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Shocking Aspects of European Enlargement

ABSTRACT: The objective of this article is to assess whether the recent economic evolution of EU accession countries and their expected developments for the coming years put them in a better or a worse position to join the euro. Using structural vector autoregression models, the results show that shocks are more asymmetric in candidate countries than in current euro-zone members and that the situation has worsened in the most recent years. However, it seems that monetary policies in accession countries are closely influenced by monetary conditions in the euro zone. If this is the case, then the costs of losing monetary independence when joining the euro would be reduced. In any case, and considering that, on average, correlations are still far from the values of the euro-zone countries, the flexibility of real sector and labor markets will be essential for the sustainability of joining the euro.

Nowadays, it is clear that the goal of the accession countries after they are part of the European Union is to join the euro zone. In fact, soon they will have to consider their timetables for joining the monetary union, and they will likely be participating in the new exchange-rate mechanism (ERM II) as soon as possible.

Much of the academic debate around the European Monetary Union enlargement has focused on two general aspects (Lättemäe 2003):

- The first aspect is closely related to the analysis of capital flows and
currency crises in the accession countries (see, for example, Begg et al. 2003, Eichengreen, 2003, or Eichengreen et al. 2003).

The second aspect is related to the analysis of whether the benefits of joining the euro zone would outweigh the associated costs (see, for example, Andreff 2001). In this sense, while the accession countries are expected to gain in the long run from the benefits of joining the euro zone, the loss in terms of monetary policy independence may create problems in the near term. In fact, the costs of participating in the monetary union depend to a certain extent on the similarity between business cycles in the euro zone and those in acceding countries. Only a few studies have considered this issue. One reason may be related to the shortage and instability of economic data series in accession countries. As Fidrmuc (2001) states, some of these studies review periods of seven years or less, implying that only a single business cycle is covered by the available data, when in fact the available time period needed to establish such synchronization should be longer to provide reliable results.

In this article, we focus on only a partial analysis of the problems that accession countries are facing on their road to monetary union.¹ In particular, the objective of this article is to assess whether the recent economic evolution of these countries and their expected developments for the coming years put them in a better or a worse position to join the euro zone. In this sense, it expands in four directions on previous work. First, it uses longer time series. In fact, the availability of data for the period 2000–2002 provides useful information for testing whether the slowdown of the EU economy has changed the similarity of business cycles between countries in the euro zone and the accession countries. Second, it compares the most recent evolution of the accession countries with the situation of euro-zone countries in the years preceding currency unification and the situation of the three European Union countries that have not joined the monetary union: Denmark, Sweden, and the United Kingdom. Special attention is also paid to the evolution of country groups. Third, three different structural vector autoregression (VAR) models are applied in order to check the sensitivity of the results to the econometric methodology. And fourth, the article also tries to shed some light on whether the symmetry of shocks has increased over time.

Are the Accession Countries Ready for the Euro? The Optimum Currency Areas Approach

The starting point in considering the benefits and costs of joining the euro zone for accession countries is the theory of Optimum Currency Areas (OCA). The seminal contributions of Mundell (1961), followed by McKinnon (1963) and Kenen (1969), among others, provide the basis for the studies that fol-
lowed. These initial studies took place during the 1960s and mid-1970s in the intense debate about fixed versus flexible exchange rates. Their objective was to identify the criteria that determine whether a country should join a currency area or not. The strategy consisted in identifying the main benefits and costs that an individual country would experience in joining a currency area. If for every participant, benefits outweigh costs, then the currency area is said to be optimal. The intensification of the European monetary integration process has brought the main ideas of these contributions up to date in order to analyze the potential benefits and risks of the monetary union. In this sense, while there exists a certain consensus on the positive economic effects of monetary union—especially at the microeconomic level (de Grauwe 1997), which can be summarized as direct and indirect benefits of transaction costs reduction, less uncertainty and more transparency in price determination mechanisms—there is no agreement on potential costs.

Obviously, the main cost of joining a currency area is the loss of monetary policy instruments, for example, the exchange rate, at the national level, as stabilization mechanisms against macroeconomic disturbances that affect only one country in an area or affect countries in different manners. Because these kinds of macroeconomic disturbances, known as “asymmetric shocks,” cannot be dealt with by a common monetary policy, alternative adjustment mechanisms are needed to achieve macroeconomic stabilization.

Taking as a starting point the contributions of the 1960s, various modern studies have tried to identify empirically the main adjustment mechanisms alternative to the exchange rate in euro-zone countries. The analysis of other currency areas, mainly, the United States and Canada, has demonstrated the relevance of factor mobility, fiscal federalism, and wage and price flexibility. However, the peculiarities of the accession countries make it difficult to consider this approach. In fact, a difference between more recent studies and the traditional view is an interest in what will happen with asymmetric shocks once the currency area is established.

This is the most common approach in the various studies that have considered the accession situation. The idea is that cyclical synchronicity is a positive indicator for monetary union as it indicates that the single monetary policy will be broadly appropriate for all union members. The empirical evidence identified in these previous works can be summarized as follows. During the 1990s, economic cycles in most acceding countries have been highly correlated with the euro-zone cycle; Slovenia, Hungary, and Estonia were the best-positioned countries. Indeed, correlation of business cycles in several of the accession countries appears to be higher than for some of the smaller EU countries. Therefore, the picture seems to be quite positive. However, how has
the last economic downturn changed this situation? This issue is considered in the next section.

