ISSN 0265-8003

OPERATIONALIZING THE THEORY OF OPTIMUM CURRENCY AREAS

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Discussion Paper No. 1484
October 1996

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CEPR Discussion Paper No. 1484

October 1996

ABSTRACT

Operationalizing the Theory of Optimum Currency Areas*

Recent years have seen a wave of empirical studies attempting to give empirical content to the theory of optimum currency areas as a way of marshalling evidence on the costs and benefits of EMU. This paper reviews this empirical literature, as a way of examining the success with which theory has been operationalized. We also report some new work on the impact of German unification and increasing economic integration in Europe on correlations of underlying disturbances and on geographic specialization of production. We conclude with some thoughts about directions for future research.

JEL Classification: F33, F36
Keywords: optimum currency areas, empirical work

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*This paper is produced as part of a CEPR research programme on *Market Integration, Regionalism, and the Global Economy*, supported by a grant from the Ford Foundation (no. 920–1265). It is a revised version of a paper prepared for the 'Regional Integration' conference organized by CEPR and Fundación Pedro Barrié de la Maza in La Coruña, 26/27 April 1996. It will be published in the associated conference volume.

Submitted 20 August 1996

NON-TECHNICAL SUMMARY

In the literature on optimum currency areas, theory has always run ahead of empirics. Classic contributions were essentially theoretical and, beyond some casual observations, little was done to fill the analytical framework with empirical content. This is not a criticism of the founding fathers of the theory of optimum currency areas; the real puzzle is that so little systematic empirical work seeking to operationalize this literature was undertaken over the course of the following quarter of a century.

In this respect, the debate over European monetary unification, provoked by the Delors Report and the Maastricht Treaty, has served as a healthy corrective. Recent years have seen a wave of empirical studies attempting to operationalize the theory of optimum currency areas as a way of marshalling evidence on EMU's costs and benefits. It is that empirical literature that we survey in this paper. The fact that recent empirical work is itself a product of the debate over EMU necessarily lends our discussion a European cast.

Robert Mundell is the founding father of work on optimum currency areas. In his pioneering paper in 1961 he suggested that two countries or regions will wish to adopt a common currency area when the saving in transaction costs dominates the rise in adjustment costs. The reduction in transaction costs is an increasing function of openness, since more open economies suffer more severe disruptions to trade and production from currency fluctuations. Adjustment costs are a function of the assymmetry of disturbances and the inter-regional mobility of labour. Not surprisingly, most research on optimum currency areas as applied to the European Union, rests squarely in the Mundellian tradition.

Almost all of the empirical work we survey has been done since the publication of the Delors Report and its background studies (European Commission 1990). In the intervening period relatively successful techniques have been developed for measuring the size and correlation of several key components of the theory of optimum currency areas, namely underlying disturbances across different regions, the role of labour mobility in restoring equilibrium within existing currency unions, and the level of insurance provided by federal tax systems. In addition to surveying past work, we also provide some new evidence on dynamic aspects of optimum currency areas. We find that German unification has not significantly disrupted underlying correlations across European economies, but that increasing economic integration over time does not appear to have increased these correlations either.

More generally, we find that the criteria for an optimum currency area identified in the theoretical literature – asymmetric shocks, labour mobility and fiscal transfers – do indeed appear to matter in actual currency unions. There may not be agreement on answers, but the questions have gained definition. There is, in short, a framework for debate.

Much of the dispute which remains about the interpretation of this evidence revolves around what inferences can be drawn validly from historical data. Monetary unification, in Europe as elsewhere, will be a structural break to the economy. It will alter market structures and policy processes. Correlations that held in a past of segmented national markets and independent policies may not hold in the integrated Europe of the future. Some authors have taken this point on board by searching for changes in economic relationships during the deepening of European integration and by comparing Europe with existing monetary unions like the United States. Others have attempted to look at the impact of changes over time within Europe on optimum currency area criteria. But whether these approaches provide the guidance needed to forecast changes that will take place with EMU remains an open question, and one on which reasonable people can (and do) disagree.

Despite these concerns, the impact of economic change on optimum currency area criteria is clearly becoming an increasingly important issue. The implication is that future empirical work is likely to be increasingly concerned with these dynamic aspects of optimum currency areas and, in particular, with the interaction of economic integration and the net benefits from adopting a currency union. In addition to being central to much of the debate about EMU, such issues have a much wider resonance in a world of increasing globalization. If the next five years of empirical work on optimum currency areas are as productive as the last five, the progress will be impressive indeed.

