end{pmatrix} = \begin{pmatrix} \Delta \bar{y}_t \\ \Delta \bar{p}_t \end{pmatrix} + \sum_{i=0}^{\infty} \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix}^i \begin{pmatrix} c_{11} & c_{12} \\ c_{21} & c_{22} \end{pmatrix} \begin{pmatrix} \varepsilon_{dt} \\ \varepsilon_{st} \end{pmatrix}. \tag{4}$$

This suggests that the supply and demand shocks can be derived from the values of e_{1t} and e_{2t} if we know the elements c_{11}, c_{12}, c_{21}, and c_{22} which form the matrix C, since

$$C\varepsilon_t = e_t, \tag{5}$$

where ε_t and e_t are the vectors containing two error terms each. Since we ultimately want to isolate demand and supply shocks, we are interested in the time series of ε_{dt} and ε_{st}. As shown by equation (5), we need to know the elements of C to decompose the error terms into the underlying shocks. In order to calculate the elements of the matrix C, we need four restrictions. The first three are associated with the variance covariance matrix Σ of e_t, for which we can write

$$\Omega = E(e_t\, e_t') = E(C\varepsilon_t \cdot (C\varepsilon_t)') = C\, E(\varepsilon_t \varepsilon_t')\, C'. \tag{6}$$

Two of the three restrictions reflect the assumption of unit variances of ε_{dt} and ε_{st}. The third restriction is the assumption of orthogonality of supply and demand shocks, which implies that $cov(\varepsilon_{dt}, \varepsilon_{st}) = 0$. On this basis, equation (6) becomes

$$\Omega = CC'. \tag{7}$$

This yields the following three equations

$$c_{11}^2 + c_{12}^2 = \text{var}(e_{1t}) \tag{8}$$

$$c_{21}^2 + c_{22}^2 = \text{var}(e_{2t}) \tag{9}$$

$$c_{11}c_{21} + c_{12}c_{22} = \text{cov}(e_{1t}, e_{2t}) \tag{10}$$

A fourth restriction is based on the result from the aggregate supply and aggregate demand model. As illustrated in Figure 1(a), demand shocks induce only short-run output effects. In the long run, output is unaffected by demand disturbances. This means that

$$\sum_{i=0}^{\infty} \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix}^i \begin{pmatrix} c_{11} & c_{12} \\ c_{21} & c_{22} \end{pmatrix} = \begin{pmatrix} 0 & \dots \\ \dots & \dots \end{pmatrix}. \tag{11}$$

Since the matrix on the left hand side of (11) shows the long-run multipliers, the element in the first row and the first column is zero:

$$\sum_{i=0}^{\infty} \left(a_{11,i}c_{11} + a_{12,i}c_{21} \right) = 0. \tag{12}$$

As shown in appendix II, this can be solved to yield

$$c_{21} = -\frac{1 - a_{22}}{a_{12}} c_{11}. \tag{13}$$

Hence, equations (8), (9), (10), and (13) can be used to calculate the elements of the matrix C, which we need to decompose the error terms e_{1t} and e_{2t} into time series for demand and supply shocks, i.e. ε_{dt} and ε_{st}. Appendix II explains the derivation of the elements of matrix C.

III. Data and some stylized facts

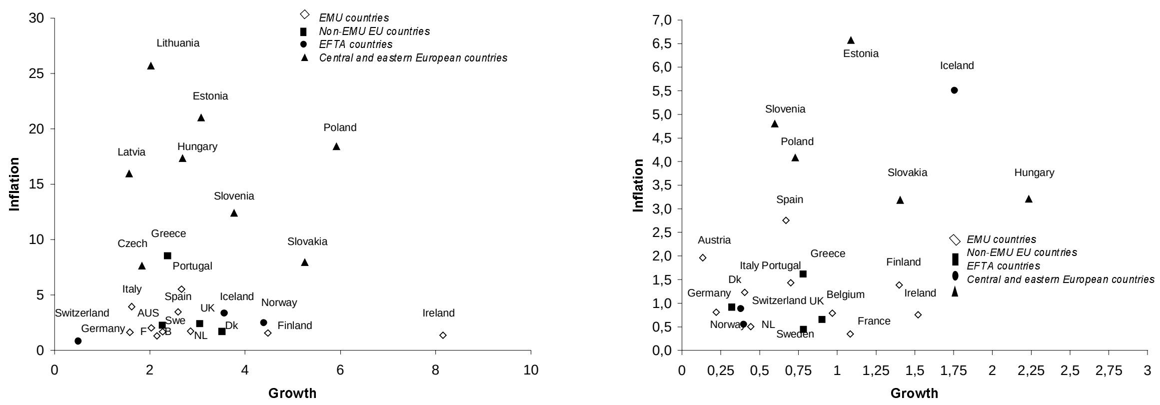
Comparing EU countries with central and eastern European countries involves several problems. First, given the transformation process which the central and eastern European countries have experienced, there were a number of structural changes, in particular in the early 1990s. This limits the existence of stable relationships between economic variables. Second, countries in central and eastern Europe have only started the transformation process around 1990. This restricts the time series that are sensible to use in our analysis. In order to exclude the initial dynamics, we only use data since 1992. Third, the data quality may not yet be comparable to the one that can be found in more mature economies in Europe. Against the background of these limitations, our analysis can only be interpreted as a first empirical investigation of these countries and the results need to be interpreted with caution.

We use quarterly output and price data for a total of 26 countries for the period 1992 Q1 to 1998 Q2. Output data employed in the estimates are real GDP data and price data are GDP deflator time series. Whenever available, data are from the International Financial Statistics (IFS) of the IMF. Otherwise, data were taken from the Wharton Econometric Forecast Associates (WEFA). We use four groups of countries. The first group represents current EMU members. The second group comprises all EU countries that are not yet EMU members. These countries are sometimes also referred to as the pre-ins. The third group includes EFTA countries and the fourth group consists of central and eastern European countries which are seeking EU membership. We exclude some countries from these groups because of the lack of data. For example, no appropriate quarterly real GDP and GDP deflator data are available for Luxembourg, Liechtenstein, and Romania.

