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NEW EMPIRICAL EVIDENCE ON THE COSTS OF EUROPEAN MONETARY UNION

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ABSTRACT

New Empirical Evidence on the Costs of European Monetary Union*

In order to assess the costs of a European Monetary Union, we use a structural VAR approach based on the long-run identifying scheme pioneered by Blanchard and Quah and extended by others. We then apply the approach to as many EU members as data limitations permit: namely, Germany, Spain, France, Italy, the Netherlands and the United Kingdom. By identifying a separate shock which would cause exchange rate jumps in the short run, we hope to assess the extent to which such jumps would produce short-run movements in prices as opposed to volumes in each country. Thereby, we hope to see how much sacrifice each EU member would suffer from the surrender of independent monetary policy. Similarly, we try to identify a separate shock to home absorption in order to see how much profit each EU member would have in preserving their fiscal policy independence inside of EMU. The asymmetry between the shocks hitting the country members of a monetary union remains an issue in the paper; but it is only one of several.

JEL Classification: F02, F15, F40
Keywords: optimum currency areas, European Monetary Union, structural VAR

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NON-TECHNICAL SUMMARY

According to the literature on optimum currency areas, the costs of monetary union consist of the inability to use independent monetary policy in order to achieve optimal adjustment to shocks. Work on the costs of European Monetary Union (EMU) has therefore mostly centred on the shocks affecting the member countries. Except for efforts to apply large-scale macroeconomic models, however, this research has mainly focused on the distinction between common and idiosyncratic or symmetric and asymmetric shocks. Only the idiosyncratic or asymmetric shocks indicate any cost to monetary union. Nonetheless, the association between shocks can never tell us enough about the costs of monetary union. Whatever the degree of association between the shocks affecting individual countries, two fundamental questions remain: what could the country do about the shocks through independent monetary policy outside a monetary union? and what may the country still be able to do to attenuate the costs of adjusting to shocks through fiscal policy inside a monetary union? As regards the first question, if monetary policy cannot attenuate the costs of adjustment to shocks today, the surrender of monetary policy independence cannot be very important. As regards the second, if fiscal policy may reduce the costs of adjustment to shocks, the disadvantages of monetary union must depend partly on how much fiscal policy independence remains inside a monetary union.

In this paper we adopt a structural VAR approach to attack these questions and thereby avoid merely contenting ourselves with an analysis of the issue of asymmetry between shocks. In order to appraise the sacrifice that each EU member would suffer from the surrender of independent monetary policy, we identify a separate shock which would cause exchange rate jumps in the short run and which is therefore akin to monetary policy in its effects. We then investigate the extent to which such jumps in exchange rates would cause short-run movements in volumes as opposed to prices. Only short-run effects on volumes would bear witness to the ability of monetary policy to serve in stabilizing the economy. In a similar way, we use the identification of a separate shock to home absorption to get some idea about the value of preserving fiscal policy independence inside a EMU.

We identify five shocks in our analysis, three of them pertaining directly to the real exchange rate and net exports. These are shocks to the price of imported raw materials, the relative velocity of money at home and abroad, and *net* foreign demand (the difference between foreign demand for home goods and home demand for foreign goods). The remaining two shocks concern home absorption and supply. The relative velocity shock is then the one causing exchange rate jumps and therefore relating to the impact of monetary policy. The absorption shock, of course, pertains to fiscal policy.

In order to identify the shocks, we use the method pioneered by Blanchard and Quah and extended by others. The particular theoretical restrictions in our structural VAR are also in the same spirit as those of Blanchard and Quah: demand influences have no effect on output in the long run; nominal variables have neutral effects in the long run. An additional long-run restriction in our work, which has not served previously in identifying shocks, is that *excess* demand determines the pressure on prices. Though this last restriction theoretically holds at all time horizons, we impose it only in the long run. In addition, we simplify by supposing that the residual of the vector autoregression of the change in the foreign currency price of imported raw materials directly yields the shock to the import price of raw materials. Those assumptions – together with the usual technical ones about variance-covariance matrix of the shocks – suffice to identify all five shocks in our analysis. The study only concerns Germany, Spain, France, Italy, the Netherlands and the United Kingdom, because we were unable to obtain sufficiently long quarterly series for the remaining EU countries, and we needed quarterly series for adequate sample size. The sample period runs from 1970–1 to 1992–4, thus including 92 observations per individual country.

The results can be summarized as follows. The shock-and-response structures differ widely between the six countries. Accordingly, the cross-country associations between the shocks are pretty low. This is true in all instances except for the shock to the import price of raw materials. The pattern of cross-country associations is particularly interesting in the case of the relative-velocity shocks. These shocks are positively associated between Germany and the Netherlands, but negatively associated between Germany and the other four countries. The pattern evidently accords with the usual impression that positive news about the Deutschmark leads the guilder also to move up but the franc, the pound, the lira and the peseta to move down. But the most important general conclusion of our analysis of the associations between the shocks, by far, is the presence of wide disparities between the six countries. This impression of disparities goes far beyond any similar one gained through previous two-part classifications of shocks: between demand and supply or between symmetric and asymmetric. Had the analysis merely stopped at this point, we would then have concluded that the costs of monetary union are high. But the rest of our analysis, concerning the two earlier questions we raised about possible ability of countries to parry shocks through independent fiscal policy and possible ability to attenuate the impact of shocks through monetary policy, leads to a totally different assessment.

In the case of fiscal policy, attention centres on absorption shocks, since fiscal policy primarily affects absorption. If absorption shocks explain a great deal of the forecast errors in output or net exports or both, fiscal policy could be helpful in stabilizing output or the current account in a monetary union – that is, it could be so as long as the absorption shocks become effective in a reasonable time, since any stabilization policy must aim at a fairly short-term impact. If we read our results in this light we find that the retention of fiscal policy would be important for all countries except Germany. Even in the German case the lack of interest in the fiscal policy instrument can be contested since the distinction between absorption and net foreign demand shocks is very unstable in the analysis. The short-run effects of the net foreign demand shocks are considerable in Germany, and it could thus be that some of the influence of foreign demand shocks should be attributed to absorption shocks instead.