I. Introduction

In the literature on optimum currency areas, theory has always run ahead of empirics. The classic contributions of Mundell (1961), McKinnon (1964) and Kenen (1969) were essentially theoretical. Beyond some casual observations -- Mundell's to the effect that Western Canada and the Western United States were subject to many of the same disturbances, McKinnon's that Canada was more open and trade dependent than its neighbor to the south, Kenen's that the U.S. economy was more sectorally diversified and less susceptible to idiosyncratic national shocks -- little was done to fill the analytical framework with empirical content. This is not a criticism of the founding fathers of the theory of optimum currency areas; the real puzzle is that so little systematic empirical work seeking to operationalize this literature was undertaken over the course of the succeeding quarter century.

In this respect, the debate over European monetary unification provoked by the Delors Report and the Maastricht Treaty has served as a healthy corrective. Recent years have seen a wave of empirical studies attempting to operationalize the theory of optimum currency areas as a way of marshalling evidence on EMU's costs and benefits. It is that empirical literature that we seek to survey in this paper. The fact that recent empirical work is itself a product of the debate over EMU necessarily lends our discussion a European cast.

There exist a number of recent surveys of the theory of optimum currency areas, including several which take into their compass both theoretical and empirical studies.[2] Our purpose here is different: we focus on empirical work, examining the success with which theory has been operationalized.[3]

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[2] See for example Masson and Taylor (1993), Tavlas (1994).

[3] Melitz (1996) covers some fo the same ground.

After providing a critical assessment of the empirical literature in Section II, we report some extensions and sensitivity analyses in Section III. Section IV, in concluding, offers an agenda for research.

II. A Review of Theory and Empirics

Mundell suggested that two countries or regions will wish to adopt a common currency area when the saving in transactions costs dominates the rise in adjustment costs. The reduction in transactions costs is an increasing function of openness, since more open economies suffer more severe disruptions to trade and production from currency fluctuations. Adjustment costs are a function of the symmetry of disturbances and the inter-regional mobility of labor. Not surprisingly, most research on optimum currency areas as applied to the European Union, rests squarely in the Mundellian tradition.

1. Symmetry of Shocks We are not aware of studies which made a serious attempt to estimate the symmetry of disturbances across and within currency areas prior to the debate over European monetary unification. In that literature, early contributors examined the correlation across countries of output movements (sometimes detrended output movements) and argued that countries whose GDPs tended to move together experienced relatively symmetrical disturbances. Cohen and Wyplosz (1989), Weber (1990) and European Commission (1990) are illustrative of this approach, which continues to be utilized to the present day (see for example Garrett, 1995).

From the point of view of faithfulness to Mundell's model, the problem with this approach is that observed output movements reflect the influence of both disturbances and responses. Imagine that two economies experience identical temporary disturbances, but that one responds more rapidly. In the

first economy, output returns quickly to its initial level, while the second remains away from its equilibrium for an extended period. Although the correlation of disturbances is high, the correlation of output movements is low, and the latter tell us little about Mundell's first criterion for an optimum currency area.[4]

Initial attempts to distinguish disturbances from other components of observed output movements identified shocks as the residuals from an autoregression. Caporale (1993), for example, regressed nominal and real GDP for various European countries on three own lags and examined the correlation of the residuals across countries. It is not clear that his results for nominal GDP are particularly useful, however, and those for real GDP are somewhat peculiar: the correlation of "shocks" to the Dutch and German economies are if anything negative; only in Denmark and Portugal do shocks follow those of Germany. There is no evidence here, in other words, of an EMU "hard core" and "periphery".