We first look at some descriptive statistics in order to generate some stylized facts about the economies of the different country groups. As shown in Figure 2(a), average inflation has been significantly higher in central and eastern European countries exceeding, in most cases, ten percent annually. EMU countries, non-EMU EU countries, and EFTA countries show fairly low inflation with annual rates below five percent on average. Growth of these countries was mostly between two and four percent.

Figure 2(b) displays the standard deviation of growth and inflation. The diagram has a similar appearance as Figure 2(a). While EMU countries, non-EMU EU countries, and EFTA countries (with the exception of Iceland) exhibit relatively low standard deviations in both growth and inflation, central and eastern European countries show higher standard deviations for growth as well as for inflation. The diagram also suggests that differences between countries within this group are considerably higher than differences between countries within each of the other country groups.

Figure 2: Growth and Inflation



(a) Average Rates of Growth and Inflation (in %)

(b) Standard Deviation of Growth and Inflation

Table 1 reveals another interesting feature of the economies included in the study. It shows the correlation of growth rates between different country groups. While the growth performance of non-EMU EU countries is closely correlated to EMU countries, the correlation between EFTA countries and EMU countries is somewhat lower. Growth of EFTA and non-EMU EU countries is about as much linked as the growth performance of EFTA and EMU countries. A significantly smaller correlation coefficient can be found for central and eastern European countries. Their growth performance exhibits very low correlation to the growth rate of the other three groups.

Table 1: Correlation Coefficients of Growth Between Different Country Groups

	EMU countries	Non-EMU EU countries	EFTA countries	Central and eastern European countries
EMU countries	1.0000			
Non-EMU EU countries	0.8459	1.0000		
EFTA countries	0.7116	0.7184	1.0000	
Central and eastern European countries	0.2556	0.1131	0.2875	1.0000

Table 2 shows the correlation between inflation rates of the four country groups. Here again, the strongest link is between non-EMU EU countries and EMU countries. In contrast to the correlation of growth rates, inflation rates of EFTA countries are hardly correlated to EMU countries or to non-EMU EU countries. The correlation is even negative for the group of central and eastern European countries.

Table 2: Correlation Coefficients of Inflation Between Different Country Groups

	EMU countries	Non-EMU EU countries	EFTA countries	Central and eastern European countries
EMU countries	1.0000			
Non-EMU EU countries	0.4639	1.0000		
EFTA countries	0.0980	0.0731	1.0000	
Central and eastern European countries	-0.3395	-0.3584	-0.1143	1.0000

IV. Demand and supply shocks and impulse-response functions

In order to identify supply and demand shocks in the countries included in the study, we estimated bivariate VARs as outlined in section II. Using quarterly data we set the lag length to four. This is based on the Akaike information criterion which suggested for our estimation that the optimal lag length was three or four. We first examine output and price data for stationarity. As indicated in the previous section, we are somewhat limited by the relatively short length of the time series. The ADF test results indicate that the hypothesis of stationarity cannot be rejected for most of the countries on the 10 percent significance level. Nearly all other cases can be classified as border cases. We therefore include them in our VARs, although the results need to be interpreted with caution.[5]

We estimate the VARs for 26 countries. In only three cases (Iceland, Lithuania, and Portugal), the results of the VAR are not consistent with the long-run effects of supply and demand shocks as described by the familiar model of aggregate demand and aggregate supply. We therefore exclude these countries from the further analysis of the shocks. On this basis and taking into account the initial country selection related to data availability, we henceforth focus on nine EMU countries (Germany, France, Italy, Austria, Belgium, Finland, Ireland, Netherlands, and Spain), four non-EMU EU countries (Greece, U.K., Sweden, and Denmark), two EFTA countries (Norway and Switzerland) and eight central and eastern European countries (Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Poland, Slovenia, and Slovakia).

Figures 3 and 4 (Appendix I) show some examples of the impulse-response functions. They illustrate output and price responses to a unit demand shock (Figure 3) and to a unit supply shock (Figure 4) for the four country groups as a whole. The construction of the impulse-response functions for the aggregate of each country group takes into account the size of the different economies included in each group. Thus, a larger economy carries a higher weight in the group aggregate. The output response to demand disturbances is positive in all cases and declines to zero over time reflecting the imposed restriction that there are no permanent real effects of demand disturbances. By contrast, a supply disturbance exerts both temporary and permanent output changes. In line with the findings of Bayoumi and Eichengreen (1993a, b) the diagrams show that short run effects of demand shocks on output are more pronounced than the short-run effects of supply shocks.

[5]This is the case because the limited number of data points restrict a valid interpretation of the ADF values.

The diagrams in Figure 3 suggest that the magnitude of the output response to a demand disturbance is relatively similar between the four country groups, although EFTA countries show a somewhat smaller response. The empirical results point to more significant differences in the price response to demand shocks. In particular, the magnitude of the response is higher in central and eastern European countries. The diagrams also show that the speed of output adjustment is more similar between EMU countries and non-EMU EU countries. The adjustment is significantly slower in EFTA countries and in central and eastern European countries. This also applies to the price response.

The magnitude of the output response to supply disturbances as shown in Figure 4 indicates a clear similarity between EMU countries and non-EMU EU countries. The magnitude is somewhat smaller for EFTA countries and considerably stronger in central and eastern European countries. The speed of output adjustment is also slower in these two country groups compared with EMU countries and non-EMU EU countries.

Figure 5 (Appendix I) shows the impulse-response functions for output of individual countries within the country groups. Appendix III includes the corresponding impulse-response functions for prices. The diagrams do not include the impulse-response functions of all individual countries in order to preserve clarity. Within the different country groups, there are some interesting features of the impulse-response functions. Within the group of current EMU countries, the output response to demand shocks follows a very similar pattern in each of member country (Figure 5(a)). As examples, we show the impulse-response functions for four countries. France exhibits a stronger reaction to a unit demand shock than the rest of the EMU member countries. However, even here, the speed of adjustment is not very different from other EMU countries. Similar results can also be found for the output response to a supply shock in EMU countries. This is also the case for the other EMU countries which are not shown in Figure 5(a).

Interesting differences can be seen in the response of non-EMU EU countries (Figure 5(b)). While the U.K. and Denmark exhibit similar output responses to demand shocks as in EMU countries, Greece and Sweden appear as economies which adjust significantly more slowly to these shocks. This also holds for the output response to supply shocks. However, here the magnitude of the reaction is relatively strong in the U.K.