**Empirical Evidence**

*Cyclical Synchronicity Between the Accession Countries and Euro-Zone Countries*

Before presenting the results of our analysis of cyclical synchronicity, in comparing the economic developments of these countries with those in the euro zone, one has to take into account that the accession country economies are involved in a transformation process that leads to a significant number of structural changes in their economies. Moreover, data quality for some of the accession countries before these years cannot be comparable to that in EU15 countries. For this reason, the time period considered for the analysis here begins in 1993 or 1995, and the countries considered are: the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia.\(^3\) Regarding EU countries, we take into account both euro-zone and non–euro-zone countries,\(^4\) with the exceptions of Austria, Greece, Ireland, Luxembourg, and Portugal, which are not included in the analysis because of data restrictions. The calculations in this article use quarterly data obtained from Organization for Economic Cooperation and Development (OECD) *Main Economic Indicators*, International Monetary Fund (IMF) *International Financial Statistics*, and the European Central Bank data set and various national sources.

First, we examine some descriptive statistics on GDP growth and inflation in EU and accession countries. As shown in Figure 1, average inflation and growth during 1994.II–2002.IV was significantly higher in accession countries than in the euro zone; the only exception is the Czech Republic. The differences between accession countries and euro-zone countries—as an aggregate—are significantly higher than between EU countries and euro-zone aggregates between 1985.II and 1998.IV. The plot of the standard deviation of growth and inflation also provides a similar picture. The fluctuation of inflation and growth rates was higher in accession countries than in EU countries. These results provide evidence that there are considerable differences in the business cycles between accession countries and EU countries. Artis and Marcellino (2003) have obtained similar results using a different methodology.

In the literature on business cycle synchronicity, early contributions examined the correlations across countries of output movements and argued that countries whose GDP tended to move together experienced relatively symmetric disturbances (see, for example, Cohen and Wyplosz 1989).
Figure 1. Growth and Inflation in Euro-Zone, non–Euro-Zone, and Accession Countries

Average growth and inflation, euro-zone countries 1986–1998

Average growth and inflation, accession and non–euro-zone countries 1996–2002
Note: Axis scales are different in both sets of figures. The axis ranges in the bottom figures are higher than the ranges for the top ones.
Using quarterly data from 1996.I to 2002.IV, we follow a similar approach. We calculate the correlation coefficients among GDP and consumer price index (CPI) year-on-year growth rates for each country and the euro-zone aggregate. In order to establish a benchmark, we also calculate these correlation coefficients for non–euro-zone countries, Denmark, Sweden, and the United Kingdom, for the same period as well as for the European Union countries before adoption of the euro for the period 1986.I to 1998.IV. Both sets of results are shown in the first two columns of Table 1.

From these results, it seems clear that, on average, the accession countries’ business cycle is less synchronized with the euro-zone aggregate than both monetary union members before euro adoption and non–euro-zone countries. The only exception is Slovenia.

However, these values are averages for the whole period, and it is important to determine whether the pattern is changing. In order to analyze the evolution of business cycle synchronicity we have separated the considered time periods into different subperiods. The results for the different subperiods are shown in the last four columns of Table 1.

If we look at changes in the correlations between the first subperiod (1996.I–1999.IV) and the second subperiod (2000.I–2002.IV), there is a clear increase in the values of the Czech Republic, Estonia, and Slovenia, while the situation has worsened for Hungary, Lithuania, and Slovakia. However, on average, the results are still below the values of other EU countries.

Another way to analyze business cycle synchronicity is related to the analysis of cyclical deviations. Once the cyclical components are estimated using the Hodrick-Prescott filter, the correlation coefficients among these components for each country and the euro-zone aggregate are also calculated similarly to the previous analysis. The results are shown in Table 2.

Using this definition of business cycle synchronicity, we find that the results are quite similar, although they provide a more pessimistic picture of the situation of the accession countries. In fact, when looking at the analysis by subperiods, it is clear that the situation has considerably worsened during most recent years.

Summarizing, it seems that the economic slowdown of 2000 to 2002 has affected the synchronization of accession countries with the euro zone. However, these differences between countries and time periods can arise either from differences in shocks that they have experienced or from differences in their responses to such shocks. The above correlation analysis cannot discriminate between the two aspects. For example, in some countries, lower second period correlations can be due to strong discipline among the considered
countries in terms of monetary policy, that is, a self-imposed restriction on adjustment mechanisms, instead of an increase of asymmetric shocks. This issue is considered in the following sections.

