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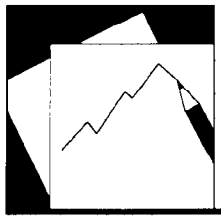

IMF Working Paper

How Symmetric Are the Shocks and the Shock Adjustment Dynamics Between the Euro Area and Central and Eastern European Countries?

Michael Frenkel and Christiane Nickel

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How Symmetric Are the Shocks and the Shock Adjustment Dynamics Between the Euro Area and Central and Eastern European Countries?

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Abstract

In this paper, we use a structural vector autoregression model to identify and compare demand and supply shocks between euro area countries and central and eastern European countries (CEECs). The shocks and the shock adjustment dynamics of these countries are also compared to EU countries that currently do not participate in the EMU. Focusing on the period 1993–2001, we find that there are still differences in the shocks and in the adjustment process to shocks between the euro area and the CEECs. However, several individual CEECs exhibit shocks and shock adjustment processes that are fairly similar to some euro area countries.

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I. Introduction

The expansion of the European Union (EU) involves a number of challenges for both the accession countries and the incumbent member countries. The accession countries have to adopt a number of measures in order to prepare their economies for the common market. The incumbent member countries have to deal with changes of the system necessary to incorporate additional members. One important aspect of the enlargement is associated with the implication it has for the European Monetary Union (EMU). In principle, each new EU member has to be committed to work towards meeting the conditions for EMU membership. The European Commission has repeatedly stressed that the full benefits of the common market can only be enjoyed with a common currency. To this end, the new Exchange Rate Mechanism (ERM II) aims at linking the currency of new EU members close to the euro so that these countries can join EMU as early as two years after they become EU members. Since the EU is currently negotiating membership with 12 countries, the widening of the EU and subsequently of the EMU can be expected to take place over the next few years.

Given that the number of EU countries—and potentially EMU countries—will soon increase, this paper examines the question of how well the economies of the accession countries are already prepared for EMU. One implication of monetary unification is that economies have to absorb shocks without using monetary policy or the exchange rate instrument. How serious these limitations are for the accession countries crucially depends on the type of shocks, the degree of asymmetry of shocks compared to the euro area, and the speed with which economies adjust to shocks. In the early 1990s, several authors investigated supply and demand shocks in the EU, when the decision was made establish a monetary union between EU countries within less than a decade. In a seminal paper, Bayoumi and Eichengreen (1993a) apply a structural VAR model in order to identify and compare demand and supply shocks in 11 EU countries. They compare the results to eight regions of the United States and also study the response of the economies to these shocks. Several other papers apply this methodology or a related approach to different compositions of country groups in Europe. For example, Bayoumi and Eichengreen (1993b) compare countries of the former European Monetary System (EMS) with other western European countries. Bayoumi and Taylor (1995) use a VAR approach to compare EMS countries with several member countries of the Organization for Economic Cooperation and Development outside the EMS. Bergman, Hutchison and Cheung (1997) use an analogous methodology to examine the four Nordic countries in Europe. Similarly, Funke (1997) presents results on a comparison of German regions and EU countries.[2]

[2] 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.

At the end of the 1990s, Masson (1999) pointed out that the VAR approach, until then, had been used for western European countries to study supply and demand shocks and the responses of economies to such shocks, but empirical research in this area had not investigated the situation in central and eastern European countries (CEECs). This can be explained primarily by three facts. First, it was still unclear whether a significant number of CEECs would be able to join the EU within a few years. Second, EMU had not yet been established in other EU countries so that little attention was given to the question of whether CEECs should join EMU at a relatively early point in time. Finally, the availability of sufficiently long time series on output and prices was limited for transition economies so that it was more problematic to apply the VAR approach. As a solution to the data problem, several earlier studies limit the analysis to the investigation of similarities of business cycles between CEECs and other European countries. For example, Boone and Maurel (1998) present correlation coefficients between the industrial production as well as unemployment of the CEECs and of the EU as well as Germany. They find relatively high degrees of correlation for several CEECs suggesting that monetary unification does not imply high costs for the accession countries. Boone and Maurel (1999) use a univariate time series model to study the integration of unemployment changes in Germany and the CEECs and conclude that the variations of more advanced CEECs are relatively similar to Germany. A similar result is presented by Fidrmuc (2001), who finds comovements in business cycles between some more advanced CEECs and Germany. One of the first papers on demand and supply shocks in CEECs and their correlation with Germany using a structural VAR analysis is the study of Frenkel et al. (1999). They look at several CEECs during the early years after the beginning of the transition process and point out that there are still significant differences between individual CEECs and Germany or France. Horvath (2000) compares the shocks of several CEECS with four EU countries, three of which are EMU members, and finds similar results.

This paper extends the work of Frenkel et al. (1999) and Horvath (2000) in three directions. First, in applying a structural VAR to the question about the similarity of demand and supply shocks and the response to these shocks between CEECs and EMU countries, it uses a longer times series and presents a more comprehensive comparison of the two country groups. Specifically, the characteristics of the shocks and the shock absorption in the CEECs are not only compared to individual EMU countries but also to the euro area as a whole. Second, it does not take into account the first two to three years of the transition process in the CEECs so that the results are not affected by the main structural changes during this first phase of the transition process. Third, the paper also tries to shed some light on whether the symmetry of shocks has increased over time. This seems to be a particularly relevant question because one may expect that advancing in the transition process will also lead to more similarity in the shocks and business cycles of the economies of the CEECs and the EMU countries. If there were a trend towards decreasing dissimilarities that could be expected to continue during the next years, this would support an as early as possible entry into EMU for CEECs.[3]

[3] Note that EMU entry implies distinctively higher macroeconomic costs than participation in ERM II. While participation in ERM II allows for realignments and a flexible exchange rate

The paper is structured as follows. Section II shows some stylized facts on output and price developments in the CEECs and in EMU countries. Section III identifies demand and supply shocks in the various European countries and shows the degree of correlation of these shocks between CEECs and EMU countries. Section IV examines the response of the different countries to an idiosyncratic shock and studies the correlation of the impulse response functions between these countries. Section V presents some conclusions of the study.

II. Data and Some Stylized Facts

Comparing economic developments in EU countries with those in central and eastern Europe involves at least three major problems. First, the transformation process in the CEECs led to a number of structural changes in their economies, particularly in the early 1990s. This limits the existence of stable relationships between economic variables. Second, as the CEECs started the transformation process only around 1990, the time series that are sensible to use in a study of demand and supply shocks is limited. In order to exclude the period of the most abrupt structural changes from the data applied in an empirical study, it seems to be useful to exclude the initial three years or so. Third, the data quality may not yet be comparable to that in more mature economies in Europe.

Our empirical analysis takes the data problems of the CEECs into account, although not all of the problems can really be overcome. We exclude data for the CEECs before 1993. This implies that changes during the first two to three years of transition do not affect our results. It can also be expected that the data quality improved during these first years when both statistical institutions as well as data collection and compilation were considerably reformed. By applying data through 2001, we use time series that are not comparable in length to the ones applied by Bayoumi and Eichengreen (1993a) in their study of EU countries but they appear to be sufficiently long to identify several demand and supply shocks.

We use quarterly output and price data for a total of 21 countries for the period 1993: Q1 to 2001: Q4. We employ real GDP data for output and the GDP deflator for the price variable. The data are from the *International Financial Statistics* (IFS) of the International Monetary Fund and from Eurostat.[4] Regarding EU countries, we take into account both EMU member countries and the non-EMU EU countries, i.e., Denmark, Sweden, and the United Kingdom. As no appropriate quarterly GDP data are available for Romania, Luxembourg,

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within bands, EMU does not offer these two outlets. In the same vein, the current currency board arrangements in some CEECs with the euro as an anchor are not the same as EMU membership. While a currency board still allows an exit or a revaluation of the exchange rate, EMU membership implies irrevocably fixed exchange rates and an exit from the union is—if at all desirable—only possible with high costs for the union at large.