As already revealed by the impulse-response function for the group of EFTA countries in Figure 5(c), the separate diagrams for the two EFTA countries included in our study (Switzerland and Norway) indicate that the magnitude of the response to a demand shock is somewhat on the low side compared to the bulk of EMU countries, but the speed of adjustment is lower. With respect to the response to supply shocks, our empirical analysis suggests that it is considerably stronger in Norway than in Switzerland. The speed of adjustment is more similar to EMU countries in Norway and again significantly slower in Switzerland.

The four central and eastern European countries shown in Figure 5(d) all belong to the group of countries for which the EU envisages EU membership within the next four to five years. Our empirical findings appear to suggest that the magnitude of the response to demand shocks in these countries is not too different from EMU member countries, but the speed of adjustment is much lower. This is particularly the case in Poland and the Czech Republic. Regarding supply disturbances, the magnitude of the reaction is higher than in EMU countries, which may not be surprising given the structural changes that these economies experienced during the decade of the 1990s. Again, the speed of adjustment is fairly slow suggesting that, compared to EMU countries, these economies are likely to incur higher costs of joining EMU than non-EMU member countries in the other groups we examined.

The underlying demand and supply disturbances are shown for the group aggregates in Figure 6 (Appendix I). It is normally very difficult to interpret every change in the various shocks as derived from a structural VAR. However, positive demand disturbances can be seen for EMU countries in 1994 and 1995, i.e., after the 1993 recession. This is likely to reflect changes in demand following the recession of the early 1990s. The magnitude of the disturbances seems to be fairly similar in the different country groups. In addition, supply and demand shocks appear to be relatively equally distributed between negative and positive shocks. Only in central and eastern European countries, we find more pronounced negative than positive disturbances.

The demand and supply shocks for individual countries, which are shown in appendix IV, reiterate the impression given by Figure 6. In addition, they appear to show greater differences between individual countries within the group of central and eastern European countries than within the other country groups.

Table 3: Correlation Coefficients of Demand and Supply Shocks
Between Individual Countries and Major EMU Countries

Countries	Demand Shocks		Supply Shocks	
	Germany	France	Germany	France
EMU countries				
Germany	1.0000	0.4202	1.0000	0.1414
France	0.4202	1.0000	0.1414	1.0000
Italy	-0.4291	-0.0492	–0.4428	0.5597
Austria	0.2558	0.1637	0.3004	0.1330
Belgium	0.5275	0.7404	0.5349	0.2130
Finland	-0.0209	0.2927	0.4390	0.2818
Ireland	0.3480	0.2357	-0.3809	0.3348
Netherlands	-0.0639	-0.0246	0.7083	0.0854
Spain	0.4314	0.5187	0.7214	0.4858
Non-EMU EU countries				
Denmark	-0.1739	0.1257	-0.4613	0.2846
Greece	0.7376	0.5971	0.0064	0.3757
Sweden	0.5939	0.7063	0.1769	0.2617
United Kingdom	0.3891	0.2196	-0.4014	0.4298
EFTA countries				
Norway	-0.5043	-0.4256	-0.2352	0.3387
Switzerland	0.3809	0.1992	0.0644	0.2658
Central and eastern European countries				
Bulgaria	0.3899	0.3017	-0.5931	0.0210
Czech Republic	-0.0473	-0.3704	0.1517	-0.2603
Estonia	-0.1349	-0.2640	0.4708	-0.0209
Hungary	0.1764	0.4377	0.2673	0.0842
Latvia	0.0731	0.1125	-0.0178	0.1832
Poland	0.4657	0.4618	-0.3702	-0.1220
Slovenia	0.6014	0.6360	-0.3627	0.0162
Slovakia	-0.2998	0.1423	-0.3397	0.3135

We now turn to a more formal investigation of the different shocks. A serious problem for any country joining EMU could stem from asymmetric shocks. We therefore first examine the correlation of demand and supply shocks between the different countries. As a benchmark, we use the two largest economies in EMU, i.e., Germany and France. Tab. 3 shows the correlation coefficients between the shocks in Germany and France and in individual non-EMU EU countries, EFTA countries and central and eastern European countries. The findings show a mixed picture. Although the correlation differs significantly from country to country even within the same country group, the overall picture suggests that, on average, the correlation is the smallest between Germany or France and central and eastern European countries. This implies that the probability of asymmetric shocks is higher for these countries than for the other countries.

Not only asymmetric shocks can cause costs of monetary integration. If member countries of EMU are hit by symmetric shocks, i.e., the same shocks, costs of monetary unification can result from significant differences of the response to these shocks. This would have to be taken into account in a cost benefit analysis of EMU membership. In terms of our analysis, this means that one should compare impulse-response functions of potential EMU member countries to different shocks with the responses of incumbent members. Tab. 4 presents correlation coefficients of output and price responses to demand and supply shocks for the country groups as a whole. As a benchmark, we use the impulse-response functions of the two largest economies in EMU, that is, Germany and France. The coefficients indicate that the correlation between the non-EMU EU countries and the EFTA countries on the one hand and Germany and France on the other hand is relatively high. With the exception of three cases, the coefficients are higher than 0.5. Half of the correlation coefficients indicate that the correlation of price and output response to demand or to supply shocks exceeds 0.7. This suggests a high similarity of the responses of the economies to the same type of shock.[6]

The correlation coefficients show a very different picture for central and eastern European countries. For these countries, the correlation coefficients of the impulse-response functions to demand and to supply shocks and the same functions for Germany and for France

[6]An alternative approach would be to calculate the adjustment concluded after a certain period, say, one year, as a ratio of the total adjustment. This is the procedure adopted by Bayoumi (1992) in his study of EU countries and several OECD countries.

are much lower. Only in the case of output responses to demand shocks, they look fairly high. However, this may be somewhat deceiving because due to the restriction that demand shocks do not exert long-run effects on output, all output response functions to demand shocks converge to zero and, therefore, one can expect that the correlation coefficients are high. With respect to the other responses for which no restrictions were applied, the correlation coefficients are even negative. This means that the response is very different. This implies that even symmetric shocks could constitute major adjustment problems for central and eastern European economies in case they were included in EMU because their different response may require the use of the exchange rate instrument. Put differently, monetary unification would imply relatively high costs for these economies.