The difficulty of interpreting Caporale's results may reflect the fact that his estimated residuals incorporate the effects of a number of disturbances: aggregate demand disturbances associated with policy, which have only temporary effects on output in the textbook aggregate-supply-aggregate-demand model, and aggregate supply disturbances associated with other factors, which should have permanent output effects. Distinguishing the two types of

[4] One may argue that differences across economies in both the symmetry of disturbances and the speed of response are in fact relevant to the decision of whether to fix the exchange rate or adopt a common currency, and that insofar as the speed of response heavily reflects Mundell's second consideration, the mobility of labor between depressed and booming regions, the information contained in output movements is still highly relevant. But from an analytical point of view, it is still important to know whether a high correlation of output movements reflects symmetric shocks or rapid, symmetric responses. About this observed output movements tell us little.

disturbances requires more information and more structure. In our own work (Bayoumi and Eichengreen 1993a,b, 1994) we utilized a method of Blanchard and Quah (1989) to distinguish aggregate supply and aggregate demand disturbances. We estimated bivariate autoregressions using data from 1968 through 1988 for output and prices, restricting demand disturbances to affect only prices in the long run while allowing supply disturbances to have long-run effects on both prices and output.[5] This exercise yielded clear evidence of an EU core and an EU periphery. The core, whose disturbances are highly correlated with those of Germany, includes Austria, Switzerland, France, Denmark and the Benelux countries. Included in the periphery are Italy, Spain, Portugal, Ireland, Greece, the United Kingdom and Finland. Sweden occupies something of an intermediate position.[6] Funke (1995) has replicated this analysis using data through 1992, finding similar results but somewhat lower correlations with Germany, not surprisingly since his period includes the highly asymmetric German unification shock.[7]

Subsequent work estimated larger dimension VARs in the attempt to

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[5] Blanchard and Quah's original study utilized data on output and unemployment, with the assumption that demand disturbances had no long-run output effects. The problem with this implementation is that it is not clear why demand disturbances should be permitted to affect unemployment in the long run either, as permitted by Blanchard and Quah. In contrast, our implementation using output and prices can utilize the textbook prediction that a rightward shift in the aggregate demand curve should, in the presence of a vertical long-run supply curve, raise prices permanently. The prediction that prices should rise rather than fall in the long run is not imposed in estimation and may be utilized to check the consistency of the results.

[6] Our 1994 paper also extended this type of approach to East Asia and the Americas.

[7] A more surprising aspect of his results is that, unlike the present authors, he finds supply shocks to the UK to be relatively highly correlated with supply shocks to Germany. This result may reflect the fact that the UK's post-1990 recession set in relatively early (as did Germany's), raising the correlation.

distinguish a larger number of different disturbances. Chamies, Deserres and Lalonde (1994) utilize the same data and approach but distinguish monetary and nonmonetary shocks on the demand side. When three shocks are specified, the distinction between and EU core and EU periphery is less clear-cut. Only Germany and Switzerland have highly correlated disturbances; Austria, Belgium, France, the Netherlands, Spain and the United Kingdom occupy an intermediate position, while Greece, Italy, Norway, Portugal and Sweden form a European periphery subject to relatively idiosyncratic shocks. Erkel-Rousse and Melitz (1995) estimate six-equation VARs on quarterly data for six European countries, finding a positive covariance between supply shocks to the Netherlands and supply shocks to Germany, but a negative association with Germany in the cases of France, the United Kingdom, Italy and Spain.[8]

The fact that some studies find disturbances to the members of the EU "hard core" to be more highly correlated than those to the EU "periphery" does not tell us that the disturbances to the core are sufficiently well correlated to support the operation of a monetary union. Neither do comparisons with existing monetary unions, although the results are suggestive. In the previously-mentioned studies, we found that the correlation of disturbances to the eight Bureau of Economic Analysis regions of the U.S. are high but far from perfect. Indeed, the correlation is little different than that evinced by the members of the EU core, though significantly higher than that of the EU periphery. Funke, on the other hand, contrasts disturbances to EU countries with disturbances to German *lander*, finding a noticeably higher correlation

[8] For completeness, we mention also Ghosh and Wolf (1994), who use a genetic approach to identify country groupings. While their method identifies several natural clusters of EU member states, they appear to find that Germany is not a natural member of any group.

among the supply disturbances to the German states.[9] In the end, then, the jury remains out on whether the observed correlation of disturbances within existing monetary unions provides encouragement for EMU.[10]

The methodology used in these studies is not uncontroversial. Lippi and Reichlin (1993) point out that the Blanchard-Quah procedure incorporates the assumption that the error terms in the model are fundamental; they show that nonfundamental representations can give different results. This is a general problem which permeates all dynamic econometric analyses, however, and is not specific to the procedure at hand. Faust and Leeper (1994) observe that the identifying restriction that demand disturbances have no long-run output effects may be difficult to implement accurately using finite-horizon data and that problems of time aggregation complicate the task of accurately identifying supply and demand shocks. While this provides more grounds for worry, neither is their critique specific to this methodology; it applies equally to other strategies for distinguishing shocks from responses and analyzing the speed with which equilibria are restored.