[4] For a detailed data description see Appendix I.

Lithuania, and Ireland, we exclude these countries from our sample. Given that Greece only joined EMU in 2001, our data series for the EMU countries as a whole refer to the euro area without Greece. We presume that choosing the alternative approach of including Greece from the beginning does not affect the qualitative results of our analysis.

We first examine some descriptive statistics on output growth and inflation of the EU countries and of CEECs. As shown in Figure 1, average inflation was significantly higher in some CEECs, especially in Estonia, Hungary, and Poland. Annual inflation rates often exceeded 10 percent during the period 1993–2001. By contrast, EMU countries and non-EMU EU countries showed fairly low inflation with annual rates below 5 percent on average. Regarding output performance, growth rates in the CEECs were on average higher than in the EU. Although not shown in Figure 1, a closer look at the data series also suggests that during the second half of the period, growth rates as well as inflation rates in the CEECs and in EU countries were more similar than in the first half of the period.

The plot of the standard deviation of growth and inflation in Figure 2 exhibits a similar picture as Figure 1. On average, the fluctuation of inflation and growth rates was higher in CEECs than in EU countries suggesting that there were considerable differences in the business cycles between CEECs and EU countries. By contrast, no such differences appear to exist between EMU and non-EMU EU countries.

Table 1 shows the correlation of growth and inflation rates between various European countries (both inside and outside the EU) on the one hand and the euro area as well as the three major economies of the euro area, i.e., Germany, France, and Italy, on the other. The first column reveals that the correlation of growth rates within the group of EMU countries is generally fairly large, although Portugal and Greece appear to be outliers. According to economic theory, high correlations suggest that asymmetric shocks between the countries are not pronounced, which, in turn, implies low costs of a monetary union. The higher the correlation is, the lower the costs most likely are and, thus, countries could indeed form an optimum currency area. Germany, France, and Italy have closely linked growth rates, as the correlation coefficients of between 0.53 and 0.86 indicate. The growth rates of the other EU countries—both as a group and individually—are closely correlated to EMU countries and also to Germany, France, and Italy. While the growth rates of Denmark and the United Kingdom seem to be more correlated to Germany, the growth rate of Sweden is more correlated to France and Italy. On average, the correlation coefficients for the non-EMU EU countries are lower compared to EMU countries. Table 1 also shows that the growth rates of the accession countries are on average not as much linked to EMU countries as a whole as the growth rates of non-EMU EU countries. However, the picture for the accession countries is very heterogeneous. This applies to the correlation coefficients of these countries vis-à-vis the EMU countries as a whole and vis-à-vis the major EMU economies individually. For example, the link of the growth rates of Hungary and Slovenia are correlated to the euro area and is comparable to the one of the United Kingdom and Denmark. Bulgaria's growth rate is also considerably linked to growth in France and in Italy and Poland's growth rate is also quite correlated to the EMU and to Germany.

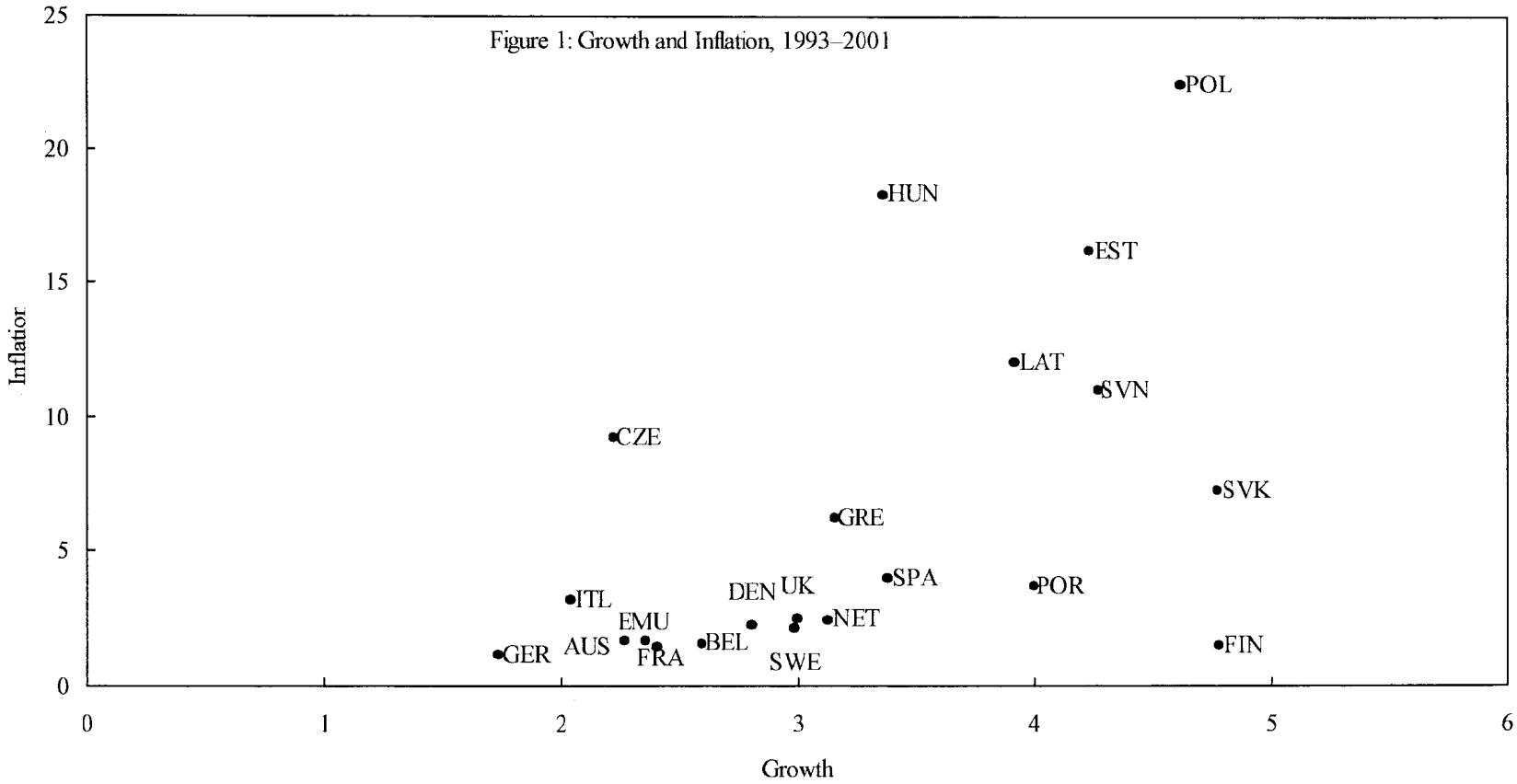
Figure 1: Growth and Inflation, 1993–2001
Inflation
Growth
25
20
15
10
5
0
0
1
2
3
4
5
6
POL
HUN
EST
LAT
SVN
CZE
SVK
GRE
SPA
POR
DEN
UK
ITL
EMU
NET
GER
AUS
FRA
BEL
SWE
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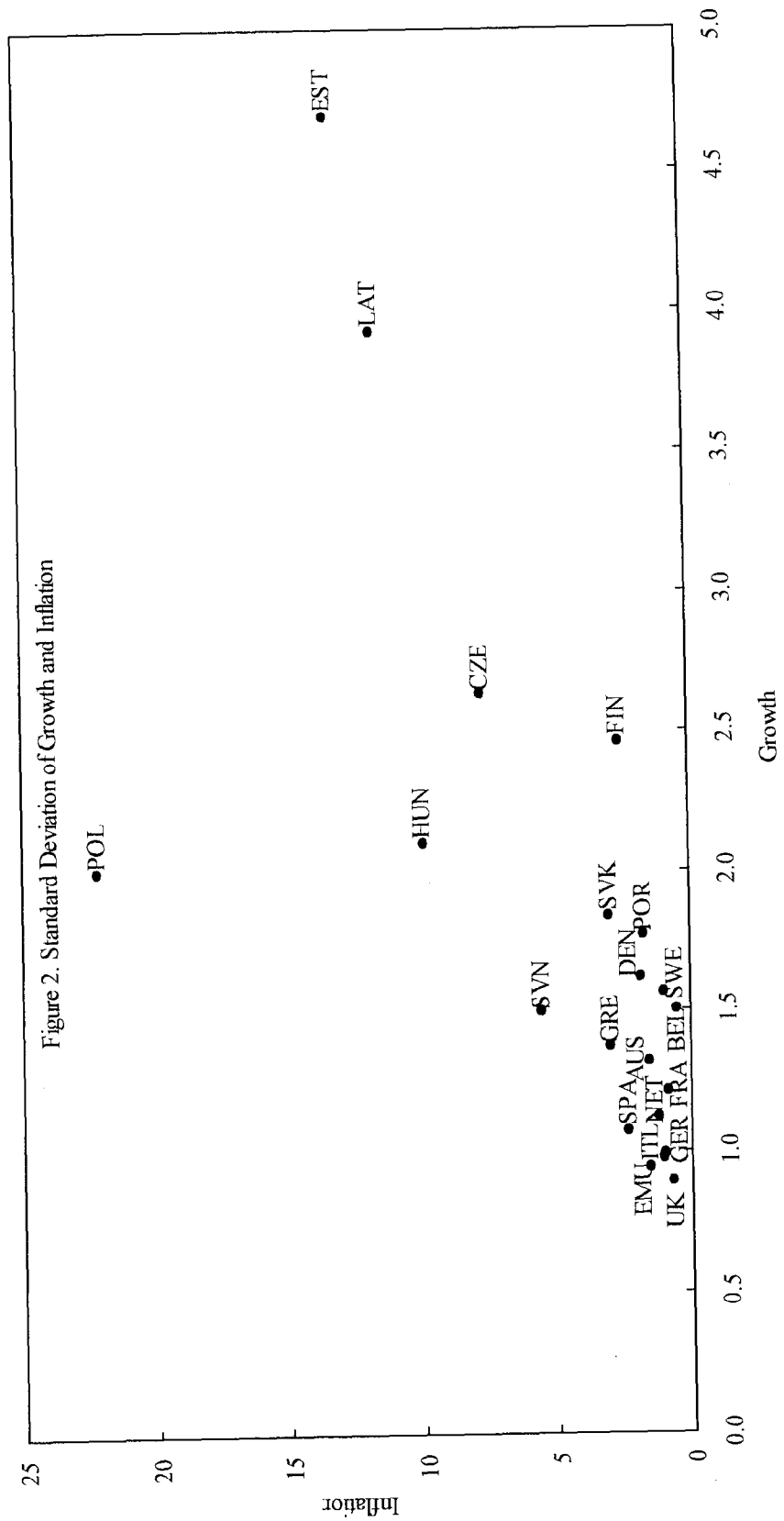
Figure 2. Standard Deviation of Growth and Inflation
Inflation
Growth
25
20
15
10
5
0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
EST
LAT
CZE
FIN
HUN
POL
SVK
POR
DEN
SVN
GRE
SWE
SPA
AUS
EMU
ITL
NET
UK
GER
FRA
BEL

