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SPECIALISATION IN EUROPE AND ASYMMETRIC SHOCKS: POTENTIAL RISKS OF EMU

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ABSTRACT: Most optimistic views, based on Optimum Currency Areas (OCA) literature, have concluded that the probability of asymmetric shocks to occur at a national level will tend 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 a higher specialisation of regions, it is expected that asymmetric shocks will increase.

Previous studies have examined to what extent asymmetric shocks have been relevant in the past using, mainly, static measures of asymmetries such as the correlation coefficients between series of shocks previously calculated from a structural VAR model (Bayoumi and Eichengreen, 1992).

In this paper, we study the evolution of manufacturing specific asymmetries in Europe from a dynamic point of view (applying the model proposed by Haldane and Hall, 1991) in order to obtain new evidence about potential risks of EMU.

***KEY WORDS*:** Optimum Currency Areas, Economic and Monetary Union, Asymmetric Shocks, Specialisation, Structural VAR Models, Kalman Filter.

JEL Classification: F42, F20 and F33.

RESUM: Els punts de vista més optimistes, basats en la literatura de les Àrees Monetàries Òptimes, arriben a la conclusió que la probabilitat d'ocurrència de *shocks* asimètrics en l'àmbit nacional tendiran a disminuir amb la Unió Econòmica i Monetària (UEM) donada la intensificació dels procés d'integració al llarg dels darrers anys. En canvi, les teories conegudes com noves teories de Geografia Econòmica prediuen un augment de l'especialització de les regions i, per tant, seria d'esperar que els *shocks* asimètrics augmentessin.

La major part dels estudis previs s'han centrat en estudiar en quina mesura els *shocks* asimètrics han estat rellevants en el passat emprant, principalment, mesures d'asimetries estàtiques com ara coeficients de correlació entre sèries de *shocks* calculades prèviament a partir d'un model VAR estructural (Bayoumi i Eichengreen, 1992) per tal de fer previsions cap al futur.

En aquest paper estudiem l'evolució de les asimetries en la producció a Europa des d'un punt de vista dinàmic (aplicant el model proposat per Haldane i Hall, 1991) per a obtenir nova evidència sobre els riscos potencials de l'UEM.

***PARAULES CLAU*:** Àrees Monetàries Òptimes, Unió Econòmica i Monetària, *Shocks* Asimètrics, Especialització, Models VAR Estructurals, Filtre de Kalman.

***Classificació JEL*:** F42, F20 i F33.

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1. INTRODUCTION[1]

In recent years, various studies have focused on the effects of European Integration and Monetary Unification, especially the convergence-divergence debate. The creation of the Euro Zone (eleven countries with three hundred million inhabitants and, approximately, a fifth of the world GDP and trade) establishes 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) (see Ishiyama, 1975 and Tavlas, 1993). The seminal contribution of Mundell (1961), followed by McKinnon (1963) and Kenen (1969), among others, form a basis for the rest of studies. These initial works emerged from the intense debate during the sixties and mid-seventies about fixed *versus* flexible exchange rates. The objective was to identify the criteria that determine whether a country should join a currency area or not. The strategy consisted in identifying the main benefits and costs that an individual country would experience 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 made it important to update the

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[1] We would like to thank T. Bayoumi and B. Eichengreen, who kindly provided us their TSP programs to calculate the series of shocks. Comments received from participants in the *I Encuentros de Economía Aplicada* (Barcelona, June 1998) and in the 38th Congress of the European Regional Science Association (Wien, August 1998) were also helpful. Finally, we are grateful to comments made by E. López-Bazo, E. Pons and other colleagues in our research group "*Grup d'Anàlisi Quantitativa Regional*". Of course, all remaining errors are our own.

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 the positive economic effects of EMU, especially at a microeconomic level (de Grauwe, 1997), due to the direct and indirect benefits of transaction costs reduction, the reduced uncertainty and greater transparency in price determination mechanisms, there is no agreement on potential costs.

Obviously, the main cost of joining a currency area is the loss of monetary policy instruments, such as the exchange rate, which serve at national level as stabilisation mechanisms against macroeconomic disturbances affecting a single country, or affecting different countries in different ways. As this kind of macroeconomic disturbance, known as an “asymmetric shock”, cannot be dealt by a common monetary policy, alternative adjustment mechanisms are needed to achieve macroeconomic stabilisation.

1.1. The heritage of the sixties: the analysis of alternative mechanisms

Taking as a starting point the contributions of the sixties[2], number of modern studies have tried to identify empirically the main adjustment mechanisms which could be in used in EMU countries as alternative to the exchange rate. The analysis of other currency areas (mainly the United States and Canada) has shown the relevance of factor mobility, fiscal federalism and wages and prices flexibility.

First, in relation to factor mobility, Kenen (1989) does not find any statistical relationship between real exchange rate variability and foreign direct investment, so it seems improbable that EMU will increase capital flows between

[2] 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.

participating countries. Moreover, Eichengreen (1992) shows that capital mobility only acts as an alternative adjustment mechanism under the restrictive assuption of constant returns to scale. In the case of labour, the existence of cultural and linguistic barriers suggests that this mechanism will not be specially effective. This is confirmed by the available empirical evidence (see 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 an increase in subsidies and tax reduction in depressed regions for both currency areas. This mechanism is practically inoperable, however, 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, considering 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 imposed byt the Stability and Growth Pact.

Third, high flexibility of wages and prices can make it possible to adjust quickly to shocks affecting production and employment, restoring competitiveness without using the exchange rate. The empirical evidence obtained by various 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. These can be attributed to different institutional mechanisms. In nearly all cases, though, there are 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 agreement that European countries have a lower response capacity in the face of adverse asymmetric shocks than other currency areas.

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

One 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. Given that alternative adjustment mechanisms are limited, the only chance of the Euro succeeding will be if asymmetric shocks tend to disappear.

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, demand shocks will tend to be more symmetric. If this view is correct, the loss of national sovereignty over the exchange rate will have no repercussion in terms of macroeconomic adjustment capacity.

The opposite, pessimistic view has been defended, among others, by Krugman, who sustains that 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 permit peripherical markets to gain locational attractiveness due to improved access. 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 (i. e. agglomeration forces prevailing) 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 and, following Krugman (1991), the reason is that the US market is more highly integrated. This evidence suggests that European countries can expect similar levels of regional concentration in the 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 few decades.

This idea was first introduced by Kenen (1969), who suggested that regional specialisation can lead to more vulnerability to asymmetric shocks. Kenen noted that, as shocks tend mostly to be sector-specific, when a region (or a country) has a sectorally-diversified productive structure, it tends to be less subject to asymmetric shocks. But as the level of economic integration increases, countries and/or regions become more specialised and, consequently, they experience more asymmetric shocks, especially if sector-specific shocks predominate.

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. If this is the case, European countries can be expected to be an OCA *ex-post* more than *ex-ante*.

Our objective is to offer new empirical evidence about the degree of symmetry between European countries, giving special attention to peripheral countries. We use data for the industrial sector from 1975 to 1996 and trying to identify which of the two *scenarios* seems to predominate.