We can interpret the results as indications of a significant difference between the central and eastern European countries and EMU member countries. The examined functional relations do not change rapidly. Hence, even if EU membership can be accomplished within the next four years, it may be advisable to prepare for a longer period until EMU membership is granted.

Table 4: Correlation Coefficients of Impulse-Response Function

Countries	Germany	France
Output response to demand shocks		
Non-EMU EU countries	0.8617	0.8091
EFTA	0.7508	0.6732
Central and eastern European countries	0.5359	0.5618
Price response to demand shocks		
Non-EMU EU countries	0.7278	0.7388
EFTA	0.5037	0.5027
Central and eastern European countries	-0.3811	-0.3965
Output response to supply shocks		
Non-EMU EU countries	0.4579	0.7271
EFTA	0.2837	0.8017
Central and eastern European countries	-0.4212	-0.3281
Price response to supply shocks		
Non-EMU EU countries	0.8223	0.6637
EFTA	0.6699	0.2542
Central and eastern European countries	-0.5363	-0.2341

These results have to be qualified for at least two reasons. First, as stressed earlier, the quality of the data and the length of the time series limit the explanatory power of the findings. Second, the structural relationships of the 1990s in central and eastern European countries are probably very much affected by the transition process of the economies. Therefore, inasmuch as the transition is completed, the behavioral functions may change, too. Thus, the results of our empirical investigation have to be interpreted with caution. Nevertheless, they can be taken as a first study on the demand and supply shocks as well as the response to different shocks in these emerging markets.

V. Summary and conclusions

This paper applies a structural vector autoregression to examine different types of shocks in EMU member countries, in non-EMU EU countries, in EFTA countries, and in central and eastern European countries. This is done with the aim of identifying possible asymmetries of shocks. In addition, the paper studies the response of countries of these four groups to demand and supply shocks. Although the findings are limited by the length of available data, the findings should be viewed as first results on including central and eastern European countries in the study of the similarity of demand and supply shocks across European countries. The findings indicate fairly small differences in the magnitude of shocks and the speed of adjustment between EMU countries and non-EMU EU countries. They also show a somewhat slower adjustment period to the same shocks in EFTA countries and a significantly slower adjustment in central and eastern European countries. Moreover, for the latter group of countries, the impulse-response function is very different from those of EMU countries. To the extent that the characteristics of the shocks and the impulse-response functions do not change rapidly, the conclusion of our analysis is that EU enlargement should not immediately lead to EMU enlargement. Otherwise there could be considerable costs of further monetary unification.

References

Bayoumi, T. (1992), “The Effect of the ERM on Participating Economies,” *IMF Staff Papers*, Vol. 39, pp. 330-356.

Bayoumi, T. and Eichengreen B. (1993a), “Shocking Aspects of Monetary European Monetary Unification” in Giavazzi, F., and Torres, F.(eds.), *Growth and Adjustment in the European Monetary Union*, Cambridge (Cambridge University Press), pp. 193-229.

Bayoumi, T. and Eichengreen B. (1993b), “Is There a Conflict between Enlargement and European Monetary Unification?” *Greek Economic Review*, Vol. 15, pp. 131-154.

Bayoumi, T., and Taylor, M. P. (1995), “Macro-economic shocks, the ERM, and Tri-Polarity”, *Review of Economics and Statistics*, Vol. 77, pp. 321-331.

Bergman, U. M., Hutchison, M. M., and Cheung, Y.-W. (1997), “Should the Nordic Countries Join a European Monetary Union? An Empirical Analysis,” Economic Policy Research Unit (EPRU), Working Paper 1997-21, Copenhagen.

Blanchard, O., and Quah, D. (1989), “The Dynamic Effects of Aggregate Demand and Supply Disturbances,” *American Economic Review*, Vol. 79, pp. 655-673.

Funke, M. (1997), “The Nature of Shocks in Europe and in Germany,” *Economica*, Vol. 64, pp. 461-469.

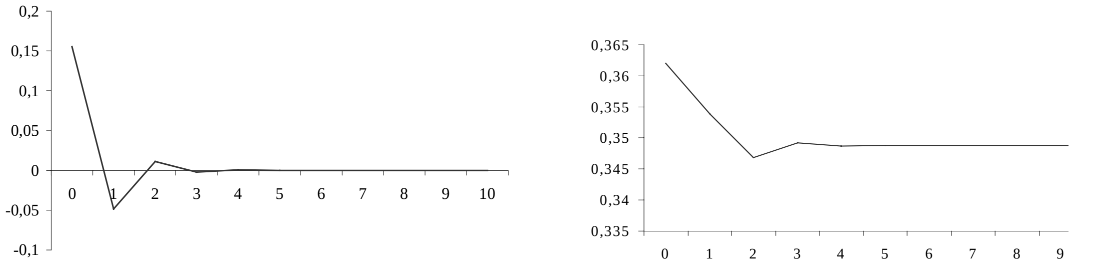
Gamber, E. M. , and Joutz, F. L. (1993), “An Application of Estimating Structural Vector Autoregression Models with Long-Run Restrictions,” *Journal of Macroeconomics*, Vol. 15, pp. 723-745.

Mélitz, J., and Weber, A. A. (1996), “The Costs/Benefits of a Common Monetary Policy in France and Germany and Possible Lessons for Monetary Union,” Centre for Economic Policy Research (CEPR), Discussion Paper No. 1374.

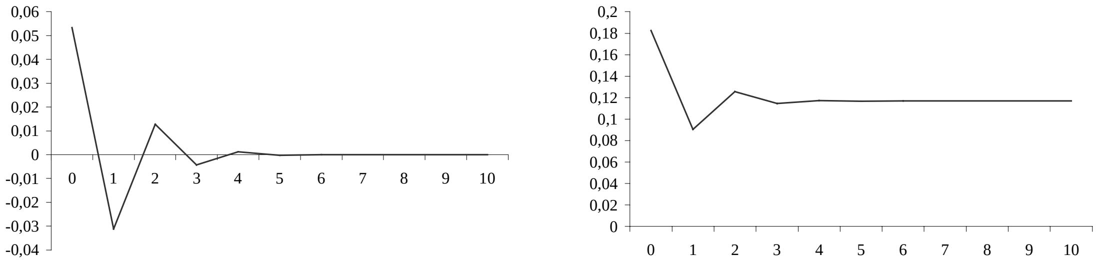
Von Hagen, J., and Neumann, M. J. M. (1994), “Real Exchange Rates Within and Between Areas: How Far Away is EMU?” *The Review of Economics and Statistics,* Vol. 76, pp. 236-244.