The lower part of Table 1 shows the correlation coefficients between inflation rates of European countries. The structure follows the one used in the upper part of Table 1. While the correlation coefficients are generally lower for inflation than for growth, the picture emerging from the calculations shows several similarities. The optimum currency area theory suggests that countries with similar inflation developments are subject to similar shocks and, therefore, like in the case of relatively high correlation of growth rates, are more likely to form an optimum currency area. The main economies of the EMU show considerable inflation correlation vis-à-vis the euro area as a whole, which is not surprising, since they make up for the largest part of this zone. Among EMU countries, the correlation coefficients range from 0.28 to 0.65. Inflation of both France and Italy is closely related to German inflation, but inflation between France and Italy is much less linked. Since the three countries exhibit weaker connections regarding inflation, the picture for the smaller countries with respect to the euro area can be significantly different from the picture vis-à-vis the larger economies. For example, inflation in Belgium is much more closely linked to Germany than to the other major economies or to the euro area as a whole. Likewise, Finland's inflation rate shows a relatively high correlation vis-à-vis France, but a very weak correlation vis-à-vis the EMU countries as a whole. Among the EU countries, the Netherlands seems to be an outlier because most of the correlation coefficients have the wrong sign.

EU countries outside the EMU show, on average, a higher correlation of their inflation rates vis-à-vis the euro area than the accession countries. Within the latter group, again significant differences exist. A high inflation correlation exists between Estonia and Germany, which can be related to the currency board link to the deutsche mark during most of the period examined here. Bulgaria's inflation does not seem to be linked to the euro area or to any of the major three economies in the EMU. Three of the four coefficients have the wrong sign and the fourth one is very low. However, the other countries do not show dramatic differences in their correlation coefficients.

III. The Similarity of Demand and Supply Shocks in EMU Countries and the CEECs

The optimum currency area literature emphasizes that costs associated with giving up monetary sovereignty and the exchange rate instruments are lower, the higher the symmetry between the shocks occurring in the member countries and the more similar the response to occurring symmetric shocks between these countries. Bayoumi and Eichengreen (1993a, b) use these considerations in their empirical analysis of former EMS countries when comparing them with the different states of the United States or with other EU and European Free Trade Association countries. We follow their approach based on the standard model of aggregate supply and demand. This model emphasizes that aggregate demand and supply shocks exert different effects on the economy. More specifically, it predicts that an expansionary permanent demand shock leads to higher prices and higher output in the short run—it only leads to an increase in prices in the long run and leaves output unchanged. By contrast, a positive supply shock leads to positive output and negative price effects in both the short and the long run. These differences allow to later separate the two effects in the data.

Table 1. Correlation Coefficients of Growth Between Different Country Groups, 1993–2001

	EMU Countries	Germany	France	Italy
		Growth Rates		
EMU as a whole	1.000			
Germany	0.788	1.000	1.000	
France	0.864	0.591	0.535	
Italy	0.726	0.598	0.561	1.000
Austria	0.583	0.542	0.571	0.192
Belgium	0.791	0.852	0.553	0.609
Finland	0.596	0.394	0.584	0.204
Netherlands	0.667	0.464	0.205	0.251
Portugal	-0.063	-0.260	0.747	-0.160
Spain	0.722	0.366	0.253	0.302
Greece	0.012	-0.154		-0.107
Non-EMU EU Countries (weighted			0.243	
average)	0.445	0.510	0.181	0.438
Denmark	0.411	0.503	0.673	0.434
Sweden	0.687	0.510	0.186	0.562
United Kingdom	0.449	0.565		0.466
			0.073	
CEECs (weighted average)	0.287	0.267	0.404	0.240
Bulgaria	0.393	0.325	-0.270	0.488
Czech Republic	-0.095	0.130	0.127	0.285
Estonia	0.213	0.098	0.628	0.293
Hungary	0.488	0.173	0.272	0.253
Latvia	0.236	0.106	0.006	0.267
Poland	0.364	0.348	-0.379	0.195
Slovenia	-0.073	0.113	0.307	0.251
Slovakia	0.478	0.392		0.285
		Inflation Rates		
EMU as a whole	1.000	0.401	0.653	0.622
Germany	0.401	1.000	0.476	0.409
France	0.652	0.476	1.000	0.277
Italy	0.622	0.409	0.277	1.000
Austria	0.287	0.521	0.479	0.207
Belgium	0.201	0.396	0.184	-0.0289
Finland	-0.078	0.228	0.345	0.272
Netherlands	-0.056	0.011	-0.096	-0.377
Portugal	0.135	0.316	0.039	0.206
Spain	0.441	0.383	0.312	0.477
Greece	0.177	0.465	0.745	0.537
Non-EMU EU Countries (weighted				
average)	0.281	0.341	0.335	0.347
Denmark	0.108	0.466	0.192	0.292
Sweden	0.333	0.704	0.585	0.360
United Kingdom	0.302	0.264	0.281	0.336
CEECs (weighted average)	0.190	0.235	0.245	0.208
Bulgaria	-0.677	-0.143	0.114	-0.144
Czech Republic	0.157	0.284	0.177	0.282
Estonia	0.348	0.684	0.628	0.574
Hungary	0.359	0.326	0.275	0.363
Latvia	0.237	0.582	0.543	0.311
Poland	0.208	0.202	0.236	0.149
Slovenia	0.084	0.196	0.266	0.164
Slovakia	0.320	0.188	0.298	0.250

