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SPECIALISATION IN EUROPE AND ASYMMETRIC SHOCKS: POTENTIAL RISKS OF EMU

ABSTRACT: One of the most obvious consequences of a monetary union is that monetary policy is lost as an instrument of national macroeconomic policy. The loss of the exchange rate as a national policy instrument has important implications for macroeconomic stability in the presence of asymmetric shocks, unexpected shocks that do not affect every nation in an equal way.

The empirical literature on Optimum Currency Areas has concluded that the probability of asymmetric shocks to occur at a national level has tended to diminish in the Economic and Monetary Union (EMU) as a result of the intensification of the integration process during the most recent years. Therefore, since Economic Geography Theories predict an increasing specialisation of regions as a result of reallocation of industrial activity, the degree of asymmetry of industry-specific shocks will be specially relevant to determine if benefits overweight the costs associated to EMU.

Previous studies, such as Bayoumi and Prasad (1995) or Helg *et al.* (1995), have examined to what extent sectoral asymmetric shocks have been relevant in the past using, mainly, static measures of asymmetries such as the correlation coefficients between series of sectoral shocks previously calculated from a structural VAR model (Bayoumi and Eichengreen, 1992). In this paper, we study the evolution of industry-specific asymmetries in Europe from a dynamic point of view (applying the methodology proposed by Boone, 1997) in order to obtain new evidence about the potential risks of EMU in the scenario proposed by Economic Geography Theories.

1. Introduction

During the last years, different studies have focused on the effects of European Integration, specially, on the convergence-divergence debate. The imminent creation of the Euro Zone (eleven countries with three hundred million inhabitants and, approximately, a fifth of the world GDP and trade) will establish a new economic frame of price stability and growth, but its probable repercussion on convergence is not clear.

The literature on this topic strongly follows the Theory of Optimum Currency Areas (OCA). The seminal contribution of Mundell (1961), followed by McKinnon (1963) and Kenen (1969), among others, put the basis for the rest of studies. These initial works were placed in the intense debate during the sixties and mid-seventies about fixed versus flexible exchange rates. Their objective was to identify the criteria that determine whether a country should join a currency area or not. The strategy consists in identifying the main benefits and costs that an individual country will experience joining a currency area. If for every participant, benefits overweight costs, then the currency area is said to be optimal. The intensification of the European Monetary Integration process has brought up to date the main ideas of these contributions to analyse the potential benefits and risks of the Economic and Monetary Union (EMU). In this sense, while there exists a certain consensus on EMU positive economic effects -specially at a microeconomic level (De Grauwe, 1997)- which can be summarised as direct and indirect benefits of transaction costs reduction, less uncertainty and more transparency in price determination mechanisms, there is no agreement on potential costs.

With no doubt, the main cost of joining a currency area is the loss of monetary policy instruments at a national level (e.g. the exchange rate) as stabilisation mechanisms against macroeconomic disturbances that only affect one country of the area or affect them in different manners. As this kind of macroeconomic disturbances, known as “asymmetric shocks”, cannot be dealt by a common monetary policy, alternative adjustment mechanisms are needed to achieve macroeconomic stabilisation.

The heritage of the sixties: the analysis of alternative mechanisms

Taking as a starting point the contributions of the sixties[1], different modern studies have tried to identify empirically the main adjustment mechanisms alternative to the exchange rate in EMU countries. The analysis of other currency areas (mainly, the United States and Canada) has shown the relevance of factor mobility, fiscal federalism and wages and price flexibility.

First, in respect to factor mobility, although it is expected that EMU will increase capital flows between participating countries, it seems improbable that regions affected by a negative asymmetric shock will increase their capital stock through foreign direct investment. In the case of labour, the existence of cultural and linguistic barriers points that this mechanism will not be specially effective (the available empirical evidence also confirms it: Begg, 1995). The second mechanism is the role of public finance. The studies of Boadway and Flatters (1982), Sachs and Sala-i-Martin (1991) and Bayoumi and Masson (1995) for the United States and Canada have shown the importance of the increase of subsidies and tax reduction in depressed regions for both currency areas. This mechanism is practically inoperative at the European level (Masson, 1996) due to the low importance of the Communitary Budget (approx. 1.27% GDP) and, more important, its lack of progressivity (Castells, 1998). However, and regarding that fiscal sovereignty will remain at a national level, it is possible that national budgets will absorb part of the shocks but not all due to the restrictions that the Stability and Growth Pact imposes. Third, a high flexibility of wages and prices will permit to adjust quickly to shocks on production and employment restoring competitivity without using the exchange rate. The empirical evidence obtained by different authors (Layard *et al.*, 1991; Heylen *et al.*, 1995; Viñals and Jimeno, 1996; Sanromá and Ramos, 1998) show that there are big differences in the response of wages and prices to negative shocks in European countries, differences that can be attributed to institutional mechanisms, and, in nearly all cases, lower responses than in the United States or Japan.

As a summary of this first approach, the obtained results are not conclusive, although there is an agreement that European countries have a lower response capacity in front of adverse asymmetric shocks than other currency areas.

A modern view: will asymmetric shocks tend to increase or diminish?

A difference between more recent studies and the traditional view is the interest about what will happen with asymmetric shocks once the currency area is established. If alternative adjustment mechanisms are limited, the only chance of success will be that asymmetric shocks tend to disappear[2].

The most optimistic view on this issue is offered by the European Commission in the report “One Market, One Money” (1990). This study predicts that asymmetric shocks in the future will decrease as a consequence of the increase in intra-industry trade and more similarities in productive structures. As De Grauwe (1997) remarks, trade based on scale economies and product differentiation would lead to a situation where most demand shocks will affect participating countries in a similar way. So, most demand shocks will tend to be more symmetric. If this view is correct, the loss of national sovereignty on the exchange rate will have no repercussion in terms of macro-economic adjustment capacity.

