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# European asymmetries

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**Abstract**

The degree of symmetry of the shocks that cause macroeconomic fluctuations in the different European economies is a basic consideration when evaluating the cost in terms of loss of the nominal exchange rate as an instrument for short-term macroeconomic adjustment. The more symmetrical these shocks, the lower the costs. This paper uses a structural Bayesian Vector Autoregressive (BVAR) approach and quarterly data from 1970 to 1996 to characterise the responses to common and specific, nominal and real, shocks in four European economies. Our findings suggest that, in the short run, asymmetrical shocks have dominated. 

*Keywords:* BVAR; Interdependence; Shocks; Exchange rate; Asymmetries

*JEL classification:* C32; E32; F02

## 1. Introduction

Literature on the international business cycle has long been interested in the interaction among real and nominal variables and the source of economic fluctuations. Indeed, one of the main issues in the debate on the European Economic and Monetary Union (EMU) is the degree to which shocks that cause short-run macroeconomic fluctuations in Europe are symmetric. The cost in terms of loss of the nominal exchange rate as a policy instrument for accommodating

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these effects is minimised when labour and capital markets are sufficiently flexible or when the integrated economies suffer common shocks with a similar impact. This paper examines the degree of asymmetry of the European economies. By asymmetry, we understand not only the predominance of country specific disturbances, but also a different transmission of common shocks.

Most of the recent literature on international business cycles has attempted to reproduce the co-movements of real variables by using equilibrium models with different real shocks (e.g. Backus et al., 1994 or Canova, 1993). Nevertheless there is not much evidence on the transmission of real and nominal fluctuations in a structural multi-country model (an exception is Van der Ploeg, 1993). In line with the identified VAR literature, our analysis considers a multicountry model that includes four European economies: Germany, France, the United Kingdom and Spain. We consider international oil prices, US output and the US interest rate as 'common' external shocks. 'Country-specific' shocks are output, inflation and interest rate for each of the countries studied.

Obviously, we do not pretend to model these economies in detail; we will not attempt to identify supply and demand shocks or disturbances stemming from fiscal and labour market or from monetary policy innovations. Nor will we attempt to evaluate the performance of the nominal exchange rate as an adjustment instrument. Instead, we attempt to assess the relative importance of external and internal sources of European fluctuations and compare the transmission of external shocks so as to characterise symmetries in terms of the sign, magnitude and persistence of the effects of the disturbance. We differentiate between nominal and real sources of fluctuations and between short- and long-run effects, focusing our attention on the short-run as it is here that the loss of the nominal exchange rate will be of the greatest importance.

We should further stress that we do not aim to predict the impact of EMU on the various economies or the degree of symmetry that will exist once EMU is actually in place. Instead, we attempt to calculate the potential cost of EMU with the current degree of symmetry. Advocates of EMU (e.g. Emerson, 1992) argue that it will reduce the number of asymmetric shocks and their effects for each of the member countries. We therefore also investigate whether the empirical evidence suggests that the steps taken towards EMU during the 80s and early 90s mean that the sources of short-run fluctuations are more symmetrical now than they were in the 1970s.

Following this introduction, we proceed to briefly describe the VAR methodology and the specifics of the estimated model in Section 2. Section 3 uses the variance decomposition and impulse-response results to characterise the degree of openness of European economies and the transmission of shocks for the whole sample period 1970–1996. Section 4 reports on the robustness of results to specific changes in the restrictions used to identify the model. Section 5 analyses the stability detected before and after 1979 in an effort to assess the performance of the European Monetary System (EMS) as a cooperation mechanism. Section 6 presents our conclusions.

## 2. The VAR approach

### 2.1. Methodology

Our analysis assumes that the $n$-dimensional observable vector $Y$ is determined at each $t$ according to the model

$$\boldsymbol{Y}(t) = \mathrm{X}(t)\boldsymbol{\beta}(t) + \boldsymbol{\varepsilon}(t) \tag{1}$$

where

$$\mathrm{X}(t) = \begin{bmatrix} \boldsymbol{X}_1(t)' & & & & \\ & \ddots & & & \\ & & \ddots & & \\ & & & \ddots & \\ & & & & \boldsymbol{X}_n(t)' \end{bmatrix}$$

$$\boldsymbol{X}_i(t)' = (Y(t-1)' \ldots Y(t-m)'\boldsymbol{D}(t)')$$

$$i = 1,\ldots,n$$

$$\boldsymbol{\beta}(t)' = (\beta_1(t)' \ldots \beta_n(t)')$$

$$\boldsymbol{\beta}(t) = \mathbf{S}\beta(t-1) + \boldsymbol{u}(t)$$

$$\boldsymbol{\varepsilon}(t)|\mathbf{F}_{t-1} - \boldsymbol{N}\left(\mathbf{0}, \sum\nolimits_{\varepsilon}\right)$$

$$\boldsymbol{u}(t)|\mathbf{F}_{t-1} - \boldsymbol{N}\left(\mathbf{0}, \sum\nolimits_{u}\right)$$

$$\varepsilon, u \text{ independent}$$

$\boldsymbol{D}(t)$ is a $d$-dimensional vector of deterministic variables, so $X_i(t)$ and $\beta_i(t)$ are $k$-dimensional vectors, $k = mn + d$, and $\mathbf{S}$ is a $k \times k$ matrix. $\mathbf{F}_{t-1}$ is the information set at the end of period $t-1$.

VARs are weakly restricted models and, as such, very useful for analysing sample evidence that is unconditioned by prior controversial assumptions about the working of the economy. A key goal of the VAR methodology is precisely to make a sharp distinction between the processes of specification (intended to be uncontroversial) and identification (where disagreement is more likely to arise), clearly stating the restrictions used to identify the model. This goal explains the usual two-step procedure used to estimate the dynamics that underlie the evolution of the vector of endogenous variables $\boldsymbol{Y}$.