In order to apply this framework to the euro area as well as to a number of potential new member countries, we first have to identify the demand and supply shocks that occurred in individual countries. We focus on the period 1993–2001 in order to eliminate the years of more drastic changes during the transition process of the CEECs.[5] The methodology used for the identification of different shocks was first suggested by Blanchard and Quah (1989) who investigate the effects of supply and demand shocks on output and employment. The application of this approach to the question of shock symmetry was also used in the analyses of Bayoumi (1992) and Bayoumi and Eichengreen (1993a, b). Since these authors explain the technique in detail, we only highlight the basic idea and refer to the literature for more details. According to the standard aggregate supply and demand model, output in any period (Δy_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 (Δp_t) and restricting the system to one lag, we get the bivariate structural VAR system.[6]

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

The two error terms ε_{dt} and ε_{st} represent demand and supply shocks and are assumed to be white-noise and uncorrelated. The two equations yield the reduced form:

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

This system can be rearranged to:

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

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[5] 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 France.

[6] The absolute term can be interpreted as a trend. One restriction of this first-order VAR model is that this system of difference equations is stable.

where the elements a_{ij} as well as the new error terms e_{1t} and e_{2t} are derived from rearranging (1). We assume expected values of zero for the error terms, 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 $(\varepsilon_{dt}, \varepsilon_{st})'$ 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}. In order to identify demand and supply shocks, a two-step procedure is applied. First, the VAR system (2) is estimated so that values of the error term are generated. Second, using the error term can be decomposed into the demand and supply shocks, ε_{dt} and ε_{st}.[7]

We apply this methodology to the countries of the euro area, to other EU countries, and to the CEECs. We use quarterly data for real and nominal GDP from which we derive the GDP deflator as the appropriate price level for our analysis. In estimating the VAR system (2), we set the lag length to four.[8] This is based on the Akaike information criterion which suggested for our estimation that the optimal lag length was three or four. Since the VAR system (2) represents a 2x2 system of linear first-order difference equations, it is stable only if the absolute values of all eigenvalues of the system matrix are smaller than unity. Appendix I shows that eigenvalues for all countries included in our study suggest stability. On this basis, our study includes a total of 21 countries, 10 of which are current EMU countries, 3 are non-EMU countries of the EU, and 8 are CEECs.

Figure 3 depicts the identified demand and supply shocks for the euro area as a whole, for the group of EU countries outside the EMU, and for the CEECs. It is normally very difficult to interpret every single change in the various shocks as derived from a VAR. However, positive demand disturbances can be seen for EMU countries in the mid-1990s, which can probably be interpreted as expansionary demand changes following the recession of the early 1990s. The graphs also suggest that supply and demand shocks appear to be relatively equally distributed between negative and positive shocks. The demand and supply shocks for individual countries, which are not shown here, basically show the same picture. In addition, they appear to show greater differences between individual countries within the group of the CEECs than within the other country groups.[9] This finding seems to indicate that during the considered time period the convergence progress towards the EU countries did not follow the same pace in all CEEC. Though these differences have become smaller in recent years, they were acknowledged by the EU, which initially divided the accession countries into "first-wave" and "second-wave" countries.

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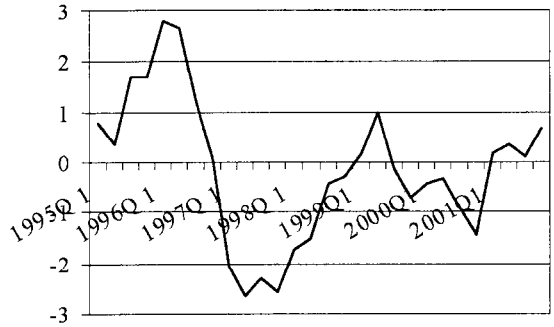
[7] This technique uses the predictions of the model of aggregated demand and supply and is explained in Blanchard and Quah (1989) as well as in Bayoumi and Eichengreen (1993a, b).

[8] Though data from 1993 to 2001 is used, the methodology implies that shocks and impulse response functions can only be analyzed from 1995 to 2001. The first four quarters are cut off by focusing on year-on-year changes. The second four quarters are cut off by setting the optimal lag length to four.

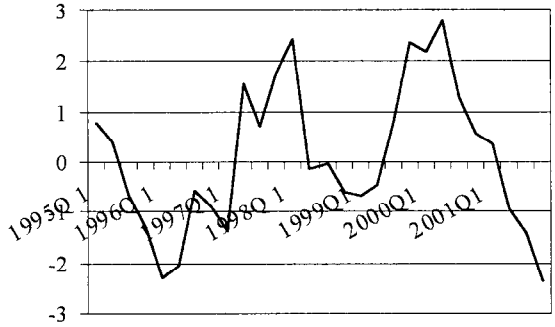
[9] The plots for the individual countries can be obtained from the authors upon request.

Figure 3. Identified Demand and Supply Shocks in Different European Country Groups

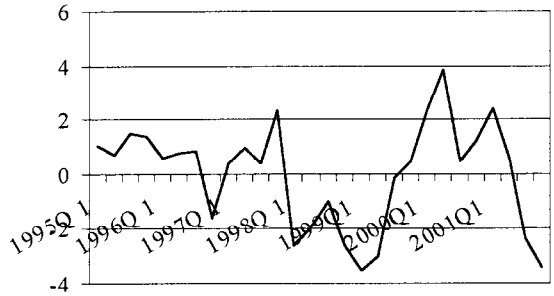
Demand Shocks in the EMU



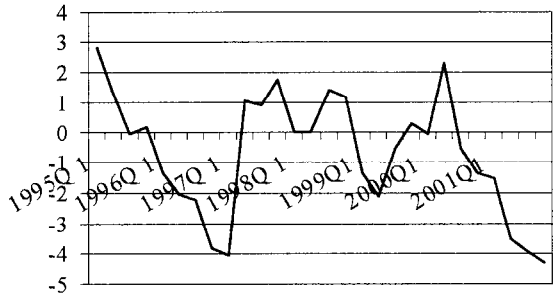
Supply Shocks in the EMU



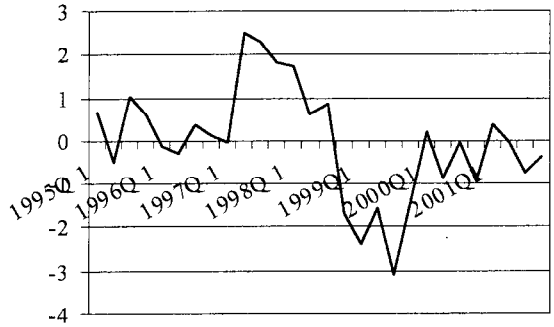
Demand Shocks in the Non-EMU EU countries



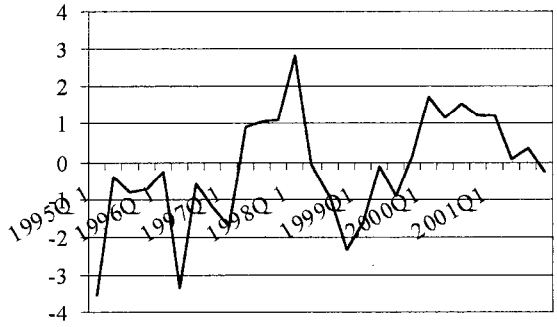
Supply Shocks in the Non-EMU EU countries



Demand Shocks in CEECs



Supply Shocks in CEECs



A formal analysis of the similarity of shocks between countries can be performed by comparing correlation coefficients for the same type of shock. Table 2 shows the correlation coefficients of demand shocks. As already shown in similar studies, the correlation coefficients normally vary considerably between countries. Nevertheless, an interesting picture emerges from the comparison of the values between different countries and country groups. The three largest economies in the euro area exhibit mostly correlation coefficients around 0.3. However, no such link can be derived from the data for the correlation between demand shocks in Italy and Germany. Other smaller countries in the EMU, with the exception of Portugal, show a considerable link of their demand shocks to at least one of the three large economies of the euro area. Nevertheless, several of them exhibit negative correlation coefficients vis-à-vis the euro area as a whole.