Appendix I **Figure 3: Response to Demand Shocks**

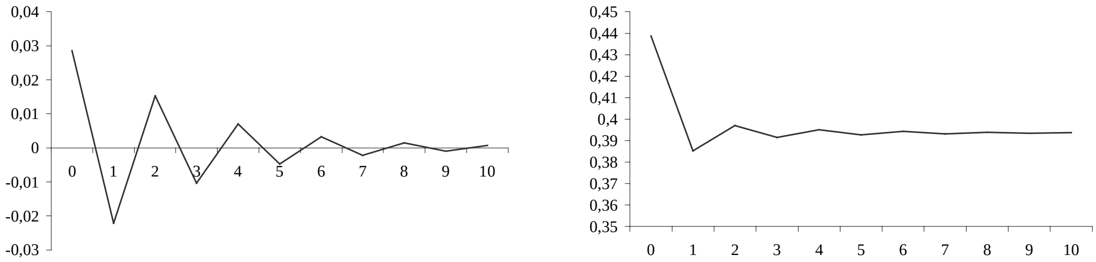
Output Response **Price Response**



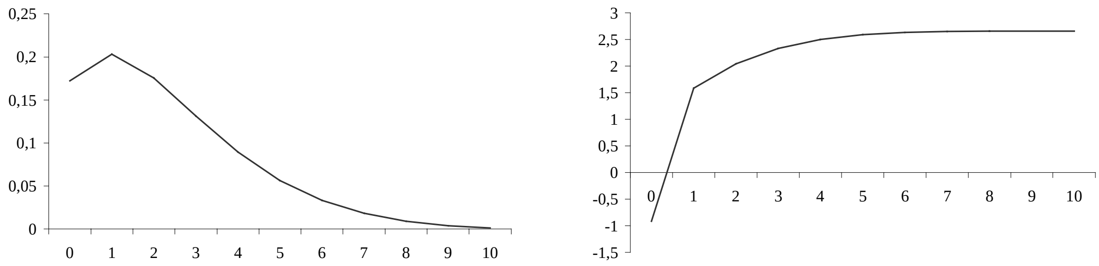
(a) EMU countries



(b) Non-EMU EU countries



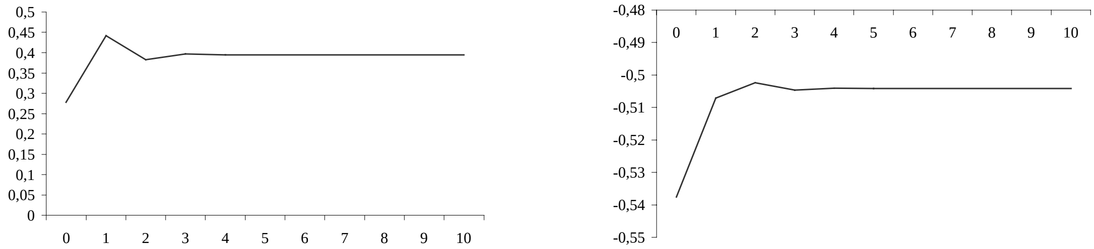
(c) EFTA countries



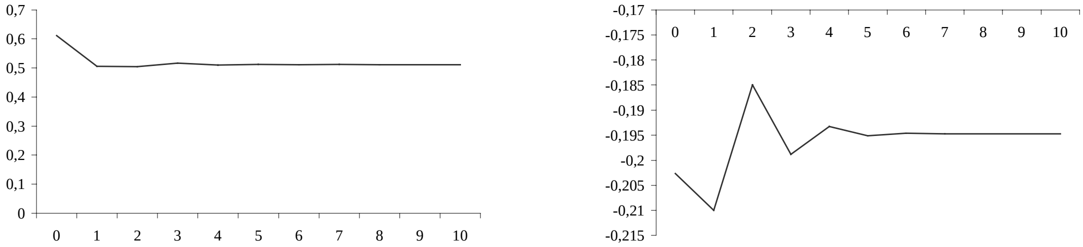
(d) Central and eastern European countries