Our conclusions regarding the value of independent monetary policy are far more to the point because the contributions of the relative velocity shocks prove much more stable than those of the absorption shocks in the analysis. With the possible exception of the United Kingdom, Germany represents the only country where the relative-velocity shocks provide an important source of unexpected real behaviour in the short run. This shock explains to a large extent, the surprises in output performance in Germany over a six-quarter horizon. By comparison, for Spain, France, Italy and the Netherlands, this shock accounts for almost none of the unexpected short-run behaviour of output or the current account. On this evidence these four countries would thus lose little by surrendering their monetary policy independence. This last conclusion would be less strong if the relative-velocity shocks bore little effect on prices as well as output and net exports, since it could then be argued that we simply got a poor sample of observations of the shocks during the study period. But such is not the case. In fact, the previous shocks generally explain a lot of the surprise movement in inflation in the analysis – exceptionally so for France and the Netherlands. Thus, the evidence indicates that monetary policy feeds directly into prices rather than volumes in all four countries. In other words, the four countries seem to offer textbook examples of cases where monetary policy has no value as a stabilization device.

In sum, we provide a different reading of the evidence about the costs of European Monetary Union than the usual one. Though our decomposition of shocks in six member countries of the EU accentuates the conventional emphasis on the importance of asymmetric shocks in Europe, many of our other results, in regard to the efficacy of fiscal and monetary policy, raise considerable doubts about the costs of monetary union outside Germany and possibly the United Kingdom.

We should also emphasize, in closing, that the scarcity of experience with similar study methods in the context of the European economies calls for some caution in interpreting our empirical results. Indeed, we are inclined to underline the methodological interest of our work as much as our specific results. Decompositions of the shocks affecting individual economies can potentially provide major evidence about the costs of monetary union, going far beyond the question of the associations between shocks.

I. Introduction

Work on the costs of European Monetary Union (EMU) has mostly centered on the shocks affecting the member countries. Except for efforts to apply large-scale macroeconomic models,[1] this research has usually tried to distinguish between common and idiosynchratic or symmetric and asymmetric shocks.[2] Only the idiosynchratic or asymmetric ones spell any cost of monetary union. Recently Bayoumi and Eichengreen (1992) have taken a different tack: they try to distinguish between two shocks within each individual country and subsequently analyse the association of each separate shock between countries. The two shocks in their analysis are demand and supply ones. We shall extend Bayoumi and Eichengreen's analysis by trying to identify more shocks than they do. By isolating a separate shock representing the effect of a surprise in monetary policy (which could also come from abroad or from the demand for money), we hope to see whether monetary policy can deal with asymmetric shocks in the short run. If surprises in monetary policy merely affect prices rather than volumes in the short run, then the sacrifice of monetary policy independence would not seem very costly. Similarly, if we can identify a separate shock which represents unexpected fiscal policy and trace its effects, then we may be able to see if fiscal policy independence would help reduce the cost of monetary union. In sum, the identification of shocks provides an opportunity to carry the analysis of the costs of monetary union much further than the mere question of the degree of asymmetry between the shocks.

Our first task will be to explain the basic philosophy underlying our work (section II). Next, we will present our theoretical model (section III). This model is an open economy

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[1]See CEE (1990) and Minford, Rastogi and Hughes Hallett (1993).

[2]Sometimes this work has been done at the national level and has distinguished between shocks affecting two-country sums and two-country differences. See, in particular, Cohen and Wyplosz (1989). Sometimes the work has been done at the industry level and the distinction has been between shocks affecting an entire industry in the EC and others hitting only the firms in the industry in one particular country. See Bini-Smaghi and Vori (1993) and Helg, Manasse, Monacelli and Rovelli (1994).

version of IS-LM with a Phillips curve. It admits five shocks, three of which pertain directly to the real exchange rate and net exports. These are shocks to the price of imported raw materials, the relative velocity of money at home and abroad, and *net* foreign demand (the difference between foreign demand for home goods and home demand for foreign goods). The remaining two shocks concern home absorption and supply. The relative velocity shock incorporates unexpected monetary policy, the absorption one unexpected fiscal policy.

The section following the theoretical model (IV) presents our data and econometric method. First, we discuss the data, the order of integration of the series, and the tests of cointegration. Next, we explain precisely what we did in order to extract the shocks. Our method was pioneered by Blanchard and Quah (1989), later repeated by Bayoumi and Eichengreen, and extended by others.[3] It consists of using the structural VAR approach based on a long run identifying scheme. However, as we try to identify five different shocks, we naturally require more theoretical restrictions than either Blanchard and Quah or Bayoumi and Eichengreen (both of whom only needed to identify two) do. Our study will concern only six EU countries -- France, Germany, Italy, the Netherlands, Spain and the United Kingdom -- since we were not able to obtain long enough quarterly series for any of the rest, and we needed quarterly series in order to have an adequate sample size, if nothing else.[4] It is only because they use annual series that Bayoumi and Eichengreen are able to discuss more EU countries. We shall present our results in a separate section (V) which centers on the evidence bearing on the costs of monetary union.

One general caveat is in order. The only wide experimentation with VAR models thus far in connection with aggregate economic performance relates to the U.S. Serious evaluations

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[3]See, in particular, Gali (1992).

[4]See Canova, Faust, and Leeper (1993) who also argue that a high frequency of observations may be important because of the assumption of the independence of the structural shocks in the statistical analysis.

of Blanchard and Quah's proposal for identifying shocks have depended heavily on these earlier experiments. There is no similar breadth of experience with applications of the same methods to the European aggregates, while the results in Europe could differ sharply because of the smaller size and greater openness of the economies. To make matters worse, we are concerned with cross-country evidence. For all these reasons, we shall emphasize our logic and bases for inference as much as what we find.