Table 2. Correlation Coefficients of Demand Shocks in European Countries, 1995–2001

	EMU Countries	Germany	France	Italy
EMU as a whole	1.000			
Germany	0.307	1.000		
France	0.353	0.335	1.000	
Italy	0.546	-0.059	0.034	1.000
Austria	-0.037	0.179	0.257	0.382
Belgium	0.941	0.013	-0.393	0.403
Finland	-0.099	0.606	0.418	0.321
Netherlands	-0.581	-0.122	0.225	-0.006
Portugal	0.114	0.133	-0.271	-0.121
Spain	0.031	0.124	0.438	0.483
Greece	-0.006	-0.042	0.302	0.012
Non-EMU EU Countries (weighted average)	-0.091	0.029	0.222	0.301
Denmark	0.386	-0.043	0.154	0.244
Sweden	0.334	0.262	0.452	0.647
United Kingdom	-0.215	0.009	0.189	0.281
CEECs (weighted average)	-0.277	0.041	-0.003	0.061
Bulgaria	-0.224	0.250	0.274	-0.045
Czech Republic	-0.241	0.343	0.309	0.232
Estonia	-0.241	0.343	0.309	0.232
Hungary	0.122	-0.197	-0.087	0.546
Latvia	-0.428	0.260	0.472	-0.020
Poland	0.217	-0.200	-0.431	-0.312
Slovakia	-0.433	-0.097	0.327	0.275
Slovenia	-0.147	0.049	0.105	-0.183

Demand shocks of non-EMU EU countries as identified by the VAR approach are comparable to the countries of the euro area. Most correlation coefficients of individual EU countries outside the EMU show that demand shocks in these countries are linked to the major economies in the EMU, only the correlation coefficient between Denmark and Germany has the wrong sign. Regarding the link to the euro area as a whole, the United Kingdom and the group of EU countries outside the EMU show a negative correlation coefficient.

Regarding the correlation between identified demand shocks in CEECs and the euro area, the link still seems to be weaker than within the EU. This can be derived primarily from the overall number of negative correlation coefficients calculated for these countries. However, a closer look reveals that several countries do not present a totally different picture compared to non-EMU EU countries and even some EMU countries. For example, there seems to be a considerable link between the demand shocks in Poland and the euro area and between the Czech Republic, Estonia, Hungary, Slovakia, and Latvia vis-à-vis at least one of the bigger economies of the euro area.

Table 3 shows the correlation coefficients of supply shocks between the different European countries. Overall, the calculations based on the estimates of the VAR suggest that supply shocks are somewhat more linked across Europe than demand shocks. Supply shocks between Germany, France, and Italy exhibit positive and fairly high correlation coefficients. With the exception of Greece and Portugal, virtually all other countries of the euro area have supply shocks that seem to be connected to the other countries of the currency area.

The EU countries outside EMU show consistent positive correlation coefficients for their supply shocks compared to both the euro area as a whole and to the three major economies. The picture is somewhat different for the CEECs. The group as a whole does not show a positive correlation of supply shocks compared to the euro area as a whole. However, the coefficients suggest relatively close links between nearly all CEECs included in the study and at least one of the bigger economies. With the exception of Poland, the more advanced CEECs, notably the Czech Republic, Slovenia, and Hungary appear slightly more linked to the euro area than the other CEECs.

It is often argued that in studies for the accession countries significant structural changes occurred during the 1990s so that the situation versus the end of the decade may have been different compared to the beginning of the decade. To see whether our data support this argument, we split the period into two equal halves. However, a comparison of the correlation coefficients for demand as well as supply shocks does not reveal any significant differences. We therefore do not report the results here.[10]

[10] The results can be obtained from the authors upon request.

Table 3: Correlation Coefficients of Supply Shocks in European Countries, 1995–2001

	EMU Countries	Germany	France	Italy
EMU as a whole	1.000			6
Germany	0.622	1.000		
France	0.737	0.425	1.000	
Italy	0.756	0.437	0.372	1.000
Austria	0.178	0.186	0.509	-0.149
Belgium	0.996	0.597	0.719	0.746
Finland	0.536	0.115	0.432	0.215
Netherlands	-0.069	-0.134	0.361	-0.244
Portugal	-0.179	-0.277	-0.290	0.060
Spain	0.415	-0.022	0.523	0.058
Greece	-0.104	-0.225	0.090	-0.203
Non-EMU EU Countries (weighted average)	0.699	0.442	0.608	0.628
Denmark	0.468	0.361	0.297	0.469
Sweden	0.595	0.377	0.724	0.392
United Kingdom	0.682	0.459	0.402	0.774
CEECs (weighted average)	-0.159	0.144	0.081	0.144
Bulgaria	0.280	0.462	0.296	0.196
Czech Republic	0.339	0.036	0.033	0.426
Estonia	0.339	0.036	0.033	0.426
Hungary	0.726	0.263	0.556	0.549
Latvia	0.333	0.022	-0.027	0.443
Poland	-0.690	-0.494	-0.404	-0.566
Slovakia	0.182	0.384	-0.052	0.357
Slovenia	0.658	0.434	0.506	0.488

IV. The Similarity of Shock Adjustment Dynamics Between EMU Countries and the CEECs

The identification of shocks reveals important information about the symmetry or asymmetry of shocks because the optimum currency area theory highlights asymmetry as an important cost factor of a currency union. The same line of literature also stresses that symmetric shocks also cause economic costs in a currency union if the response to the same type of shock is very different. For example, if two countries are hit by the same shock but output, wage, and price responses are different then different economic performance can induce disequilibria between member countries of a currency union. In this case, relative international competitiveness is affected between the countries and costs arise because countries cannot use the exchange rate to eliminate the disequilibria.

On the basis of these considerations, we examine the dynamics of the response between the euro area and potential EMU candidates, particularly the CEECs. Figures 4 and 5 show the impulse-response functions for a positive one unit demand and a positive one unit supply shock. They illustrate output and price responses for each shock for the three country groups, i.e. the euro area, the other countries of the EU, and the CEECs. The construction of the impulse response functions for the aggregate of each country group takes into account the relative size of the different economies in each group. 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. The responses shown in Figures 4 and 5 are in line with the effects suggested by the model of aggregate demand and supply. That is, demand shocks do not exert real effects in the long run, but lead to price effects as illustrated in the graphs on the right side of Figure 4. More specifically, a positive demand shock involves a positive price effect in the long run. Likewise, the diagrams in Figure 5 confirm the theoretical result according to which an expansionary supply shock induces positive long-run output effects and negative long-run price effects.

The diagrams in Figure 4 suggest that the magnitude of the output response to a demand disturbance is not very different between the three country groups. In order to not lose the clarity, the diagrams do not include the impulse-response functions of all individual countries. For the country groups as a whole, output effects of supply shocks shown in Figure 5 also seem to be relatively similar. At first sight, the speed of output adjustment is more similar between EMU countries and non-EMU EU countries. The adjustment is somewhat slower in the CEECs. This also applies to the price response to both types of shocks.