Appendix I **Figure 4: Response to Supply Shocks**

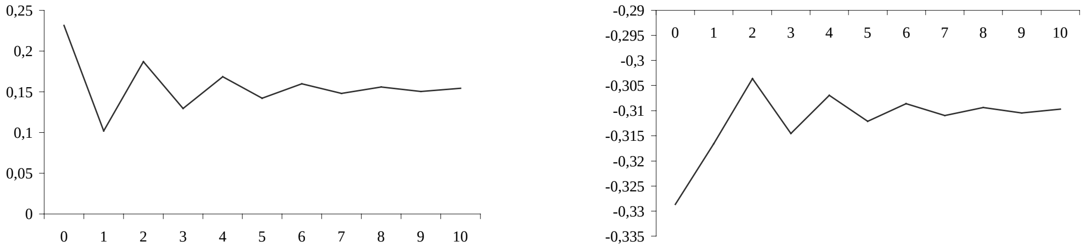
Output Response **Price Response**



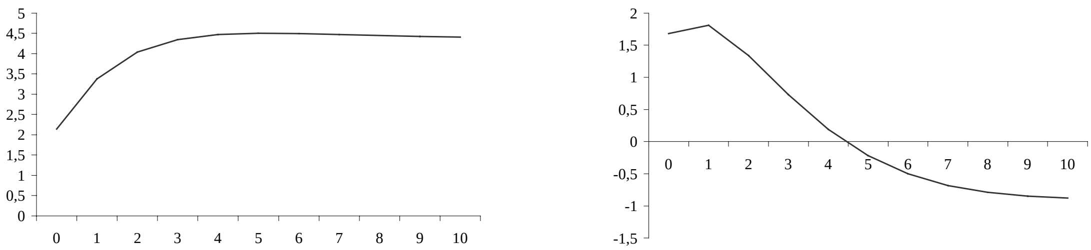
(a) EMU countries



(b) Non-EMU EU Countries



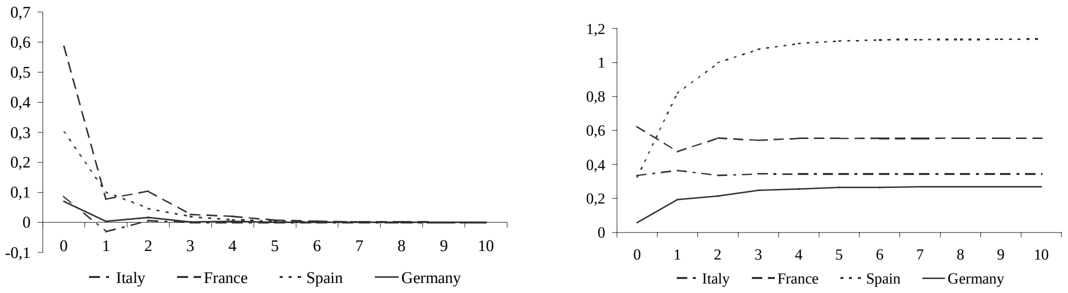
(c) EFTA countries



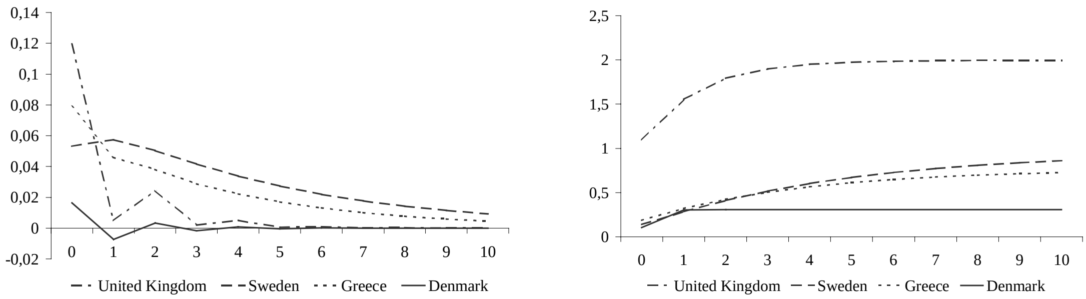
(d) Central and eastern European countries

Appendix I **Figure 5: Output Response in Individual Countries**

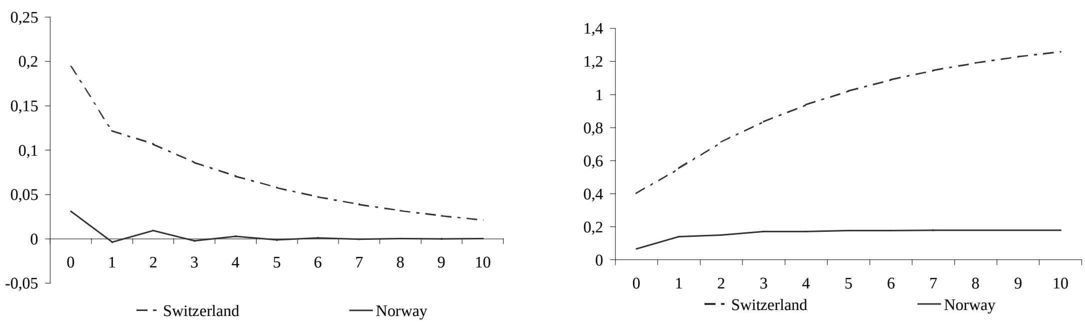
Demand Shock **Supply Shock**



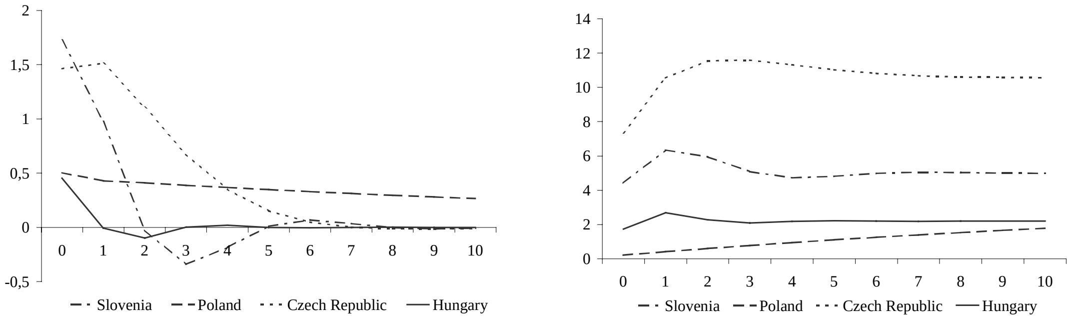
(a) EMU countries



(b) Non-EMU EU Countries

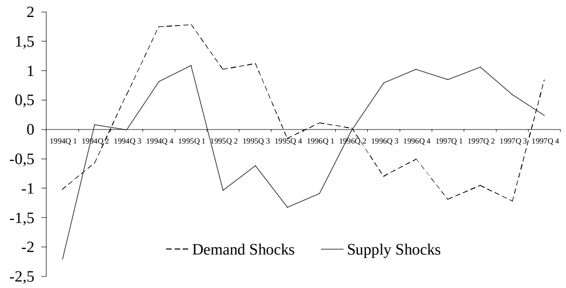


(c) EFTA countries

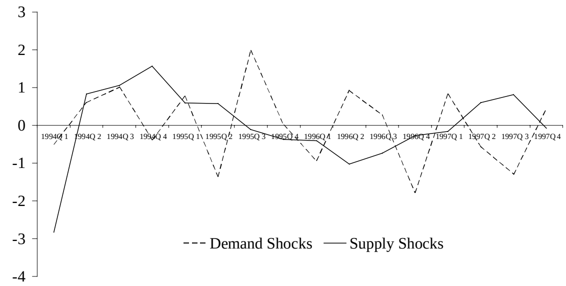


(d) Central and eastern European countries

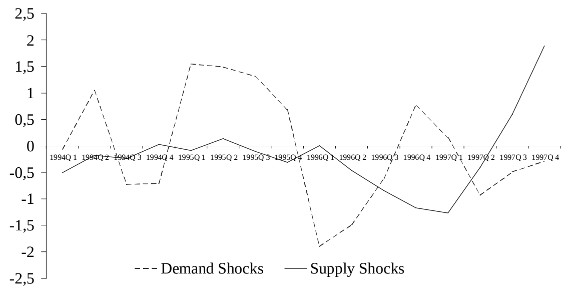
Appendix I Figure 6: Demand and Supply Shocks in Different Country Groups