II. Basic Principles

What does a country sacrifice when it gives up a separate currency -- apart from any matter of political prestige? According to the literature on optimum currency areas, the costs of monetary union consist of the inability to use independent monetary policy in order to achieve optimal adjustment to shocks. Thus, we must look for higher adjustment costs. Suppose then that we know the structure of the shocks affecting macroeconomic performance in all individual countries and that this knowledge extends to the covariances of the shocks affecting the individual countries. There are still two reasons why we cannot infer the loss of welfare caused by monetary union (apart from issues of social preferences, including the social discount rate). One is that a country may still be able to respond to shocks without a separate currency. The other is that a union member might not be able to do anything about the shocks anyhow. Both of these reasons are important.

To all evidence, the individual countries of Western Europe -- certainly the large ones -- will retain more influence over domestic fiscal policy after entry into EMU than exists in any other monetary union today -- far more such influence than the Canadian provinces possess, for example, to say nothing of the American states. Studies always show that the mobility of labor in the EU is lower than within national borders.[5] Thus, member countries' capacity to

[5]See, for example, Eichengreen (1990) and De Grauwe and Vanhaverbeke (1991). Low labor mobility in the EU is typically invoked as a major argument against EMU. But it is also true that such low mobility would make fiscal policy more effective.

tax will be correspondingly higher. Supporters of EMU also differ widely in their preferred degree of centralization inside the EU. It is therefore important not to identify the costs of European monetary union with those of surrendering all independent macroeconomic management, but to maintain a clear distinction between EMU and a European Union with all power over fiscal policy concentrated at the center.

As regards monetary policy independence today, imagine a progressive sub-division of a country into smaller and smaller regions. As the regions get smaller, the variance of the shocks hitting them must rise in many individual cases and become more distinct from the variance hitting the aggregate of the rest, since the smaller the regions the more specialised many of them will be. Does this mean that the costs of monetary union correspondingly rise with lower size? To say so would be almost paradoxical. Yet the paradox is revealing and the answer is clear: with lower size also comes lower capacity to wield the instruments of macroeconomic policy in any meaningful way. A very small economy has little autarchy with respect to macroeconomic policy. As reflected in the literature on optimum currency areas, successively smaller regions also become increasingly open and price-takers. The mere covariance of the shocks between different countries therefore cannot instruct us adequately about the costs of monetary union. We must take separate account of the degree of sacrifice of macroeconomic influence.

In order to heed these problems, we shall need to distinguish and analyse more shocks than demand and supply ones. While the cross-country relationships between the shocks will provide relevant information, so will other evidence about the shocks, as we will see. The variance decomposition of the influences of the shocks on real variables at home will prove particularly useful in interpreting the costs of monetary union.

III. The Model

Since we will want the smallest possible framework in order to increase the chances of a successful application of a structural VAR, the model we will propose will be somewhat unfamiliar. Rather than proceed directly to this model, therefore, we will start with a larger one which is more easily recognizable. The larger model we have in mind is an open economy version of IS-LM with a Phillips curve. It can be expressed, in general functional form, as follows:

(1) $A = f_A(Y, R - \Delta p^e_{+1}, U_A)$	Absorption
(2) $X = f_X(Y, Y^*, \frac{P}{EP^*}, U_X)$	Net exports
(3) $\overline{Y} = f_{\overline{Y}}(K, N, Q, U_S)$	Supply
(4) $Y = A + X + \Delta\overline{Y}$	Output
(5) $\Delta P = f_P(\Delta P_{-1}, \Delta(EP^*), A + X - \overline{Y})$	Phillips curve
(6) $Q = f_Q(Q_{-1}, U^*_Q)$	Imported raw materials
(7) $P^* = f_{P^*}(P^*_{-1}, U^*_Q, U^*_{MS}, U^*_{MD})$	Price of foreign output
(8) $R^* = f_{R^*}(R^*_{-1}, U^*_{MS}, U^*_{MD})$	Foreign interest rate
(9) $R = R^* + \Delta e^e_{+1} + U_{MS}$	Interest rate parity
(10) $\frac{M}{P} = f_{MD}(Y, R, U_{MD})$	Demand for money
(11) $\frac{P}{EP^*} = f_{P/EP^*}(X, U^*_Q, U^*_{MS}, U^*_{MD}, U_{MS}, U_{MD})$	Real exchange rate

Much of the notation is familiar enough not to need explanation. All the U variables refer to shocks. Equation (1) pertains to home absorption A, equation (2) to *net* exports X, $\overline{Y}$ in equation (3) refers to supply of output and Q in this equation to imported raw materials. Equations (1) through (5) represent the IS and the Phillips curves. Equation (4) may appear to be a definition, but is instead a statement about production. In fact, this statement deviates from the typical textbook which says that output only responds to demand shocks in the current period, while supply shocks affect output (through prices) after a lag. This idea of strictly lagged influences of supply shocks involves a strong restriction that we do not wish to impose (compare Gali (1992), who adopts the same view). Our alternative hypothesis is that a positive (negative) supply shock will cause firms to raise (lower) capacity and thereby affect *current* output (through demand for capacity). Based on the last equation (or (4)), firms will also respond to positive (negative) demand shocks, in the textbook manner, by raising (lowering) output without changing capacity. Correspondingly, equation (5), which represents the Phillips curve, allows for *contemporary* effects on prices of, both, differences between demand (A+X) and supply ($\overline{Y}$), and changes in import prices (EP*).