In the first step, the reduced-form coefficient vector $\beta$ is estimated. This usually poses a degree of freedom problem,[1] which may be handled by using the Bayesian approach originally designed to deal with the over-fitting problem typical of large VAR models. In this case, a prior distribution for $\beta$ is specified as a function of a parameter vector, such as $\boldsymbol{\tau}$, which controls unknown aspects of the prior (mean, degree of tightness, etc.). The reason for introducing the functional dependence on $\boldsymbol{\tau}$ is that with finite samples we do not expect the prior to be neutral (in the sense of not affecting the posterior), and it is therefore necessary to have a choice criterion. A reasonable criterion is to select the prior associated with $\boldsymbol{\tau}^*$ that maximises the model's likelihood function, taking the mean and variance of the resulting posterior distribution as the estimates of the coefficients in $\beta$ and their corresponding covariance matrix. See Doan et al. (1984) and Sims (1986) for a more detailed description of the Bayesian VAR (BVAR) methodology.

As will be observed, the coefficients of the model ($\beta$) are time dependent. An economic justification for using a coefficient vector that changes with time $t$ is that it helps account for possible structural shifts within the sample period, providing a mechanism to protect the implications of the model from the Lucas critique without having to explicitly model expectations.

It should be stressed that the only restriction imposed with certainty in the first step of the estimation procedure is the maximum number of lags allowed for ($m$). Stationarity is not imposed, so unit roots and cointegration relations may occur if the data suggest that they characterise the stochastic process under analysis.

The second step involves proposing and estimating a set of contemporaneous interactions among the components of $\boldsymbol{Y}$. These interactions are intended to account for the contemporaneous correlations of the error term $\boldsymbol{\varepsilon}$ (as reflected in the previously estimated covariance matrix $\Sigma_{\varepsilon}$) and generate a new error vector of orthogonal components, $\boldsymbol{\nu}$. This is actually why the process is sometimes referred to as the 'orthogonalisation process', although, in fact, the orthogonalisation process involves using variance–covariance matrix restrictions to identify the model.

There are many ways to orthogonalise $\boldsymbol{\varepsilon}$ by imposing contemporaneous restrictions. Each set of restrictions generates a particular structural model and might possibly imply different dynamic properties. Formally, the identification (orthogonalisation) process requires matrices $\mathbf{A}$ and $\Sigma_{\nu}$ be estimated such that

$$\mathbf{A}\boldsymbol{\varepsilon} = \boldsymbol{\nu}$$

and

$$\sum_{\varepsilon} = \mathbf{A}^{-1} \sum_{\nu} \mathbf{A}^{-1}$$

where $\Sigma_{\nu}$, diagonal, is the covariance matrix of the disturbance vector $\boldsymbol{\nu}$. Changing

[1] In a model such as Eq. (1) the number of coefficients to be estimated increases exponentially with the number of variables included in the system.

the structure of the identification scheme involves changing the non-zero entries of the matrix **A**. Identifying the model by simply imposing restrictions on the set of contemporaneous interactions is not the only possibility. Some authors also use restrictions on the sums of structural coefficients, also called long-run restrictions. For instance, Blanchard and Quah (1989) impose the absence of long-run effects of nominal shocks on real variables.

### *2.2. The estimated model*

The VAR includes variables of four European countries: Germany, France, the United Kingdom and Spain, which were selected because they are both quantitatively and qualitatively representative of the European Union. In quantitative terms, our selection accounts for roughly 70% of the Union's GDP.

In qualitative terms, our goal is to include a significantly heterogeneous group that accounts for 'core' and 'peripheral' diversity. Germany and France represent 'core' countries. The inclusion of Germany obviates the need to include the Deutschemark area countries (Belgium, Holland, Luxembourg and Austria) which are already a de facto monetary union. Of the other two countries included in the model, Spain is the most clearly 'peripheral' and is expected to be representative of other 'peripheral' countries like Ireland, Portugal and Greece. The choice of Spain is justified by the fact that its economy is larger than those of the other 'peripheral' nations. Although is unclear whether the UK can be considered a 'core' or a 'peripheral' country, it is precisely this ambiguity together with the considerable size of its economy that led us to include the UK in our model, rather than choosing Italy which, though not a clearly 'peripheral' country, is probably closer to Spain in terms of economic structure and size.[2] Italy and the Scandinavian countries are probably the most significant exclusions. Nevertheless, we consider that our choice is sufficiently representative of European diversity to allow us to examine possible (a) symmetries across Europe.

The model analysed contains three domestic variables for each country plus three variables from the 'rest of the world', so that $n=15$. For the European countries, the model includes: growth in real output, inflation rate and short-run nominal interest rates. 'Rest of the world' variables include the rate of change in oil prices, growth in output and the nominal interest rate for the US economy.[3] Our failure to include nominal exchange rates in our model can be justified on two

[2] At the time of writing the UK has announced its decision not to join EMU in 1999. This does not imply that its inclusion in the model is irrelevant. On the contrary, the UK's decision may be signalling that asymmetries of the type reported in this paper are at work. Moreover, it is still important to characterise interdependence between 'ins' and 'outs' in order to design future policies aimed at reducing the cost of EMU.

[3] By focusing on output growth and inflation rates, we analyse variability abstracting from stochastic trend components. The null hypothesis of absence of common stochastic trends in levels is accepted according to a Johansen (1991) multivariate test.

grounds. First is the assumption that relative PPP holds, at least in the long run, accounting for adjustments in nominal exchange rates when the different inflation rates are part of the system. Secondly, our interest is not in measuring how the nominal exchange rate adjusts to shocks under fixed or flexible regimes, but in exploring how the other variables respond to shocks in the presence or absence of exchange rate movements.

The model for this whole set of variables seeks to measure interdependence relationships and differs from other estimated VARs that attempt to compare intra-country relationships across different industrialised economies (e.g. Schiantarelli and Grilli, 1990; Bayoumi and Eichengreen, 1993; Roubini and Kim, 1995). By including both 'European' and 'rest of the world' variables we can attempt to isolate common external shocks from European specific shocks.

We use quarterly data for the period 1970:1–1996:4 (see Appendix A) to estimate the model. Three lags are included ($m=3$). Since no deterministic trend was detected, the deterministic component ($D$) contains a single constant term. The number of coefficients in each equation is thus $15\times3+1=46$. Although integrated or even cointegrated variables may be included, we have estimated our model with the kind of prior information typically used in the Bayesian Vector Autoregression literature, i.e. information which does not take prior explicit account of potential long-run relations among variables. Due to the superconvergence property of the unit roots and cointegration aspects of the data, we consider these aspects of the model to be quite insensitive to the prior. This view is expressed in Sims (1991a), Sims (1991b) and supported by the Monte Carlo evidence presented in Alvarez and Ballabriga (1994).

