NATIONAL SPECIFITIES AND MONETARY-POLICY TRANSMISSION IN EUROPE

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Abstract

This work presents five structural co-integrating VAR models used to describe the economies of France, Germany, Italy, the Netherlands and Spain in the years 1983-1998 and to analyse their economic policies. Short-run dynamics move around the long-run structure, represented by money, goods and capital market equilibrium conditions. The fitting of the reference theoretical model to the data is not imposed a priori but empirically tested. Long- and short-run properties of models highlight deep heterogeneities in the economic structures and in the monetary policy transmission mechanism among the countries. Germany plays a dominant role in the European economy and, together with the Netherlands, seems to have formed an economic area where the money, goods and capital markets are integrated. France is linked to this area, while Italy turns out to be less integrated. Finally, Spain seems to be completely disjoined.

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1. Introduction and objectives

During the EMS years, in the eighties and nineties, the European Community States shared a tendency to make their own economies converge towards a common stance, as homogeneous as possible. Above all, this tendency concerned the objectives and interventions of monetary policy, which culminated in the beginning of the EMU. Scholars have analysed a considerable number of the aspects of this harmonization process. In particular:

a) the existence of an integrated economic area consisting of the money, goods and capital markets and how national economic systems have approached it (Britton and Whitley, 1997);

b) the adjustment of national monetary policies to a common European policy (as, for instance, in Dornbusch, Favero and Giavazzi, 1998, and in Locarno, Morgan, Van Els and Villetelle, 2003, who simulate the effects of a common monetary policy with a fixed intra-European exchange rate);

c) the forming of a central position among European economies, able to express a national monetary policy that could be European too (as, for
instance, in Giavazzi and Giovannini, 1989, von Hagen and Fratianni, 1990, Bajo–Rubio and Montávez, 2002, who analyse the causal links between the interest rate in Germany and in other European Countries);

d) the ability of this central position to make the currency policies of other countries increasingly similar to its own (as, for instance, in Hughes Hallett and Piscitelli, 2002);

e) the effectiveness of States’ monetary policies on their economic activities (see, among others, Ehrmann, 2000, Clements, Kontolemis and Levy, 2001, Mojon and Peersman, 2003).

The results of these analyses have varied considerably and have often been quite contradictory, with scholars believing the econometric method, the model specification, the poor power of tests, or even the sample choice were the causes of different results. This harmonization process started with each country having its own specific economic stance and not always experiencing economic benefits from the convergence towards an integrated area. It is interesting, therefore, to analyse not only the aspects of the process mentioned above, but also the more or less deep differences (specificities) existing among the economies of EMS countries during the convergence period. The aim of this work is to analyse these aspects in five European economies, namely France, Italy, Germany, Spain and the Netherlands, in the years leading to the EMU, on the basis of their interactions with the Rest of Europe (RoE). This foreign aggregate means the economy of each country can be evaluated in relation to the other European economies and their differences can be taken into account. To

1 Von Hagen and Fratianni, 1990, for instance, refute Germany’s dominance within the EMS and the hypothesis that high-inflation countries entered the EMS to exploit the Bundesbank’s credibility; this hypothesis is supported by, among others, Giavazzi and Giovannini, 1989.
study the five aspects discussed above, we use only one econometric procedure in order to minimize the probability that the results are heavily dependent on the instrument that was used. The procedure is based on a re-interpretation of the structural co-integrating VAR approach defined in Garratt, Lee, Pesaran and Shin, 2003, and derived from the co-integrating VAR models, which have characteristics that are specifically useful for the economic-policy analyses we want to perform. The use of the same specification for several countries, differing only in their (estimated) parameter values, which is typical of VAR models, allows a comparison of various economic phenomena, such as the effects of shocks, or the convergence towards a common set-up, or the existence of a central position in countries that are connected (or on the point of being connected) by trade, as well as by financial and institutional links. A different specification for each country, which is common in simultaneous-equation models and aims to make the data more representative of each economy, may in fact distort the comparative results.

This work is divided into ten Sections. The next one presents the analytical structure of the model we use to analyse the points above. Section 3 deals with the long-run equilibrium structure, which is made up of three equations (constituting the co-integrating relationships from an econometric point of view) around which the economic system is assumed to fluctuate. Section 4 associates the aspects defined in the Introduction with some hypotheses that may be tested on VAR model parameters. Sections 5–9 elaborate the data (quarterly, for the period 1983:2–1998:2): firstly, the results of the tests performed to check the fit of models are shown, and afterwards some aspects of the five economies are analysed with regard to both long-run peculiarities (Sections 5 and 6) and the short-run convergence of national economic systems towards equilibrium stances (Section 7). In Section 8 the hypothesis of the dominance of Germany in the European economy is analysed, and in Section 9 the effects of national monetary
policies on their respective real economies are described. The conclusions follow and the bibliographical notes conclude. Four separate Appendixes illustrate the fits of models to data and how the aspects defined in the Introduction are associated to testable hypotheses on VAR model parameters.