There is a straightforward reason for analysing only the industrial sector, defined as the production of manufactured goods, i.e. excluding activities related to energy and construction. This is because manufacturing has been more intensely exposed to the effects of the Single Market programme than the rest of the economy due to its greater opennes (European Commission, 1990). Although manufacturing represents a limited share of GDP (around 20% in European countries), manufactured goods account for a considerable proportion of total exports and imports in EU countries (around 75%). Hence, the greater part of economic trade in goods and services between EU countries involves manufactured goods, so the development of the internal market and the process towards monetary unification is likely to have more effect on the manufacturing sector.

The rest of the paper is organised as follows. In the next section, we analyse the correlations between EU countries' output evolution at a national and sectoral level to obtain evidence on the interdependence of the economies considered. Then, in the third section, as shocks at the sectoral level are more related to Krugman's scenario, we investigate whether most shocks occur at the national or the sectoral level and if their relative importance has changed through time for different groups of European countries. To distinguish shocks from responses, the methodology applied is that proposed by Stockman (1988). Next, in the fourth section, we apply the Bayoumi and Eichengreen model (1992, 19969 to assess the main sources of asymmetry using correlation coefficients and distinguishing between demand and supply shocks for European countries.

However, these measures of symmetry are mainly static. In fact, it is implicitly assumed that correlation coefficients are stable for the period considered. This is why in the fifth section we try to overcome this problem by using a dynamic measure which relies on state-space models and the Kalman filter, following Haldane and Hall (1991). This method allows us to estimate a time-varying coefficient model and to assess the evolution of the degree of symmetry through the study period. Finally, we conclude summarising the main results obtained.

2. THE ANALYSIS OF OUTPUT CORRELATIONS

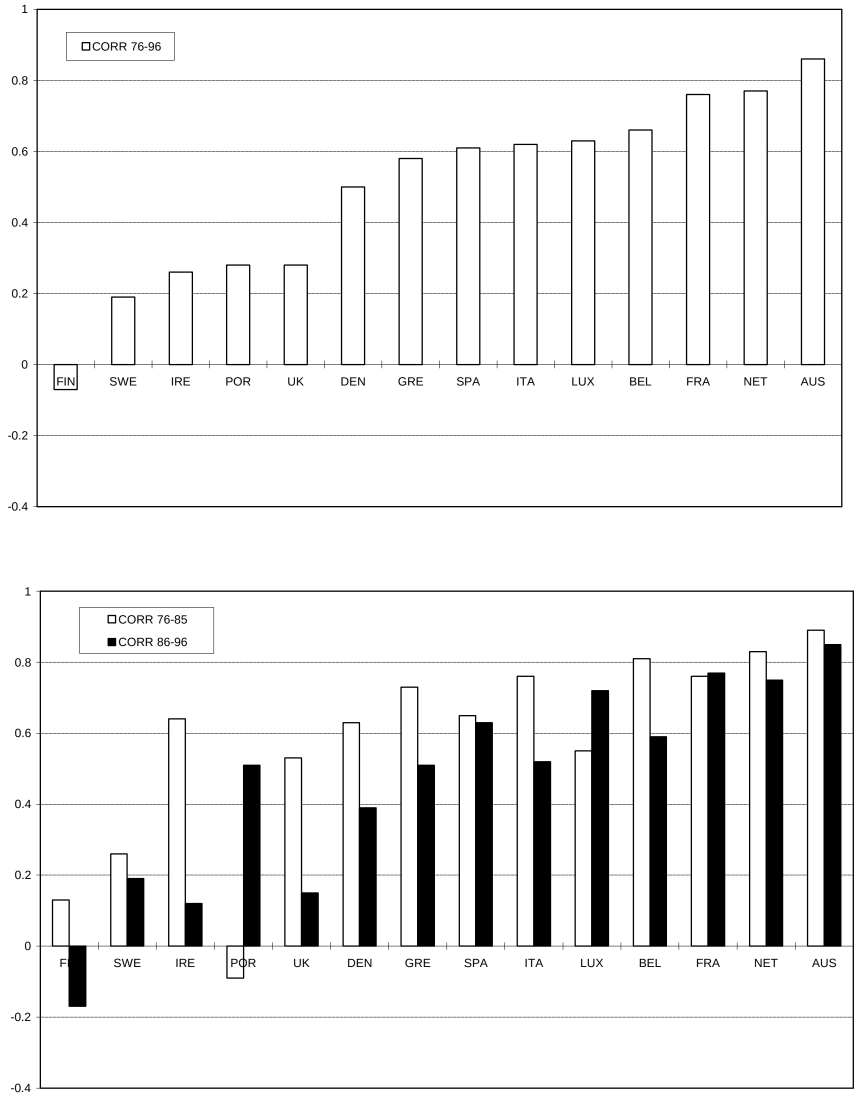
In the literature on the asymmetry of shocks, early contributions examined the correlations of output movements across countries and argued that countries whose GDP tended to move together experienced relatively symmetrical disturbances (see for example, Cohen and Wyplosz, 1989).

Using annual data for the manufacturing sector for EU-15 countries, we have calculated the correlation coefficients between Germany and other European countries for industrial production growth rates from 1076 to 1996. The results in figure 1 show the existence of important differences between core and peripheral countries.

If we distinguish between sub-samples, 1976-1985 and 1986-1996,we find that in general (with the exception of Portugal, Luxembourg and France) correlations have decreased in the most recent period. This would seem to indicate that asymmetric shocks have tended to increase rather than reduce as the integration process has advanced.

Other authors, such as Helg *et al.* (1995), have considered the existence of two kind of relationships: on one hand, the relationships between the evolution of different sectors in one country and, on the other, the relationships between the evolution of the same sector in different countries (common sectoral shocks). In this sense, if all the sectors in one country are closely related, the national dimension is more important and national asymmetric shocks are more probable. However, the probability of asymmetric shocks at a national level diminishes if a country is highly integrated at a sectoral level with the others countries in the currency area (common sectoral shocks).

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



We have carried out this analysis for the EU-15 countries for the period

1976-1996 using data by OECD on the Industrial Production Indices at the ISIC two digit sectoral aggregation level (see table 1) with base year 1990 and annual periodicity, published by OECD[3].

Table 1. Sector description

Description	ISIC	Description	ISIC
Food, beverages and tobacco (F)	31	Chemicals (C)	35
Textiles, clothing and leather (T)	32	Non-metallic mineral products (H)	36
Wood and wood products (W)	33	Basic metals (M)	37
Paper and paper products (P)	34	Metal products, machinery and equipment (K)	38

Table 2 shows the results of calculating the arithmetic averages of the correlation coefficients between growth rates of the Industrial Production Indices of different sectors in the same country. Average values for each country, which approximate the existence of a national specific cycle, are given in the last row. The results for sectoral specific cycles are shown in table 3. We have calculated the arithmetic averages of the correlation coefficients representing growth rates of the Industrial Production Indices for the same sector in different countries. The last column shows the average value of these correlations for each country.