Equations (6), (7), and (8) introduce various shocks from abroad: one to the foreign *price* of imported raw materials, U_Q^*, and two more to the prices of other imports besides raw materials and the foreign nominal interest rate. We label these last two shocks U_{MS}^* and U_{MD}^* on the view that foreign monetary policy (MS for money supply) or foreign money demand (MD) will be heavily responsible. Equation (9) states interest rate parity on the basis of one-period-ahead forecasts of the rate of appreciation of the exchange rate Δe_{+1}^e (where e is the log of the exchange rate E) in conformity with the general presentation of the model in interval time. Since we suppose that the authorities fix U_{MS} (possibly at zero, as in the case of no money-supply surprises), quite significantly, our formulation considers the domestic monetary authorities to set the money interest rate R and not the money stock M. Being unanticipated, U_{MS} enters separately in equation (9). Equation (10) concerns the demand for money or the LM curve. The last equation, (11), which serves to determine E, notably ties the real exchange rate to current account balance X as well as a number of shocks. Finally, the two expected variables, p_{+1}^e and e_{+1}^e, can be interpreted as the mathematical expectations of p and e in the next period.

But while the model may be small, it is extremely large for the application of a VAR. There are probably too many shocks: eight of them altogether. Therefore we proceeded to reduce the model by eliminating the real interest rate as a separate influence in the absorption equation. One interpretation would be that $R-\Delta p_{+1}^e$ does not affect demand. But a better interpretation, we think, would be the presence of a strong positive association between $R-\Delta p_{+1}^e$ and the real exchange rate P/EP* which is reinforced by the responses of the monetary authorities to other shocks and therefore the behavior of U_{MS}. On this next view, the impact of P/EP* in the demand equation really comprises that of $R-\Delta p^{e}_{+1}$.

Having eliminated $R-\Delta p^{e}_{+1}$, we may reformulate the model as follows:

(12) $y-x=\alpha_o+(u_s-\alpha_1 u^*_q)-\alpha_2(p-e-p^*)+u_a$

(13) $x=\beta_o-\beta_1(\alpha_o+u_a)-(\beta_2-\beta_1\alpha_2)(p-e-p^*)+u_x$ $\qquad\qquad \beta_2>\beta_1\alpha_2$

(14) $\Delta p^*_q=\Delta p^*_{q,-1}+u^*_q$

(15) $p-e-p^*=(p-e-p^*)_{-1}+\lambda_1 x\pm\lambda_2 u^*_q+u_v$

(16) $\Delta p=\Delta p_{-1}+\delta_o u^*_q-\delta_1 u_v+\delta_2(u_a+u_x-u_s)$

Small Roman letters serve to indicate logarithms of the previous capitals except in the case of x, which now stands for the log of the ratio of exports to imports, and that of p^*_q, a new symbol representing the log of the foreign price of imported raw materials. Greek letters refer to (positive) coefficients. We thus adopt a loglinear form. Because of this loglinear choice, we subdivide Y multiplicatively between the ratio of exports to imports and the rest, rather than additively, as before, between A, X and $\Delta\overline{Y}$. The sign of the influence of the real exchange rate in equation (12), relating to all output except for net exports,[6] echoes the previous idea that $p-e-p^*$ may reflect the implicit joint effect of $R-\Delta p^{e}_{+1}$ and thus may bear a negative impact on home investment. Equation (13), in turn, derives from:

(13a) $x=\beta_o-\beta_1 a-\beta_2(p-e-p^*)+u_x$

where a is the (logarithmic) reflection of home absorption and equals $y-x-u_s+\alpha_1 u^*_q$.

[6]Since net exports enter positively in $y-x$ through y but negatively through $-x$, they may be supposed not to be concerned in the equation at all (just as they clearly were not in equation (1) before). This matters because we shall need to assume that u_a and u_x are uncorrelated in our econometric work.

The biggest contraction of the model of all comes from the compression of the previous shocks U^*_{MS}, U^*_{MD}, U_{MS} and U_{MD} into a single one, u_v (v for velocity). This new shock then is supposed to embrace all influences of monetary policies and demands for money at home and abroad on the real exchange rate. We term this shock a relative-velocity one because of its presumed monetary origins. Thus, two countries in a monetary union would experience identical u_v shocks. Furthermore, any unexpected change in competitiveness resulting from wage contracts at home, for example, would not be reflected in u_v but u_s. The endogenous variables become simply output, the ratio of exports to imports, the foreign price of imported raw materials, the real exchange rate, and the price of home output.

Once we rewrite equations (12) through (16) in reduced form, we can undertake the necessary steps to convert the system into a VAR model and then proceed to apply Blanchard and Quah's method of imposing long run restrictions in order to identify the shocks. The particular restrictions we shall use are in the same spirit as theirs. Demand influences have no effect on output in the long run: therefore, neither u_a nor u_x has any long run effect on y. Similarly, nominal variables have neutral effects in the long run: thus, u_v should leave the real exchange rate unchanged in the long run (as this shock strictly reflects nominal conditions at home and abroad). But if u_v does not affect $p - e - p^*$, it cannot affect either the current account, x, or output, y. This already yields us five separate long run restrictions in the VAR. A sixth one derives from the Phillips curve: it says that the difference between demand and supply, or the excess demand, determines the pressure on prices. If so, the respective effects of $u_a + u_x$ and u_s on Δp should be of equal and opposite strength (as equation (16) asserts). Imposing this last condition only in the long run allows short run deviations and therefore restricts the dynamics less than a similar short run application would.

We simplified further by treating the vector autoregression of the variable Δp^*_q of equation (14) as directly yielding the import-price shock (while testing the assumption with causality tests). Consequently, the identification of the shocks became much easier in the VAR. As we shall show later on, the preceding six long run identification conditions suffice.

IV. The Series and Methodology

(a) The series

All of our statistical series come from the OECD. Our figures for output (GDP), the price level (the price of GDP), exports and imports are seasonally adjusted and drawn from the Quarterly National Accounts. The price of imported raw materials comes from the International Trade and Competitiveness Indicators, the exchange rates from the Main Economic Indicators. As mentioned before, given our decision to use quarterly data, we limit ourselves to six EMS countries: France, Germany, Italy, the Netherlands, Spain and the U.K. The sample period runs from 1970.1 to 1992.4 -- 92 observations per individual country. In order to construct real exchange rates, we must pay separate attention to the prices of foreign competitors, or in terms of our earlier notation, P* times E. We do so by collecting quarterly data for the price of GDP from as many OECD members as possible and then constructing weighted averages for P* for each of our six EMS country members on the basis of the prices of all the rest (notably comprising the U.S., Japan and Canada --among others -- as well as the other five countries in the EU). The weights depend on the import shares recorded in the OECD model INTERLINK. We construct E in the same way: that is, on the basis of the bilateral exchange rates with the same set of foreign trade partners and the same weights.