The alternative most pessimistic view has been defended, among others, by Krugman. According to Krugman, the interaction of increasing returns, transportation costs and demand is the main driving force behind geographic concentration of production. Following this literature, known as economic geography or "new trade" theories, the complete removal of barriers to trade and the improvement of the functioning of the Single Market as a result of EMU, will lead to regional concentration of industrial activity. The basic argument is that when barriers to trade decline, two opposite forces appear: agglomeration forces, which in the presence of scale economies will tend to concentrate production in a single location with large local demand (core), and disagglomeration forces, which due to the improved access to peripherical markets will permit these countries to gain locational attractiveness. The graphical illustration of the two forces is the well known U-shaped curve that relates the level of integration and the relative wage of the periphery (Krugman and Venables, 1990). The fact that trade may lead to regional concentration (agglomeration forces prevail) has been illustrated by comparing the regional distribution of production in the United States and Europe. Production in the United States is more regionally concentrated that in the EU's countries and, following Krugman (1991), the reason is that the US market is more highly integrated than EU's. This evidence suggests that European countries will expect similar levels of regional concentration in a near future. However, recent studies on this topic, such as Sapir (1996), conclude that there have only been small changes in the pattern of specialisation of European Countries during the last decades. Kenen (1969) also suggested that regional specialisation can lead to more asymmetric shocks. Kenen noted that when a region (or a country) has a sectorally-diversified productive structure, it will tend to experience less asymmetric shocks if most shocks are sector-specific. The idea, then, is that as the level of economic integration increases, countries and/or regions would become more specialised and as a consequence they will experience more asymmetric shocks rather than few, specially if sector-specific shocks predominate.

In this paper, we try to offer new empirical evidence about the degree of symmetry between European countries -putting special attention to peripherical countries- using data for the manufacturing sector[3] from 1975 to 1996 and trying to identify which of both *scenarios* seems to predominate.

The structure of the paper is as follows. First, in the next section, we analyse if most shocks occur at a national or at a sectoral level and if the relative importance of each dimension has changed through time for different groups of European countries. The methodology applied has been the one proposed by Stockman (1988). Next, in the third section, we calculate the series of demand of supply shocks following the Bayoumi and Eichengreen (1992, 1996) model. This methodology permits to asses the main sources of asymmetries distinguishing between demand and supply shocks for every individual country respect Germany, which has been usually defined as the anchor area for Europe. The analysis of correlation coefficients between Germany and different countries' series of shocks permits to estimate the degree of symmetry between them. However, the above measures of symmetry are mainly static. In fact, it is implicitly assumed that correlation coefficients are stable for the considered period. This is the reason why in the fourth section we try to overcome this problem using a dynamic measure, which relies on state-space models and the Kalman filter, following Haldane and Hall (1991). This method allows to estimate a time-varying coefficient model, which permits to asses the evolution of the degree of symmetry through the considered time period. Finally, we conclude summarising the main obtained results and pointing the future lines of research.

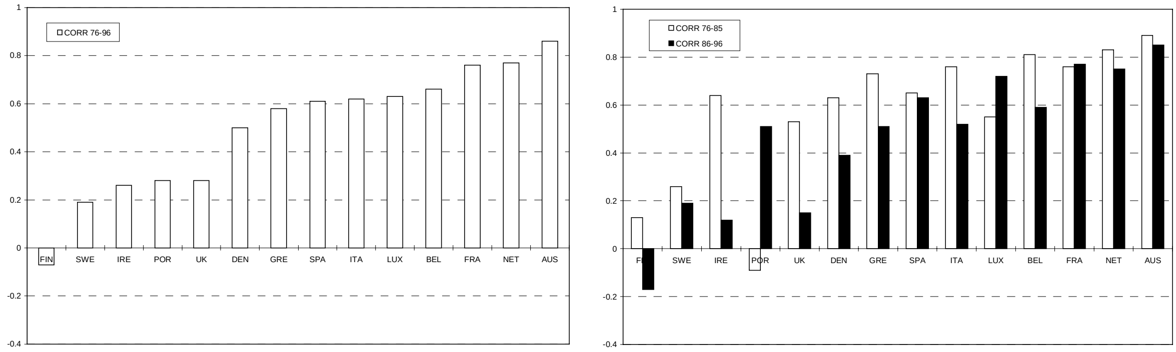
2. The relevance of the sectoral dimension *versus* the national one

In the literature studying the asymmetry of shocks, early contributions examined the correlations across countries of output movements and argued that countries whose GDP tended to move together experienced relatively symmetrical disturbances (see for example, Cohen and Wyplosz, 1989).

Using annual data for the manufacturing sector for EU-15 countries, we have calculated the correlation coefficients between Germany industrial production growth rates and other European countries for 1976-1996. The results in figure 1 show the existence of important differences between core and peripherical countries.

If we distinguish between sub-samples -1976-1985 and 1986-1996- the results show that, in general (except Portugal, Luxembourg and France), correlations have decreased in the most recent years. One could think, then, that asymmetric shocks have tended to increase instead to reduce as the integration process has advanced.

Figure 1. Correlation coefficients between Germany and European countries industrial production growth rates



However, these differences between countries and time periods can arise either from differences in shocks that they have experienced, or either from differences in the responses to these shocks. The above correlation analysis cannot discriminate between the two aspects. In fact, the second period lower correlations can be due to a strong discipline among the considered countries in terms of monetary policy (a self-imposed restriction on adjustment mechanisms) instead of an increase of asymmetric shocks.

There have different attempts to distinguish disturbances from other components of observed output movements (see, for example, Caporale, 1993). As a first approximation, in this section we estimate an error component model following Stockman (1988)[4,5] for the manufacturing sectors in European countries. Our objective is to identify which part of the variation of industrial production growth in different groups of countries and different time periods can be attributed to country-specific shocks or sectoral-specific ones.