Table 1

Correlation Coefficients with Euro Zone: Growth Rates

|                     | 1996.I–2002.IV | 1996.I–1999.IV | 2000.I–2002.IV |
|---------------------|----------------|----------------|----------------|
|                     | GDP  | CPI  | GDP  | CPI  | GDP  | CPI  |
| Czech Republic      | 0.11 | −0.15| −0.31| 0.32 | 0.48 | 0.41 |
| Estonia             | 0.18 | 0.18 | 0.22 | 0.86 | 0.65 | 0.71 |
| Hungary             | −0.07| −0.01| 0.51 | 0.91 | −0.36| 0.25 |
| Latvia              | 0.17 | 0.19 | 0.32 | 0.95 | 0.26 | 0.15 |
| Lithuania           | −0.27| 0.20 | −0.06| 0.92 | −0.65| 0.36 |
| Poland              | 0.55 | −0.04| 0.11 | 0.92 | 0.81 | −0.07|
| Slovakia            | −0.28| −0.16| −0.18| −0.28| −0.82| −0.26|
| Slovenia            | 0.48 | 0.30 | 0.32 | 0.04 | 0.45 | −0.28|
| Denmark             | 0.43 | 0.67 | 0.66 | 0.33 | 0.33 | 0.62 |
| Sweden              | 0.76 | −0.20| 0.37 | 0.05 | 0.95 | −0.14|
| United Kingdom      | 0.11 | 0.10 | 0.11 | 0.67 | 0.13 | 0.23 |
| Accession countries | 0.55 | 0.26 | 0.45 | 0.14 | 0.58 | 0.07 |
| Non-euro zone       |       |      |      |      |      |      |

|                     | 1986.1–1998.4 | 1986.1–1992.4 | 1993.1–1998.4 |
|---------------------|---------------|---------------|---------------|
|                     | GDP  | CPI  | GDP  | CPI  | GDP  | CPI  |
| Belgium             | 0.86 | 0.73 | 0.86 | 0.87 | 0.88 | 0.83 |
| Finland             | 0.46 | 0.83 | 0.69 | 0.70 | 0.89 | 0.20 |
| France              | 0.92 | 0.91 | 0.90 | 0.72 | 0.92 | 0.87 |
| Germany             | 0.88 | 0.37 | 0.33 | 0.42 | 0.92 | 0.83 |
| Italy               | 0.86 | 0.89 | 0.80 | 0.83 | 0.88 | 0.83 |
| Netherlands         | 0.62 | 0.04 | 0.56 | 0.52 | 0.87 | 0.56 |
| Spain               | 0.84 | 0.78 | 0.74 | 0.25 | 0.92 | 0.91 |
| Denmark             | —    | —    | —    | —    | —    | 0.34 |
| Sweden              | —    | —    | —    | —    | —    | 0.63 |
| United Kingdom      | —    | —    | —    | —    | —    | 0.44 |
| Euro zone           | 0.75 | 0.65 | 0.70 | 0.61 | 0.90 | 0.72 |
| Non-euro zone       | —    | —    | —    | —    | —    | 0.47 |

countries in terms of monetary policy, that is, a self-imposed restriction on adjustment mechanisms, instead of an increase of asymmetric shocks. This issue is considered in the following sections.
Table 2

Correlation Coefficients with Euro Zone: Cyclical Deviations

|                    | 1996.I–2002.IV | 1996.I–1999.IV | 2000.I–2002.IV |
|--------------------|----------------|----------------|----------------|
|                    | GDP  | CPI  | GDP  | CPI  | GDP  | CPI  |
| Czech Republic     | 0.14 | −0.29| 0.09 | −0.30| 0.17 | −0.24|
| Estonia            | −0.18| −0.16| 0.02 | −0.26| −0.28| 0.23 |
| Hungary            | −0.29| −0.22| 0.18 | −0.15| −0.47| −0.30|
| Latvia             | −0.10| −0.07| −0.06| −0.15| −0.23| −0.02|
| Lithuania          | −0.55| −0.30| −0.37| −0.26| −0.84| −0.42|
| Poland             | 0.22 | −0.33| 0.22 | −0.04| 0.30 | −0.63|
| Slovakia           | −0.20| 0.02 | −0.08| 0.41 | −0.24| −0.61|
| Slovenia           | 0.46 | 0.82 | −0.01| 0.81 | 0.82 | 0.86 |
| Denmark            | 0.45 | 0.31 | 0.49 | 0.50 | 0.49 | 0.01 |
| Sweden             | 0.14 | 0.83 | 0.10 | 0.77 | 0.17 | 0.94 |
| United Kingdom     | 0.64 | −0.31| 0.40 | −0.30| 0.90 | −0.36|
| Accession countries| −0.06| −0.07| 0.00 | 0.01 | −0.10| −0.14|
| Non-euro zone      | 0.41 | 0.28 | 0.33 | 0.32 | 0.52 | 0.20 |