The $\boldsymbol{\tau}$ vector is described in Appendix B. Since the prior information defined by this vector makes the univariate estimation inefficient, we have used the multivariate version of the Kalman filter to estimate the system. We consider that both the dimensionality of the $\boldsymbol{\tau}$ vector and the number of lags included in the model are appropriate since the stochastic structure of the estimated reduced form residuals did not appear to deviate from the white noise hypothesis.

The fact that the sample period is marked by a considerable number of changes in both international and domestic economies suggests that the data may actually contain important structural breaks. To account for this possibility we first incorporate time-varying coefficients in our model, in an attempt to detect regime changes which are either country-specific or affect more than one European country. Secondly, we proceed to analyse pre- and post-1979 stability.

We identify the model by imposing restrictions on the set of contemporaneous interactions.[4] A basic assumption is that the countries are hierarchically ranked in

[4]The estimated scheme is available on request, as are the complete variance decomposition and impulse-response results from the current identification scheme (Section 3) and the schemes presented in Section 4.

accordance with their relative size. The specific restrictions imposed are as follows:

- European shocks do not have a contemporaneous effect on the world block. Within this block, energy price is a primitive source of variability affecting both US real activity and interest rates, which may also react to current real activity.
- With the exception of energy prices, only domestic variables have a direct current effect on European inflation rates.
- Within Europe, contemporaneous interactions follow a hierarchical pattern: Germany→[France, UK]→Spain.
- European domestic variables follow a standard triangular pattern: output→interest rate→inflation 'classical' scheme.

## 3. European interdependence: 1970–1996

This section reports the results of the variance decomposition and impulse-response effects for the entire sample period (1970:1–1996:4) and the identification scheme discussed above. In subsequent sections, we discuss the robustness of these results, both through alternative identification criteria and across subsamples.

It is difficult to characterise analytically the distribution of the variance decomposition and impulse-response effects. We therefore follow standard practice and use Monte Carlo methods. Specifically, the numbers in the tables and graphs are the result of a Monte Carlo experiment involving 200 draws from the posterior distribution of the reduced form coefficient vector $\beta(T)|\mathbf{F}_T$, computing for each draw the corresponding decomposition and impulse-response effects. Average shares and responses are reported along with the 90% interval.

We discuss the degree of interdependence on a variable-by-variable basis: exploring output, inflation and nominal interest rates. We also differentiate between 'short-run' and 'long-run' effects. Our focus, however, is on short-run effects (4th quarter ahead forecast step) because we are concerned with the potential cost involved in loss of the nominal exchange rate as an adjustment mechanism. In the long run such a loss would be minimised because the real exchange rate has to be adjusted even when the nominal exchange rate is fixed.

The degree of symmetry is characterised both by the relative importance of external/internal shocks and by the responses to common disturbances, which may stem either from a world or specific European-country source. A common shock is considered to be symmetric if the sign, magnitude and persistence of the responses do not vary significantly across countries.

Table 1
European interdependence: percentage of European output, inflation and interest rate variability explained by own and external shocks at the 4th quarter ahead forecasting step

*Output*

| | World | | European | | | Own Output | Total external shocks |
|---|---|---|---|---|---|---|---|
| | Oil price | $Y_{US}$ | $Y_{GE}$ | $Y_{FR}$ | $Y_{UK}$ | | |
| GE | 2.3 | 8.4 | – | 1.1 | 1.6 | 81.4 | 16.4 |
| | (0, 6.9) | (1.8, 15.0) | | (0, 3.2) | (0, 5.5) | (73.0, 89.8) | (6.9, 25.4) |
| FR | 2.4 | 5.7 | 20.6 | – | 2.2 | 65.0 | 33.7 |
| | (0, 6.0) | (0, 11.8) | (12.9, 28.3) | | (0, 5.5) | (44.5, 75.5) | (24.1, 43.2) |
| UK | 9.7 | 3.7 | 8.9 | 1.4 | – | 71.9 | 26.8 |
| | (3.5, 15.9) | (0, 8.1) | (3.8, 14.0) | (0, 4.3) | | (63.4, 79.4) | (19.3, 34.3) |
| SP | 2.8 | 5.9 | 15.2 | 7.8 | 10.0 | 48.6 | 46.5 |
| | (0, 6.5) | (0, 13.3) | (4.0, 26.4) | (0, 15.7) | (8.1, 11.9) | (36.4, 60.8) | (32.9, 60.1) |

*Inflation*

| | World | | European | | | | Own | | Total external shocks |
|---|---|---|---|---|---|---|---|---|---|
| | Oil Price | $Y_{US}$ | $\pi_{GE}$ | $\pi_{FR}$ | $\pi_{UK}$ | European output | $Y$ | $\pi$ | |
| GE | 3.0 | 2.6 | – | 0.8 | 0.9 | 4.6 | 3.8 | 81.4 | 13.6 |
| | (0, 8.6) | (0, 7.0) | | (0, 2.2) | (0, 2.7) | (0, 12.3) | (0, 9.5) | (71.4, 91.4) | (4.8, 22.3) |
| FR | 7.4 | 3.8 | 3.0 | – | 1.7 | 4.1 | 1.8 | 73.1 | 25.1 |
| | (3.0, 11.8) | (0, 10.5) | (0, 8.1) | | (0, 4.5) | (0, 12.5) | (0, 5.2) | (63.6, 82.6) | (20.3, 34.6) |
| UK | 6.5 | 11.6 | 1.8 | 1.5 | – | 4.6 | 2.4 | 73.6 | 20.8 |
| | (0, 15.4) | (4.4, 18.0) | (0, 5.2) | (0, 4.4) | | (0, 14.5) | (0, 5.5) | (62.1, 84.9) | (8.8, 32.8) |
| SP | 3.6 | 3.0 | 2.8 | 6.8 | 2.3 | 12.1 | 21.9 | 42.7 | 34.4 |
| | (0, 10.3) | (0, 8.6) | (0, 7.5) | (0, 14.0) | (0, 7.2) | (0, 27.9) | (16.0, 27.8) | (34.3, 51.0) | (23.4, 45.4) |