In this context, it is worth noting the work of Decressin and Fatas (1993), who examine employment rather than output. They regress employment in individual European regions (U.S. states) on employment in Europe (the U.S.)

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[9] De Grauwe and Vanhaverbeke (1993), on the other hand, can be read as showing that the shocks to regions within EU countries are relatively large, implying that the observed asymmetry of shocks to the various candidate nations for EMU are not a prohibitive barrier to its successful operation.

[10] Inference suffers from the further problem, as we have noted in our own work, that the observed pattern of disturbances may shift with EMU. This Lucas Critique is less likely to apply to permanent, or supply, disturbances, insofar as those are associated with economic structure, than to temporary, or demand, disturbances associated with policy. Hence, our discussion here, as elsewhere, focuses primarily on the correlation of supply disturbances. We return to this point below.

as a whole, and find that the R-squared from these regressions averages 0.6 for the U.S. but only 0.2 for Europe.[11] Controlling for country-specific shocks diminishes but does not eliminate this differential.

2. Regional Specialization While Mundell and later contributors to the OCA literature focused on the symmetry of disturbances, Kenen (1969) noted that asymmetric disturbances may be of little consequence if they are small. Only if disturbances are both large and asymmetric do they create a case for national policy autonomy. Kenen's article pointed to regional specialization as a determinant of the magnitude of shocks. When a region possesses a sectorally-diversified "portfolio" of jobs, sector-specific shocks will tend to cancel out, minimizing the amplitude of aggregate disturbances, much in the manner that shocks to individual asset returns cancel out in a well-diversified financial portfolio. Two countries whose "employment portfolios" are diversified so as to overlap will also tend to experience relatively symmetric aggregate disturbances *if* most shocks are sector specific.

That's a big "if." Stockman (1988) finds that country-specific shocks account for as large a share of the variance of output as do sector-specific shocks that are common to different nations. This is not surprising if one thinks that demand shocks are important (since demand-management policy is made at the national level).[12] But none of this is to question that both national and industrial disturbances matter; it is possible for many shocks on the supply side to be sector-specific (due to changes in technology and

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[11] An earlier study which reported essentially the same finding is Eichengreen (1990).

[12] Costello (1993) has undertaken a similar exercise using measures of productivity growth (Solow residuals): she finds that nation-specific factors are substantially more important than industry-specific components.

productivity that affect particular industries regardless of the country in which they are located), while most demand shocks are country specific.

Bayoumi and Eichengreen (1996) attempt to test for evidence of a connection between such factors and observed policy toward the exchange rate. Using data on the network of bilateral exchange rates among the industrial countries in the 1960s, 1970s and 1980s, they relate the variability of bilateral rates to a vector of variables which includes the dissimilarity of the commodity composition of two countries' exports (defined as the sum of the absolute values of the differences in the shares of manufactured goods, food and minerals in total merchandise trade for each country).[13] They find strong evidence in support of the existence of this linkage.

Assuming a significant incidence of sector-specific shocks, it then becomes important to know the diversification and overlap of regional employment portfolios. Bini-Smaghi and Vori (1993), Helg et al. (1994) and Masson and Taylor (1994) have examined this question using data for European countries and the United States. They find a greater degree of diversification and overlap among member states of the European Union than among the 50 U.S. states. The problem with basing inferences on this finding, as Krugman (1993) notes, is that these differences may themselves be artifacts of the historical degree of integration of the U.S. and European economies. Because the 50 U.S. states constitute a highly integrated internal market, each can specialize along lines of comparative advantage and exploit economies of scale and scope. As European integration deepens it will become more

[13] Manufactured goods were defined as the total of basic manufactures, chemicals, machines and transport equipment, miscellaneous manufactured goods, and other goods. Food is the sum of food and live animals, beverages and tobacco, and animal, vegetable oils and fats. Minerals amalgamate data on crude materials excluding fuel with mineral fuels, etc.

likely that EU member states will do likewise, and the observed overlap and diversification of member state employment portfolios will decline.