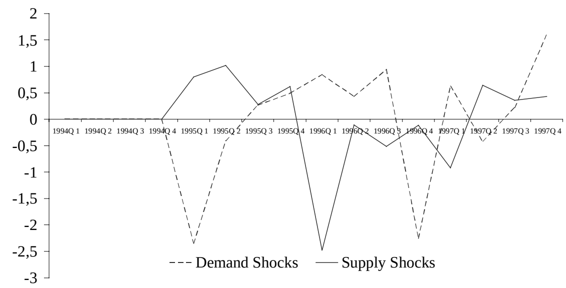
(a) EMU countries



(b) Non-EMU EU countries



(c) EFTA countries



(d) Central and eastern European countries

Appendix II: Derivation of the Elements of Matrix C

Here, we first show how equation (12) can be solved to yield equation (13). With A denoting the matrix of coefficients a_{ij} in system (11), we can write

$$\sum_{i=0}^{\infty} A^i = (I - A)^{-1} = \begin{pmatrix} 1-a_{11} & -a_{12} \\ -a_{21} & 1-a_{22} \end{pmatrix}^{-1} = \frac{1}{\det(I-A)} \begin{pmatrix} 1-a_{22} & a_{12} \\ a_{21} & 1-a_{11} \end{pmatrix}.$$

so that the restriction on the long-run output effect of demand shock implies

$$\frac{1-a_{22}}{\det(I-A)} c_{11} + \frac{a_{12}}{\det(I-A)} c_{21} = 0.$$

Simple rearranging of this equation gives

$$c_{21} = -\frac{1-a_{22}}{a_{12}} c_{11} .$$

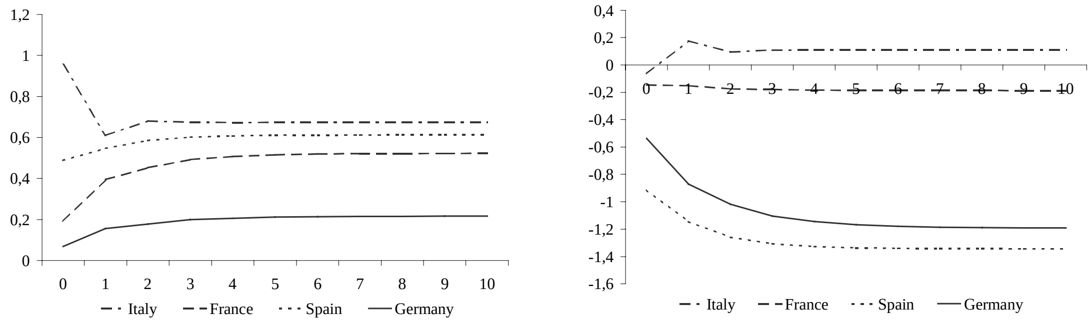
which is used for the decomposition of error terms into supply and demand shocks. Combining equations (8), (9), (10), and (13) gives the elements of matrix C as

$$C = \begin{pmatrix} \sqrt{\mathrm{var}(e_{1t}) - c_{12}^2} & \sqrt{\dfrac{(\mathrm{cov}(e_{1t}, e_{2t}) - z\,\mathrm{var}(e_{1t}))^2}{\mathrm{var}(e_{2t}) - 2z\,\mathrm{cov}(e_{t1}, e_{2t}) + z^2\,\mathrm{var}(e_{1t})}} \\ zc_{11} & \dfrac{\mathrm{cov}(e_{1t}, e_{2t}) - z\,\mathrm{var}(e_{1t}) + zc_{12}^2}{c_{12}} \end{pmatrix}$$

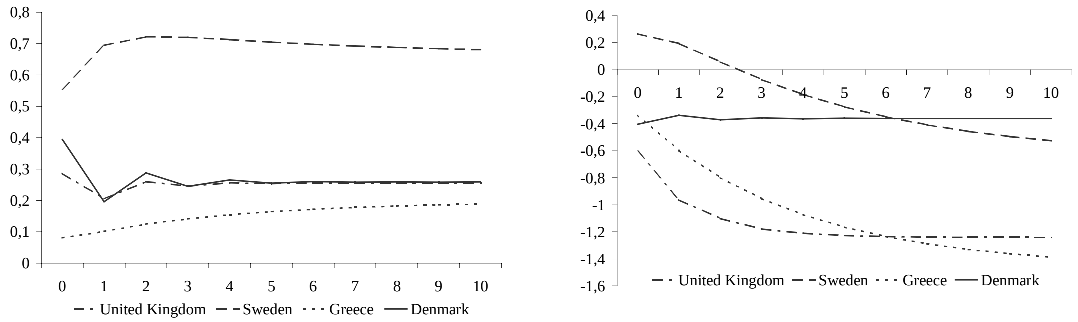
where $z = -\dfrac{1-a_{22}}{a_{12}}$.