The proposed statistical model is given by:

$$\Delta ln\ IPI(i,n,t) = m(i,n) + f(i,t) + g(n,t) + u(i,n,t) \qquad (1)$$

where $\Delta ln\ IPI(i,n,t)$ represents the first difference of the natural logarithm of the industrial production index of sector *i* in country *n* for time *t*. The term *m(i,n)* is a constant specific factor for sector *i* in country *n*. The term *f(i,t)* represents the interaction between a fixed effect of sector *i* with a fixed time effect. *f(i,t)* is a group of dummy variables which take value one for sector *i* at time *t* and zero for the rest in every considered country. This term tries to approximate every common shock that affects production in sector *i* in every country. The term *g(n,t)* tries to approximate common shocks in every sector in the same country, as for example, changes in national policies. Finally, *u(i,n,t)* is a random variable distributed following a normal distribution with zero mean which represents sectoral-specific shocks in every country and every instant.

However, the model represented by equation (1) is not identified because some combinations of dummy variables are perfectly linear and as a consequence it is necessary to make some normalisations to make the estimation feasible: first, a base country is chosen so *g(n,t)*=0 for this country and, second, *f(i,t)*=*g(n,t)*=0 for time *t*[6].

Other fact to take into account before proceeding to estimate the model is the possibility that *f(i)* and *g(n)* can be correlated. This means that sectoral and national effects may not be independent[7]. From an econometric point of view, the solution implies estimating the orthogonal components of *f(i)* and *g(n)* and their joint variation.

If the main determinant of the evolution of a sector in a given country is the sectoral dimension, then the orthogonal component *f(i,t)* should be statistically significant and quantitatively important, while if the relevant dimension is the national then the orthogonal component of *g(n,t)* would be more important. The main advantage of this methodology in respect to others is that it is not necessary to impose any restriction on the dynamic structure of shocks in respect to production growth.

However, before proceeding to estimate equation (1), it is important to notice one inconvenient: the model assumes that a national-specific shock affects every sector in the same manner without taking into account the fact that sectors may have different cyclical amplitudes. To relax this assumption a modified version of (1) can be estimated:

$$\Delta ln\ IPI(i,n,t) = m(i,n) + f(i,t) + \beta^i \cdot g(n,t) + u(i,n,t) \qquad (2)$$

where β^i is a unique coefficient for sector *i* but common for every country. Model (2), which is non-linear, presents a high number of parameters to attempt direct estimation. The solution consists in transforming the data before estimating it. In particular, the growth rate of every sector is divided by the standard deviation of every sector of the base country and multiplied by a constant[8].

Data used to estimate model (2) are the Industrial Production Indices of the European Union Countries for the period 1975-1996 at ISIC's two digit sectoral aggregation level (see table 1) with base year 1990 and annual periodicity, published by OECD[9].

Table 1. Sector description

Description	ISIC Code	Description	ISIC Code
Food, beverages and tobacco	31	Chemicals	35
Textiles, clothing and leather	32	Non-metallic mineral products	36
Wood and wood products	33	Basic metals	37
Paper and paper products	34	Metal products, machinery and equipment	38

Results of estimating model 2 for different groups of countries and different time periods are shown in table 2. In particular, we have estimated the model for four groups of countries: EU-15, EU-11 (Euro zone), EU-6 (core countries: Benelux, France, Germany and Italy) and EU-7 (peripherical countries: Denmark, Finland, Greece, Ireland, Portugal, Spain and Sweden) and from 1976 to 1996 and two sub-samples: 1976-1985, 1986-1996.

The obtained results are coherent with previous studies. Both dimensions, the national and the sectoral, are relevant, although the national dimension is more important than the sectoral one for the considered countries. The importance of the sectoral dimension is higher when considering core countries or peripherical countries in respect to EU-15 or EU-11. A possible explanation for this result is that it is due to bigger differences in terms of productive structures. For example, relative differences in terms of productive structures are more important inside core countries or between Nordic and Mediterranean countries than in the EU-15 as an average (see Ramos *et al.*, 1998). Also it is important to note that the relevance of sector-specific shocks has tended to diminish in the second period in peripherical countries.

In respect to the national dimension, the results show two other interesting features. First, the relative importance of country-specific shocks is higher in peripherical countries than in core countries. The results obtained for core countries are similar to the ones obtained by other studies. For example, Stockman (1988) (see note 4 for description of considered countries and sample) finds that the relative importance of national disturbances is 28%; while Bayoumi and Prasad (1995), using a slightly different methodology, estimate the importance of national disturbances in the manufacturing sector as 27%[10]. The higher relevance of national-specific disturbances in EU-15 or in peripherical countries is not surprising as country-specific shocks are related to differences in monetary and fiscal policies which occur at a national level. The results are due to the fact that differences in terms of policies are bigger between peripherical countries than between central ones. The second feature is that the relative importance of country-specific shocks have tended to diminish from the first to the second period for the different groups of countries, but specially in peripherical ones. This fact is quite optimistic in terms of shocks symmetry as it can be interpreted as policies in Members States have been more co-ordinated during recent years making less improbable policy-induced asymmetric shocks.

Although the main advantage of this methodology is that it is not necessary to impose any restriction on the dynamic structure of shocks, it has one disadvantage: it does not permit to asses the incidence of country-specific shocks (associated to demand shocks) and sector-specific (which can be associated to supply shocks) on every individual country. In the following section, we try to overcome this inconvenient applying a different methodology.

3. Supply and demand shocks: the Bayoumi and Eichengreen (1992) model

Bayoumi and Eichengreen (1992, 1996) took an alternative approach to distinguish shocks from responses in output movements. Their starting point is the aggregate demand and supply model (for example, Dornbusch and Fischer, 1986).

The main assumption of this model is that there are two kind of shocks: shocks that affect the demand curve (for example, due to monetary or fiscal policy changes) and shocks that affect the supply curve (for example, technological changes). From the model it is also clear that demand and supply shocks have different effects on output and prices. In fact, it implies that while supply shocks have permanent effects on the level of output, demand shocks only have temporary effects, while both have permanent effects on the level of prices.