Table 2. Average correlations between different sectors in the same country

sector/country	Aus	Bel	Den	Fin	Fra	Ger	Gre	Ire	Ita	Lux	Net	Por	Spa	Swe	UK
F	0.26	0.09	0.15	0.36	0.26	0.53	0.32	0.30	0.46	0.15	0.23	0.17	0.21	0.39	0.45
T	0.44	0.22	0.37	0.39	0.32	0.54	0.27	0.12	0.54	0.27	0.35	-0.03	0.34	0.46	0.47
W	0.42	0.23	0.50	0.51	0.46	0.58	0.22	0.33	0.60	-0.06	0.11	-0.01	0.41	0.48	0.61
P	0.46	0.39	0.58	0.46	0.55	0.67	0.15	0.24	0.41	-0.03	0.52	n.a.	0.27	0.40	0.55
C	0.38	0.41	0.59	0.50	0.49	0.57	0.22	0.21	0.63	0.15	0.38	0.23	0.41	0.05	0.51
M	0.53	0.31	0.52	0.38	0.61	0.60	0.27	0.32	0.60	0.08	0.40	0.29	0.36	0.43	0.63
H	0.35	0.20	0.46	0.22	0.60	0.55	0.30	0.13	0.66	0.19	0.38	0.20	0.30	0.39	0.59
K	0.50	0.42	0.56	0.29	0.56	0.60	0.14	0.33	0.59	0.27	0.45	0.23	0.31	0.51	0.51
Average	0.42	0.28	0.47	0.39	0.48	0.58	0.24	0.25	0.56	0.13	0.35	0.15	0.32	0.39	0.54

To analyse the obtained results, values in the last row of table 2 and in the last column of table 3 have been used to produce figure 2. The horizontal axis represents the importance of the national specific cycle in different EU countries,

[3] At this level of aggregation and for the considered countries and periods, the amount of missing data is reduced.

while the vertical axis represents sector specific cycles. Discontinuous lines indicate the average values of both measures.

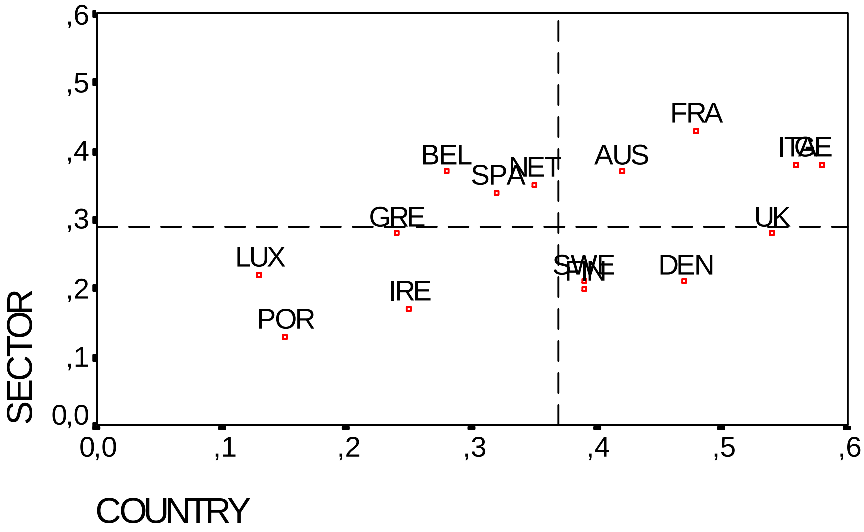
From the figure it is clear that national specific cycles are more important that sectoral ones. It is also clear that there are big differences between the considered countries. In Germany, Italy, France, and Austria, the values of the national specific cycle measure are high, indicating that losing the exchange rate as an adjustment mechanism could have high potential costs. However, values of the sectoral measure are also high, which indicate a high interdependence with other countries and, as a consequence, less probability of experiencing shocks that affect only one of them. Belgium, the Netherlands and Spain are close to this first group of countries with high values for both sectoral and national cycle indicators. The United Kingdom is also close to the first group of countries, but seems less connected to them.

Table 3. Average correlations between the same sector in different countries

Country/sector	F	T	W	P	C	H	M	K	Average
Austria	0.02	0.32	0.34	0.40	0.49	0.37	0.54	0.45	0.37
Belgium	0.05	0.33	0.23	0.49	0.57	0.40	0.42	0.45	0.37
Denmark	-0.03	0.26	0.03	0.22	0.40	0.23	0.28	0.29	0.21
Finland	-0.03	0.23	0.14	0.40	0.34	0.21	0.17	0.14	0.20
France	0.12	0.45	0.35	0.48	0.60	0.45	0.52	0.47	0.43
Germany	0.15	0.35	0.31	0.39	0.57	0.30	0.53	0.40	0.38
Greece	0.15	0.31	0.24	0.24	0.41	0.29	0.48	0.13	0.28
Ireland	0.02	-0.02	0.02	0.21	0.35	0.19	0.29	0.26	0.17
Italy	0.19	0.29	0.31	0.40	0.52	0.40	0.47	0.48	0.38
Luxembourg	-0.03	0.07	0.08	0.27	0.45	0.13	0.35	0.41	0.22
Netherlands	0.14	0.22	0.22	0.47	0.55	0.36	0.43	0.45	0.35
Portugal	0.01	0.40	0.00	n.a.	0.17	0.12	0.07	0.15	0.13
Spain	0.12	0.35	0.31	0.35	0.50	0.36	0.41	0.35	0.34
Sweden	-0.05	0.29	0.14	0.38	-0.04	0.32	0.26	0.38	0.21
United Kingdom	0.08	0.08	0.15	0.41	0.50	0.26	0.45	0.31	0.28

The Nordic countries -Denmark, Sweden and Finland- have a strong national component in their economic cycle, probably due to the importance of the public sector in their economies. They are very weakly related with other countries. These economies are, *a priori*, worse situated than the rest. In fact, Denmark is for the moment not taking part in the EMU final stage.

Figure 2. National and sectoral cycles



Finally, Luxembourg, Portugal, Greece, and Ireland are characterised by a less distinct national cycle (the value of the national measure is under 0.25) and practically non existent connections with the other countries. This leaves their situation in the future unclear, as the latter indicates a higher probability of asymmetric shocks, but the former suggests that the exchange rate would not be the best choice for macroeconomic adjustment.

However, these differences between countries and time periods (in the initial results) could arise either from differences in shocks that they have experienced, or from differences in the responses to these shocks. The correlation analysis cannot discriminate between the two aspects. For example, the lower correlations in the second period may be due to a strong discipline in terms of monetary policy (a self-imposed restriction on adjustment mechanisms) rather than an increase in asymmetric shocks. For these reason, the objective of the following sections is to attempt to distinguish between shocks and responses.

3. THE RELEVANCE OF SECTORAL AND NATIONAL SHOCKS

There have been various 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 based on that of 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 national-specific (demand) shocks and which to sector-specific (supply) ones. The distinction between demand and supply shocks is relevant as demand shocks are thought to be related to differences in economic structures (closer to Krugman's scenario).

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

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[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 obtaining 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.

group of dummy variables which take value one for sector *i* at time *t* and zero for the rest in each country considered. This term approximates every common shock that affects production in sector *i* in all countries (supply shocks). The term *g(n,t)* approximates common shocks, such as changes in national policy, affecting all sectors in the same country (demand shocks). Finally, *u(i,n,t)* is a random variable distributed following a normal distribution with zero mean which represents sector-specific shocks in every country at 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 respect to growth.