*Interest rates*

| | World | | European | | | | Own | | Total external shocks |
|---|---|---|---|---|---|---|---|---|---|
| | $Y_{US}$ | $\boldsymbol{R}_{US}$ | $\boldsymbol{R}_{GE}$ | $\boldsymbol{R}_{FR}$ | $\boldsymbol{R}_{UK}$ | $Y_{GE}$ | $\pi$ | $\boldsymbol{R}$ | |
| GE | 5.9 | 22.4 | – | 0.2 | 2.5 | 4.0 | 13.1 | 43.3 | 40.1 |
| | (0, 12.0) | (14.0, 30.4) | | (0, 0.6) | (0, 4.9) | (0, 9.4) | (5.2, 21.0) | (35.6, 51.0) | (31.4, 48.8) |
| FR | 7.5 | 17.4 | 10.9 | – | 1.4 | 4.2 | 1.3 | 44.8 | 49.9 |
| | (0, 16.7) | (9.5, 25.3) | (6.7, 15.1) | | (0, 3.5) | (0, 10.3) | (0, 5.7) | (35.8, 53.8) | (40.5, 59.3) |
| UK | 3.5 | 13.3 | 1.7 | 0.4 | – | 10.2 | 3.0 | 58.2 | 38.2 |
| | (0, 9.3) | (6.1, 20.5) | (0, 3.0) | (0, 1.2) | | (0, 20.4) | (0, 6.9) | (46.0, 60.4) | (27.0, 49.4) |
| SP | 6.0 | 1.4 | 1.5 | 1.2 | 2.4 | 2.0 | 1.2 | 70.1 | 26.7 |
| | (0, 14.5) | (0, 3.3) | (0, 2.9) | (0, 3.3) | (0, 5.3) | (0, 5.1) | (0, 3.1) | (60.1, 80.1) | (16.8,36.6) |

Note: For each cell we report the average and the 90% interval (in parenthesis) from a Monte Carlo experiment with 200 draws.

### 3.1. Output

The first panel in Table 1 shows the variance decomposition for each of the four European country outputs. The last column shows the sum of all external shocks considered ('world' and 'European'). The main short-run results are as follows:

1. We find significant differences in the relative importance of external and internal sources of real fluctuations: external sources account for less than 25% of total variability in Germany, between 20 and 40% in France and the UK, and between 30 and 60% in Spain. These differences basically reflect different weights of real external shocks across countries. The corresponding opposite pattern of shares is estimated for domestic sources of variability, which are mainly own output shocks. We can therefore state that idiosyncratic real variability is large and that the degree of 'real openness' varies significantly across countries. This suggests that common sources of real variability are unimportant.[5]
2. As to the explanatory power of 'world' innovations, we find that oil price shocks are not particularly important in explaining output variability: less than 15% for all countries considered. Cochrane (1994) reports that they are equally unimportant in terms of explaining real fluctuations in the US economy. Moreover, US output shocks do little to explain European real variability, although their explanatory power is slightly higher than that of oil price shocks, except in the case of the UK.
   The responses of European growth rates to US output growth innovations (see Fig. 1, first column) show that, although the responses are positive, they differ in size and timing: on impact the US output effect is greater in Germany (over 0.2) than in other European countries. Moreover, the shock is felt immediately in all countries except Spain, where it peaks about four quarters later. Thus, the output innovation is asymmetric, albeit of small quantitative importance.
   From the evidence presented in Table 1 we can also infer that there is a clear difference in the relative importance of oil price innovations, which have a greater impact on the UK economy. This contradicts Bayoumi and Eichengreen (1993), who claim that responses of European output to supply shocks differ, depending on whether the country belongs to the 'core' or the 'periphery' of the European Union.
3. In terms of intra-European real transmission, the German economy is important in explaining both French and Spanish real variability and less so in explaining real variability in the UK. The German economy explains between 13 and 28%

[5] Serletis and Krichel (1992) explore the degree of shared output trends among EC countries for 1962–1990 and find it to be low. However, they attribute this to domestic policies, an interpretation which favours current plans to coordinate the move towards a monetary union.