These assumptions can easily be introduced in a structural bivariate VAR on output and prices to obtain the series of demand and supply shocks.

Table 2. Results of the error component model estimation -equation 2-

	EU-15			Euro Zone EU-11		
Sample	1976-1996	1976-1985	1986-1996	1976-1996	1976-1985	1986-1996
Observations (sectors x country)	2461 (2520)	1158 (1200)	1303 (1320)	1807 (1848)	853 (880)	954 (968)
Total sum of squares	86.19	46.76	39.44	68.59	37.24	31.35
Corrected R^2	0.54	0.54	0.59	0.53	0.51	0.61
Explained sum of squares	50.01	27.56	24.41	40.12	21.03	20.54
Squares sum attributable to $f(i,t)+g(n,t)$	29.24	15.04	12.91	22.73	11.79	10.25
Orthogonal component $f(i,t)$						
Explained sum of squares	5.95	3.04	2.55	6.01	3.12	2.61
Percentage	20%	20%	20%	26%	26%	25%
F (P-value)	2.23 (0.001)	2.12 (0.001)	2.34 (0.001)	2.05 (0.001)	1.84 (0.001)	2.37 (0.001)
Orthogonal component $g(n,t)$						
Explained sum of squares	14.02	7.41	5.85	9.75	5.43	4.00
Percentage	48%	49%	45%	43%	46%	39%
F (P-value)	2.63 (0.001)	2.58 (0.001)	2.68 (0.001)	2.33 (0.001)	2.25 (0.001)	2.55 (0.001)

Table 2. Results of the error component model estimation - equation 2 (continuation)-

	Core countries EU-6 (Benelux, France, Germany and Italy)			Peripherical countries EU-7 (Denmark, Finland, Greece, Ireland, Portugal, Spain and Sweden)		
Sample	1976-1996	1976-1985	1986-1996	1976-1996	1976-1985	1986-1996
Observations (sectors x country)	990 (1008)	465 (480)	525 (528)	1135 (1176)	533 (560)	602 (616)
Total sum of squares	29.50	14.01	15.49	50.19	29.55	21.73
Corrected R^2	0.58	0.63	0.58	0.58	0.56	0.65
Explained sum of squares	18.21	9.33	9.51	31.09	18.05	14.73
Squares sum attributable to *f(i,t)+g(n,t)*	11.95	5.79	6.05	18.30	9.81	7.21
Orthogonal component *f(i,t)*						
Explained sum of squares	4.21	1.92	2.15	5.44	3.23	1.86
Percentage	35%	33%	35%	30%	32%	26%
F (P-value)	1.82 (0.001)	1.95 (0.001)	1.78 (0.001)	1.63 (0.001)	1.57 (0.001)	1.66 (0.001)
Orthogonal component *g(n,t)*						
Explained sum of squares	2.85	1.61	1.34	8.29	4.59	2.94
Percentage	24%	28%	22%	45%	47%	38%
F (P-value)	1.72 (0.001)	2.30 (0.001)	1.55 (0.001)	2.90 (0.001)	2.61 (0.001)	3.06 (0.001)

Consider the model

$$\begin{bmatrix}\Delta Y_t \\ \Delta P_t\end{bmatrix} = \sum_{i=0}^{\infty} \begin{bmatrix} a_{11i} & a_{12i} \\ a_{21i} & a_{22i} \end{bmatrix} \cdot \begin{bmatrix}\varepsilon_{dt} \\ \varepsilon_{st}\end{bmatrix} \tag{3}$$

where ΔY_t and ΔP_t represent, respectively, changes in the logarithm of output and prices at time t, ε_{dt} and ε_{st} represent supply and demand shocks and a_{iij} represent each of the elements of the impulse-response function to shocks.

The identification restriction is based on the previously stated assumption: while supply shocks have permanent effects on the level of output, demand shocks only have temporary effects. As output data is in first differences, this implies that cumulative effects of demand shocks on output must be zero.

$$\sum_{i=o}^{\infty} a_{11i} = 0 \tag{4}$$

The model defined by equations (3) and (4) also imply that the bivariate endogenous vector can be explained by lagged values of every variable. If B represents the value of model coefficients, the model to be estimated is the following:

$$\begin{bmatrix}\Delta Y_t \\ \Delta P_t\end{bmatrix} = B_1 \cdot \begin{bmatrix}\Delta Y_{t-1} \\ \Delta P_{t-1}\end{bmatrix} + B_2 \cdot \begin{bmatrix}\Delta Y_{t-2} \\ \Delta P_{t-2}\end{bmatrix} + \ldots + \begin{bmatrix}e_{yt} \\ e_{pt}\end{bmatrix} \tag{5}$$

where e_{yt} and e_{pt} are the residuals of every VAR equation. Equation (5) can be also expressed as

$$\begin{bmatrix}\Delta Y_t \\ \Delta P_t\end{bmatrix} = (I - B(L))^{-1} \cdot \begin{bmatrix}e_{yt} \\ e_{pt}\end{bmatrix} = \left(I + B(L) + B(L)^2 + \ldots\right) \cdot \begin{bmatrix}e_{yt} \\ e_{pt}\end{bmatrix} \tag{6}$$

and in an equivalent manner

$$\begin{bmatrix}\Delta Y_t \\ \Delta P_t\end{bmatrix} = \sum_{i=0}^{\infty} \begin{bmatrix} d_{11i} & d_{12i} \\ d_{21i} & d_{22i} \end{bmatrix} \cdot \begin{bmatrix}e_{yt} \\ e_{pt}\end{bmatrix} \tag{7}$$