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[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.

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 same as in the previous analysis. Results of estimating model (2) for different groups of countries and different time periods are shown in table 4. 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: 1976-85, 1986-96.

In all cases, the values of the corrected R^2 were satisfactory and similar to the ones obtained by other studies. The results obtained were coherent with those in the previous section and also with findings by other authors. Both dimensions, national and the sectoral, were found to be relevant, although the national dimension was more important than the sectoral one. The differences in the

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[8] See Stockman (1988) for more details.

importance of the sectoral dimension between core countries (35%) and peripheral countries (30%) is bigger than between EU-11 (26%) and EU-15 (20%). Also it is important to note that the relevance of sector-specific shocks tended to diminish in peripheral countries in the second period (32% to 26%).

In respect to the national dimension, two other interesting features emerged. First, the relative importance of national-specific shocks is greater in peripheral countries than in core countries (45% and 24%). 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%[9].

The greater relevance of national-specific disturbances in EU-15 or in peripheral countries is not surprising, as national-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 peripheral countries than between central ones. The second feature is that the relative importance of country-specific shocks has tended to diminish in the second period, especially in the Euro Zone countries (46% to 39%) and in peripheral ones (47% to 38%). This finding is quite optimistic in relation to the relative size of demand shocks affecting European countries. It can be interpreted as meaning that policies in member states have been more coordinated during recent years, making policy-induced asymmetric shocks less probable.

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[9] The European considered countries are eight: Austria, Belgium, Denmark, Germany, Greece, Italy, Netherlands, and the United Kingdom.

Table 4. 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)

	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)

The analysis in this section has one disadvantage: there is no theoretical assumption to perfectly distinguish between demand and supply shocks. In the following section, we try to overcome this shortcoming by applying a different methodology.

4. 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 relation to changes in output. Their starting point was the aggregate demand and supply model (see 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.

The starting point of the model is the system:

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

where ΔY_t and ΔP_t represent, respectively, changes in the logarithm of output and prices at time *t*, e_{dt} and e_{st} represent demand and supply 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 about the effects of the shocks. 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 implies 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

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

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),

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

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

$$\begin{bmatrix} e_{yt} \\ e_{pt} \end{bmatrix} = \left(\sum_{i=0}^{\infty}\begin{bmatrix} d_{11i} & d_{12i} \\ d_{21i} & d_{22i} \end{bmatrix}^{-1} \cdot \sum_{i=0}^{\infty} L^i \cdot \begin{bmatrix} a_{11i} & a_{12i} \\ a_{21i} & a_{22i} \end{bmatrix} \right) \cdot \begin{bmatrix} e_{dt} \\ e_{st} \end{bmatrix} = c \cdot \begin{bmatrix} e_{dt} \\ e_{st} \end{bmatrix}. \qquad (9)$$

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 e_{dt} and e_{st}. The usual convention in VAR model consists in imposing the two variances equal to one, which together with the assumption of orthogonality define the third restriction $c'c=S$, where S 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). In terms of the model, introducing (4) in (9), it follows that:

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

and the resolution of this system allows us to estimate the series of demand and supply shocks from residuals of the estimated VAR introducing a linear restriction on 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[10]: Belgium, Denmark, Finland, Germany, Greece, Ireland, Spain, Sweden and the United Kingdom. In all cases the number of lags introduced in VAR models has been set to two, as the Schwartz information criterion has indicated this to be optimal in most cases. In this sense, the identification scheme has been homogeneous for all countries.

Figure 3 shows the value of the correlation coefficient measuring the relationship between demand (left) and supply (right) shocks in Germany and other countries. Comparing these results with the ones obtained by Bayoumi and Eichengreen (1992, 1996) and Funke (1997) applying the same methodology, correlations are on average higher, probably due to the fact that we are considering a more recent period and only the manufacturing sector.

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 peripheral countries (except Spain) are higher than in terms of demand.

One problem with the previous analysis is that the measures that we have been using to contrast the existence of relationships between the series of shocks are mainly static. As Boone (1997) suggested, European Economic and Monetary integration process is a dynamic process. Bilateral relationships between countries are subjected continuously to structural changes, changes which the correlation coefficient is not able to capture. In the next section, we apply the

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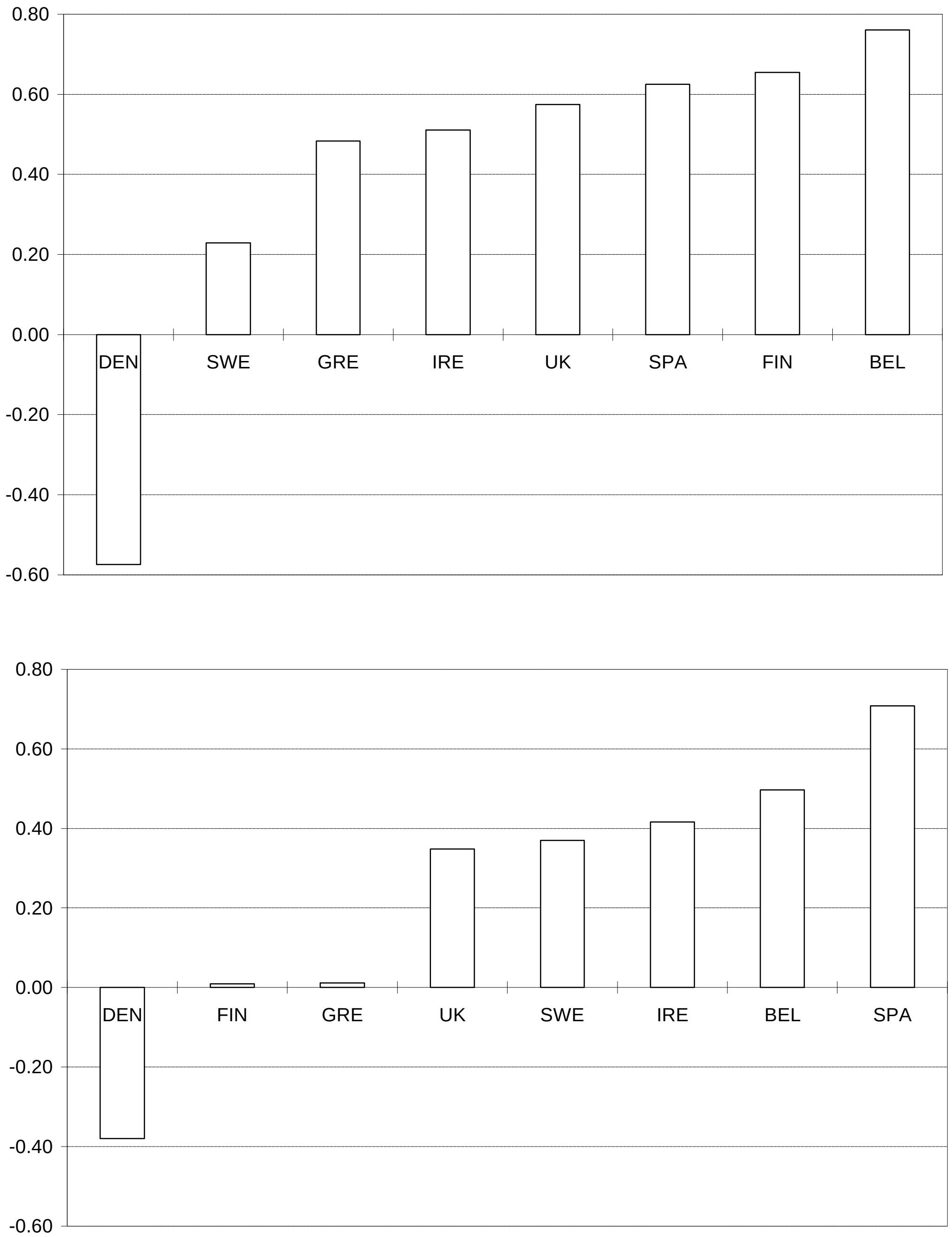
[10] We have considered peripheral countries (Nordic and Mediterranean, except Portugal as data on prices were not available), Belgium as a control for core countries and Germany as anchor area (see Bayoumi and Eichengreen, 1992 and Boone, 1997 on a discussion of the idoneity of Germany as reference country to study the asymmetry of shocks).