|                    | 1986.I–1998.IV | 1986.I–1992.IV | 1993.I–1998.IV |
|--------------------|----------------|----------------|----------------|
|                    | GDP  | CPI  | GDP  | CPI  | GDP  | CPI  |
| Belgium            | 0.86 | 0.86 | 0.90 | 0.92 | 0.80 | 0.70 |
| Finland            | 0.55 | 0.62 | 0.34 | 0.82 | 0.88 | −0.07|
| France             | 0.91 | 0.78 | 0.88 | 0.86 | 0.91 | 0.73 |
| Germany            | 0.66 | 0.55 | 0.62 | 0.53 | 0.84 | 0.68 |
| Italy              | 0.82 | 0.74 | 0.77 | 0.91 | 0.82 | 0.72 |
| Netherlands        | 0.78 | 0.64 | 0.74 | 0.69 | 0.81 | 0.38 |
| Spain              | 0.85 | 0.73 | 0.78 | 0.78 | 0.88 | 0.82 |
| Denmark            | —    | —    | —    | —    | 0.77 | 0.38 |
| Sweden             | —    | —    | —    | —    | 0.04 | 0.57 |
| United Kingdom     | —    | —    | —    | —    | 0.80 | −0.65|
| Euro zone          | 0.78 | 0.70 | 0.72 | 0.79 | 0.85 | 0.57 |
| Non-euro zone      | —    | —    | —    | —    | 0.54 | 0.10 |

Demand and Supply Shocks: The Bayoumi and Eichengreen (1992) Model

A different econometric methodology should be applied to determine whether the differences in business cycle synchronicity between countries and time
periods arise from differences in shocks or from differences in responses to these shocks.

There have been various attempts to differentiate disturbances from other components of observed output movements (see, for example, Caporale 1993 or Stockman 1998). However, in this context, the methodology proposed by Bayoumi and Eichengreen (1992, 1996), extending the work by Blanchard and Quah (1989) has become the standard. The main assumption of their model is that there are two kinds of shocks: shocks that affect the demand curve, for example, due to monetary or fiscal policy changes, and shocks that affect the supply curve, for example, technological changes. From the model, it is also clear that demand and supply shocks have different effects on output and prices. In fact, it implies that while supply shocks have permanent effects on the level of output, demand shocks have only temporary effects, while both have permanent effects on the level of prices.

These assumptions can easily be introduced in a structural bivariate VAR on output and prices to obtain the series of demand and supply shocks. The starting point of the model is the following:

$$\begin{align*}
\Delta Y_t &= \sum_{i=0}^{\infty} \begin{bmatrix} a_{11i} & a_{12i} \\ a_{21i} & a_{22i} \end{bmatrix} \begin{bmatrix} \epsilon_{dt} \\ \epsilon_{st} \end{bmatrix}, \\
\Delta P_t &= \sum_{i=0}^{\infty} \begin{bmatrix} b_{11i} & b_{12i} \\ b_{21i} & b_{22i} \end{bmatrix} \begin{bmatrix} \epsilon_{dt} \\ \epsilon_{st} \end{bmatrix},
\end{align*}$$

where $\Delta Y_t$ and $\Delta P_t$ represent changes in the logarithm of output and prices, respectively, at time $t$, $\epsilon_{dt}$ and $\epsilon_{st}$ represent supply and demand shocks, and $\epsilon_{st}$ represents each of the elements of the impulse-response function to shocks.

The identification restriction is based on the previously stated assumption about the effects of the shocks. As output data is in first differences, this implies that the cumulative effects of demand shocks on output must be zero:

$$\sum_{i=0}^{\infty} a_{11i} = 0. \quad (2)$$

The model defined by equations (1) and (2) also implies that the bivariate endogenous vector can be explained by lagged values of every variable. If $B_i$ represents the value of model coefficients, the model to be estimated is the following:

$$\begin{align*}
\begin{bmatrix} \Delta Y_t \\ \Delta P_t \end{bmatrix} &= B_1 \cdot \begin{bmatrix} \Delta Y_{t-1} \\ \Delta P_{t-1} \end{bmatrix} + B_2 \cdot \begin{bmatrix} \Delta Y_{t-2} \\ \Delta P_{t-2} \end{bmatrix} + \cdots + B_{\infty} \cdot \begin{bmatrix} \epsilon_{yt} \\ \epsilon_{pt} \end{bmatrix},
\end{align*}$$

(3)
where \( e_{yt} \) and \( e_{pt} \) are the residuals of every VAR equation. Equation (3) can be also expressed as:

\[
\begin{bmatrix}
\Delta Y_t \\
\Delta P_t
\end{bmatrix} = (I - B(L))^{-1} \begin{bmatrix}
e_{yt} \\
e_{pt}
\end{bmatrix} = (I + B(L) + B(L)^2 + \ldots) \begin{bmatrix}
e_{yt} \\
e_{pt}
\end{bmatrix},
\]

and in an equivalent manner:

\[
\begin{bmatrix}
\Delta Y_t \\
\Delta P_t
\end{bmatrix} = \sum_{i=0}^{\infty} \begin{bmatrix} d_{11i} & d_{12i} \\
d_{21i} & d_{22i}
\end{bmatrix} \begin{bmatrix} e_{yt} \\
e_{pt}
\end{bmatrix}.
\]

Putting together equations (1) and (5):

\[
\sum_{i=0}^{\infty} \begin{bmatrix} d_{11i} & d_{12i} \\
d_{21i} & d_{22i}
\end{bmatrix} \begin{bmatrix} e_{yt} \\
e_{pt}
\end{bmatrix} = \sum_{i=0}^{\infty} L^i \begin{bmatrix} a_{11i} & a_{12i} \\
a_{21i} & a_{22i}
\end{bmatrix} \begin{bmatrix} \varepsilon_{dt} \\
\varepsilon_{st}
\end{bmatrix},
\]

a matrix, denoted by \( c \), can be found that relates demand and supply shocks with the residuals from the VAR model.