Putting together equations (3) and (7),

$$\sum_{i=0}^{\infty}\begin{bmatrix} d_{11i} & d_{12}i \\ d_{21i} & d_{22i} \end{bmatrix}\cdot\begin{bmatrix} e_{yt} \\ e_{pt} \end{bmatrix} = \sum_{i=0}^{\infty} L_i \cdot \begin{bmatrix} a_{11i} & a_{12i} \\ a_{21i} & a_{22i} \end{bmatrix}\cdot\begin{bmatrix} \varepsilon_{dt} \\ \varepsilon_{st} \end{bmatrix} \tag{8}$$

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

$$\begin{bmatrix} e_{yt} \\ e_{pt} \end{bmatrix} = \left[\sum_{i=0}^{\infty}\begin{bmatrix} d_{11i} & d_{12}i \\ d_{21i} & d_{22i} \end{bmatrix}\cdot\sum_{i=0}^{\infty} L^i \cdot \begin{bmatrix} a_{11i} & a_{12i} \\ a_{21i} & a_{22i} \end{bmatrix}\right]\cdot\begin{bmatrix} \varepsilon_{dt} \\ \varepsilon_{st} \end{bmatrix} = c\cdot\begin{bmatrix} \varepsilon_{dt} \\ \varepsilon_{st} \end{bmatrix} \tag{9}$$

From (9) it also seems clear that in the *(2x2)* considered model, four restrictions are needed to define uniquely the four elements of matrix *c*. Two of these restrictions are simple normalisations that define the variances of shocks ε_{dt} and ε_{st}. The usual convention in VAR model consists in imposing the two variances equal to unity, which together with the assumption of orthogonality define the third restriction $c'c=\Sigma$, where Σ is the covariance matrix e_y and e_p. The final restriction that permits matrix *c* to be uniquely defined comes from Economic Theory and has previously be defined in equation (4): cumulative effects of demand shocks on output must be zero. In terms of the model, introducing (4) in (9), it follows that

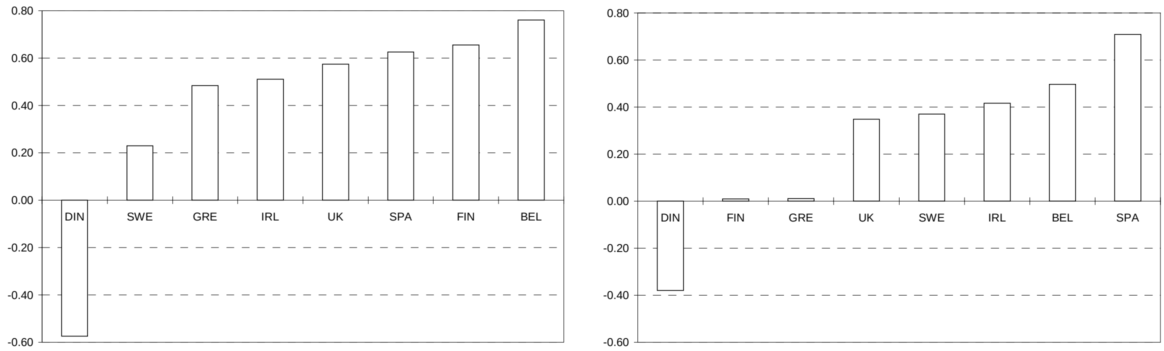
$$\sum_{i=0}^{\infty}\begin{bmatrix} d_{11i} & d_{12i} \\ d_{21i} & d_{22i} \end{bmatrix}\cdot\begin{bmatrix} c_{11} & c_{12} \\ c_{21} & c_{22} \end{bmatrix} = \begin{bmatrix} 0 & . \\ . & . \end{bmatrix} \tag{10}$$

and the resolution of this system permits to estimate the series of demand and supply shocks introducing a linear restriction on VAR model coefficients.

We have estimated this VAR model using annual data on manufacturing production and producer prices series from 1975 to 1996 for selected European countries[11]: Belgium, Denmark, Finland, Germany, Greece, Ireland, Spain, Sweden and United Kingdom. In all cases the number of lags introduced in VAR models has been set to two to keep an homogeneous identification scheme for every country (moreover, the Schwartz information criterion have also indicated this was the optimal lag in most cases).

Figure 2 shows the value of the correlation coefficient measuring the relationship between demand (left) and supply (right) shocks in Germany with the rest of countries. Comparing these results with the ones obtained by Bayoumi and Eichengreen (1992, 1996) and Funke (1997) applying the same methodology, it seems clear that, as an average, correlations are higher due, probably, to the fact that we are considering a more recent period and only the manufacturing sector.

Figure 2. Demand and supply shocks correlation coefficients with Germany



The higher correlations in terms of demand shocks confirm the results obtained in the previous section: asymmetries due to differences in national policies have tended to diminish. In terms of supply shocks, the results are more pessimistic as differences between core and most peripherical countries (except Spain) are higher than in terms of demand.

One problem with the previous analysis is that the measures that we are using to contrast the existence of relationships between the series of shocks are mainly static. As Boone (1997) has suggested, the European Economic and Monetary integration process is a dynamic process. Bilateral relationships between countries are subjected continuously to structural changes, changes that the correlation coefficient is not able to capture. In the next section, we apply the model proposed by Boone (1997) to distinguish if there has been an effective movement towards greater symmetry in terms of shocks between the considered countries or if higher values of the correlation coefficients are simply due to sample selection.

4. The instability of economic relationships: changing asymmetries

In classic statistic and econometric modelling, it is supposed that relationships between economic variables is stable through the considered period. It is, then assumed, that statistics for that period are stable and valid for the whole sample. However, the empirical evidence shows that relationships are not always stable. Stock and Watson (1996) show that most relationships between economic variables for the United States in the post-war period have changed along time with a very high frequency.

A first approach to overcome this inconvenient is the one that we have applied in the second section: split the complete period in two or more sub-samples. This approach offers a solution to the problem but it has one important disadvantage: sub-samples must be defined *a priori*, so results depend on how well we can approximate the structural break point. Also the number of structural breaks must be imposed.