Continuing the study until the end of 1992 means dealing with the German unification shock. This poses important problems about 1990-92 German data, to which there is no easy solution. We opted in favor of calculating German output and prices since the third quarter of 1990 by extending the earlier West German data on the basis of the pan-German growth rates. German output following unification is then the West German output in 1990.3 times one plus the compounded quarterly rate of growth of output in east and west therefrom; and the German price level obtains the same way. As a result of this procedure, the poor output performance of the eastern region in 1990-92 shows up in our data as a deceleration of German output growth, and therefore as a negative shock. Had we simply switched instead to the data for pan-German output in 1990.3, the contribution of East Germany to output would have signified more growth (as we are using output aggregates), and the effect of unification on output would then have shown up as a positive shock. This consideration explains our choice, since we tend to think of unification as a negative output shock with inflationary implications (thus a negative *supply* shock). On the other hand, as regards the ratio of exports to imports, we did simply switch from the West German to the pan-German data in 1990.3. Consequently, we display a sharp deterioration of the German current account at the time of unification, implying a negative net foreign demand shock u_X (in terms of our notation in equation (13)). Had we used the West German current account data instead, we would have exhibited a marked *increase* in the trade surplus following unification in light of the massive transfer of goods from the western to the eastern region of the country. The West German data thus becomes particularly misleading about trade relations with the rest of the world after unification, and it is extremely important to view the current account of Germany on a pan-German basis from that time on. With respect to the price of imported raw materials (P_Q^*) and the home price of foreign goods (P*E), we simply extended the previous West German series and therefore, quite specifically, kept the same weights of foreign prices throughout (whether they be those of the OECD, as in the case of P_Q^*, or ours, as in the case of P*E).[7]

(b) Integration and cointegration

The passage into logs yields y, x, Δp, Δp_q^*, and $p - e - p^*$. Subsequently, we must check for the order of integration of the series for $y - x$, x, Δp , Δp_q^*, and $p - e - p^*$. We did so for $\Delta p - \Delta p_q^*$ as well in order to be able to substitute this variable for Δp, as turns out to be useful later on. To check for the order of integration, it is important to choose the length of the lags carefully, since totally different results can obtain depending on lag lengths. We must also pay attention to the possibility of I(2) or second-order integration. The procedure we used

[7]There was some problem with the published quarterly Dutch data as well, which only begins in 1977. However, we were able to obtain earlier Dutch figures directly from the OECD, and when we converted these to a 1980 base -- the same base year we used for all the other countries in our study -- we found no break in any of the individual Dutch series.

(prescribed by Jobert (1992)) is to choose an appropriate lag length based on various criteria, and then carry out a whole battery of augmented Dickey-Fuller tests in a particular sequential order depending on the significance of constants and deterministic time trends in earlier steps. We performed Schmidt-Phillips tests as well. These tests lead to an acceptance of I(0) for Δp, Δp^*_q and $\Delta p - \Delta p^*_q$, but as we might expect, adjusted output, $y - x$, and the real exchange rate, $p - e - p^*$, are clearly I(1). The only ambiguity concerns the export/import ratio x, which appears I(0) for one country (the U.K.), I(1) for another (Spain), but could be either one for the rest depending on the test. Since we aim to construct some cross-country aggregates and to make cross-country comparisons, we have strong reason to prefer adopting the same order of integration for all the countries. I(1) then seems to be the superior choice on general principles (better to err by treating I(0) series as I(1) than doing the reverse), and it suits us better as well since $y - x$ is I(1) and we shall need to add up $y - x$ and x in order to obtain y later on. The hypothesis I(2) can be uniformly rejected.

Given the clear presence of a unit root in adjusted output $(y - x)$ and the real exchange rate, cointegration between these two variables and between them and the rest becomes a plain possibility, in which case, of course, the Vector Error Correction Model (VECM) would be more appropriate than a VAR. Tests of cointegration require first finding the optimal number of lags (using a VECM). Based on the usual criteria, this number turns out to be one or two depending on the country. In testing for cointegration, we chose two lags everywhere, and subsequently resorted to tests of maximum eigenvalue and trace. But since questions of cointegration did not determine our final choice of the number of quarterly lags, we also duplicated our tests of cointegration based on our preferred choice of lags and got essentially the same results.

The only significant cointegrating relationships that emerged from these tests, according to the thresholds in the tables of Osterwald-Lenum (1992) (which modify those of Johansen and Juselius (1990)), are between Δp and Δp^*_q and the alternative pair $\Delta p - \Delta p^*_q$ and Δp^*_q. This is clearly true everywhere except the U.K. But it also holds there as well if we apply stringent enough significance tests to deny the presence of a second cointegrating relationship (at the 2.5 percent level). Since Δp , Δp_q^* and $\Delta p - \Delta p_q^*$ are I(0), the cointegration of either Δp and Δp_q^* or $\Delta p - \Delta p_q^*$ and Δp_q^* poses no problem and we were able to pursue the rest of the analysis with a VAR (compare Karras (1994)).