As the differences between the groups of countries do not appear to be extreme, we examine the similarity between the dynamic responses following a symmetric shock in more detail. Table 4 shows the correlation coefficients of the impulse response functions between the output response of different countries and country groups. The calculations confirm the impression conveyed by the diagrams, i.e., the greater similarity between the euro area and the group of non-EMU EU countries if compared with the CEECs. However, the correlation coefficients reveal that several CEECs have similar values as individual countries in the euro area. This cannot only be derived from the correlation coefficients between the CEECs and the euro area as a whole but also from the coefficients between these countries and the individual euro area countries.

Figure 4. Impulse Response Functions to a Demand Shock

Output response: left; Price response: right

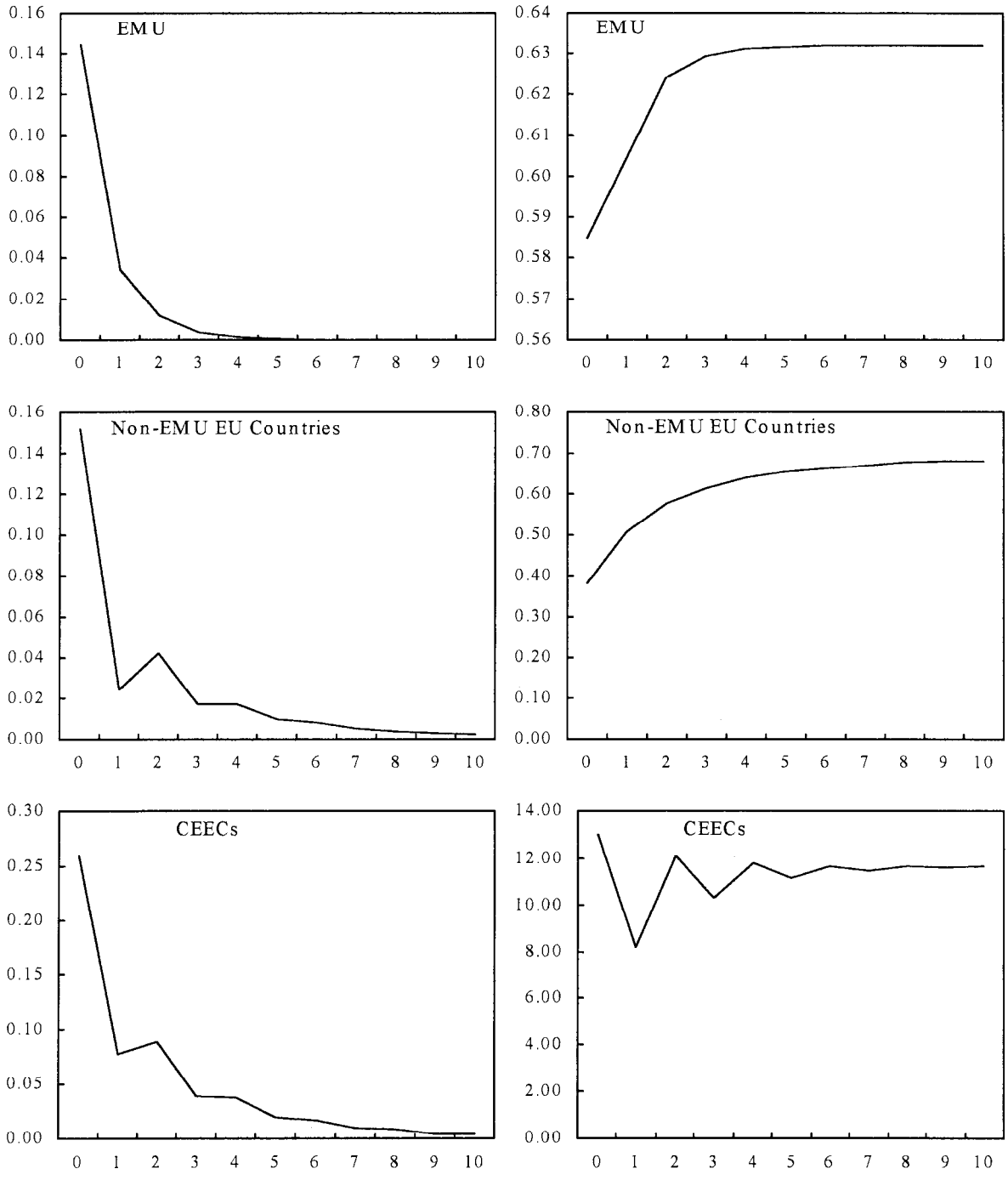


Figure 5. Impulse Response Functions to a Supply Shock
Output response: left; Price response: right