Two objections can be raised to this reasoning. One concerns the identification of regions with nations. Even if economies of scale and scope increasingly dominate locational decisions as the process of European integration proceeds, there is no reason to think that industrial concentrations will respect national borders. What was true in the past of the iron and steel complex of the Ruhr, the Saar and Lorraine will also be true, to an extent, in the future. A second objection is to the notion that external economies necessarily dominate location decisions. The advantages of agglomeration have to be balanced against lower costs of labor, land and other factor services outside the industrial heartland. (The attractions of peripheral locations are evident in the tendency for U.S. industry to relocate away from the traditional manufacturing belt in the 1980s.) If this tendency dominates the evolution of Europe's economic geography as well, Bini-Smaghi and Vori may be right in assuming the continued expansion of intra-industry trade and growing overlap of regional employment portfolios.[14]

Additional light is shed on this question by Bayoumi and Prasad (1995), who distinguish global, regional and industrial specific shocks. Comparing U.S. regions with eight European countries, they find that the share of the variance in output explained by region-specific shocks is slightly higher in Europe than in the U.S. (31 per cent of the variance explained as against 26 per cent). For employment, in contrast, region-specific shocks dominate in Europe, industry-specific shocks in the United States. The lesser importance of region-specific shocks in the U.S. points to the higher degree of

[14] For similar arguments, see Gros and Thygesen (1991) and Spahn (1992).

integration of the U.S. labor market, a topic to which we now turn.

3. Labor Market Adjustment Blanchard and Katz (1992) is the most widely cited study of the contribution of labor mobility to regional adjustment. Using data for U.S. states, they find that inter-state migration plays a major role in adjustment to shocks. The contribution of migration to the elimination of labor-market disequilibria, according to their results, dominates those of wage flexibility and labor force participation.[15] Decressin and Fatas (1993) obtain different results for the regions of Europe. In the first three years following a disturbance, they find, the largest portion of a decline in regional labor demand is met by lower labor force participation; immigration is important only after four years. Together, these results support the presumption that Europe is less well suited for monetary union than the United States on the grounds of its lesser responsiveness of migration to region-specific shocks.[16]

These conclusions are supported by the analysis of Eichengreen (1993a), who finds that the elasticity of inter-regional migration with respect to unemployment and wage differentials is significantly smaller in the U.K. and,

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[15] Buiter (1995), while not denying that labor mobility is higher in the U.S. than in Europe, questions whether the degree of labor mobility in the U.S. is really sufficient to contribute importantly to adjustment to macroeconomic shocks.

[16] Thomas (1994) also provides a vector-autoregression-based analysis of U.S. and European data. While confirming Blanchard and Katz's findings for the United States, he suggests that in Europe the substitute for inter-regional migration is not changes in labor force participation rates but persistent unemployment. Part of the explanation for the discrepancy appears to be the unit of observation: Thomas analyzes time series at the national level for various European countries, rather than a panel of regional data like the other authors. One can imagine that a national shock to employment could give rise to persistent unemployment, while a shock specific to a region within that country does not. But this cannot be the entire difference, since Thomas also finds that region-specific shocks give rise to persistent unemployment differentials in a panel of British regions.

especially, in Italy than in the United States.[17] De Grauwe and Vanhaverbeke (1993) similarly find that the migratory response across regions is significantly less in Southern than Northern Europe.

It is worth recalling that Mundell emphasized the role of migration in the operation of currency areas because he presumed that the social costs of relocation were less than the social costs of unemployment. But in fact neither Blanchard and Katz nor Decressin and Fatas find that the alternative to migration is unemployment; the former find that real wage flexibility is the other adjustment mechanism in the U.S., while the latter identify changes in labor force participation as the main alternative in Europe. Neither team of authors finds much evidence that regional shocks result in persistent unemployment differentials. Their combined results support the notion that Europe is less well suited to monetary unification only if the social costs of migration are less than the social costs of reduced labor force participation, which is less than clear a priori.