(c) Identification

Based on the previous analysis, the model we will investigate will be:

(17) $\mathbf{z}(t) = C(L)\mathbf{e}(t)$

where the vector $\mathbf{z}(t) \equiv [\Delta(y-x)(t), \Delta x(t), \Delta p(t), \Delta(p-e-p^*)(t), \Delta p_q^*(t)]'$ (alternatively with $(\Delta p - \Delta p_q^*)(t)$ instead of Δp (t)) is a stationary process, L is the lag operator, C(L) is a 5×5 matrix of lagged polynomials, and $\mathbf{e}(t) \equiv [e_a(t), e_x(t), e_s(t), e_v(t), e_{q^*}(t)]'$ is assumed to be a serially uncorrelated vector of structural disturbances relating to absorption, the ratio of exports to imports, supply, relative velocity, and the foreign-currency price of imported raw materials, in that order. Under usual assumptions, $\mathbf{z}(t)$ has a moving-average, Wold representation such that

(18) $\mathbf{z}(t) = E(L)\mathbf{v}(t)$

where E(L) is an invertible 5×5 matrix of lagged polynomials, E(0) is the identity matrix of order 5, and $\mathbf{v}(t)$ is the vector of innovations of the elements of $\mathbf{z}(t)$. As E(L) is invertible, equation (18) can be estimated in the autoregressive VAR form $E(L)^{-1}\mathbf{z}(t) = \mathbf{v}(t)$, which yields an estimate of the matrix E(L).

The critical next step is to assume that the vector of innovations can be expressed as a linear combination of the structural shocks:

(19) $\mathbf{v}(t) = S\mathbf{e}(t)$

where S is an invertible matrix. From (17), (18), and (19), we have

(20) C(L) = E(L) S

Thus, if we can succeed in determining the matrix S, we can identify the structural shocks in equation (19) and C(L) can be derived.

The identification of S results from a set of restrictions. Since S is a 5×5 matrix, 25 restrictions on its components are necessary. Equation (19) implies a strict relation between the variance-covariance structure of the innovations or $V(v(t))$ and that of the structural shocks or $V(e(t))$: namely,

$$(21)\ V(v(t)) = S\,V(e(t))\,S'$$

where the estimated residuals of the VAR, of course, provide convergent estimators of $V(v(t))$.

According to a conventional normalisation, the 5 diagonal elements of the $V(e(t))$ matrix are set equal to one. It is also commonly assumed (rather heroically) that the covariances of the structural shocks are all equal to zero. From these conventions, $V(e(t))$ is the identity matrix of order five and equation (21) reduces to:

$$(22)\ V(v(t)) = SS'$$

Based on the perfectly symmetric nature of $V(v(t))$, we can then deduce 15 non-linear and independent constraints on the components of S. Four additional restrictions derive in our case from the idea that the price of imported raw materials p_q^* is exogenous, which means that the other four structural shocks in the analysis have no influence upon this price. This last assumption can be written as:

$$(23)\ S_{5i} = 0 \qquad \forall i = 1 \text{ to } 4$$

Causality tests clearly support this assumption except in the case of Spain where it can only be accepted at the one percent significance level (rather than the five percent one). In regard to the remaining six identifying restrictions $(25-15-4=6)$, we depend on our theoretical hypotheses about the long run effects of shocks.

Specifically, the use of these next theoretical ideas can be explained as follows. Let the matrix of long run structural coefficients C(1) be:

$$(24)\ C(1) \equiv \begin{bmatrix} c_{ya} & c_{yx} & c_{ys} & c_{yv} & c_{yq^*} \\ c_{xa} & c_{xx} & c_{xs} & c_{xv} & c_{xq^*} \\ c_{pa} & c_{px} & c_{ps} & c_{pv} & c_{pq^*} \\ c_{va} & c_{vx} & c_{vs} & c_{vv} & c_{vq^*} \\ c_{q^*a} & c_{q^*x} & c_{q^*s} & c_{q^*v} & c_{q^*q^*} \end{bmatrix}$$

where the coefficient c_{ij} is the long run response of the variable i (i = $\Delta(y-x), \Delta x$, Δp or $\Delta p - \Delta p_q^*$, $\Delta(p-e-p^*)$, Δp_q^*) to the structural shock j (j = $e_a, e_x, e_s, e_v, e_{q^*}$). Our previous theoretical assumptions would say:

$$(25)\ C(1) = \begin{bmatrix} c_{ya} & c_{yx} & c_{ys} & 0 & c_{yq^*} \\ -c_{ya} & -c_{yx} & c_{xs} & 0 & c_{xq^*} \\ c_{pa} & c_{px} & -(c_{pa}+c_{px}) & c_{pv} & c_{pq^*} \\ c_{va} & c_{vx} & c_{vs} & 0 & c_{vq^*} \\ c_{q^*a} & c_{q^*x} & c_{q^*s} & c_{q^*v} & c_{q^*q^*} \end{bmatrix}$$

The twin conditions $c_{xa} = -c_{ya}$ and $c_{xx} = -c_{yx}$ follow from the supposed absence of any long run influence of demand shocks on output y. The condition $c_{vv} = 0$ is, practically speaking, our definition of the relative-velocity shock e_v and implies c_{yv} and $c_{xv} = 0$ as well. $c_{ps} = -(c_{pa} + c_{px})$ expresses the Phillips-curve hypothesis that inflation depends on *excess* demand. The last row of the matrix, which relates to effects on p_q^*, should obviously contain four zero's. But this last property of C(1) is already contained in the construction of S via equation (23) and the exogeneity of p_q^*. Given equation (20), the preceding six long run theoretical conditions imply six corresponding restrictions on the product E(1)S, which can serve in identifying S. The count is right: with 25 conditions, S is just-identified.