\[
\begin{bmatrix} e_{yt} \\
e_{pt}
\end{bmatrix} = \left[ \sum_{i=0}^{\infty} \begin{bmatrix} d_{11i} & d_{12i} \\
d_{21i} & d_{22i}
\end{bmatrix} \right]^{-1} \sum_{i=0}^{\infty} L^i \begin{bmatrix} a_{11i} & a_{12i} \\
a_{21i} & a_{22i}
\end{bmatrix} \begin{bmatrix} \varepsilon_{dt} \\
\varepsilon_{st}
\end{bmatrix} = c \cdot \begin{bmatrix} \varepsilon_{dt} \\
\varepsilon_{st}
\end{bmatrix}.
\]

From (7) it seems clear that in the \( 2 \times 2 \) model considered, four restrictions are needed to define uniquely the four elements of matrix \( c \). Two of these restrictions are simple normalizations that define the variances of shocks \( \varepsilon_{dt} \) and \( \varepsilon_{st} \). The usual convention in VAR models consists of setting the two variances equal to 1, which, together with the assumption of orthogonality define the third restriction \( c^\prime \Sigma c = \Sigma \), where \( \Sigma \) is the covariance matrix of the residuals \( e_y \) and \( e_p \). The final restriction that permits matrix \( c \) to be uniquely defined comes from economic theory and has been previously defined in equation (2). In terms of the model introducing (2) in (7), it follows that:

\[
\sum_{i=0}^{\infty} \begin{bmatrix} d_{11i} & d_{12i} \\
d_{21i} & d_{22i}
\end{bmatrix} \begin{bmatrix} c_{11} & c_{12} \\
c_{21} & c_{22}
\end{bmatrix} = \begin{bmatrix} 0 \\
\cdot
\end{bmatrix},
\]

and the resolution of this system permits us to estimate the series of demand and supply shocks from residuals of the estimated VAR.
We have estimated this VAR model using quarterly data on GDP and consumer price series from 1995.I to 2002.IV for the accession countries under consideration and the euro-zone aggregates and for EU countries from 1986.I to 1998.IV. In all cases, the number of lags introduced in VAR models has been set to four as the Schwartz information criterion indicates that this is the optimal lag in most cases. In this sense, the identification scheme has been homogeneous for every country.

Table 3 shows the values of the correlation coefficients measuring the relationship between demand and supply shocks in the euro zone with those in the rest of the countries. The first column shows the value of the correlation coefficients for the whole period, while the second refers to the period 1997.I–1997.IV and the third refers to the most recent period 2000.I–2002.IV. Results for the euro-zone and non–euro-zone countries for the period 1988.I–1998.IV, and for 1988.I–1992.IV and 1993.I–1998.IV, are also shown in order to compare the situation of the accession countries with the situation of EU countries before euro adoption.8

In terms of demand shocks, and looking at the period 1998.I–2002.IV, four out of eight countries, Estonia, Hungary, Lithuania, and Slovenia, have negative correlations with the euro zone. In terms of supply shocks, and for the same period, two countries, Latvia and Lithuania, have negative correlations. The average values of the correlation coefficients for demand and supply shocks for the accession countries are clearly lower than those by non–euro-zone countries for the same period and by euro-zone countries before euro adoption.

When looking at the different subperiods, the most interesting result is that, in terms of demand shocks, correlations have decreased in nearly all countries under consideration, except Hungary. It seems that the economic slowdown has increased the heterogeneity of demand shocks. However, except in Poland and Latvia, the correlations in terms of supply shocks have clearly increased. This result shows that in recent years asymmetric shocks are related to factors controllable by national governments (demand) while those related to non-controllable factors have tended to decrease (supply), which can be interpreted as good news for the accession countries.

However, one shortcoming of the Bayoumi and Eichengreen model is that it ignores the potential role of policy in creating shocks (see, for example, Chamie, DeSerres, and Lalonde 1994; Erkel-Rousse and Mélitz 1995; or Artis 2003). This possibility will be considered in the following section.

Extensions of the Basic Model: The Potential Role of Policy in Creating Shocks

Later applications of structural VAR models in the spirit of Blanchard and Quah (1989)—the starting point of the Bayoumi and Eichengreen model—have
developed this technique by recognizing that two different types of demand shock were potentially important:

- Real demand shocks, resulting, for example, from increases in private sector spending or government expenditure; and
Nominal demand shocks, resulting from shocks to the stance of monetary policy or from shocks arising in foreign exchange markets.

There have been various proposals on how to disentangle these shocks using a variety of identification restrictions. In this article, two alternative specifications that allow for monetary policy influences are considered: in the previous specification, the first one includes the evolution of real interest rates while the second includes the evolution of real exchange rates. In both cases, further restrictions are required in order to identify real demand, nominal demand, and supply shocks from the residuals of these trivariate VAR models.