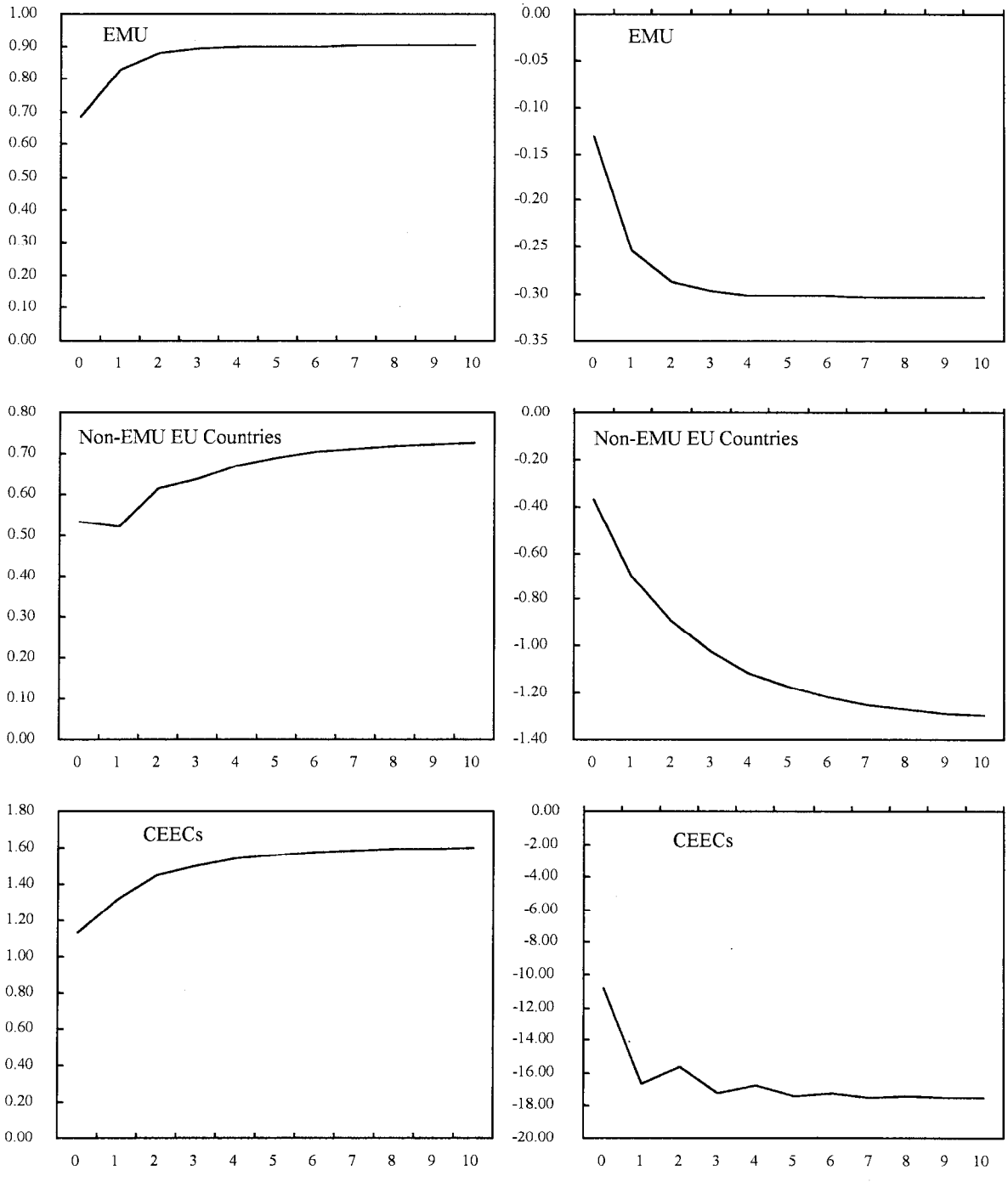


Table 4: Correlation Coefficients of Impulse Response Functions to Demand Shocks

	Impulse Response of Output				Impulse Response of Prices			
	EMU	Germany	France	Italy	EMU	Germany	France	Italy
EMU as a whole	1,000				1,000			
Germany	0,985	1,000			0,991	1,000		
France	0,971	0,995	1,000		0,413	0,319	1,000	
Italy	0,960	0,934	0,894	1,000	0,990	0,997	0,377	1,000
Austria	0,876	0,939	0,962	0,773	0,998	0,992	0,403	0,991
Belgium	0,932	0,969	0,989	0,818	0,943	0,962	0,098	0,938
Finland	0,756	0,844	0,889	0,605	-0,532	-0,615	0,546	-0,565
Netherlands	0,937	0,882	0,841	0,970	0,927	0,925	0,132	0,896
Portugal	0,981	0,960	0,929	0,996	0,992	0,998	0,372	1,000
Spain	0,997	0,988	0,982	0,935	0,826	0,764	0,844	0,800
Greece	0,918	0,917	0,876	0,977	0,913	0,928	0,472	0,951
Non-EMU EU Countries (weighted average)	0,979	0,978	0,968	0,933	0,973	0,983	0,462	0,971
Denmark	0,822	0,894	0,932	0,678	0,948	0,953	0,168	0,930
Sweden	0,996	0,981	0,960	0,979	0,993	0,999	0,309	0,993
United Kingdom	0,999	0,991	0,981	0,951	0,978	0,989	0,517	0,974
CEECs (weighted average)	0,887	0,882	0,845	0,933	0,538	0,526	0,473	0,552
Bulgaria	0,740	0,832	0,876	0,597	-0,433	-0,522	0,613	-0,474
Czech Republic	0,990	0,998	0,995	0,928	-0,591	-0,663	0,486	-0,610
Estonia	0,952	0,952	0,917	0,986	0,949	0,962	0,443	0,978
Hungary	0,908	0,883	0,832	0,989	0,976	0,986	0,408	0,995
Latvia	0,917	0,959	0,983	0,795	0,056	-0,052	0,924	0,004
Poland	0,860	0,842	0,785	0,963	0,936	0,951	0,450	0,969
Slovakia	0,813	0,797	0,735	0,936	0,921	0,939	0,447	0,959
Slovenia	0,913	0,964	0,983	0,810	-0,503	-0,588	0,572	-0,538

Table 5 shows the correlation coefficients of impulse response functions to supply shocks. The response functions again confirm the impression of the diagrams of Figure 5 according to which the speed of adjustment in CEECs is somewhat lower than in the other two country groups. The differences between output and price responses of the CEECs as a group on the one hand and the euro area on the other hand are more significant than the same difference between the non-EMU EU countries and the euro area. This could be interpreted as an indication of considerable structural differences between several of the CEECs and the EMU member countries for the concerned time period. These differences for the supply shocks compared to the responses to demand shocks seem to be more pronounced in the output responses than in price responses.

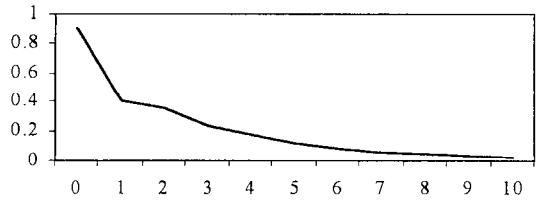
Table 5: Correlation Coefficients of Impulse Response Functions to Supply Shocks

	Impulse response of output				Impulse response of prices			
	EMU	Germany	France	Italy	EMU	Germany	France	Italy
EMU as a whole	1,000				1,000			
Germany	0,741	1,000			0,830	1,000		
France	0,986	-0,627	1,000		0,997	0,850	1,000	
Italy	0,977	-0,631	0,995	1,000	0,966	0,932	0,980	1,000
Austria	0,117	0,555	0,255	0,228	0,995	0,853	1,000	0,981
Belgium	-0,688	0,997	-0,568	-0,576	0,987	0,894	0,983	0,975
Finland	0,783	-0,995	0,679	0,685	-0,702	-0,233	-0,696	-0,566
Netherlands	0,968	-0,779	0,925	0,896	0,719	0,259	0,674	0,523
Portugal	0,977	-0,626	0,996	1,000	0,973	0,925	0,984	1,000
Spain	0,995	-0,797	0,965	0,953	1,000	0,825	0,995	0,962
Greece	0,858	-0,452	0,914	0,944	0,852	0,934	0,883	0,951
Non-EMU EU Countries (weighted average)	0,512	0,839	0,750	0,717	0,974	0,878	0,978	0,974
Denmark	0,669	0,988	0,552	0,566	0,923	0,561	0,913	0,817
Sweden	0,337	0,796	0,173	0,561	0,996	0,869	0,999	0,985
United Kingdom	0,492	0,935	0,843	0,739	0,986	0,910	0,990	0,992
CEECs (weighted average)	0,434	-0,549	0,441	0,507	0,659	0,641	0,762	0,746
Bulgaria	0,229	-0,536	0,637	0,303	0,844	0,435	0,837	0,728
Czech Republic	0,398	-0,720	0,492	0,387	0,870	0,740	0,878	0,894
Estonia	-0,441	0,904	-0,286	-0,271	0,895	0,845	0,921	0,676
Hungary	0,551	-0,583	0,281	0,495	0,831	0,849	0,751	0,793
Latvia	0,796	-0,777	0,768	0,654	0,894	0,766	0,987	0,935
Poland	0,394	-0,502	0,441	0,514	0,574	0,543	0,803	0,765
Slovakia	0,670	-0,478	0,621	0,751	0,849	0,833	0,780	0,649
Slovenia	0,599	-0,764	0,481	0,877	-0,078	0,540	-0,067	0,093

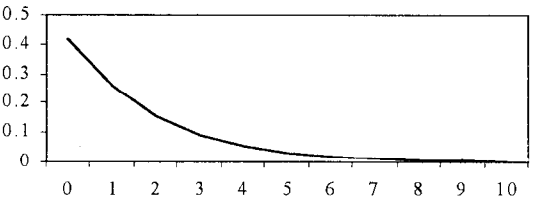
The overall picture that emerges from the analysis of the response dynamics is that the group of CEECs adjusts more slowly to the same shocks than EU countries. However, this does not apply to all CEECs. Especially the more advanced CEECs seem to be very similar to some euro area countries. For example, Hungary, Estonia, Latvia, Slovenia, and, at least with respect to the output response, the Czech Republic are not significantly different from, for example, Greece. As an example, Figure 6 shows the impulse response functions of Greece and Hungary. The diagrams show a nearly striking similarity pointing to the notion that the structural differences between a "fast reforming" transition country and a relatively poor EMU country are (slowly) disappearing. The evaporation of the differences between the EU and the CEECs could be explained by (i) the common perception that the real convergence of the CEECs also is reflected in progressively more similar pattern of shocks and impulse functions; (ii) the increasing diversification of the trade and production structures that also reduce the occurrence of asymmetric shocks; and (iii) the accession process requiring that the incumbent members adopt the common EU rules, standards and policies, which also promotes a similar response to similar shocks.