2. The structural co-integrating VAR model

We utilize the co-integrating model consisting of the vector autoregression

\[ y_t = c_0 + c_1 \cdot t + \sum_{j=1}^{s} \Theta_j \cdot y_{t-j} + \Phi \cdot d_t + \epsilon_t \]  

specified in the following error correction form (VECM)

\[ \Delta y_t = a_0 + \sum_{j=1}^{s-1} \Gamma_j \cdot \Delta y_{t-1} + A \cdot \epsilon_{t-1} + \Phi \cdot d_t + \epsilon_t \]  

This model allows us to take into account both the short-run dynamics (represented by relations between variables in first differences, which are collected in the \( k \)-dimensional vector \( y_t \)) and the long-run structure represented by the vector of residuals \( \epsilon_t \) of co-integrating relations

\[ b_0 \cdot t + B' \cdot y_t = \epsilon_t \]  

In (2) \( \Gamma_j \) s are matrices of autoregression coefficients; matrix \( A \) collects the adjustment coefficients of short-run dynamics to long-run paths, \( a_0 \) is a vector of constants (not constrained to belong to the co-integration space and thus referring to both the short- and the long-run), \( d_t \) is a vector of

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2 Appendixes are not presented in this version of the paper for the sake of brevity. They can be found at the address: http://dep.eco.uniroma1.it/~carlucci
dummy variables with parameters contained in matrix $\Phi$, and $u_t$ is a vector of residuals distributed according to (3). Equation (4) summarizes $r < k$ equilibrium relationships that we suppose to work in the economy; matrix $B$ collects the coefficients of variables forming vector $y_t$; and vector $b_0$ collects slopes for deterministic trends, which we suppose linear and constrained to belong to the co-integration space to avoid quadratic trends in the variables in the levels. For the dynamic simulation analyses, model (2) is transformed into its moving average form (with variables in levels)

$$y_t = \Psi \cdot a_0 \cdot t + \Psi \cdot \sum_{h=1}^{i} u_h + \Psi \cdot \Phi \cdot \sum_{h=1}^{i} d_h + \Psi^0 (L) \cdot \left( u_t + a_0 + \Phi \cdot d_t \right) + y_0$$  \hspace{1cm} (5)$$

where the matrix

$$\Psi = B \perp \left( A \perp \Gamma B \perp \right)^{-1} A \perp$$

with

$$\Gamma = I - \sum_{j=1}^{r l} \Gamma_j$$

measures the impact of shocks cumulated from time 1 to $t$ on $y_t$. $\Psi^0 (L)$ is a polynomial matrix of infinite degree in the lag operator $L$, and $y_0$ is a vector of observations for $y_t$ preceding the sample.

3. The specification of the common model

The stylized long-run structure of each economy is obtained by specifying equilibrium conditions in the money, goods and capital markets according to a static Mundell-Fleming scheme. The equilibrium relationships have been made more general than in the theoretical schemes to enable them to shed more light on the aspects discussed in the Introduction (by inserting a deterministic trend and constraining some parameters) and also to overcome the original theoretical limitations created by considering the foreign economy as exogenous. These three long-run relationships, which we will specify in the following sub-Sections, contain two monetary variables, the money stock, $m_t$, and the interest rate $i_t$. 

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(constructed as in Garratt, Lee, Pesaran e Shin, 2003); one variable linked to economic activity, the output $y_t$, the price level $p_t$ and the exchange rate $q_t$. These variables are constructed as shown in Box 1 in Appendix 1. It is worth noting that through this formulation we do not consider an average European economy but five different economies for the RoE. In this way we do not want to highlight the difference between the economy of a given country and a European average but rather between this economy and the economy of the other European countries (its RoE), so that we can analyse how economies are converging. Long-run relations are approximated by log-linear equations, with residuals $\varepsilon_t$ representing deviations (“long-run structural shocks”) from long-run paths. These shocks are incorporated in model (2), which is therefore estimated in accordance with long-run theoretical principles. Thus, this model enables us to study both long-run equilibrium relations and short-run dynamics. Furthermore, national specificities can be highlighted according to the parameter values collected in vector $b_0$, in co-integration matrices $B$ and in adjustment matrices $A$.

**The equilibrium condition in the money market**

The specification of the first long-run relationship derives from the introduction of interdependence links between the national economy and the economy of the RoE in the money market. As usual, we can set

$$m_t - p_t = \alpha_0 \cdot t + \alpha_1 \cdot y_t + \alpha_2 \cdot i_t + u_{LMB}$$

and

$$m_t^* - p_t^* = \alpha_0^* \cdot t + \alpha_1^* \cdot y_t^* + \alpha_2^* \cdot i_t^* + u_{LMB}^*$$

respectively, where the real money stock, $m - p$ ($m^* - p^*$), depends on a linear trend, the level of output $y$ ($y^*$) and the interest rate. Trends in (6) and (7) enable us to represent technological development in banking and finance brokerage under the assumption that the capacity of the banking system to create credit depends on its stage of evolution (Chick and Dow,
In both equations, the residuals $u_{LM}$ and $u_{LM}^*$ are assumed to be stationary. Let us now examine the output coefficients. If $\alpha_i \neq \alpha_i^*$, the expansion of money will differ in the two areas even in the presence of convergence in activity levels, so that we can set $\alpha_i = \alpha_i^*$ (Arestis and Sawyer, 2001). Subtracting (7) from (6), we obtain the first long-run relationship

$$
(m^* - m^*) - (p^* - p^*) = \beta_0 \cdot t + \beta_1 \cdot (y - y^*) + \beta_2 \cdot i^* + \beta_3 \cdot i^* + \epsilon_{LM} \tag{8}
$$

where $\beta_0 = \alpha_0 - \alpha_0^*$, $\beta_1 = \alpha_i = \alpha_i^*$, $\beta_2 = \alpha_2$, $\beta_3 = -\alpha_2^*$, and $\epsilon_{LM} \sim I(0)$.

With regard to the parameters, we can expect

$$
\beta_1 \geq 0, \quad \beta_2 \leq 0, \quad \beta_3 \geq 0.
$$

The left hand side in (8) can be interpreted as the national real money to the RoE real money ratio, so that, on the preceding assumption, a positive (negative) sign for $\beta_0^*$ points to a higher degree of development in the domestic banking market (in the RoE) than in the RdE (domestic) one.