It is worth noting (as does Buiter, 1995) that the finding that real wage flexibility plays a larger role in labor-market adjustment in the U.S. than Europe has ambiguous implications for EMU. If real wages are rigid, they are unaffected by changes in nominal variables; any sacrifice of monetary autonomy associated with EMU is irrelevant from this point of view. However, few observers would go so far as to assert that real wages are impervious to exchange rate changes in the short run; the question, rather, is how the response divides into wage and employment effects. But there is the further question of whether the response of wages is itself a function of the exchange

[17] For other analyses that point in the same direction, see Muet (1991, 1995) and Mantel (1994).

rate regime. Alogoskoufis and Smith (1992) and Eichengreen (1993b) provide evidence that this has been the case historically. Blanchard and Muet (1991) detect little sign that French wage behavior has changed as the government's commitment to its exchange rate peg has hardened. Anderton and Barrell (1993), on the other hand, report some evidence of increasing wage flexibility in Italy over the period of that country's ERM membership.

4. Fiscal Federalism The labor market is not the only channel of adjustment to region-specific shocks. Since Ingram (1959), economists have argued that fiscal transfers within monetary unions provide an important cushion against asymmetric shocks. Sala-i-Martin and Sachs (1992) estimate that extent of the stabilization provided by fiscal transfers among states within the U.S. economic and monetary union, concluding that approximately a third of the impact of region-specific shocks is offset by the federal tax and transfer system. Their results have been criticized for neglecting the distinction between equalization and stabilization -- transfers undertaken in response to persistent income differentials between regions and those extended in response to cyclical fluctuations, in other words.[18] (For our purposes, the distinction is equivalent to that between income differentials arising from permanent and temporary shocks.) Subsequent work by Bayoumi and Masson (1995) distinguishing equalization from stabilization scaled back Sala-i-Martin and Sachs' estimate of the stabilization offset from a third to a fourth or a fifth.[19]

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[18] See von Hagen (1992).

[19] They also find a smaller stabilization effect operating through taxes and transfers in Canada than in the United States, which is offset to a large extent by the greater freedom of Canadian provinces (compared to U.S. states) to borrow and run deficits in recessions.

Bayoumi and Masson (1995) and Jones (1995), among others, have confirmed that fiscal equalization and stabilization are also important in other monetary unions, including those operated by individual European countries. The question is not whether equalization and stabilization take place, however, but whether they are indispensable to monetary union. The early literature pointed out that fiscal transfers were likely to be more important the less responsive was migration to regional wage and unemployment differentials; by implication, the absence of a system of fiscal federalism in Europe could be devastating, given the region's relative low levels of labor mobility.

Italianer and Pisani-Ferry (1992) have shown that installing a system of intra-state transfers that mimicked the regional stabilization role of the U.S. and Canadian systems would require increasing the size of the EU budget by approximately 50 per cent, assuming that the increased resources were targeted at this function. The problem with such a scheme is that the tendency for differences in national unemployment rates to persist would lead to large-scale redistribution across member states, not merely coinsurance. Even activating the scheme only after unemployment differentials exceeded a threshold level would fail to significantly diminish this effect (Melitz and Vori, 1992). A more sophisticated system that made intra-EU transfers a function of a vector of economic variables (not just unemployment) could finesse this problem in principle (von Hagen and Hammond, 1995) but would be difficult to implement in practice.

None of this is to suggest that such a program is likely to be adopted

in the foreseeable future.[20] Responding to these doubts about the prospects for significant fiscal centralization, Bean (1992), Diba (1992), and Kletzer (1995), among others, have suggested that fiscal stabilization can be carried out by the national governments of the countries that constitute the monetary union, operating on their own. National governments can run deficits and finance them externally in recessions and repay during expansions. Insofar as the inter-regional transfers accomplished by the institutions of fiscal federalism can be replicated by the unilateral actions of governments, the need for fiscal centralization and coordination is obviated.[21]

Unfortunately, local jurisdictions may be inhibited by credit constraints from borrowing on the requisite scale. The smaller the region and the more mobile its tax base, the less scope it has for raising taxes relative to those prevailing in neighboring regions to service and repay debts incurred in recessionary periods. This constraint will be further tightened by monetary union insofar as the removal of capital controls and reduction of

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20 Von Hagen (1993) suggests that this resistance is rational, on the grounds that a system of federal fiscal transfers to depressed states, say through the operation of an EU-financed unemployment insurance program, would give rise to serious moral hazard problems that are more easily contained within existing EU member states by national solidarity. Goodhart and Smith (1993), however, propose a mechanism with which potential moral hazard problems might be contained.