Other possible way to overcome this inconvenient consists in applying a time varying coefficient model as it has been suggested in the previous section. This kind of model was first proposed by Haldane and Hall (1991), who studied the relationship between the US Dollar and the Sterling Pound and the Deustchemark and the US Dollar bilateral exchange rate using high frequency daily data between January 1976 and August 1989. The question under consideration was to what extent movements in the Sterling bilateral exchange rates were associated with movements in the Dollar and with movements in the DM. They considered the model

$$[DM/£]_t = a_t + b_t \cdot [DM/\$]_t + \varepsilon_t \tag{11}$$

$$a_t = a_{t-1} + \eta_{1t} \tag{12}$$

$$b_t = b_{t-1} + \eta_{2t} \tag{13}$$

where DM/£ represents the logarithm of the nominal DM-Sterling exchange rate and DM/$ the corresponding DM-Dollar rate. Using time-varying estimation methods, Haldane and Hall obtained estimates for a_t and b_t, the parameters of equation (11). The results for b_t showed that it has changed from being approximately the unity in the seventies to nearly zero by the mid-eighties. This fact shows that the Sterling has converged on the Deustchmark over time. The use of a static measure, such as the correlation coefficient, would not have revealed this[12].

This methodology was first used, to our knowledge, in the context of the European Monetary integration process by Boone (1997) to analyse the degree of symmetry of demand and supply shocks for the whole economy. The considered model was the following:

$$(Z - X)_t = a_t + b_t \cdot (Z - Y)_t + \varepsilon_t \tag{14}$$

$$a_t = a_{t-1} + \eta_{1t} \tag{15}$$

$$b_t = b_{t-1} + \eta_{2t} \tag{16}$$

where Z_t represents the series of shocks in Germany, X_t the series of shocks in the considered country and Y_t, the shocks in the rest of the world (which is proxied by shocks in the United States). The parameters a_t and b_t are time-varying coefficient which allow to assess the dynamic evolution of asymmetries. The value of coefficient a_t summarises differences in the average of variables which can be interpreted as an indicator of "autonomous" convergence between countries. In respect to b_t , if $b_t \rightarrow 1$, then X moves towards Y. Shocks are more similar to the rest of the world (USA) than to Germany. If $b_t \rightarrow 0$, there is convergence between X and Z. If b_t moves from 1 to 0, it indicates that country X is moving from the influence area of Y to Z in terms of shocks.

Boone's results provide evidence in favour of convergence, in terms of supply shocks, of the core countries but also for the peripherical countries, except Greece. The United Kingdom also remains aside of this process. With respect to demand shocks, he finds that the distinction between core and peripherical countries is very weak, although the convergence process seems to have stopped since the mid-eighties.

The results presented in this section differ from Boone (1997) in two aspects. First, we analyse the degree of symmetry between shocks for the manufacturing sector, not the whole economy, and we do not consider all EU-15 countries but peripherical countries. Second, the estimated model is slightly different: as the series of shocks, estimated following the Bayoumi and Eichengreen's methodology, have by definition zero mean, we impose the restriction that a_t=0[13]. The introduction of this assumption implies the estimation of only two equations:

$$(Z - X)_t = b_t \cdot (Z - Y)_t + \varepsilon_t \tag{17}$$

$$b_t = b_{t-1} + \eta_t \tag{18}$$

which can be easily estimated for every consider country using the Kalman filter once the model is interpreted as a *state-space* representation: equation 17 can be understood as the measurement equation and equation 18 as the transition equation. The details of the estimation procedure can be found in the Cuthberson *et al.* (1992) and Harvey (1989).

The obtained results for demand and supply shocks symmetry (the evolution of b_t)between Belgium, Denmark, Finland, Greece, Ireland, Spain, Sweden and United Kingdom in respect to Germany as opposite to the rest of the world (USA) are shown in figures 3 and 4.

In respect to demand shocks, nearly all the considered countries (except Denmark) show strong evidence of convergence with Germany. The lowest values of the *b* coefficient at the end of the sample are those of Belgium and Finland, while Spain, Greece, Ireland and Sweden together with the United Kingdom remain at an intermediate level. These results are not surprising since demand shocks are supposed to be related with differences in national macroeconomic policies, differences that have been effectively reduced due to the greater coordination among EU countries. For the case of the United Kingdom and Denmark, the reasons that may have lead to divergence seem clear: the lack of political willingness to take part in the final stage of EMU.

In terms of supply shocks, the results confirm the convergence of Belgium with Germany during practically the whole period. Only the German unification[14] seem to have slightly altered this relation. For the considered Mediterranean countries, only Spain has achieved a high degree of convergence with Germany. In fact, Greece, together with the United Kingdom, are the countries with higher values of the *b* coefficient at the end of the sample. In Nordic countries, the situation seems to have worsened during the most recent years, although the values of the coefficient show a considerable degree of convergence. Different factors may be accounted for this. A first possible explanation is that the departure from the convergence path is just temporary due to conjunctural factors (such as the impact of Germany reunification) and after a short period of time (not included in the sample) they will return to convergence. A second explanation may be related with differences in terms of "positive" supply shocks. For example, if Mediterranean and Nordic countries experience productivity increases (due for example to the effects of structural funds) higher than Germany, this will help to reduce differences between EU countries in terms of "catching-up". In this sense, divergence between supply shocks should not be very much worrying for EMU. In any case, the divergence process seems to have stopped during the most recent years.

5. Conclusions

Following the Theory of Optimum Currency Areas, there is a wide consensus that the capacity of EU countries to face adverse asymmetric shocks without using the exchange rate is lower than in other currency areas such as the United States or Canada. As a result, different studies have focused on what will happen with asymmetric shocks once the currency area was stablished. Two different views have tried to answer this question. The EC Comission argues that asymmetric shocks will tend to diminish as a consequence of intra-industry trade, while Krugman's view insists on the dangers of regional specialisation as a source of asymmetries if shocks are sector-specific.