The equilibrium condition in the goods market

Output is defined as

$$
y = \Phi_0 \cdot t + \Phi_1 \cdot i + \Phi_2 \cdot q + \Phi_3 \cdot (p - p^*) + u_{IS} \tag{9}
$$

$$
y^* = \Phi_0^* \cdot t + \Phi_1^* \cdot i + \Phi_2^* \cdot q + \Phi_3^* \cdot (p - p^*) + u_{IS}^* \tag{10}
$$

respectively in the two economies, where the deviation from the long-run path, $y - \Phi_0 \cdot t (y^* - \Phi_0^* \cdot t)$, depends on the interest rate $i$ ($i^*$), the nominal effective exchange rate $q$ and the relative prices $p - p^*$. The residual $u_{IS}$ ($u_{IS}^*$) is assumed to be stationary.

As for the parameters, we can expect

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3 As observed in Dornbusch, Favero and Giavazzi, 1998, with an independent central bank the measurement of monetary policy impacts is not influenced by fiscal shocks. The absence of fiscal variables in the long-run equations does not appear as too strong an
\( \varphi_0 \geq 0, \varphi_0^* \geq 0, \varphi_1 \leq 0, \varphi_1^* \leq 0, \varphi_2 \geq 0, \varphi_2^* \leq 0, \varphi_3 \leq 0, \varphi_3^* \geq 0. \)

Subtracting (10) from (9) we obtain the second long-run relationship:

\[
y_t - y_t^* = \beta_4 \cdot t + \beta_5 \cdot i_t + \beta_6 \cdot q_t + \beta_7 \cdot (p_t - p_t^*) + \beta_8 \cdot i_t^* + \varepsilon_{IS_t}
\]

where \( \beta_4 = \varphi_0 - \varphi_0^* \), \( \beta_5 = \varphi_1 \), \( \beta_6 = \varphi_2 - \varphi_2^* \), \( \beta_7 = \varphi_3 - \varphi_3^* \), \( \beta_8 = -\varphi_1^* \) and \( \varepsilon_{IS_t} \sim N(0) \). As for the parameters, we can expect

\( \beta_5 \leq 0, \beta_6 \geq 0, \beta_7 \leq 0, \beta_8 \geq 0. \)

The left hand side in (11) can be interpreted as the domestic GDP to RoE GDP ratio. A positive (negative) sign of \( \beta_4 \) indicates a higher growth in domestic (in the RoE) output than the RoE (domestic) one.

**The equilibrium condition in the capital market**

Under the assumption that agents have complete information, we represent this condition by means of the Uncovered Interest Parity (UIP) relationship, where we insert a flexibility factor through parameter \( \beta_9 \), in order to synthesize the risk premium

\[
i_t = i_t^* + \beta_9 \left[ E(q_{t+1}) - q_t \right] + u_{UIP_t}
\]

where \( E(q_{t+1}) \) is the exchange rate at time \( t+1 \) expected in \( t \), which, following Juselius, 1995, we suppose to be given by

\[
E(q_{t+1}) = p_t - p_t^*
\]

so that (12) becomes

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\( ^4 \) The specification we use for the economic activity level is similar to the one used by Fatas, 1998, to analyse the permanent and transitory GNP components (in terms of yearly per cent changes) of EU countries by the approach in Cochrane, 1988. It is worth noting that in (9) and (10) the output per capita was not used so as to avoid adding a new variable to the equation system.
\[ i_t - i_t^* = \beta_0 \left( p_t - p_t^* - q_t \right) + u_{UIP} \quad (14) \]

with \( 0 \leq \beta_0 \leq 1 \) and \( u_{UIP} \), a stationary residual. The character of convergence can be inserted in (14) by adding a linear trend which represents the spread between the domestic and the RoE interest rates

\[ i_t - i_t^* = \beta_0 \left( p_t - p_t^* - q_t \right) + \beta_{10} t + \varepsilon_{UIP} \quad (15) \]

Thus, the third long-run condition is obtained, with \( \varepsilon_{UIP} \square I(0) \), which can be used to describe the monetary rule that national authorities follow in the long-run.

**Co-integrating relations in a compact form**

If we insert the six variables \( m_t - m_t^* \), \( y_t - y_t^* \), \( i_t \), \( q_t \), \( p_t - p_t^* \), \( i_t^* \) into vector \( y_t \), their parameters defined in (8), (11) and (15) into matrix \( B \), of order \( 6 \times 3 \), parameters \( \beta_0 \), \( \beta_4 \) and \( \beta_{10} \) into vector \( b_0 \), and residuals \( \varepsilon_{LMt} \), \( \varepsilon_{IS} \) and \( \varepsilon_{UIP} \) into vector \( \varepsilon_t \), three equilibrium conditions can be written in the matrix form (4), which generates \( y_t \) in the long-run.

**4. Economic hypotheses to be tested**

With the model (2)–(4) we can verify the aspects mentioned in the Introduction. But we cannot test them directly since a direct correspondence between the statistical hypotheses that can be associated with the characteristics of the model and those aspects is difficult to find and in any case open to criticism. It is therefore necessary to transform these aspects into economic hypotheses statistically testable in a direct way. Thus, they are tested by cascade. Firstly, the transformed economic hypotheses, which we will report on in the Appendix 2, are verified by means of tests on the characteristics of the model; secondly, the results are used to characterize the points indicated in the Introduction.