Figure 6. Impulse Response Functions of Greece and Hungary

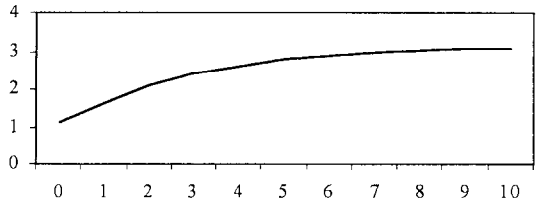
Greece: Demand Shock, Impulse Response of Output



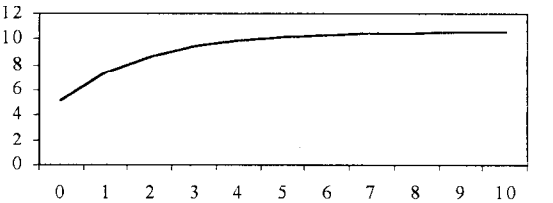
Hungary: Demand Shock, Impulse Response of Output



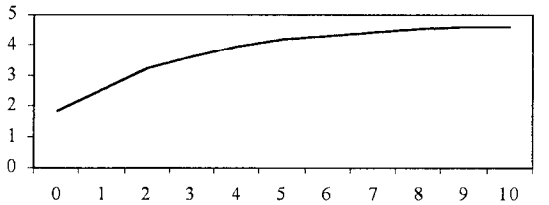
Greece: Demand Shock, Impulse Response of Prices



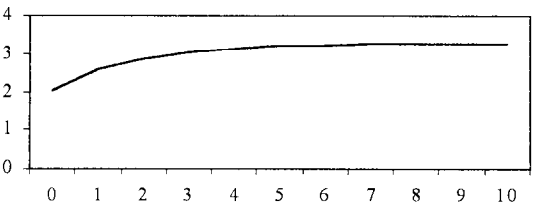
Hungary: Demand Shock, Impulse Response of Prices



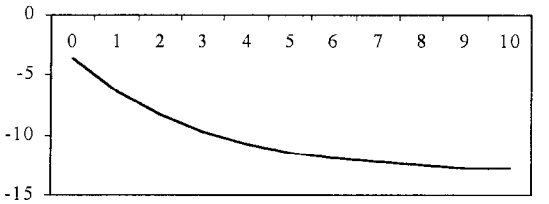
Greece: Supply Shock, Impulse Response of Output



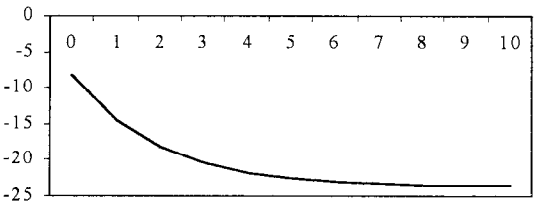
Hungary: Supply Shock, Impulse Response of Output



Greece: Supply Shock, Impulse Response of Prices



Hungary: Supply Shock, Impulse Response of Prices



Our empirical findings appear to suggest that the magnitude of the response to demand shocks in these countries is not very different from EMU member countries, but the speed of adjustment appears to be somewhat lower.

V. Summary and Conclusions

In this paper, we use a vector autoregression analysis to examine the symmetries and asymmetries of demand and supply shocks between the euro area and the CEECs. In addition, we compare the dynamic adjustment to the same shock in these countries. In order to eliminate the years of the biggest structural changes in the transition process of the CEECs, we study the period 1993–2001. Our results indicate that there are still differences in the shocks and in the adjustment process to shocks, when we compare the euro area as a whole and the CEECs as a group. This also holds when we compare the similarity of shocks and shock adjustment between the group of CEECs and Germany, France, and Italy as the biggest euro area economies with the similarity between individual euro area countries and the three large EMU countries.

When we compare individual CEECs with individual countries of the euro area, a different picture emerges. The more advanced CEECs are hardly different in the correlation of their shocks vis-à-vis the euro area and the bigger EMU countries than the smaller countries of the EU that have already adopted the euro as their currency. Moreover, there are reasons to believe that the similarity between the CEECs and other countries of the euro area will increase over the next few years, especially since their economies will become even more integrated with the euro area once they become EU members. Hence, our results suggest for the CEECs that loosing the exchange rate instrument in several years may not be associated with the level of high costs some earlier studies pointed out. This finding would certainly support an entry into EMU for more advanced CEECs at the earliest possible date.

Data Description and Test for Stability

Our calculations use quarterly data from 1993:1 to 2001:4. The data were either obtained from the *International Financial Statistics*, from Eurostat (New Cronos database), or from the IMF's World Economic Outlook (WEO) database. Appendix Table 1 below indicates which specific series we applied. For IFS data, we also show which series we used. For example IFS "99b" is the data series 99b from the IFS. We used data from Eurostat or the WEO database whenever they were not available from the IFS and whenever the time series provided by Eurostat or the WEO was longer than in the IFS. We calculated the GDP deflator as (nominal GDP / real GDP) · 100.

For some accession countries, quarterly GDP data were not available for the full length of the time series. The time series for Estonia only start in 1993, and for Bulgaria, Hungary, and Poland they start in 1994. In case of the latter, we used available annual data and extrapolated the missing data points for the year 1993 backwards by using the same weights for each quarter as in the year 1994.

Appendix Table 1: Data Sources

	GDP	real GDP
Bulgaria	IFS 99b (1993-2001)	Eurostat (1993-2001)
Czech Republic	IFS 99b (1993-2001)	Eurostat (1993-2001)
Estonia	IFS 99b (1993-2001)	IFS 99b.p (1993-2001)
Hungary	IFS 99b (1993-2001)	Eurostat (1993-2001)
Latvia	IFS 99b (1993-2001)	IFS 99b.p (1993-2001)
Poland	Eurostat (1993-2001)	Eurostat (1993-2001)
Slovakia	IFS 99b (1993-2001)	IFS 99b.p(1993-2001)
Slovenia	IFS 99b (1993-2001)	Eurostat (1993-2001)
Austria	IFS 99b (1993-2001)	Eurostat (1993-2001)
Belgium	IFS 99b (1993-2001)	IFS 99b.p (1993-2001)
Denmark	IFS 99b (1993-2001)	IFS 99b.p (1993-2001)
Finland	IFS 99b (1993-2001)	IFS 99b.p (1993-2001)
France	IFS 99b (1993-2001)	Eurostat (1993-2001)
Germany	IFS 99b (1993-2001)	IFS 99b.p (1993-2001)
Greece	Eurostat (1993-2001)	Eurostat (1993-2001)
Italy	IFS 99b (1993-2001)	IFS 99b.p (1993-2001)
Netherlands	IFS 99b (1993-2001)	IFS 99b.p (1993-2001)
Portugal	IFS 99b (1993-2001)	IFS 99b.p (1993-2001)
Spain	IFS 99b (1993-2001)	Eurostat (1993-2001)
Sweden	IFS 99b (1993-2001)	Eurostat (1993-2001)
United Kingdom	IFS 99b (1993-2001)	IFS 99b.p (1993-2001)

After calculating the VARs for all countries, we examine whether the eigenvalues of the system (shown in Appendix Table 2) lie within the unit circle in which case this indicates stability.

Appendix Table 2: Eigenvalues of the System Matrices

Countries	Eigenvalues	
Austria	-0.61083	0.407579
Belgium	-0.38339	0.249684
Bulgaria	-0.61139	0.115535
Czech Republic	-0.29308	0.395519
Denmark	-0.49066	0.114725
Estonia	-0.28662	0.661674
Finland	-0.51568	0.017517
France	-0.39563	0.406305
Germany	-0.37322	0.478145
Greece	-0.26295	0.713689
Hungary	0.026375	0.594947
Italy	-0.01849	0.513014
Latvia	-0.39073	0.215456
Netherlands	-0.28165	0.909038
Poland	-0.00571	0.684909
Portugal	-0.09622	0.495435
Slovakia	0.043595	0.715359
Slovenia	-0.52487	0.373357
Spain	-0.09716	0.256329
Sweden	-0.12992	0.425162
United Kingdom	-0.26931	0.45968

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