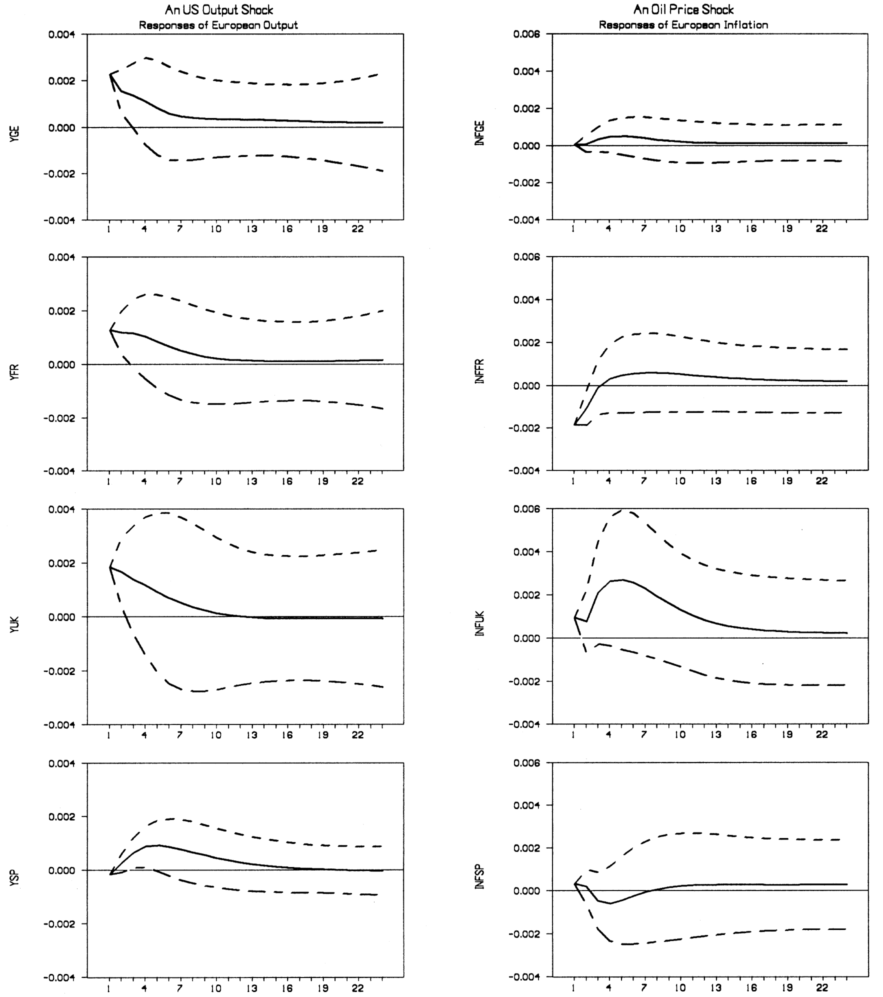


Fig. 1. Two asymmetric world shocks. Note: In each figure we report the average and the 90% band responses from a Monte Carlo experiment with 200 draws.

of France's real variability, between 4 and 26% of Spain's, and less than 14% of the UK's. Along with the US output innovations described in 2), these linkages are consistent with a 'locomotive' effect running from the US to Germany, then France and the UK (although the UK is an economy that seems fairly isolated from continental Europe), and finally reaching Spain. In Fig. 2 (first column) we present the responses of European output to a shock in

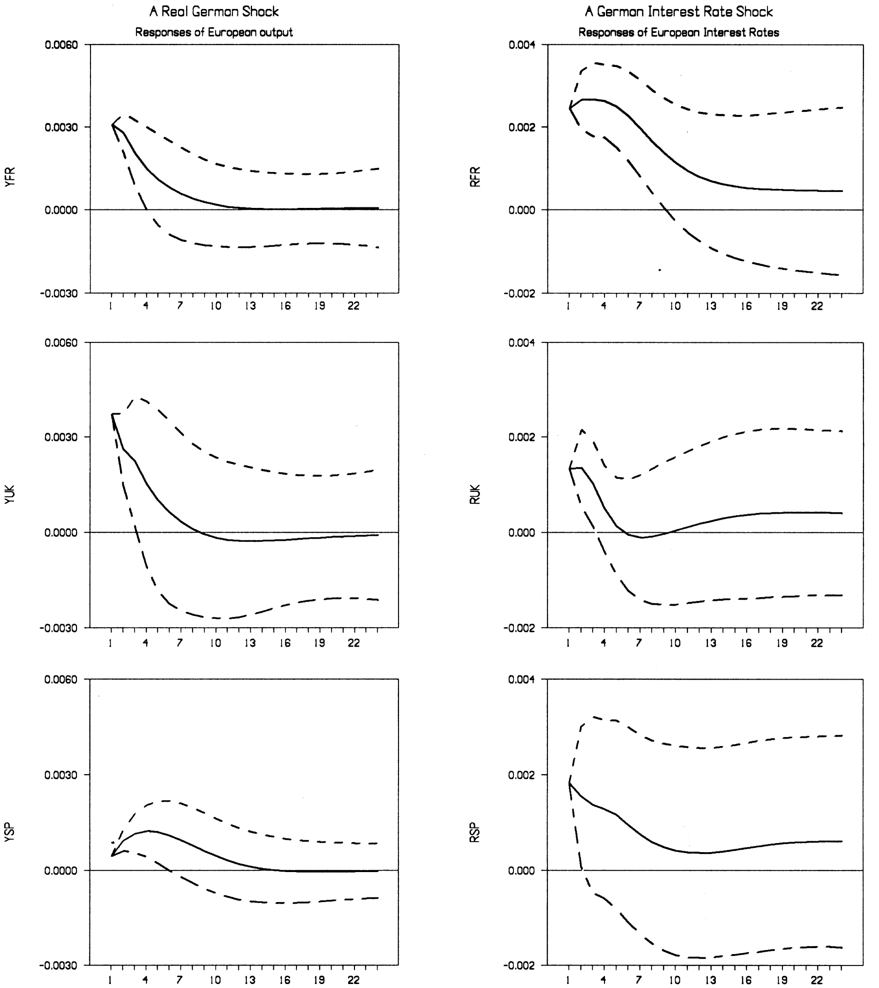


Fig. 2. Two asymmetric European shocks. Note: In each figure we report the average and the 90% band responses from a Monte Carlo experiment with 200 draws.

German activity.[6] Overall, the evidence reveals significant differences in terms of magnitude and persistence, what lead us to consider that such shocks are also ‘asymmetric’.

[6]Although the size of the first period response of the UK output to a real German shock is bigger than in France and Spain, the relatively larger variance of the UK output innovation and the low persistence of the response produces a lower share of German real innovations at the 4th quarter ahead forecast error.

### 3.2. Inflation

During part of the sample period some governments or independent central banks managed to keep inflation more tightly controlled and some countries were able to coordinate their monetary policies. This hinted that inflation variability would be more symmetrical. However, that was not the case as will be seen from our findings:

1. In the short run, most of the variability in European inflation is explained by own-country innovations (see second panel in Table 1), whose explanatory power is between 71 and 91% for Germany, 64 and 83% for France, 62 and 85% for the UK, and 34 and 51% for Spain. The evidence that prices (and also nominal wages) do not move with real shocks also appears in related country-specific analyses (e.g. Turner, 1993 for the UK or Giannini, 1992 for Italy).
2. Oil price innovations are of little importance in explaining the variability of European inflation rates: less than 15% for France and UK, and less than 10% for Germany and Spain. However, the responses differ across countries (see Fig. 1, second column). Again, the shock is 'asymmetric': the British inflation rate rises in response to oil price innovations, while French inflation goes down, thought the effect is less persistent. The responses of Germany and Spain are not significant.

The drop in French inflation may seem puzzling. It is well known, however, that if economic agents accept the loss in purchasing power derived from higher import prices, the oil shock might not have an inflationary effect. Unfortunately, the dimension of our VAR does not permit us to analyse the transmission mechanism between prices and wages or determine whether institutional arrangements in the labour markets across European countries might have played an important role in this asymmetry.