**The long-run structure**
For a given country, the three long-run relationships can be jointly or partially valid. If all three are contemporaneously valid we can consider the country’s economy to be well balanced and belonging to an area where the money, goods and capital markets are well integrated, with a stable economic structure. The countries where statistically $r = 3$ should possess three long-run relationships (the transformed economic hypotheses), which we can suppose to realistically coincide with the relationships specified in economic terms above, and to be not dissimilar to each another. These countries would then be the components of the integrated economic area. Therefore, the determination of $r$ for each country leads to the testing of aspect a) of the Introduction. In the case of the countries with $r < 3$, we should find an indication of stickiness between the national and RoE economies, as $r$ can be interpreted as an indicator of the degree of deregulation in an economy (Juselius, 1996). In other words, we should obtain an indication of only partial integration, still within the hypothesis of similar long-run relationships. Additionally, it should be useful to establish which long-run relationship is missing in order to shed light in what way the country is included in the integrated area. For this purpose, for each market some economically relevant hypotheses are formulated which constrain the relative equation. These hypotheses are tested through the likelihood ratio test, conditional upon $r$ (the dimension of co-integration space). When tests give positive results, we obtain a strong indication of validity for the restrained equilibrium condition. These transformed economic hypotheses are reported in Table A.2 in Appendix 2, where they are also explained. Having determined $r$ for each country, the final specification of the long-run structure is obtained once again by means of likelihood ratio tests between the exactly identified VECM and the one where non-significant long-run parameters [contained in vector $b_0$ and matrix $B'$ of model (2)–(4)] are eliminated. Furthermore, we check that the final co-integrating relations are similar in order to verify the existence of an integrated
economic area.

Short-term dynamics

After estimating the long-run structure, VECMs, which are now structuralized, can be used to analyse the short-term dynamic properties of each economy, and in particular of their own national monetary policies. The finding (or otherwise) of convergence of the national monetary policies towards a common European one concerns aspect b) of the Introduction. To associate this common monetary policy with that adopted by a member State means studying aspects c) and d). The analysis of short-term dynamic properties can be carried out by following three different (but complementary) approaches. The first two methods use persistence profiles (Pesaran and Shin, 1996) and generalized impulse response functions (Pesaran e Shin, 1998) on the constrained co-integration relations to study the convergence speed towards a country’s equilibrium position. Persistence profiles allow to describe the way in which an economic system returns towards its long-period trend after being disturbed by a shock affecting the whole system. Generalized impulse response functions show the effects of a shock, equal to one standard deviation, on a specific co-integration relation (or on a specific variable), taking into account the residual correlation structure. This methodology does not allow a structural interpretation to be attributed to the impulses, but it does overcome the problem of model identification by providing a characterization of dynamic responses to typically observable shocks. In the third approach, adjustment matrix coefficients are examined to study the influence of deviations from long-run equilibrium paths on elements of \( y_t \). The uniform modelling for all countries provides a direct comparison of estimates for feedback coefficients, thus making it easy to identify the peculiarities of national economies. With regard to model (2), but writing each equation with the explicit indication of the long-run relationship residuals \( \varepsilon \), we can set
\[ \Delta \left( m_t - m^*_t \right) = \alpha_{LM}^{(m-m')} \cdot e_{LM,t-1} + \alpha_{IS}^{(m-m')} \cdot e_{IS,t-1} + \alpha_{PNI}^{(m-m')} \cdot e_{PNI,t-1} + \ldots \]

\[ \Delta \left( y_t - y^*_t \right) = \alpha_{LM}^{(y-y')} \cdot e_{LM,t-1} + \alpha_{IS}^{(y-y')} \cdot e_{IS,t-1} + \alpha_{PNI}^{(y-y')} \cdot e_{PNI,t-1} + \ldots \]

\[ \Delta i_t = \alpha_{LM}^{i} \cdot e_{LM,t-1} + \alpha_{IS}^{i} \cdot e_{IS,t-1} + \alpha_{PNI}^{i} \cdot e_{PNI,t-1} + \ldots \]

\[ \Delta q_t = \alpha_{LM}^{q} \cdot e_{LM,t-1} + \alpha_{IS}^{q} \cdot e_{IS,t-1} + \alpha_{PNI}^{q} \cdot e_{PNI,t-1} + \ldots \]

\[ \Delta \left( p_t - p^*_t \right) = \alpha_{LM}^{(p-p')} \cdot e_{LM,t-1} + \alpha_{IS}^{(p-p')} \cdot e_{IS,t-1} + \alpha_{PNI}^{(p-p')} \cdot e_{PNI,t-1} + \ldots \]

\[ \Delta i_t^* = \alpha_{LM}^{i*} \cdot e_{LM,t-1} + \alpha_{IS}^{i*} \cdot e_{IS,t-1} + \alpha_{PNI}^{i*} \cdot e_{PNI,t-1} + \ldots \]

where the parameters are easily interpreted. For instance, the coefficient \( \alpha_{LM}^{(m-m')} \), if statistically significant and negative, can explain the condition in the money market as money demand. Furthermore, the absolute value of the coefficient can be interpreted as the degree of absorption of shocks guaranteed by the national bank system. The coefficient \( \alpha_{LM}^{(y-y')} \), if statistically significant and negative, can explain the condition in the goods market as aggregate demand. The absolute value of the coefficient indicates the relevance of temporary components in economic growth, i.e. the degree of vulnerability derived from real shocks (Fatas, 1998). The feedback coefficient \( \alpha_{PNI}^{i} \) indicates the degree of adjustment of the domestic (RoE) interest rate with respect to the RoE (domestic) one, i.e., it shows how similar the domestic and RoE interest rate dynamics are. Furthermore, the adjustment matrix makes it possible to identify (weakly) exogenous variables, when some rows in matrix \( A \) contain only zeroes.