In this paper we have tried to offer new empirical evidence about the degree of symmetry between selected European countries using manufacturing data from 1975 to 1996 and trying to identify which of both views seems to predominate.

First, in the second section, using the methodology proposed by Stockman (1988) to distinguish shocks from responses, we have found that both national and sectoral dimensions are important, so Krugman's view cannot be discarted. The relevance of country-specific shocks (associated to demand) has tended to decrease during the considered period, so there is also evidence in favour of EC's view.

With the aim to asses the degree of symmetry of shocks for every individual country (instead of between groups of countries), we have applied the Bayoumi and Eichengreen (1992) model to calculate the series of demand and supply shocks. Taking Germany as the anchor area, the values of correlation coefficients are higher than the ones obtained by other studies The difference between core and peripherical country has reduced in the analised period, specially in terms of demand shocks.

However, the analysis of correlation coefficients cannot capture the dynamics of the considered relationship. This is the reason why in the fourth section we have applied a time varying coefficient model to assess convergence between countries series of shocks. The obtained results show that demand and supply shocks, but specially the first, have been more symmetric in respect to Germany during the most recent years. Future research will focuse on causes of asymmetries between shocks, such as an increase in regional and/or country specialisation or, as it has been mentioned, the effects of structural funds.

Figure 3. Demand shocks convergence with Germany as opposite to the rest of the world 1978-1996

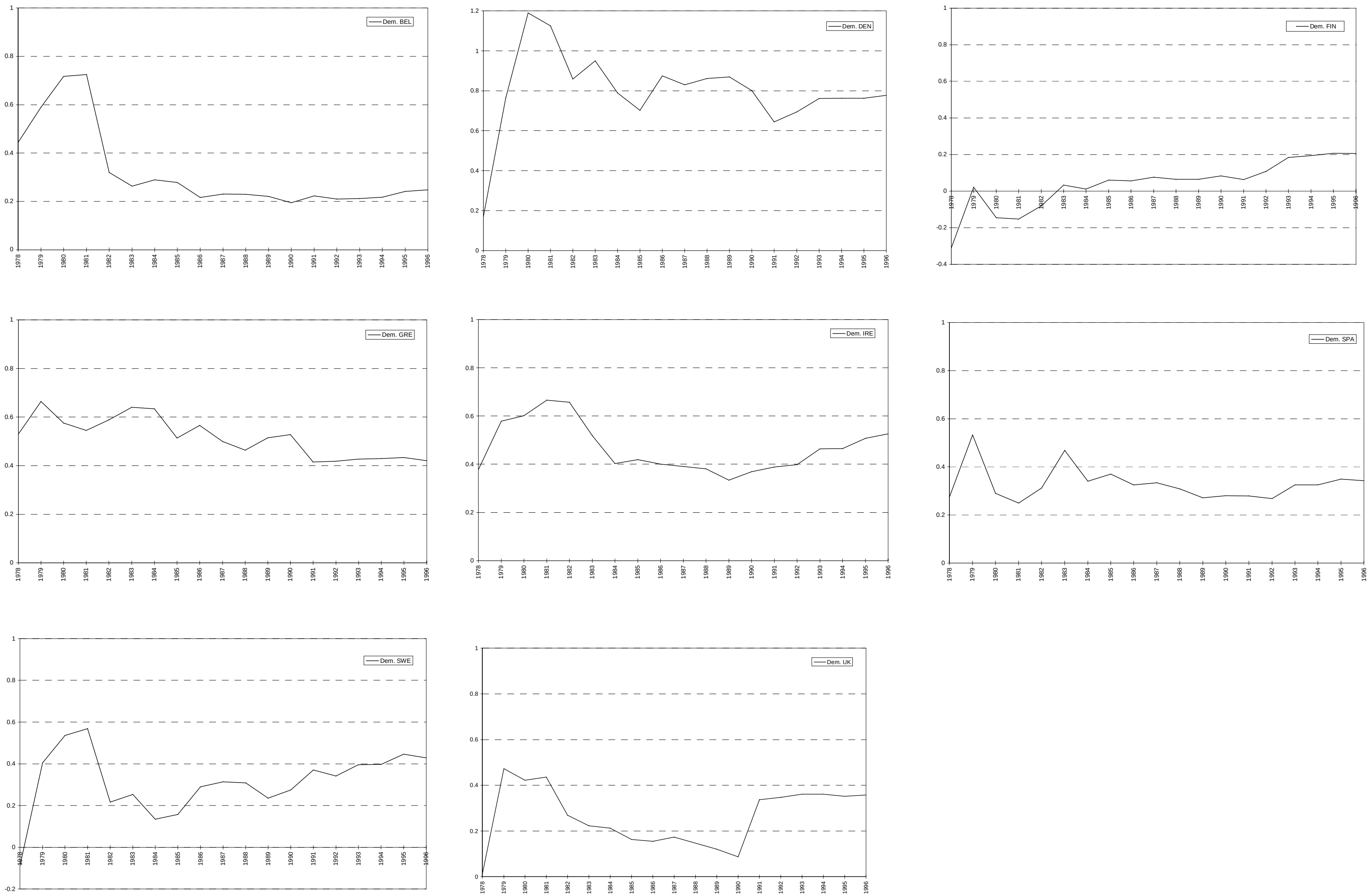
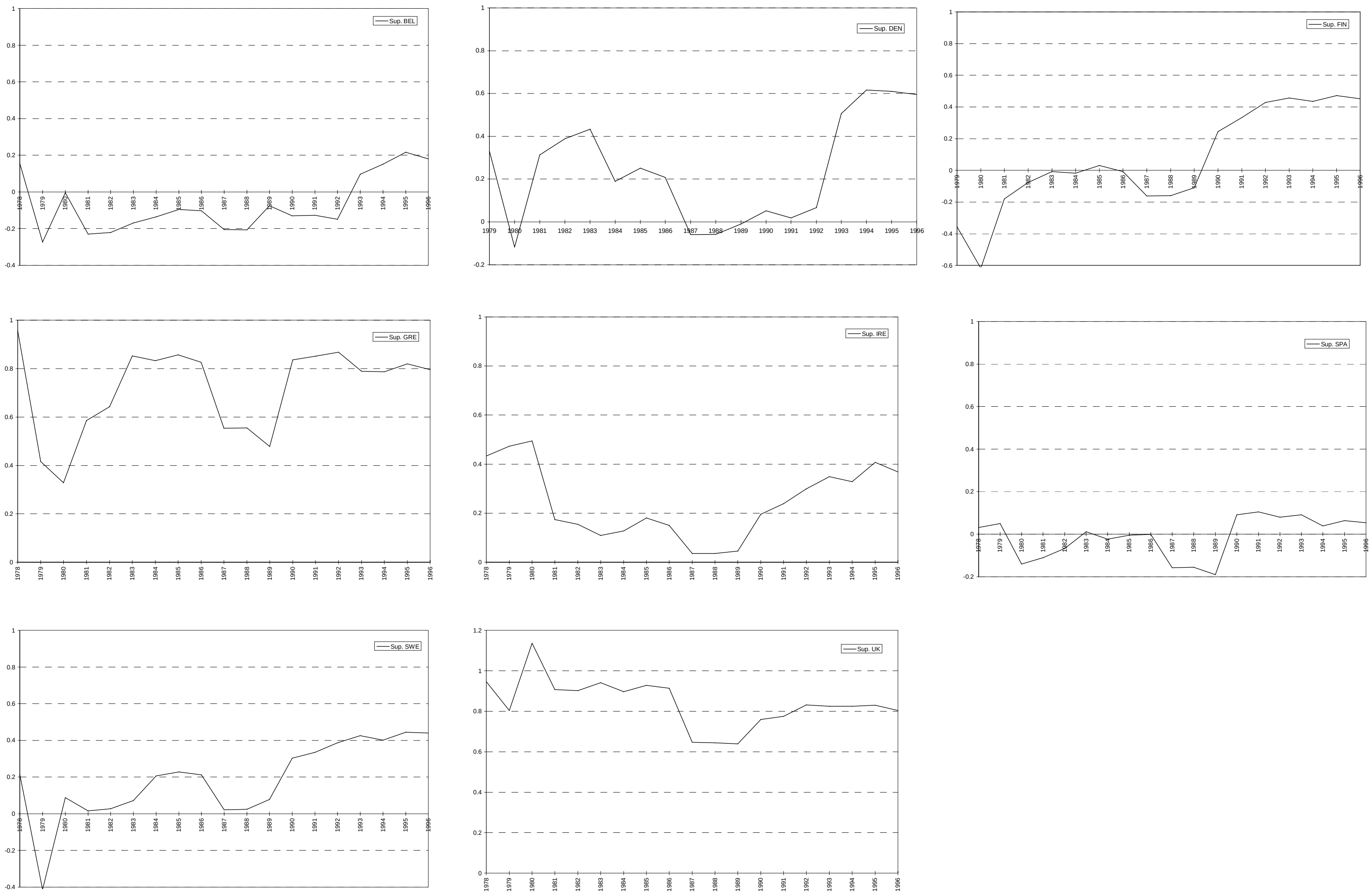