model proposed by Boone (1997) to distinguish if there has effectively been a movement towards greater symmetry between countries in terms of shocks or if higher values of the correlation coefficients are simply due to sample selection.

Figure 3. Demand and supply shocks correlation coefficients with Germany



5. THE INSTABILITY OF ECONOMIC RELATIONSHIPS: CHANGING ASYMMETRIES

In classic statistical and econometric modelling, it is assumed that relationships between economic variables are stable throughout the study period. It is therefore 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.

One way of overcoming this problem is that applied in the second section, i.e. to split the period into two or more sub-samples. This approach offers a solution, but it has an important disadvantage: sub-samples must be defined *a priori*, so results depend on how well the structural break point has been approximated and the number of structural breaks imposed.

Another possible way of overcoming this difficulty consists in applying a time varying coefficient model as suggested in the previous section. This 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 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:

$$[DM/£]_t = a_t + b_t \cdot [DM/\$]_t + \varepsilon_t, \qquad (11)$$

$$a_t = a_{t-1} + \eta_{1t}, \qquad (12)$$

$$b_t = b_{t-1} + \eta_{2t}, \quad (13)$$

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 unity in the seventies to nearly zero by the mid-eighties. This shows that over time the Pound has converged on the Deustchmark over time. The use of a static measure, such as the correlation coefficient, would not have revealed this[11] .

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 model used was the following:

$$(Z - X)_t = a_t + b_t \cdot (Z - Y)_t + \varepsilon_t, \quad (14)$$

$$a_t = a_{t-1} + \eta_{1t}, \quad (15)$$

$$b_t = b_{t-1} + \eta_{2t}, \quad (16)$$

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 (using shocks in the United States as a proxy). The parameters a_t and b_t are time-varying coefficients which allow an evaluation of 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

[11] Hall *et al.* (1992) and Button and Pentecost (1996) have also applied this model to study EC economies 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 peripheral countries is very weak, although the convergence process seems to have ceased since the mid-eighties.

The results presented in this section differ from Boone (1997) in two respects. 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 peripheral 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[12]. The introduction of this assumption implies the estimation of a system formed by only two equations:

$$(Z - X)_t = b_t \cdot (Z - Y)_t + \varepsilon_t, \quad (17)$$

$$b_t = b_{t-1} + \eta_t . \quad (18)$$

These equations can be easily estimated for every consider country using the Kalman filter once the model is interpreted as a *state-space* representation: (17) can be understood as the measurement equation and (18) as the transition

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[12] See Hall *et al.* (1992) for the justification of this restriction for the case of inflation rates differentials.

equation. The Kalman filter is a recursive procedure that permits the computing of optimal estimates of the state vector (b_t) at time t using information available at t-1 and the updating of these estimates as additional information becomes available[13]. However, before applying the Kalman filter algorithm, it is necessary to obtain estimates for the unknown hyperparameters -in this case, the covariance matrix of disturbances in equations (17) and (18)- and solve the initialisation problem. Respect to the hyperparameters, the usual maximum likelihood procedure using the error prediction decomposition (Harvey, 1984, 1989) has been applied and to approximate the initial values of b_t, OLS estimates of the measurement equation have been used following Harvey (1981).

The results obtained 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 4 and 5.

In respect to demand shocks, nearly all the countries considered (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 co-ordination 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.