### 3.3. Interest rates

The last panel in Table 1 shows the variance decomposition for each of the four European countries' interest rate series. The main results are the following:

1. Consistent with the significant degree of financial integration that exists, a large percentage of nominal interest rate variability is generally explained in the short run by external factors, but there are significant differences: these factors

explain between 40 and 60% of variability in France, between 27 and 50% in Germany and the UK, and between 17 and 37% in Spain.[7]
2. The US nominal interest rate is important in Germany, France and the UK, but its effect in Spain is almost negligible.
3. German interest rate innovations are important in explaining French rates, but have little effect on UK and Spanish rates, and are therefore an additional source of asymmetries (see Fig. 2, column 2).

To sum up, we detected major asymmetries in terms of both the importance of idiosyncratic variability and transmission of real and nominal shocks across different European countries throughout the entire sample period.

## 4. Alternative identification schemes

Although conditional on our identification scheme, the findings described in the previous section are only partially dependent on it. At this point we should recall that our identification method does not restrict the dynamic interactions among variables.

Several characteristics of the identification may be especially controversial. The first is the triangularisation of world and domestic European blocs, whereby output leads interest rates, a 'classical' direction of causality. This implies that interest rates may only have a delayed effect on output whereas they immediately respond to current economic activity. In order to determine whether the results depend on this assumption, we inverted the order of output and interest rate within each bloc (both world and domestic European). Output could then respond contemporaneously to interest rate but not vice versa, thereby giving a 'demand determined' set up. Interestingly enough, interdependence results were not affected, except for a slight increase in the effect of US interest rate shocks and a proportionate decrease in the effect of US output shocks on the variance decomposition of European interest rates.

A second questionable characteristic of our scheme is the imposed output hierarchy between Germany, on the one hand, and France and UK, on the other. We let German economic growth have a direct contemporaneous effect on that of France and the UK but not vice versa. When the model is estimated allowing for current output feedback from France and the UK to Germany, we do not detect any significant change. More specifically, the UK remains relatively isolated from European real innovations. Interestingly enough, under this identification the real effects of German output shocks in France continue to be significant (between 5

[7]The existence of international capital flow controls in the Spanish economy during part of the sample period may explain such a difference in the short run.

and 20%) whereas the importance of French output shocks in Germany remain very low (less than 3%).

Lastly, our identification scheme does not allow for contemporaneous effects of domestic inflation on domestic interest rates. This amounts to ruling out potential current monetary policy reactions and the indirect effects of expected inflation that may be reasonably assumed when analysing quarterly data. When we relax this restriction, we do not find any significant changes in the weight of world, European, and domestic disturbances on the model.

We conclude that either a 'classical' or 'Keynesian' short-run identification is consistent with an important degree of asymmetry in these economies, and that both the uneven real connection between the German and French economies and the UK's relative isolation from continental Europe in terms of real variability are independent of the assumed output hierarchy.

## 5. Stability analysis: 1970–1979 and 1980–1996

In order to detect possible changes associated with developments in the European exchange rate regime and the economic integration process, we divide our sample into two subperiods:

- 1970–1979: a period that includes the end of the Bretton Woods system and the first oil shock, and which is characterised by high real growth rates followed by a pronounced recession, a generalised inflationary process followed by disinflation and an upward trend in nominal interest rates.
- 1980–1996: a period that includes the second oil price increase in 1979–80 and the 1986 plunge in oil prices, the birth of the European Monetary System, advances in European economic integration and substantial trade and financial deregulation throughout the world. The period was marked by two recessions followed by sizeable expansions, mainly in the US; significant appreciation in US nominal and real exchange rates, disinflationary processes in all countries and a downward trend in nominal interest rates.

Generally speaking, we would expect a greater degree of interdependence in real output and interest rates in the 1980–96 period due to the integration processes mentioned above. We would also expect more interaction among European inflation rates as a result of the Exchange Rate Mechanism. Moreover, the important fluctuations in the US nominal exchange rate could be expected to further isolate the European economies from the United States. However, only the first of these expectations is to some degree confirmed by the data. Indeed, our empirical results suggest that the 80s and 90s have not made the shocks more symmetrical. A summary of our findings is set out below.[8]

### 5.1. European output

The most important changes concern the interaction among European variables. Specifically, we estimate that German output variability was the source of a higher degree of real interdependence during the second subperiod (see Table 2, first panel): the 90% intervals in Table 2 shift to the right for all the remaining European countries but France. At the same time, the weight of external shocks decreases in all the countries, producing a moderate increase in real 'idiosyncrasy' that is attributable to own output innovations. Using a country-by-country structural VAR, Schiantarelli and Grilli (1990) found internal shocks to be more important than external ones in explaining output variability during the 80s, especially in Germany and the UK. Their findings therefore coincide with ours.

### 5.2. European inflation

The comparison between subperiods clearly indicates that the weight of external shocks continued to be lower than the weight of idiosyncratic shocks during the second subperiod and that oil price shocks still account for only a small proportion of inflation variability, although the divergence observed in the 70s has been reduced (Table 2, second panel).

By countries, we observe, first, a remarkable increase in UK inflation's response to external shocks, particularly the oil price, even with a flexible exchange rate throughout almost the entire second subperiod. Second, that the importance of external shocks, particularly oil price shocks, was practically identical in France and Germany during this period, at which time both countries were in the EMS. Third, and despite attempts to follow Deutschemark movements, Spanish inflation response to domestic factors increased significantly.

Interestingly enough, we conclude that the existence of policies that limited exchange rate variability has not prevented inflation in France and Germany from being affected by mainly domestic factors and inflation in Spain from being affected by both external and domestic factors.[9]

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[8] In accordance with Bayes' rule, the same prior information used for the entire sample (see Appendix B) was combined with the sample data and the identification scheme estimated for each subperiod.

[9] Stockman (1992) also studied inflation and monetary processes in different countries during the Bretton Woods period and found limited transmission of monetary policies and, hence, of inflation rates. However, increasing international capital mobility could modify this result.