Figure 4. Supply shocks convergence with Germany as opposite to the rest of the world 1978-1996



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Final Notes

[1] The analysis of the first authors studying theoretically currency areas focused on adjustment mechanisms alternative to the exchange rate. See Ishiyama (1975) for an extensive review.
[2] A different view is adopted by Frankel and Rose (1996), who argue that OCA criteria are endogenous. This means that as the integration process advances, alternative adjustment mechanisms will become more relevant and asymmetric shocks will diminish as a consequence of the own process. It is expected that European countries will be an optimum currency area *ex-post* more than *ex-ante*.
[3] The reason to analyse the manufacturing sector instead of the whole economy is clear: manufacturing has been exposed with a greater intensity to the effects of the Single Market programme.
[4] Stockman (1988) applies this kind of model with a similar objective using quarterly and annual industrial production data for Belgium, France, Germany, Italy, Netherlands, Switzerland, United Kingdom and United States for the period 1964-1975. In both data sets, he finds that national and sectoral shocks are statistically significant. Bini-Smaghi and Vori (1993) obtained similar results considering eleven European countries (EU-12 except Luxembourg). Bayoumi and Prasad (1995, 1997) have also applied a similar model to compare the relevance of both shocks at a regional level for the United States and Europe arriving to similar conclusions.
[5] Error component models have also been used with different objectives. For example, Costello (1993) analyses the relevance of sectoral and national shocks on productivity growth in Canada, Germany, Japan, United Kingdom and United States for 1960-1985.
[6] The following results have taken as base country the United Kingdom and 1996 the base year. We have also taken other countries and years as base and the results have not changed substantially.
[7] As Stockman (1988) remarks, the correlation falls when more countries and sectors are considered but it is not possible to know *a priori* if the number of countries and sectors would be enough to mitigate the problem.
[8] See Stockman (1988) for more details.
[9] At this level of aggregation and for the considered countries and periods, the number of missings is reduced.
[10] The European considered countries are eight: Austria, Belgium, Denmark, Germany, Greece, Italy, Netherlands, and the United Kingdom.
[11] We have considered peripherical countries (Nordic and Mediterranean, except Portugal as data on prices were not available), Belgium as a control for core countries and Germany as anchor area (see Bayoumi and Eichengreen, 1992 and Boone, 1997 on a discussion of the idoneity of Germany as reference country to study the asymmetry of shocks).
[12] Hall *et al.* (1992) and Button and Pentecost (1996) have also applied this model to study EC economies convergence.
[13] See Hall *et al.* (1992) for the justification of this restriction for the case of inflation rates differentials.
[14] Only indirect effects are considered here as we are using data for West Germany.

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