The effectiveness of national monetary policies

The effectiveness of monetary policy choices on the real economy can be associated, according to some scholars, with the degree of development and the structure of monetary and banking markets.\(^5\) One of the more usual

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\(^5\) In Borio, 1996, the main differences related to expiries of contracts as well as the variability of interest rates in the five financial markets are reported. These two aspects are relevant to establish the effectiveness of a monetary policy measure. In general, the shorter
approaches to analysing monetary-policy effectiveness [aspect e) in the Introduction] existing in literature is based on the identification of different effects caused by the impact of a monetary shock on output or prices. To analyse the effects of individual monetary policies on economies, co-integration properties are used to discriminate between impulses with permanent effects and others with transitory ones, following King, Plosser, Stock e Watson, 1991. The permanent component can be separated from the transitory one by means of a suitable re-parameterization of model (5). Thus, the problem of identifying system concerns only the sub-model that is relevant to the analysis, i.e. the transitory one, since in the long-run the effects of a monetary policy are expected to be zero. Therefore, only $r \cdot (r - 1)/2$ restrictions are necessary. The identification of the typical (normal) monetary policy shock is achieved by using the recursive scheme based on the following causal ordering

$$u_t \rightarrow u_{m-m} \rightarrow u_{y-y}.$$ 

according to the interpretation of an economic system in which a restrictive (not anticipated) measure by the monetary authorities first reflects on the interest rate structure and then spreads to the real side of the economy through the banking and financial system.

5. Econometric implementation

Preliminary analyses

The estimation of the model (2)–(4) was conditional on running unit-root tests for the variables and misspecification tests for the models over the

is loan duration (as in Italy and Spain) and the greater is speed at which credit to economy reacts to monetary policy impulses. Furthermore, the presence of variable rate contracts (as in Italy) induces a quick propagation of monetary shocks over the real side of economy, unlike financial systems with fixed prices (as in Germany and its monetary satellites), which are able to dilute the impact of these shocks.
period 1983:2–1998:2. The initial time sample was chosen to eliminate the first EMS years, which were viewed as a period of adjustment to the new monetary system. The last months of 1998 were not included because they were seen as a period of transition towards the third EMU stage. This time span refers to a stable macroeconomic framework, characterized by the absorption of oil shocks, stronger exchange rate constraints, and a progressive liberalization of financial transactions. All six variables in $y_t$ were considered \textit{a priori} endogenous in VAR models, verifying \textit{ex-post} their (possible) weak exogeneity. Both the unit-root and misspecification tests are illustrated in the Appendix 3, which also presents the dummy variables used in the estimation as well as the structural change tests (Tables A.3–A.7).

\textit{The number of long-run relationships}

To determine co-integration rank $r$ we can use either a maximum eigenvalue test or a trace test, but we also need to consider the relevant economic theory and, more in general, all potentially useful information available (Hendry and Juselius, 2001). Table 1 reports on the maximum eigenvalue (lower part) and trace (upper part) test (in the version corrected for degrees of freedom) statistics, together with the critical values at 5% and 1% significance levels (taken by Osterwald–Lenum, 1992). Following the observations made by Johansen, 1992, generally the trace test is preferred because the maximum eigenvalue test may produce a non-coherent testing strategy. The results of this test point to the existence of two long-run relationships for France, Germany and Italy, three for the Netherlands and zero for Spain. For Germany the maximum eigenvalue test suggests the existence of three co-integration relations, so that the analysis is continued conditionally on an, as yet, undefined indication for this country: $r$ may be 2 or 3. But the recursive trace test (Hansen and Johansen, 1993), whose
results are not reported, suggests that \( r = 3 \) and confirms the other findings.\footnote{Additionally to the tests presented, the cointegration rank has been chosen by checking the stability of recursive eigenvalues, by analysing the significance of adjustment coefficients related to the \( r + 1 \)-th cointegrating vector (where \( r \) stands for the rank used in the analysis) as well as the graphical inspection of cointegration residuals.}

The results obtained in both versions of the test (i.e., holding fixed short-run parameters or estimating them at each iteration) are the same for all models.

To sum up, we take \( r = 2 \) for France and Italy, \( r = 3 \) for Germany and the Netherlands, and we interrupt the analysis for Spain, since \( r = 0 \).

| \( H_0 \) | \( H_1 \) | \( r \geq 1 \) | \( r \geq 2 \) | \( r \geq 3 \) | \( r \geq 4 \) | \( r \geq 5 \) | \( r = 6 \) |
|---|---|---|---|---|---|---|
| \( R = 0 \) | \( r = 1 \) | 114.90 | 124.75 | 141.09 | 178.95 | 177.56 | 173.78 | 110.57 |
| \( R \leq 1 \) | \( r = 2 \) | 87.31 | 96.58 | 96.19 | 99.54 | 98.61 | 107.00 | 71.15 |
| \( R \leq 2 \) | \( r = 3 \) | 62.99 | 70.05 | 61.00 | 57.62 | 59.92 | 65.17 | 37.81 |
| \( R \leq 3 \) | \( r = 4 \) | 42.44 | 48.45 | 28.55 | 25.39 | 31.02 | 38.08 | 22.35 |
| \( R \leq 4 \) | \( r = 5 \) | 25.32 | 30.45 | 13.86 | 15.06 | 14.95 | 17.11 | 10.17 |
| \( R \leq 5 \) | \( r = 6 \) | 12.25 | 16.26 | 3.35 | 6.91 | 3.44 | 4.95 | 3.66 |

Table 1 – Determination of the number of co-integration relations using the trace test (upper) and the maximum eigenvalue test (lower). Statistics in italics (bold) indicate acceptance of the null hypothesis at the 5% (1%) significance level.