Table 2
Stability analysis: percentage of European output, inflation and interest rate variability explaine by own and external shocks at the 4th quarter head forecasting step

Output

| | $Y_{GE}$ | | Own output | | Total external shocks | |
|---|---|---|---|---|---|---|
| | 1970–79 | 1980–96 | 1970–79 | 1980–96 | 1970–79 | 1980–96 |
| GE | | – | 69.9 | 83.5 | 27.7 | 15.1 |
| | | | (55.7, 84.0) | (77.4, 89.6) | (11.7, 43.7) | (8.5, 21.7) |
| FR | 21.0 | 19.5 | 59.1 | 66.5 | 39.4 | 31.8 |
| | (14.1, 27.9) | (11.5, 28.0) | (47.8, 60.3) | (57.6, 75.4) | (29.1, 49.7) | (23.3, 40.3) |
| UK | 6.3 | 12.3 | 67.1 | 73.1 | 32.5 | 26.1 |
| | (3.2, 9.4) | (4.9, 19.7) | (58.9, 75.3) | (63.7, 82.5) | (23.5, 41.5) | (17.9, 34.3) |
| SP | 9.8 | 18.6 | 40.4 | 50.0 | 55.7 | 46.1 |
| | (2.8, 16.8) | (15.3, 31.9) | (30.9, 49.9) | (36.7, 63.3) | (44.2, 67.2) | (33.4, 58.8) |

Inflation

| | Oil price | | Own inflation | | Total external shocks | |
|---|---|---|---|---|---|---|
| | 1970–79 | 1980–96 | 1970–79 | 1980–96 | 1970–79 | 1980–96 |
| GE | 2.2 | 6.6 | 81.2 | 71.3 | 10.8 | 19.9 |
| | (0, 5.3) | (0, 14.8) | (75.0, 87.4) | (56.7, 85.9) | (4.2, 17.4) | (8.9, 30.9) |
| FR | 22.6 | 5.6 | 62.0 | 71.7 | 38.3 | 23.8 |
| | (14.8, 30.3) | (0, 14.0) | (50.5, 73.5) | (59.5, 83.9) | (28.3, 39.3) | (10.0, 37.6) |
| UK | 7.4 | 20.2 | 70.9 | 47.7 | 19.6 | 38.2 |
| | (2.7, 12.1) | (8.0, 22.4) | (59.6, 82.2) | (36.9, 58.5) | (11.2, 28.0) | (26.2, 50.2) |
| SP | 7.7 | 2.3 | 30.6 | 48.9 | 41.6 | 31.6 |
| | (0, 17.7) | (0, 6.5) | (23.1, 39.1) | (39.0, 58.8) | (28.4, 54.8) | (18.6, 44.6) |

Interest rates

| | $Y_{US}$ | | $\boldsymbol{R}_{US}$ | | $Y_{GE}$ | | $\boldsymbol{R}_{GE}$ | | Total external shocks | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1970–79 | 1980–96 | 1970–79 | 1980–96 | 1970–79 | 1980–96 | 1970–79 | 1980–96 | 1970–79 | 1980–96 |
| GE | 2.9 | 12.1 | 32.0 | 18.0 | 1.0 | 9.0 | 38.2 | 38.9 | 48.0 | 40.3 |
| | (0, 6.5) | (2.2, 22.0) | (26.8, 37.2) | (10.6, 25.4) | (0, 2.1) | (0, 19.2) | (32.8, 43.6) | (30.0, 47.8) | (40.1, 55.9) | (30.6, 50.0) |
| FR | 5.7 | 10.3 | 17.7 | 15.4 | 2.9 | 4.4 | 11.8 | 10.7 | 50.7 | 51.8 |
| | (0, 14.4) | (2.6, 18.0) | (10.8, 24.6) | (9.5, 21.3) | (0, 7.6) | (0, 11.0) | (6.4, 17.2) | (7.4, 14.0) | (40.4, 61.0) | (40.3, 63.3) |
| UK | 2.3 | 8.5 | 14.0 | 12.5 | 5.6 | 11.4 | 1.9 | 0.9 | 31.0 | 44.0 |
| | (0, 6.1) | (0.5, 16.5) | (8.9, 19.1) | (4.8, 20.3) | (0, 12.3) | (0, 23.1) | (0.3, 3.5) | (0.1, 1.7) | (22.8, 39.2) | (28.5, 59.5) |
| SP | 6.0 | 4.6 | 6.0 | 1.0 | 1.2 | 3.1 | 0.4 | 2.7 | 27.1 | 29.9 |
| | (0, 14.2) | (0, 12.0) | (2.9, 9.1) | (0, 2.8) | (0, 3.3) | (0, 8.2) | (0, 0.8) | (0.8, 4.6) | (17.7, 36.5) | (18.2, 41.6) |

Note: For each cell we report the average and the 90% interval (in parenthesis) from a Monte Carlo experiment with 200 draws.

## 5.3. European interest rates

All the European countries included in our model revealed a higher degree of interaction with real external factors, mainly US output (See Table 2, third panel, and Fig. 3). This higher explanatory power of real innovations implies that during the 80s the weight of idiosyncratic disturbances decreased slightly in all European countries, except Germany. Furthermore, although European interest rates do not