In the first case, the proposed structural VAR model consists of three variables: real GDP growth rate, variations in the real interest rate, and the inflation rate. Following the identification scheme proposed by Artis (2003), structural shocks are identified as follows:

- Nominal \( (\varepsilon_{mt}) \) and real \( (\varepsilon_{dt}) \) demand shocks do not affect the long-run level of output \( (\Delta Y_t) \);
- Nominal demand shocks \( (\varepsilon_{mt}) \) do not have any permanent effect on real interest rates \( (\Delta R_t) \).

These assumptions are summarized in the following equation:

\[
\begin{bmatrix}
\Delta Y_t \\
\Delta R_t \\
\Delta P_t
\end{bmatrix} = \sum_{i=0}^{\infty} \begin{bmatrix}
a_{11i} & 0 & 0 \\
0 & a_{22i} & 0 \\
0 & 0 & a_{33i}
\end{bmatrix} \begin{bmatrix}
\varepsilon_{st} \\
\varepsilon_{dt} \\
\varepsilon_{mt}
\end{bmatrix},
\] (9)

In the second case, the proposed structural VAR model consists of three variables: real GDP growth rate, variations in the real effective exchange rate, and the inflation rate. Following the identification scheme proposed by Clarida and Galí (1994) and also used in this context by Lättemäe (2003), the structural shocks are identified as follows:

- Nominal \( (\varepsilon_{mt}) \) and real \( (\varepsilon_{dt}) \) demand shocks do not affect the long-run level of output \( (\Delta Y_t) \);
- Nominal demand shocks \( (\varepsilon_{mt}) \) do not affect the long-run level of real effective exchange rate \( (\Delta Q_t) \).

These assumptions are summarized in the following equation:

\[
\begin{bmatrix}
\Delta Y_t \\
\Delta Q_t \\
\Delta P_t
\end{bmatrix} = \sum_{i=0}^{\infty} \begin{bmatrix}
a_{11i} & 0 & 0 \\
0 & a_{22i} & 0 \\
0 & 0 & a_{33i}
\end{bmatrix} \begin{bmatrix}
\varepsilon_{st} \\
\varepsilon_{dt} \\
\varepsilon_{mt}
\end{bmatrix},
\] (10)

We have estimated VAR models using both sets of variables and identifying
restrictions using quarterly data on GDP, real interest rates or real exchange rates, and consumer price series from 1995.I to 2002.IV for the accession countries under consideration and the euro-zone aggregates, and from 1986.I to 1998.IV for EU countries. In all cases, the number of lags introduced in VAR models has been set to four as the Schwartz information criterion indicates that this is the optimal lag in most cases. In this sense, the identification scheme is homogeneous for every country.

Table 4 shows the correlation of real demand shocks, supply shocks, and monetary shocks as unexplained real interest rate disturbances. In terms of demand shocks, most correlations are lower, as should be expected when an additional source of shocks has been identified. However, the accession countries retain quite high correlations in terms of real demand shocks related to other countries, for example, the Czech Republic, Hungary, or Poland. The correlations for monetary shocks are also quite high for the accession countries.

Table 5 shows the correlation of real demand shocks, supply shocks, and monetary shocks, but now as unexplained real exchange rate disturbances. Again, in terms of demand shocks, most correlations are lower, but the accession countries retain quite high correlations in terms of real demand shocks related to other countries.

Conclusions and Final Remarks

The objective of this article was to assess whether the recent economic evolution of the EU accession countries and their expected developments for the coming years puts them in a better or a worse position to join the euro zone. Similarly to previous studies (Fidmruč and Korhonen 2003; Lättemäe 2003), we find that the shocks are more asymmetric in candidate countries than in current euro-zone members. However, some countries are more ready to adopt the euro from this perspective. For example, if we look at supply shocks, the values of correlation coefficients for Hungary, Poland, the Czech Republic, and Estonia are quite high. And in terms of real demand shocks in the most recent years, only Latvia, Slovakia, and Slovenia show negative values of the correlation coefficient.

Some other interesting results emerge from the analysis of symmetries in monetary shocks when using the real interest rate specification. It seems that monetary shocks in most candidate countries are more correlated with euro-zone countries than are supply shocks or real demand shocks. This result, also found by Lättemäe (2003) for the Baltic countries, is especially interesting taking into account the actual differences between the exchange rates systems
and levels of financial integration. Moreover, it shows that monetary policies in accession countries are closely influenced by monetary conditions in the euro zone. If this is the case, then the costs of losing monetary independence when joining the euro zone would be reduced.

In any case, and taking it into account that, on average, correlations are still far from the values of the euro-zone countries, the flexibility of real sector and labor markets will be essential for the sustainability of joining the euro.

To conclude, there are some issues that should be considered when interpreting the previous results from a policy point of view:

- First, and in accordance with the critique of Lucas (1976), changes in economic policy could lead to changes in economic structure, which makes it difficult to analyze ex ante policies based on ex post data. Moreover, in the context of OCA literature, Frankel and Rose (1996) claim that OCA criteria may be endogenous. According to these authors, a monetary union will cause more trade, and this would increase the degree of business cycle synchronicity. In addition, once it is established, there will be a single monetary policy, which would increase the degree of integration of participating countries. Ex post correlations would be higher than ex ante correlations.