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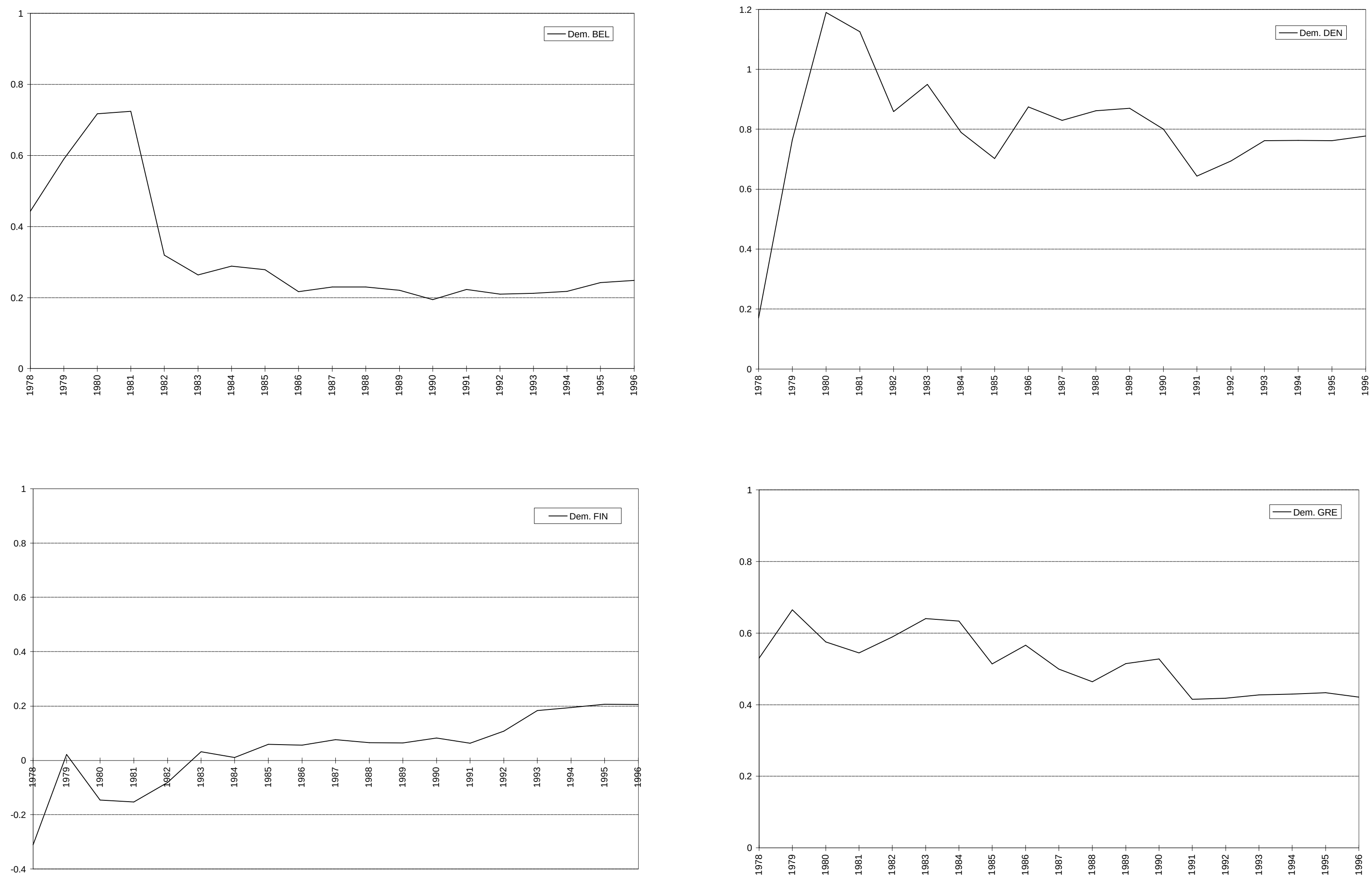
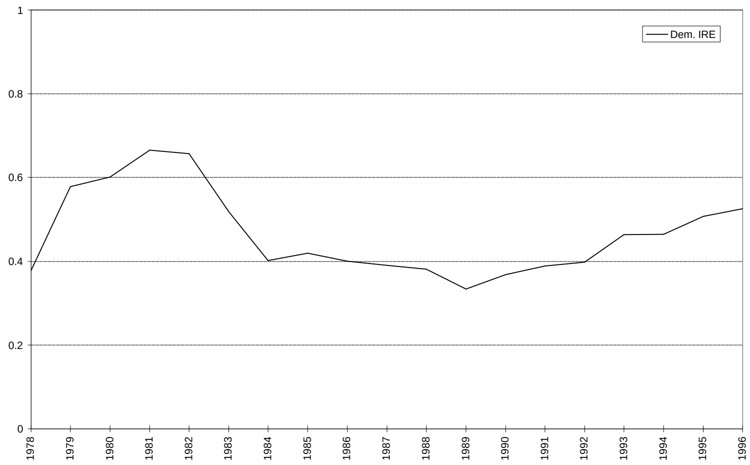
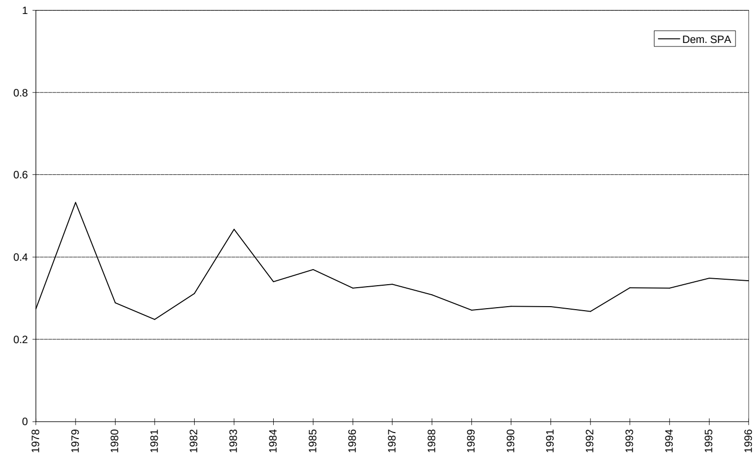
[13] For further details, see Harvey (1989) or Cuthberson *et al.* (1992).