Appendix III: Impulse-Response Functions of Individual Countries for Prices

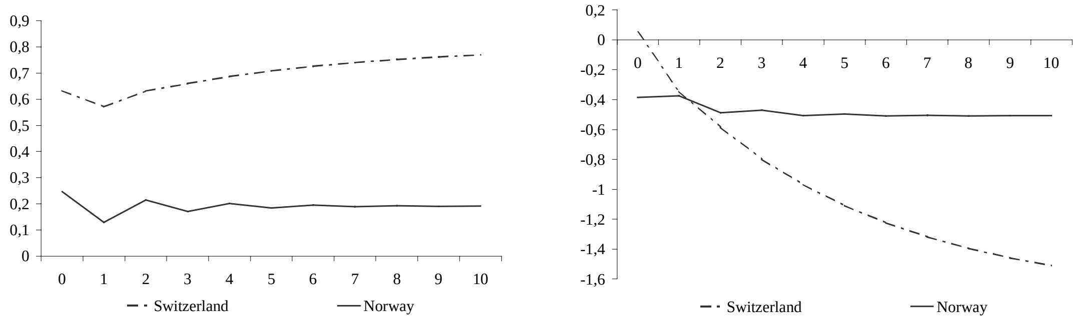
Demand Shock | Supply Shock



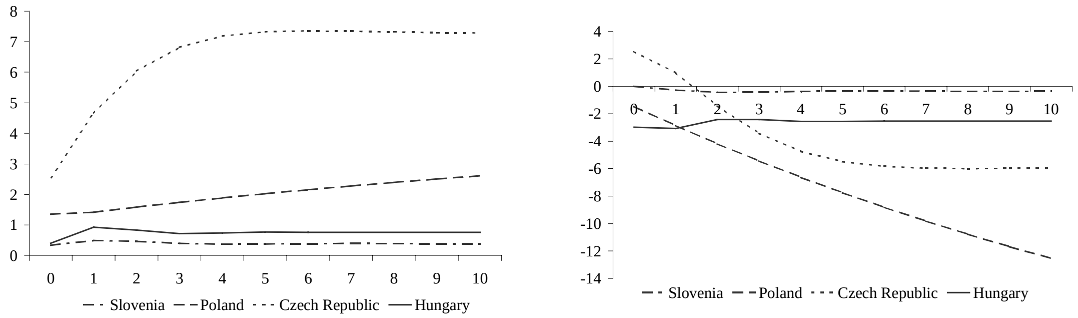
(a) EMU countries



(b) Non-EMU EU countries



(c) EFTA countries

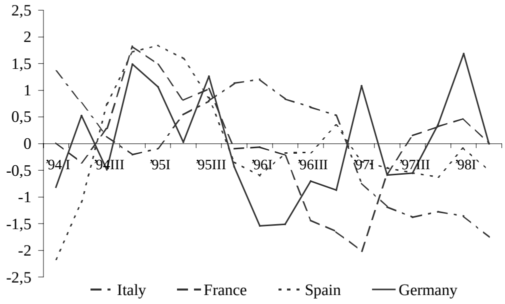


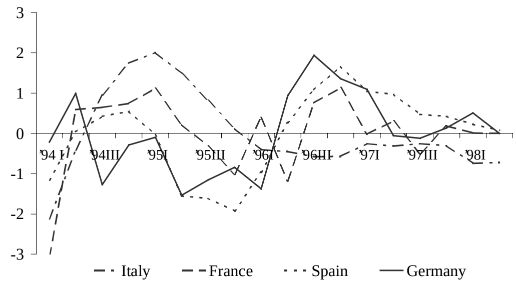
(d) Central and eastern European countries

Appendix IV: Identified Demand and Supply Shock in Individual Countries

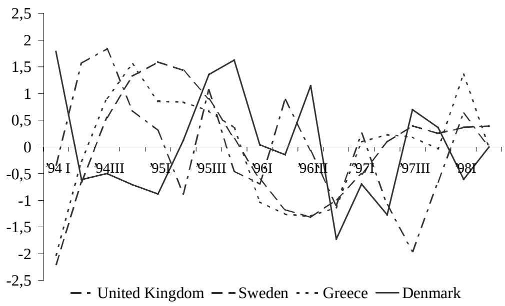
Demand Shock

Supply Shock

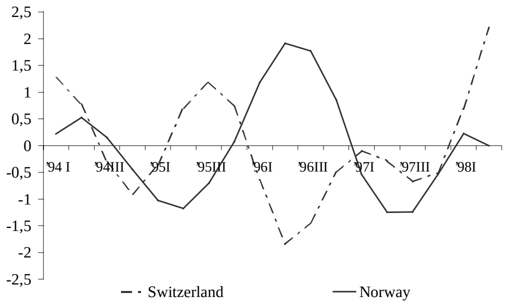


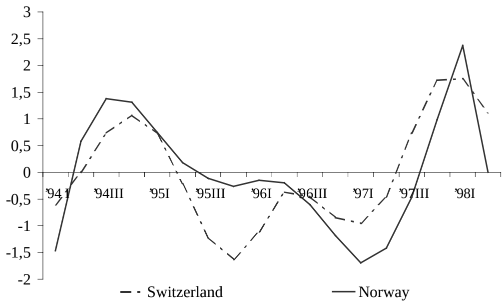


(a) EMU countries

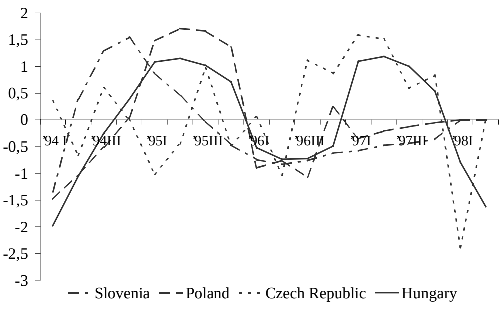


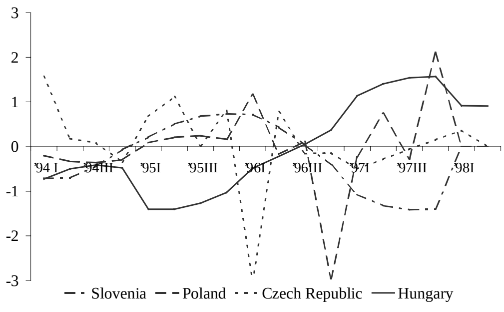
(b) Non-EMU EU countries





(c) EFTA countries





(d) Central and eastern European countries

Recent Publications:

Dong Heon Kim

“ Another Look at Yield Spreads: Monetary Policy and the Term Structure of Interest Rates“,

RN-98-3, October 1998

Jeffrey Sachs

“ Creditor Panics: Causes and Remedies“,

RN-98-4, November 1998

Namwon Hyung

“Linking Series Generated at Different Frequencies and its Applications“

RN-99-1, December 1998

Yunsook Lee

“The Federal Funds Market and the Overnight Eurodollar Market“

RN-99-2, January 1999

Andreas Gottschling and Christof Kreuter

"Approximation Properties of the Neuro-Fuzzy Minimum Function"

RN-99-3, March 1999