- Second is the problem of “sufficiency” (Artis 2003). The main findings of this article rely on cross-correlations of shocks but “there is nothing in the relevant theory to establish what is a ‘satisfactory value’ for a cross-correlation. This is the problem of sufficiency” (Artis 2003: 25). In this article, we have compared the values of the correlations of the accession countries with euro-zone aggregates and with the values of these correlations for non–euro-zone countries and with the values between EU countries before adopting the euro. We have seen that, in most cases, the values for the accession countries were lower, but are they lower enough to indicate that most shocks have been asymmetric rather than simply less coincident?

- Third, it is important to stress again that the analysis in this article is a partial one. We have focused on the role of asymmetric shocks in the light of the probable accession to the monetary union of some Central and East European countries. However, these economies also face other problems on the road to the monetary union. One of the most important ones is related to the probability of financial crisis under large capital inflows, but, as we have pointed out previously, if the accession countries continue to internationalize their banking systems and efficient monitoring mechanisms are implemented, the danger of such banking problems should be reduced considerably (Eichengreen and Ghironi 2001).
Table 4

Correlation Coefficients with Euro Zone: SVAR, Real GDP, Real Interest Rates, and Inflation

|                  | 1998.I–2002.IV |          |          | 1998.I–2000.IV |          |          | 2001.I–2002.IV |          |
|------------------|----------------|----------|----------|----------------|----------|----------|----------------|----------|
|                  | demand    | supply | monetary | demand    | supply | monetary | demand    | supply | monetary |
| Czech Republic   | 0.54      | 0.23    | 0.41     | 0.50      | 0.45    | 0.53     | 0.60      | 0.28    | 0.27     |
| Estonia          | 0.10      | −0.06   | 0.39     | 0.08      | −0.09   | 0.38     | 0.21      | −0.16   | 0.36     |
| Hungary          | 0.24      | −0.29   | 0.41     | −0.07     | −0.46   | 0.13     | 0.53      | 0.12    | 0.78     |
| Latvia           | −0.07     | 0.12    | 0.18     | 0.27      | 0.16    | 0.40     | −0.24     | 0.08    | 0.16     |
| Lithuania        | 0.12      | −0.22   | 0.06     | 0.06      | −0.20   | 0.09     | 0.27      | −0.46   | 0.00     |
| Poland           | 0.30      | 0.50    | 0.43     | −0.21     | 0.58    | 0.53     | 0.70      | 0.30    | 0.29     |
| Slovakia         | −0.09     | 0.44    | 0.24     | 0.05      | 0.59    | 0.27     | −0.30     | −0.06   | 0.12     |
| Slovenia         | 0.09      | −0.22   | 0.17     | 0.29      | −0.16   | 0.04     | −0.46     | −0.44   | 0.24     |
| Denmark          | 0.28      | 0.40    | 0.37     | −0.02     | 0.53    | 0.15     | 0.43      | 0.20    | 0.53     |
| Sweden           | −0.23     | 0.25    | 0.12     | −0.83     | 0.11    | −0.15    | −0.05     | 0.43    | 0.69     |
| United Kingdom   | −0.02     | 0.19    | 0.14     | 0.37      | −0.26   | 0.32     | −0.81     | 0.65    | −0.15    |
| Accession countries | 0.15   | 0.06    | 0.29     | 0.12      | 0.11    | 0.30     | 0.16      | −0.04   | 0.28     |
| Non-euro zone    | 0.01      | 0.28    | 0.21     | −0.16     | 0.13    | 0.11     | −0.14     | 0.43    | 0.35     |
| Country         | 1988.I–1998.IV | 1988.I–1992.IV | 1993.I–1998.IV |
|----------------|----------------|----------------|----------------|
|                | demand | supply | monetary | demand | supply | monetary | demand | supply | monetary |
| Belgium        | 0.30    | 0.54    | 0.48      | 0.39    | 0.51    | 0.53      | 0.30    | 0.60    | 0.46      |
| Finland        | 0.36    | 0.31    | 0.13      | 0.48    | 0.25    | 0.18      | 0.24    | 0.38    | 0.06      |
| France         | 0.32    | 0.46    | 0.38      | 0.34    | 0.56    | 0.44      | 0.33    | 0.37    | 0.39      |
| Germany        | 0.25    | 0.55    | 0.41      | 0.05    | 0.58    | 0.35      | 0.50    | 0.54    | 0.59      |
| Italy          | 0.17    | 0.35    | 0.28      | 0.20    | 0.49    | 0.25      | 0.09    | 0.22    | 0.36      |
| Netherlands    | -0.07   | 0.01    | 0.29      | -0.17   | -0.19   | 0.09      | 0.08    | 0.40    | 0.74      |
| Spain          | 0.32    | 0.29    | 0.36      | 0.34    | 0.03    | 0.39      | 0.32    | 0.76    | 0.39      |
| Denmark        | —       | —       | —         | —       | —       | —         | —       | 0.25    | 0.47      |
| Sweden         | —       | —       | —         | —       | —       | —         | -0.09   | 0.07    | 0.06      |
| United Kingdom | —       | —       | —         | —       | —       | —         | 0.28    | 0.21    | 0.41      |
| Euro zone      | 0.24    | 0.36    | 0.33      | 0.23    | 0.32    | 0.32      | 0.27    | 0.47    | 0.43      |
| Non-euro zone  | —       | —       | —         | —       | —       | —         | 0.15    | 0.25    | 0.24      |
### Table 5