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




Dem. IRE


Dem. SPA


Dem. SWE

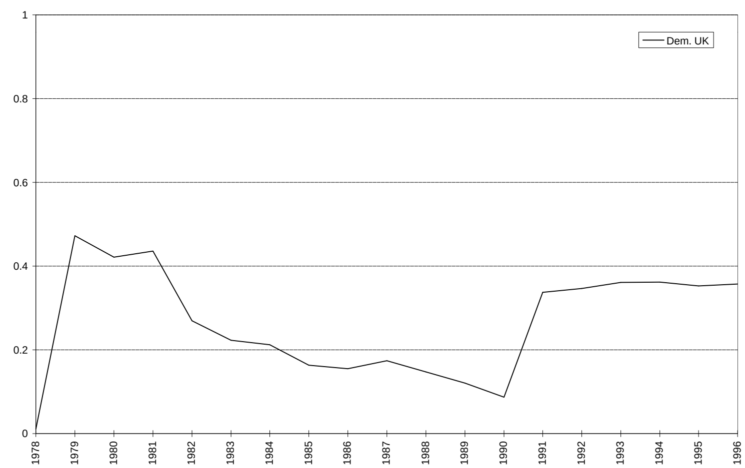
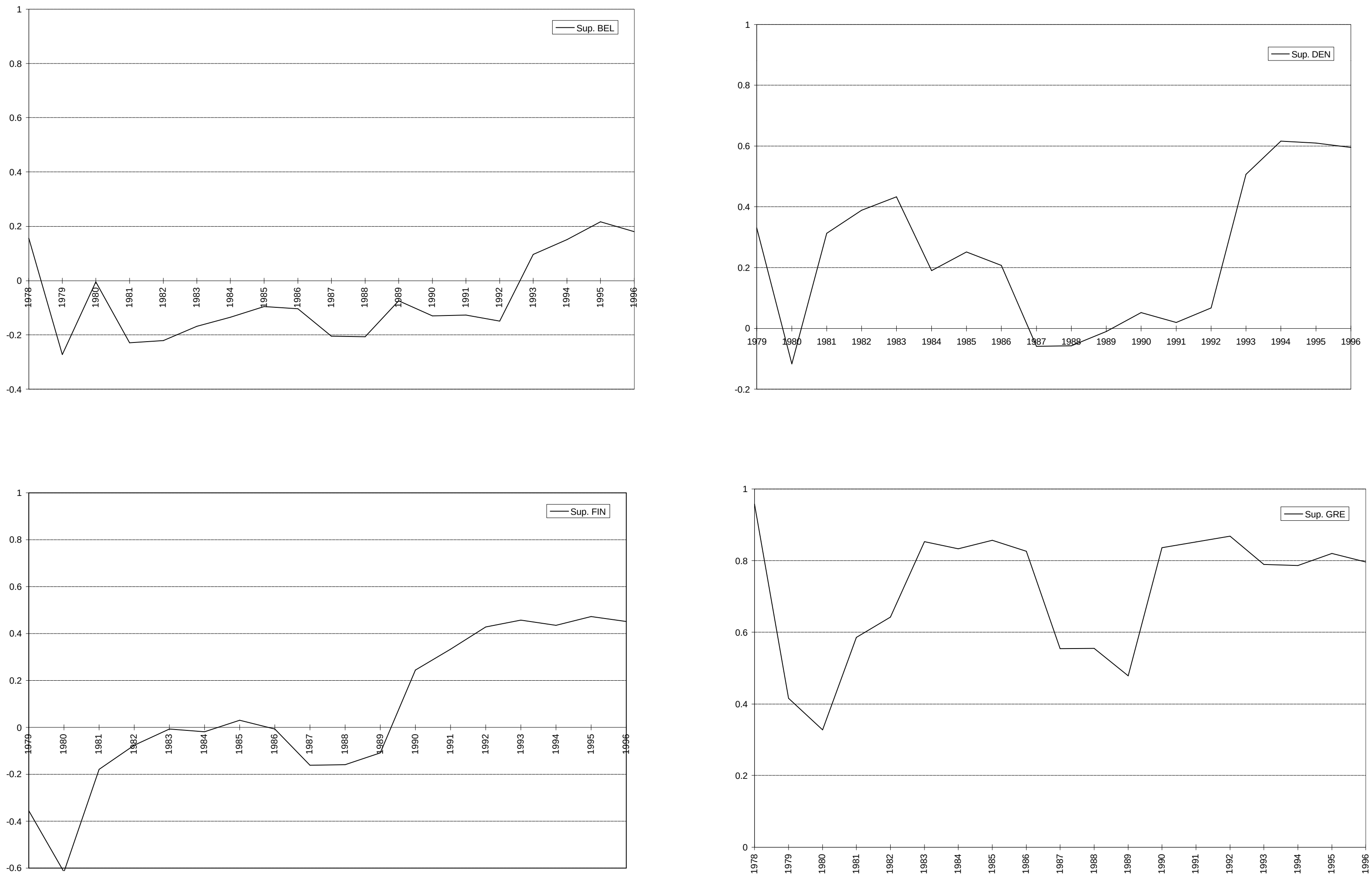
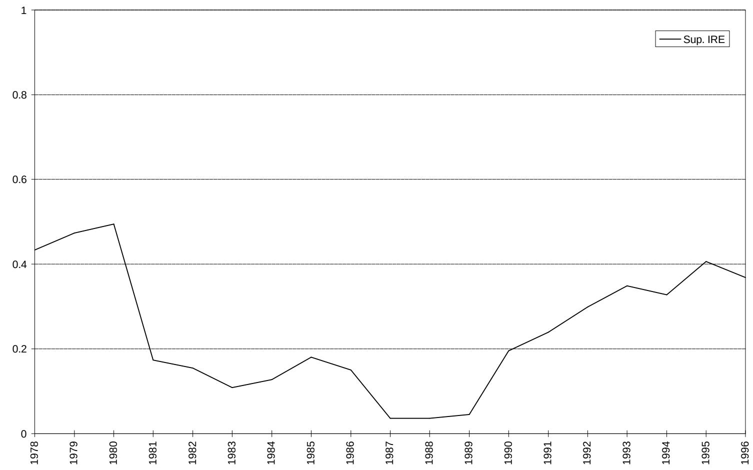
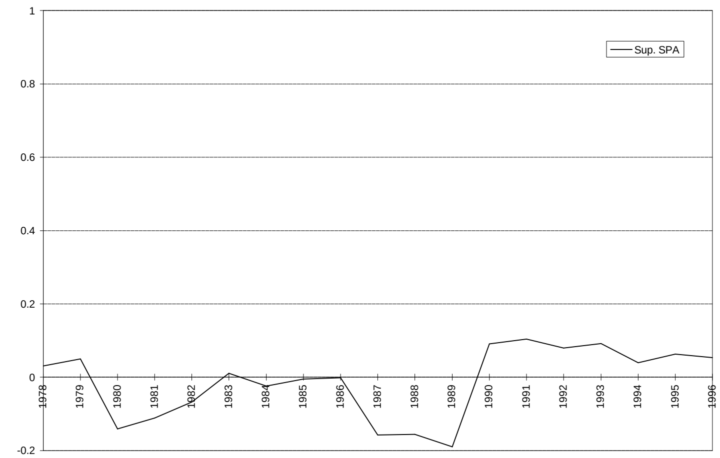
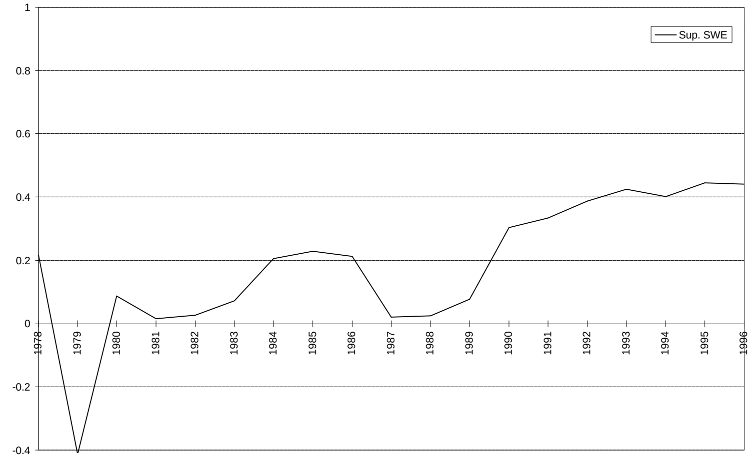

Dem. UK

Figure 5. Supply shocks convergence with Germany as opposite to the rest of the world 1978-1996




Sup. IRE


Sup. SPA


Sup. SWE


Sup. UK

In terms of supply shocks, the results confirm the convergence of Belgium with Germany during practically the whole period. German unification[14] seems to be the only event to have slightly altered this relationship. For the 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 highest values of the *b* coefficient at the end of the sample. In Nordic countries, although the values of the coefficient show a considerable degree of convergence, the situation seems to have worsened during the most recent years.

Different factors may account for this. A first possible explanation is that the departure from the path of convergence is just temporary due to particular factors, such as the impact of Germany reunification. If this is the case, after a short period of time (not included in the sample), they will return to convergence.

A second explanation is related to a possible increase in specialisation patterns in European countries in recent years. To test this hypothesis we carried out a correspondence analysis using information about the productive structures of the considered countries for 1980 and 1990 (see Appendix). Applying this multivariate technique, it is possible to project the co-ordinates of the nine countries and the eight sectors for both time periods in the same bi-dimensional space. The results are shown in figure 6[15], which shows that the average European productive structure has been roughly stable in those ten years. However, there have been several changes in the behaviour of individual countries. In general, and opposite as thought, European countries' productive structures have tended to approximate to each other during these years, so an increasing specialisation cannot explain the divergence in terms of shocks.