V. The Results

We used the method of seemingly unrelated regressions in order to estimate the matrix of coefficients in the VAR rather than OLS because of the exogenous nature of the import price of raw materials. At first we experimented with a uniform number of lags in these matrices in all six countries, and once having identified the matrix S, we compared the influence of the structural shocks with our theoretical specification. Bayoumi and Eichengreen did the same. But whereas they merely looked for two particular signs of influence (positive effects of demand shocks and negative effects of supply shocks on inflation), we had many more signs to check. Our five shocks yield 15 different effects on three variables of major policy interest: output y, inflation Δp, and the current account x. Of these 15 effects, 13 have a specific sign on the basis of our theoretical model (equations (12) through (16)) -- that is, they do so if we consider the situation prior to complete adjustment when many of those influences go to zero.[8] Not surprisingly, never do our estimates satisfy all 13 corresponding conditions (prior to complete adjustment). But occasionally, they obey as many as 10 of them. Following an examination of the robustness of the results based on a wide range of specifications (concerning lag length, Δp or $\Delta p - \Delta p_q^*$ as a dependent variable, etc.), we decided eventually to adhere to as uniform a specification as possible on condition of having at least a majority of correct signs. The country estimates we then choose yield 10 correct signs (out of the 13) in two country cases, 9 correct signs plus one ambiguous one in another, 8 correct ones in two others, and 7 correct signs plus two ambiguous ones in one case. The specifications giving rise to these results differ only as regards the presence of either three or four lags in the autoregressive VAR and Δp or $\Delta p - \Delta p_q^*$ as a dependent variable.

We may begin the discussion of the empirical results with a cursory look at the variance decompositions of the forecast errors in output (y), the current account (x), and

[8]Quite specifically, the signs of those influences are as follows, where parenthetical zeros serve to indicate the cases of a tendency for the influence to vanish in the long run:

	e_a	e_x	e_s	e_v	e_{q^*}
y	+(0)	+(0)	+	−(0)	−
x	−	+	?	−(0)	?
Δp	+(0)	+(0)	−(0)	−(0)	+(0)

inflation (Δp), which we will examine more closely later on. A glance at table 1 shows that the shock-and-response structures differ widely between the countries. It will not be surprising, in this light, to find that the cross-country associations between the shocks are very low except in the instance of the import price of raw materials.

In order to measure these associations, we constructed a foreign shock pertaining to each country which consisted of a weighted-average of the other five (with fixed weights based on national output relative to the aggregate output of all six in marks during the middle of the sample, or in 1978-82). Next, we calculated covariances between the home and foreign shock ($cov(e_h, e^*)$) for each country and each shock. The ratio of the covariance to the variance ($cov(e_h, e^*) / V(e_h)$) served as our measure of association. This measure has the desirable property of reflecting amplitude as well as direction. The measure is also particularly desirable in our case because of our use of a weighted-average foreign shock, which makes the correlation coefficient a bit awkward since the latter becomes impossible to divorce from the composition of the variances between the foreign countries, whereas, in principle, a correlation is meant to be distinct from variances.

Table 2 shows the only strong association between the shocks to concern the import price of raw materials, e_{q^*}, as we mentioned before. In the case of the other shocks, the ratios of the covariance to the variance are generally small and mostly close to zero. Even the association between the e_{q^*} shocks is weaker than we might expect, being only around 0.4 to 0.6. Since these expectations rest on annual oil prices, we also examined the associations between the annual averages of the e_{q^*} shocks and found them to be indeed much higher: in the 0.60-0.80 range.

The only other column of table 2 deserving comment is the relative-velocity one, essentially because the contribution of the e_v shock to the variance decompositions proved to be much more stable than those of e_a, e_x and e_s (in the first three columns) in the earlier trials.[9] Table 3, which concerns bilateral relations with Germany, facilitates the interpretation of the e_v column of table 2 (though table 2 remains our basic point of reference, since we posit a monetary union between all six countries rather than alternatives ones between Germany and one of the other countries, each taken in turn). This next table shows a positive association between the e_v shocks in Germany and the Netherlands but a negative one between those in Germany and every other country. This result conforms to the usual impression that positive news about the mark leads the guilder also to move up but the franc, the pound, the lira and the peseta to move down.

The general upshot of this analysis is a view of great disparities between the six countries -- greater than any similar impression gained through previous two-part classifications of shocks: between demand and supply or between symmetric and asymmetric. From the perspective of the associations between shocks, therefore, the costs of monetary union seem very high.

But the analysis can go on to consider the two earlier questions we raised about the possible ability of countries to parry shocks through independent fiscal policy within a monetary union and their possible ability to attenuate the impact of shocks through monetary policy outside a monetary union. The first question -- regarding fiscal policy -- requires focus on the impact of absorption shocks as such, since fiscal policy essentially affects absorption. If absorption shocks explain a great deal of the forecast errors in output or net exports or both,

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[9] Indeed, the estimates of the absorption and net foreign demand shocks proved particularly unstable. At first we thought that we had not provided adequate grounds for distinguishing the two. Therefore, we experimented with the very strong identifying condition that e_x has no immediate influence on absorption, in accordance with equations (12) and (13) of our theoretical model. This means imposing an additional zero in the e_x column (along the $y - x$ row) of the matrix S and correspondingly dropping one of our earlier identifying restrictions. We picked the absence of long run influence of e_v on either x or $y - x$ as the condition to drop. However, the same instability in the estimates of e_a and e_x remained. Therefore, we stuck to the previous long run theoretical restrictions, which we prefer (as a bit less confining).

then presumably fiscal policy could be helpful in stabilizing output or the current account in a monetary union. More specifically, it could be so as long as the absorption shocks become effective in a reasonable time, since any stabilization policy must aim at a fairly short-term impact.

If we read the first numerical column of table 1 in this light, we find that the retention of fiscal policy would be important for all countries except Germany, since in all of the other cases, the e_a shock contributes a lot to explaining news about output or net exports or both within a six-quarter horizon. As a matter of fact, even the German lack of interest in keeping the fiscal policy instrument can be contested, because of aforementioned instability in the distinction between absorption and net foreign demand shocks in the analysis (see note 9). Since the short run effects of the foreign demand shocks are considerable in Germany according to table 1, it could then be that some of the influence of these shocks in the table should be attributed to absorption shocks instead.