**Correlation Coefficients with Euro Zone: SVAR, Real GDP, Real Exchange Rate, and Inflation**

|            | 1998.I–2002.IV | 1998.I–2000.IV | 2001.I–2002.IV |
|------------|----------------|----------------|----------------|
|            | demand | supply | monetary | demand | supply | monetary | demand | supply | monetary |
| Czech Republic | 0.17   | 0.14   | 0.09     | 0.31   | −0.13  | 0.12     | 0.09   | 0.52   | −0.05    |
| Hungary     | 0.52   | −0.45  | 0.05     | 0.37   | −0.72  | 0.01     | 0.68   | 0.48   | −0.08    |
| Poland      | 0.22   | 0.03   | −0.03    | 0.35   | −0.03  | 0.01     | 0.10   | 0.16   | −0.17    |
| Slovakia    | 0.02   | −0.08  | 0.10     | −0.16  | −0.12  | 0.20     | 0.32   | 0.09   | −0.02    |
| Denmark     | 0.16   | 0.27   | 0.78     | −0.18  | 0.42   | 0.69     | 0.52   | 0.23   | 0.77     |
| Sweden      | 0.46   | −0.19  | −0.13    | 0.29   | −0.23  | −0.04    | 0.63   | −0.27  | −0.02    |
| United Kingdom | 0.19  | −0.21  | −0.33    | 0.34   | −0.23  | 0.11     | 0.03   | −0.31  | −0.57    |
| Accession countries | 0.23 | −0.09 | 0.05     | 0.22   | −0.25  | 0.09     | 0.30   | 0.31   | −0.08    |
| Non-euro zone | 0.27  | −0.04  | 0.11     | 0.15   | −0.01  | 0.25     | 0.39   | −0.12  | 0.06     |
|                | 1988.I–1992.IV | 1993. I–1998.IV | 1990. I–1998.IV |
|----------------|---------------|-----------------|-----------------|
|                | demand | supply | monetary | demand | supply | monetary | demand | supply | monetary |
| Belgium        | 0.54    | 0.59   | 0.69     | 0.54    | 0.59   | 0.75     | 0.59   | 0.54   | 0.69     |
| Finland        | -0.01   | 0.25   | 0.19     | -0.05   | 0.11   | 0.27     | -0.03  | 0.44   | 0.13     |
| France         | 0.62    | 0.60   | 0.60     | 0.58    | 0.74   | 0.62     | 0.76   | 0.35   | 0.59     |
| Germany        | 0.40    | 0.53   | 0.47     | 0.35    | 0.65   | 0.65     | 0.51   | 0.39   | 0.38     |
| Italy          | 0.40    | 0.34   | 0.24     | 0.30    | 0.17   | 0.42     | 0.56   | 0.52   | 0.14     |
| Netherlands    | 0.32    | 0.06   | 0.69     | 0.19    | 0.06   | 0.78     | 0.57   | -0.07  | 0.61     |
| Spain          | 0.39    | 0.26   | 0.28     | 0.44    | 0.01   | 0.13     | 0.35   | 0.69   | 0.41     |
| Denmark        | —       | —      | —        | —       | —      | —        | -0.08  | 0.25   | 0.69     |
| Sweden         | —       | —      | —        | —       | —      | —        | 0.45   | 0.31   | 0.20     |
| United Kingdom | —       | —      | —        | —       | —      | —        | 0.37   | -0.02  | -0.50    |
| Euro zone      | 0.38    | 0.37   | 0.45     | 0.34    | 0.33   | 0.52     | 0.47   | 0.41   | 0.42     |
| Non-euro zone  | —       | —      | —        | —       | —      | —        | 0.24   | 0.18   | 0.13     |
Notes

1. A more general analysis involving topics such as fiscal imbalances, the need to monitor accession countries’ banking systems, implications for labor markets, or the European Central Bank design after accession can be found in Eichengreen (2003) and Eichengreen and Ghironi (2001).
2. An extensive review of this literature can be found in Fidrmuc and Korhonen (2003).
3. Malta and Cyprus are not included in the analysis due to data restrictions.
4. In the analysis in the following sections, it is important to take into account that the values of the correlation coefficients for non–euro-zone countries are increased due to the “Denmark effect.” During the period under consideration, monetary policy in Denmark has strongly followed the euro-zone policy. However, this is not the case for Sweden or the United Kingdom.
5. Different lags and leads were also considered. The results are available from the authors on request.
6. We have also computed the correlations over successive intervals of five years, using a five-year “rolling window.” The conclusions from this analysis are similar to those summarized in the text. The results are available from the authors on request.
7. See note 6.
8. We have also calculated the correlations between demand and supply shocks over successive intervals of three years. The results are available from the authors on request.
9. Due to data restrictions, Estonia, Latvia, Lithuania, and Slovenia are not included in the analysis.

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