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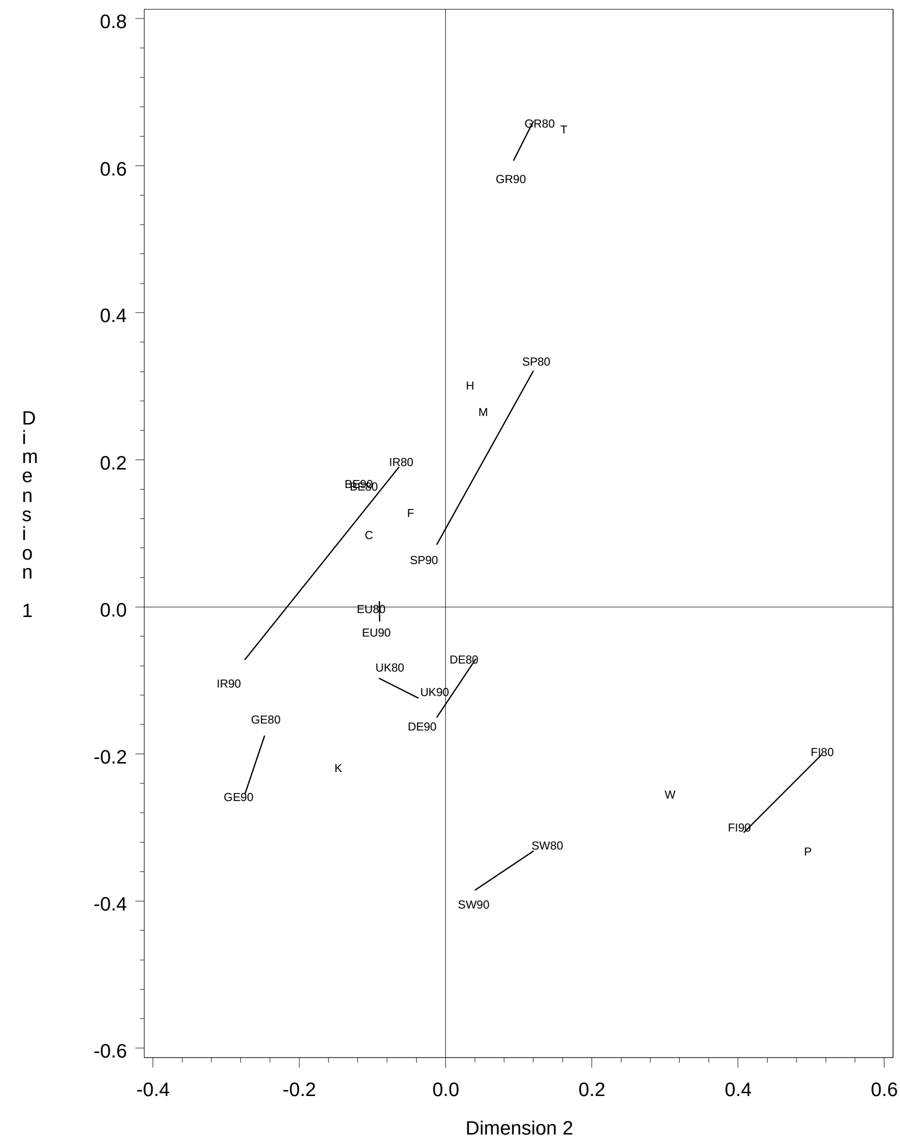
[14] Only indirect effects are considered here as we are using data for West Germany.

[15] The variables that most contribute to form the axis are shares in metal products, textiles and basic metals, although the rest of variables are also relevant. It is important to remark that these two axis retain more than 75% of the original variables variance and, in general terms, the projection goodness for every observation is satisfactory.

Figure 6. Correspondence analysis of productive structures for 1980 and 1990



A possible explanationn for this fact is that reliable data for analysing in more detail the patterns of specialisation over the last few years (where the effects of the Single Market Programme should be more evident) are not yet available. Maybe the latest data will show the emergence of the process suggested by the increase in the relative supply shocks (see section 3) and its greater asymmetry.

6. CONCLUSIONS

According to OCA Theory, 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 to asymmetric shocks once the currency area was stabilised. Two different views have tried to answer this question. The EC Commission 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 we have calculated output correlations between EU countries to analyse their degree of interdependence. The results show a clear distinction between groups of countries (core-periphery) and time periods. However, the interpretation of this results must be taken with care as they are influenced by differences in terms of shocks and responses.

In the third section we have applied 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 analysed period, specially in terms of demand shocks.

However, the analysis of correlation coefficients fails to capture the dynamics of the considered relationship. This is why in the fifth section we have applied a time varying coefficient model to assess convergence between the countries in terms of shocks. The results show that demand and supply shocks, and especially the first, have been more symmetrical with respect to Germany. In fact, during the most recent period, the degree of asymmetry in terms of supply shocks has tended to increase. Two factors may account for this: first, the side-effects of German reunification and second, an increase in specialisation among European countries. Nevertheless, the results obtained and the limited evidence availabele (Amiti 1997, Sapir 1996) do not reflect an increase in specialisation. This could be due to the fact that reliable data are not yet available for analysing this process in recent years when the effects of the Single Market Programme should be more marked.

In conclusion, the empirical evidence show that the two scenarios which have always been seen as alternatives (the EC's view versus Krugman's) may not in fact be conflicting but complementary. The reduction in asymmetry between demand shocks could be attributed to the factors identified by the EC, while the increase in the most recent period of asymmetry in terms of supply shocks could be attributed to factors related to Krugman's view. In this sense, in this study a number of interesting features have been identified and several key questions formulated. The answers to these questions will help reach a better understanding of the “potential” real risks of EMU.

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APPENDIX: European countries productive structure

Table A.1 Share (in percentage) of every sector in national production 1990

	Bel	Den	Fin	Gre	Ger	Ire	Spa	Swe	UK	EU
F	11.82	21.16	13.58	21.10	8.90	24.94	17.13	8.99	13.51	13.06
T	8.52	4.01	3.48	19.88	3.41	3.66	8.14	1.82	6.27	7.31
W	5.57	6.12	7.63	2.33	3.63	1.44	4.37	7.05	3.38	3.74
P	2.95	9.80	22.45	5.28	5.05	4.77	7.65	13.54	11.22	7.43
C	22.95	15.70	12.35	19.26	16.04	16.85	16.89	11.15	17.61	17.29
H	5.80	5.35	4.71	8.47	3.41	3.77	7.78	2.73	3.74	4.97
M	10.57	0.00	4.49	7.12	4.95	0.67	4.37	5.57	4.70	5.82
K	31.82	37.86	31.31	16.56	54.62	43.90	33.66	49.15	39.57	40.37
Man	100	100	100	100	100	100	100	100	100	100

Source: OECD

Table A.2 Share (in percentage) of every sector in national production 1980

	Bel	Den	Fin	Ger	Gre	Ire	Spa	Swe	UK	EU
F	11.27	20.68	11.71	12.28	16.59	30.15	13.37	10.25	13.36	13.19
T	9.52	6.04	8.00	2.76	21.96	8.60	17.03	2.97	7.02	8.15
W	5.69	5.22	10.25	4.02	2.69	2.71	3.31	8.30	2.97	3.47
P	2.67	10.44	22.30	4.71	4.44	6.60	8.57	14.45	9.04	6.94
C	18.93	13.51	11.82	19.06	15.89	17.20	16.91	11.17	15.52	17.42
H	6.16	6.76	4.05	4.36	10.40	8.24	5.37	3.48	4.86	4.64
M	11.15	1.94	4.84	6.66	10.86	0.82	9.26	6.66	4.99	6.21
K	34.61	35.41	27.03	46.15	17.17	25.68	26.17	42.73	42.24	39.97
Man	100	100	100	100	100	100	100	100	100	100

Source: OECD