The issue of the value of independent monetary policy requires us to shift our attention to the relative velocity shock. The results concerning this shock are more interesting than those about e_a since the contributions of the e_v shocks to the variance decompositions are far more stable. With the possible exception of the United Kingdom (where the e_v shock has some short-run significance in explaining output and net export performance, if we take the two together), according to table 1, Germany represents the only country where the e_v shocks are an important source of unexpected real behavior in the short run. The relative-velocity shock explains a good deal of the surprises in output performance in Germany over a six-quarter horizon. By comparison, in the case of France, Italy, Spain, and the Netherlands, this shock accounts for almost none of the unexpected short run behavior of output or the current account. On this evidence, these four countries would lose little by surrendering their monetary policy independence. Indeed, this last conclusion can be reinforced, since the argument cannot be questioned on the ground that the influence of the e_v shocks merely evaded us, as in all four countries the e_v shocks have important effects on inflation --

exceptionally so in the case of France and the Netherlands.[10] The evidence would then say that monetary policy feeds directly into prices rather than volumes in the four countries. All four countries seem to offer textbook examples of cases where monetary policy has no value as a stabilization device.

VI. Conclusion

We have provided a different reading of the evidence about the costs of European monetary union. Our decomposition of five shocks in six member countries of the EU (the only six for which we had the required data) shows the association between individual shocks to be much lower than has often been recorded. But we also pursued the analysis to examine the impact of monetary and fiscal policy on economic performance. Independent monetary policy might be of little value outside of monetary union, and independent fiscal policy could serve to mitigate costs of adjustment later on, inside a monetary union.[11] In pursuing the analysis thus far, we responded to some important concerns about European monetary union which have often been slighted in empirical work. Our conclusions on the basis of these added considerations lead to a different assessment. Major doubts arise about the costs of monetary union except for Germany and possibly the United Kingdom.

Once again, we should emphasize in closing that our empirical results regarding the individual European economies must be viewed with caution because of a scarcity of experience with similar study methods in the European context. We are very much inclined to underline the methodological interest of our work quite apart from our specific results. Decompositions of the shocks affecting individual economies can potentially provide major

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[10]The Spanish case might seem a bit questionable, but our conclusions about the impact of the e_v shocks in the Spanish example (as to relative effects on inflation and real performance) proved quite robust under alternative specifications (which we rejected because of fewer theoretically correct signs).

[11]Interestingly enough, the very presence of highly asymmetric shocks amplifies the argument for independent fiscal policy by diminishing the problem of non-cooperative behavior.

evidence about the costs of monetary union, going far beyond the question of the cross-country associations between shocks.

TABLE 1

DECOMPOSITION OF FORECAST ERRORS

Shock	Absorption	Net foreign demand	Supply	Relative velocity	Import-price of raw materials
Germany (Δp; 3 lags)					
Output: 6 quarters	4	51	6	28	12
30 quarters	7	31	1	29	32
Net exports: 6 quarters	0.2	40	49	0.5	10
30 quarters	0	66	22	0.3	12
Inflation: 6 quarters	17	12	31	33	7
30 quarters	16	15	30	32	7
France (Δp; 3 lags)					
Output: 6 quarters	57	17	24	0.5	2
30 quarters	46	35	15	3	1
Net exports: 6 quarters	5	30	63	0.3	2
30 quarters	8	42	41	1	8
Inflation: 6 quarters	3	2	2	83	10
30 quarters	4	2	2	80	12
United Kingdom (Δp; 4 lags)					
Output: 6 quarters	39	1	49	5	6
30 quarters	28	1	43	6	22
Net exports: 6 quarters	9	19	61	10	3
30 quarters	2	16	38	24	21
Inflation: 6 quarters	7	1	3	50	39
30 quarters	6	2	2	37	53

TABLE 1 (cont.)

Shock	Absorption	Net foreign demand	Supply	Relative velocity	Import-price of raw materials
		Italy (Δp; 3 lags)			
Output: 6 quarters	46	4	15	2	33
30 quarters	40	5	12	13	30
Net exports: 6 quarters	2	40	43	2	14
30 quarters	1	38	45	1	16
Inflation: 6 quarters	26	7	3	40	24
30 quarters	18	5	5	35	38
		Spain ($\Delta p - \Delta p_q^*$; 3 lags)			
Output: 6 quarters	29	2	66	0.4	2
30 quarters	18	14	62	2	4
Net exports: 6 quarters	28	58	8	3	3
30 quarters	48	20	25	1	6
Inflation: 6 quarters	14	15	15	17	39
30 quarters	12	13	30	9	36
		Netherlands ($\Delta p - \Delta p_q^*$; 3 lags)			
Output: 6 quarters	1	3	87	3	7
30 quarters	1	4	90	3	2
Net exports: 6 quarters	77	9	7	0.4	7
30 quarters	88	2	4	0.1	7
Inflation: 6 quarters	19	5	2	68	6
30 quarters	20	6	2	66	6

TABLE 2

RATIOS OF COVARIANCE TO VARIANCE

	Absorption	Net foreign demand	Supply	Relative velocity	Import-price of raw materials
Germany	0.08	0.03	−0.06	−0.09	0.58
France	−0.03	0.07	−0.04	0.03	0.44
United Kingdom	0.12	−0.07	−0.02	−0.04	0.58
Italy	0.12	−0.04	−0.02	−0.08	0.40
Spain	−0.06	0.05	−0.05	0.01	0.46
Netherlands	−0.02	0.03	0.00	−0.03	0.50

TABLE 3

RATIOS OF COVARIANCE TO VARIANCE

IN RELATION TO GERMANY ALONE

	Absorption	Net foreign demand	Supply	Relative velocity	Import-price of raw materials
Germany	1	1	1	1	1
France	0.04	0.06	−0.08	−0.07	0.53
United Kingdom	−0.06	−0.00	−0.09	−0.19	0.72
Italy	0.43	0.04	−0.07	−0.17	0.51
Spain	0.05	0.11	−0.07	−0.04	0.45
Netherlands	−0.11	−0.05	0.17	0.34	0.69

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