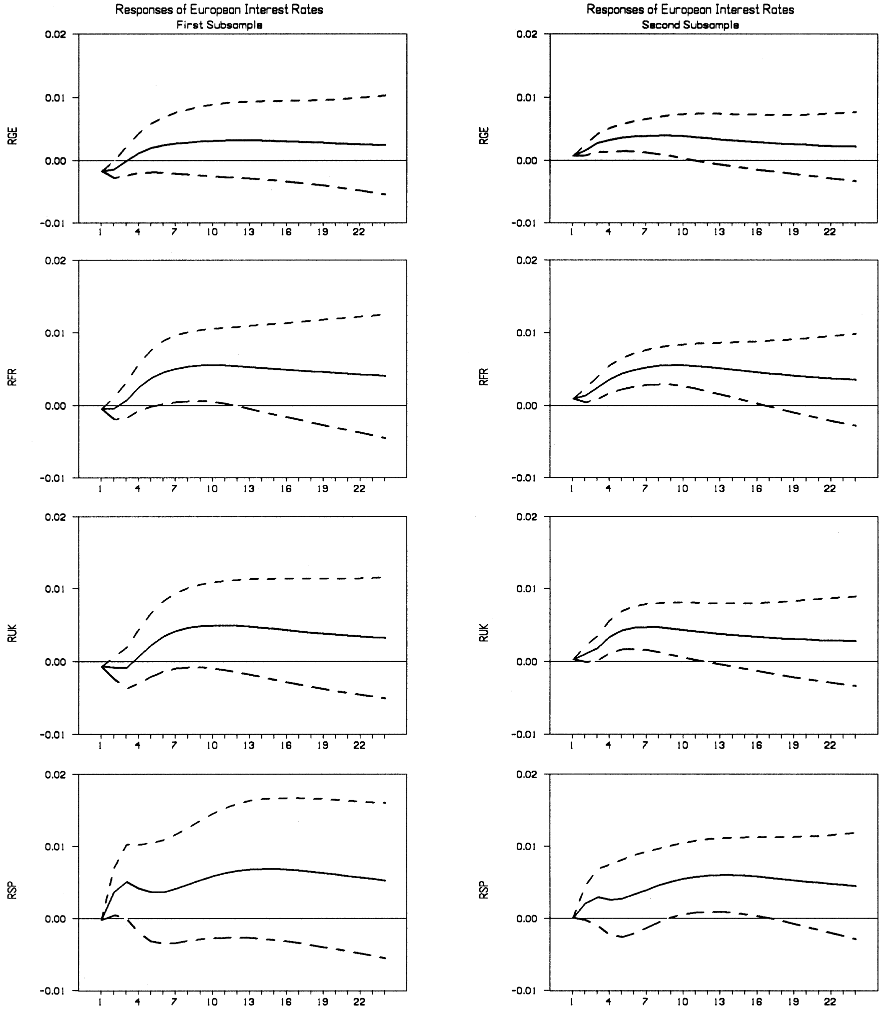


Fig. 3. A shock in US output: higher financial interaction. Note: In each figure we report the average and the 90% band responses from a Monte Carlo experiment with 200 draws.

appear to be significantly more dependent on German interest rate innovations, US rate innovations are still the major source of external variability in the financial sectors of most of the European countries in our sample.

These findings are consistent with more integrated financial markets, a consequence of market deregulation and reduced transaction costs, although European monetary policies may have shown cyclical disparities with respect to the Fed monetary policy. However, the generally small differences in the 90% intervals for external shares do not allow us to interpret the decrease in the degree of financial idiosyncrasy as more than just an incipient tendency.

## 6. Conclusions

This paper quantifies the degree of interdependence of four European economies, analysing the relative importance of domestic and foreign shocks, their real or nominal source and their persistence over time. The analysis allows us to assess the degree of symmetry of the sources of short-run macroeconomic fluctuations in Germany, France, the United Kingdom and Spain, for the sample period 1970 to 1996 and the subperiods 1970–79 and 1980–96.

On the real side we found important sources of asymmetry for the whole sample period. First, real variability is largely idiosyncratic and the degree of 'real openness' varies significantly across countries. Second, the relative importance of common external shocks is different across countries. Third, regarding intra-European real transmission, the evidence is consistent with a 'locomotive' effect that runs from Germany to France and the UK and then to Spain, with the UK economy fairly isolated from continental Europe. On the inflation side, the degree of asymmetry is even higher, despite coordinated monetary policies in some countries during part of the sample period. Most inflation rate variability is explained by domestic factors. The effect of oil price innovations in inflation rates can also be considered asymmetrical. On the financial side, we detect a higher similarity in the weight of external factors, which is consistent with the process of financial integration. However, idiosyncratic sources of variability still tend to dominate. Moreover, we also detect two additional sources of asymmetry: one stemming from the role of the US rates in explaining variability in European nominal interest rates and the other from the effect of German rates on other European countries.

When the two subperiods (1970–1979 and 1980–1996) are analysed separately, the most important changes on the real side are a higher degree of European real interdependence during the second subperiod, which stems from German output variability and affects the UK and Spain, and a moderate increase in real idiosyncrasy. On the inflation side, there are still some disparities in the effects of external shocks and the dominance of domestic factors of variability during the second subperiod. On the financial side, the weight of external factors remains basically unchanged in both subperiods, although there is an increase in the symmetry of real external factors. Overall, symmetric shocks cannot be said to have gained much ground during the 80s and 90s.

Therefore, accepting the conventional wisdom that the nominal exchange rate is a potentially effective stabilisation tool, and in the absence of alternative (e.g. factor mobility or price flexibility), our findings suggest that the move towards monetary union in Europe will be a costly process because it entails giving up a macroeconomic stabiliser in an area characterised by asymmetric macroeconomic fluctuations.


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## Appendix A

### Data

The following quarterly time series for the period 1970:1–1996:4 have been used in this study:

- Real GDP and GDP deflator (Germany, France, USA and UK), OECD; (Spain), INE.
- Treasury Bill Rate (US and UK), IMF; 3 Month Money Market interest rate (Germany and France), IMF; (Spain), Banco de España.
- World Average Oil Price ($ per barrel), and IMF.

## Appendix B

### Prior information

The $\boldsymbol{\tau}$ vector has ten components, each controlling the following aspects of the prior (the numbers in brackets indicate the optimal setting in this model, $\boldsymbol{\tau}^*$):

$\tau_0$ first own lag prior mean [0.7322]
$\tau_1$ overall tightness [0.0242]

| | |
|---|---|
| $\tau_2$ | other variable lags tightness [0.2953] |
| $\tau_3$ and $\tau_4$ | lag decay [1.0000] and constant term [5.0] tightness |
| $\tau_5$ and $\tau_6$ | time variation in $\beta$; $\tau_5 \neq 0$ and $\tau_6 = 1$ amounts to assuming a random walk law of motion for $\beta$ ($\mathbf{S} = \text{diag}(\tau_6)$), whereas $\tau_5 = 0$ and $\tau_6 = 1$ imposes $\beta(t) = \beta(t-1)$ all $t$ [$0.710^{-5}$ and 1.0000] |
| $\tau_7$ | tightness of World variables in European equations [1.4902] |
| $\tau_8$ | tightness of European variables in World equations [0.2309] |
| $\tau_9$ | tightness of Spanish variables in European and World equations [0.0000] |

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