6. The empirical results for long-run structures

The results of the (over-)identification test on parameters in the long-run equations are shown in the Appendix 4 and are used to detail the long-run structures of the four Countries.

The structuralization of long-run equations

For each model, the structuralization of the long-run structure is obtained by imposing \( r \) contemporaneous constraints on each co-integration relation.
(the exactly identified structure). Of these $r^2$ constraints, $r$ constraints concern the normalizations that are necessary to rotate co-integration space in the directions represented by the equilibrium conditions. The remaining $r^2 - r$ constraints are directly obtained by the theoretical relationships (8), (11) e (15) and, possibly, by the results of a preliminary analysis on the co-integration vectors.

The exactly identified structure for models with $r = 2$ (2+2 constraints) is

\[
\begin{array}{ccccccc}
 t & m - m^* & y - y^* & i & q & p - p^* & i^* \\
* & 0 & 1 & * & * & * & * \\
* & * & 0 & 1 & * & * & *
\end{array}
\]

where 1 denotes the variable towards which the relationship is normalized, 0 indicates a zero restriction, and an asterisk the generic parameter to be estimated. The exactly identified structure for models with $r = 3$ (3+6 constraints) is

\[
\begin{array}{ccccccc}
 t & m - m^* & y - y^* & i & q & p - p^* & i^* \\
* & 1 & * & * & 0 & -1 & * \\
* & 0 & 1 & * & * & 0 & * \\
* & 0 & 0 & 1 & * & * & *
\end{array}
\]

with the zero restriction originated, also in this case, directly from theoretical relations, except the one for the European interest rate in the relationship normalized towards $y - y^*$, which is justified by the analysis shown in the Appendix 4. The estimated long-run structure is given in Table 2 (solved with respect to residuals), where non-significant parameters have been eliminated and constraints have been directly suggested by the theoretical model. It is worth noting that in money market equations (for Germany and the Netherlands) the coefficient of $y - y^*$ is equal to $-1$, so that the endogenous variable can be interpreted as the ratio of money circulation velocities (of the RoE over the national one).
Table 2 – The final estimated long-run structure for each model. Error standards are reported in round brackets. LR test statistics, distributed as a $\chi^2$, with the d.o.f. number depending on the over-identification constraints, are in the penultimate column. p-values are in square brackets (last column).

Table 3 – Recursive LR test results to check the statistical significance of the over-identified long-run structures, on the quarters 1996:3-1998:2.

Altogether, the long-period structures for the four countries appear substantially stable, as highlighted in Table 3.
The results of the analysis

The value for $r$ and Table 2 seem to indicate that Germany and the Netherlands form an economic area where the money, goods and capital markets are all integrated. The economies of France and Italy also belong to it, although only partially, since their money markets are not integrated as yet. The Spanish economy remains outside the integrated area. For Germany the equilibrium relationship on the money market, expressed in terms of (the inverse of) money circulation velocity, suggests that the national and RoE markets are characterized by clearly different degrees of development. The relevant interest rate is the German and not the RoE one. Thus, in the long-run German monetary policy tends to represent the European one. The significant value for the trend slope shows that the German banking system is superior to the RoE one. The goods market depends on the exchange rate only and is not influenced by either interest rate. Also the differential of these two rates depends only on the real exchange rate (capital market equation). For the Netherlands the equilibrium condition in the money market shows a stable relationship between money circulation velocity in the national market and a classic LM scheme for the RoE, indicating that the Dutch monetary policy is firmly dependent, in the long-run, on the RoE one, that is on the German one, according to the discussion above. As for Germany, the trend shows a much higher degree of development in the banking and monetary system than in the RoE one. On the goods market the sign of the trend slope shows that the Netherlands’ output grows over time more than other European countries’. Real output depends on both the domestic interest rate (the only case of the four examined) and the nominal exchange rate. In the capital market, the negative trend slope means that the average RoE interest rate falls progressively in relation to the Dutch one. With regard to the French model, the absence of trends shows that the French economy in the EMS years was systematically aligned with the average of the other European countries. The equations are similar to the
corresponding ones for Germany, so that we can reassert that the French economy is a part of the integrated area made up of Germany and the Netherlands, except for its banking and monetary component, for which some friction exists. As for Italy, the sign of the trend slope in the equilibrium condition for the goods market indicates a constantly diminishing output in comparison with the RoE one. Furthermore, the coefficient of the nominal exchange rate shows a strong propensity to price competitiveness. With regard to the capital market we accept the hypothesis that the differential of the interest rates depends on both the real exchange rate, frequently depreciated to contrast the loss of competitiveness, and the trend. The increase in the latter suggests that Italy devalued on average more than was justified by the trend of the interest rate differential.

7. The short-run adjustment towards equilibrium paths

Now we analyse the speed at which and the way in which national economic systems adjust towards the equilibrium positions by means of persistence profiles (reported for each country in Table 4) and generalised impulse response functions specifically for the capital market (Table 5).

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Table 4 – Persistence profiles of estimated money (a), goods (b) and capital (c) market equilibrium conditions, on a 50 quarters horizon. Simulation results are normalized setting one at time zero.
Table 5 – Generalized Impulse Response Functions of the capital market equilibrium condition to a (positive standard error) shock on: (a) the domestic interest rate, (b) the nominal exchange rate, (c) the RoE interest rate equation (annual per cent values).

The short-term analysis is completed, in Table 6, by studying the significant coefficients of adjustment matrices (with standard errors in round brackets), conditional on the estimated co-integrating vectors.

Table 6 – Significant adjustment matrix coefficients with standard errors in round brackets. LR test statistics (penultimate row), distributed as a $\chi^2$, with the d.o.f. number depending on the over-identification constraints. p-values are in square brackets (last row).
Constraints imposed are significant and rather stable, as Table 7 shows.

<table>
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<th>Year</th>
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</table>

Table 7 – Recursive LR test results of the over-identifying restrictions on $A$ and $B$ matrices. Statistics in italics indicate that the null hypothesis is accepted at the 1% significance level.

The only exceptions concern the quarter 1997:3 for Germany and the quarters until 1997:3 for Italy, where, however, the null hypothesis is accepted at 4% and 3% significance levels, respectively.

**France**

Persistence profiles related to the goods and capital markets [parts b) and c), respectively, in Table 4] show that in both markets the system returns to its equilibrium with a fairly rapid adjustment (approximately eight quarters), again suggesting that the French economy is only partially integrated. More detailed information is obtained by analysing the responses of the UIP relationship to specific shocks on the equations of variables related to its long-run equilibrium path. Impulses on the domestic interest rate (Table 5a), the nominal exchange rate (b), and the RoE interest rate (c) produce marginal effects, again absorbed in two years, indicating a strong link between the French and RoE interest rates, as well as remarkable stability in the capital market. The analysis of adjustment coefficients (Table 6) confirms this result, indicating that the money dynamics is strongly influenced by the deviation of the interest rate from the UIP equilibrium path. It also points out that the exchange rate dynamics depends on both the
deviations from equilibrium paths found in the previous Section. These results suggest that in France, in the EMS years, significant adjustment interventions on money and exchange were carried out.

Germany

The central role of the German economy in Europe, highlighted by the long-run properties, is confirmed by persistence profiles. Following a global shock, the return to the equilibrium condition happens very slowly (in four years) in all three markets (Table 4a, b, c). This finding implies a firm stability and indicates, once more, that Germany is one component of the integrated economic area. For Germany too, as for France, impulses on the interest rates as well as the exchange rate (Table 5) produce only slight effects on the UIP relationship, although the absorption time is twice as long (16 quarters instead of eight), confirming the previous results. Relevant adjustments (Table 6) concern only money, exchange and prices. The first, in relation to the RoE one, responds to deviations from the money and the goods markets equilibriums. On the other hand, both the exchange rate and prices, the latter again in relation to the RoE one, respond to deviations concerning the UIP relationship.

Italy

Persistence profiles for Italy give clear indications. The profile on the goods market is very short, approximately one year, indicating a very quick absorption of global shocks on the economic system. The profile on the capital market is long, approximately four years, which we interpret bearing in mind the fact that in the eighties and nineties the Italian financial policy was independent of the RoE one (and therefore did not tend to adjust quickly to the long-run position determined by other European countries). This interpretation is confirmed by the generalized impulse response functions on the UIP condition to shocks on both the interest rates and the exchange rate. Absorption occurs, in all three cases, over a very long time span of more than 50 quarters. In particular, the relevance of the exchange
rate to financial policy is observed, as recognized in the previous UIP analysis. The most relevant adjustment concerns the exchange rate, showing that this is heavily controlled in response to deviations in the equilibriums of both the goods and capital markets, and confirming the finding of a pronounced activeness on the exchange rate in relation to economic activity and capital movements.

The Netherlands

Persistence profiles for the money and goods markets show a quick convergence to the equilibrium position, which is completed within the second and first year, respectively. Thus, the Dutch economic system reacts promptly, when “hit” by a global shock. These findings are confirmed by the coefficients $\alpha_{LM}^{(m-m*)}$ and $\alpha_{IS}^{(y-y*)}$ (−0.33 and −0.39, respectively). The absorption of the deviation from the money equilibrium position in the (relative) money growth equation is approximately one third by the first quarter; the adjustment to the equilibrium condition in the goods market in the (relative) output growth equation appears to be very quick, in comparison with other economies. The persistence profile on the UIP condition shows that equilibrium is restored only in the long-run (more than 32 quarters), as for Germany, indicating that the Dutch and German monetary policies are quite similar. Responses on the domestic interest rate, the nominal exchange rate and the RoE interest rate equations to impulses on the UIP relationship show time patterns like the German ones, though slighter in intensity: The connection between the Dutch monetary policy and the German one seems clear. Confirmation of this is obtained by the feedback matrix coefficients: $\alpha_{PNI}^{'} = 0.00$ and $\alpha_{PNI}^{'} = 0.19$, similar to the German ones, 0.00 and 0.10, respectively. In fact, this finding could lead to the belief that the RoE interest rate adjusts to the Dutch one, thus contradicting the specification of equilibrium on money market, on the basis of which the Netherlands’ economy was defined as “small”. But this apparent contradiction is easily explained by the fact that the Dutch
monetary policy is similar to that of a “large” country, namely Germany. Other relevant adjustments concern money and price: Both, in comparison with the RoE ones, respond to the deviation related to the UIP condition.

Two concluding observations, of a general character, seem relevant. Firstly, in all countries (except in Germany though only slightly) the goods market does not seem to be influenced by deviations from the UIP equilibrium path. Secondly, French and Italian authorities have no influence over European monetary policy, which, on the contrary, lies firmly in the hands of the German and Dutch authorities.

8. The central role of Germany

The results for Germany suggest that this country played a central role in fixing the interest rate in the 80s and 90s and other European countries adjusted to it. The dominance of the German economy also appears from an analysis of the influence of UIP condition on the exchange rate equation. For Germany, indeed, the (intra-European) exchange rate is not a (weakly) exogenous variable, unlike for the Netherlands, since the coefficient $\alpha_{PNI}^i$ is rather large, suggesting a high speed in absorbing deviations from the long-run path and confirming that German monetary authorities actively managed the (intra-European) exchange. This result allows the complete interpretation of the German UIP specification: on the one hand, the German authorities accepted an increase in the nominal value of their currency in relation to other European currencies; but on the other hand, the

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7 The restraint represented by an instantaneous adjustment (that is the additional restriction $\alpha_{PNI}^i = -1$) is significant: The statistics of the LR test, distributed as $\chi^2(19)$, is 28.43, with a p-value equal to 0.08.

8 Like France and Italy, which are the other “large” countries in the EMU. However, the aims pursued by these two countries were different: France opted for pegging to the German mark from the early nineties; on the contrary, Italy used the exchange rate as a safety valve to offset the disequilibria (in terms of competitiveness loss) of its own economic system.
price level in Germany has been systematically lower than in the RoE, with a consequent depreciation of its real exchange rate (See Graziani, 2002).

9. The effects of national monetary policies on the real side

In this Section we focus on the effects of individual national monetary policies on their respective economies, by measuring their impact on output and price levels produced by a monetary shock. For France and Italy only one restriction is needed to identify the model. Having identified the co-integration relationships as the aggregated demand function and UIP condition respectively, we can assume that the monetary policy does not immediately affect output (as, for instance, in Ehrmann, 2000). For Germany and the Netherlands the three identification constraints are directly derived from the recursive scheme of Section 4. In Table 8 responses of $y - y^*$ (upper part) and of $p - p^*$ (lower part) to a temporary impulse (in terms of deviations from the base path) are reported.

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Table 8 – Responses of output (upper) and prices (lower) to a positive standard deviation monetary policy impulse, on a 16 quarters horizon (per cent values).

With regard to output, the impact on Italy is greater than on its RoE; on
France it is the same, and on Germany and the Netherlands less and much less, respectively. In all four cases, deviations from the base path are absorbed in a short time span, either less than or slightly longer than eight quarters. For Italy there is evidence of a fall in output (as compared to RoE), which has its maximum at time zero (−0.20%) and then is absorbed in two years. For France there is no deviation, while for Germany and the Netherlands (again in comparison with RoE output) the deviations are positive and also reach their maximum at time zero (+0.24% and +0.41%, respectively). The Netherlands’ response shows a dynamics that is similar to Germany’s, but with quicker absorption, like the results of the persistence profile analysis on equilibrium condition in the goods market. Furthermore, the positive sign of deviations suggests that the monetary restriction measures spread over the other European countries, where generally the “filter” given by the fixed price structure in financial markets is absent. As for prices, the responses are as expected. In three countries there is a fall in level (in comparison with the RoE), with a maximum at time zero. In Italy a monetary contraction determines an increase of prices (in comparison with the RoE) in the short-run (price puzzle), but with limited and quickly (in time) decreasing effects. By virtue of the specification adopted for the exchange rate expectations, the increasing trend of prices could indicate a lack of credibility in the monetary policy which would produce depreciation expectations. The analysis of individual national monetary policies can also be performed by determining their cumulated (to the sixteenth quarter) effects. In Germany and the Netherlands the effects are quite similar in terms of output (+1.25% and +1.04%, respectively). In France, where the monetary policy was accommodating towards Europe, a decrease in price level (-0.35%) and a non negative effect on production (+0.06%) are observed. Finally in Italy, where the European constraint on the UIP was less strong, a restrictive measure produced a decrease in production (-1.02%) and an increase in prices (+1.42%).
10. Concluding remarks

We can conclude that in the 80s and 90s:

Germany and the Netherlands seem to have formed an economic area where the money, goods and capital markets were integrated.

France and Italy were part of this integrated area, except for the monetary and banking component.

Spain was not integrated into this economic area in any of the three markets.

The degree of development in the monetary and banking system in Germany and the Netherlands was more advanced than in the RoE.

In the long run, German monetary policy represented the RoE one.

The Netherlands’ monetary policy conformed perfectly to the RoE (that is the German) one.

As the price level in Germany was systematically lower than in the RoE, its real exchange rate was depreciated so that the country was able to export at decreasing relative prices.

In the long run, the interest rate did not affect production in any country except for the Netherlands, which also provide the only case in which the output grew constantly more than in the RoE.

In Italy production constantly diminished in comparison with the RoE. Furthermore, it strongly depended on the depreciation of the nominal exchange rate, with a clear inclination towards price competitiveness.

The UIP equation shows that the French monetary policy strongly conformed to the RoE, i.e. German, one.

However, the same equation, but for Italy, shows that the Italian monetary policy was more independent also because of competitive devaluation policies.

Italy depreciated more than was justified by the interest rate trend.

If the three markets are taken into consideration, the whole German
economy was absolutely stable.

Not only in Germany but also in France and the Netherlands the capital market appears to have been stable and scarcely influenced by the two interest rates and the exchange rate.

Italy tends to adjust its economic activity quickly when this is hit by global shocks. Adjustment is performed essentially through the exchange rate.

For Germany and the Netherlands there is evidence of an adjustment of the average European interest rate to the domestic one, and not vice-versa.

The money and goods markets in the Netherlands were characterized by a remarkable adjustment speed to the respective equilibrium paths rather than by stability.

Both the long- and short-run analyses prove the central role played by the German economy in Europe.

The effects of a restrictive (not anticipated) monetary policy in Germany and the Netherlands were felt more in the RoE than in their respective domestic economies.

A restrictive monetary policy impulse in France did not produce significant effects on the output level, while in Italy it led to a decrease in output, probably because of a relatively more independent management of monetary policy.

References
Converging Europe (Kluwer Academic Publishers).