21 An obvious question at this point is why households need the intervention of government to carry out this function. Cannot households borrow externally in periods of recession to smooth their consumption, thereby stabilizing the local economy? Atkesen and Bayoumi (1994) show that some private borrowing through capital markets in fact takes place in the U.S. economic and monetary union but that its magnitude is small, presumably reflecting liquidity constraints associated with the dominance of human capital in household wealth.

transactions costs increase capital mobility.[22] Goldstein and Woglom (1994) show that this constraint binds in the United States when ratios of state debt to state product hit nine per cent. Thus, it may not be realistic to rely on state borrowing to provide automatic stabilization. Von Hagen and Fratianni (1990) and Kletzer (1995) suggest that credit rationing can be overcome if states undertake bilateral transfers on an ad hoc basis (a booming France can extend transfers to a slump-ridden Germany, and the favor can be returned when cyclical conditions reverse), and that the repeated nature of the game can support the continued cooperation of the parties concerned. But such *ad hoc* transfers are much more visible and politically contentious than automatic transfers flowing through a federal fiscal system, making their feasibility an open question.[23]

Fiscal stabilization by local jurisdictions may also be less effective than stabilization at a federal level. If the local jurisdiction runs higher deficits in order to offset a negative disturbances, the increase in government debt will generate an expectation of higher future taxation which will lower the impact of fiscal transfers on aggregate demand. If the stabilization occurs at a higher level of government, however, a fiscal

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[22] In addition, McKinnon (1995) suggests that the members of monetary unions can rationed out of capital markets by rising default risk resulting from their lack of a central bank to backstop the market in public debt.

[23] Recall how much more difficult it was in 1994 for Washington, D.C. to arrange Congressional support for an ad hoc transfer to Mexico than to continue to transfer resources automatically to a state of California with an unemployment rate in excess of that of the rest of the country. In addition, there is the fact that bilateral transfers, as in the Franco-German example cited in the text, place a heavy burden on the country that extends the transfer compared to a system of fiscal federalism involving a dozen EU member states or 50 U.S. states, in which the burden of the transfer is shared among a number of separate jurisdictions, diversifying the risk. A Kletzer-like scheme of ad hoc transfers would clearly grow more difficult to arrange as the number of governments concerned continued to increase.

deficit in one region generated by a negative disturbance will on average be offset by fiscal surpluses in other regions with positive disturbances. To the extent that these effects cancell out, and hence there is no net impact on federal debt, there will be no expectation of future tax increases and hence no diminution of the impact on aggregate demand. Using Canadian provincial data, Bayoumi and Masson (1996) provide evidence that fiscal deficits which generate debt, and hence an expectation of future tax increases, have only 1/3 to 1/2 of the effect on consumption as those which do not create debt.

5. Relative Prices. An alternative empirical approach to assessing the suitability of a region for a currency union has been to compare movements in relative prices (measured in a common currency) between countries with those observed between regions within a country. The main advantage of having an independent exchange rate is that it provides a flexible instrument capable of moving relative prices between currency areas in the short-term. An exchange rate appreciation of (say) 5 percent will raise all prices in the appreciating country by 5 percent compared to those in the country with the weaker rate (ceterus parabus). Comparing relative price movements within and between countries allows some assessment of the degree to which countries have actually used this flexibility in practice. If countries have not needed the relative price flexibility that an exchange rate provides in the past, in that the volatility of relative prices across countries with independent currencies have been no larger than those within countries with a single currency, then this would be powerful evidence that a flexible exchange rate was not necessary for the smooth functioning of the economy.

Vaubel (1978) was the first to use such an approach to look at the issue of optimum currency areas. As interest in a single Europen currency

engendered by the Werner report of 1970 waned in the late 1970s, his paper compared the volatility of relative prices across and within European countries. He found that relative variability of CPIs (measured in a common currency) across European countries was several times that of three separate measures of variability within countries, using CPIs for German Lander, Italian cities, and U.S. cities. He concluded that Europe was not well designed for a single currency.

Interest in such an approach was reinvigorated by Polosz (1990), who compared relative price movements across Canadian provinces with those across EU countries using GDP deflators. He found that the relative price variability between the raw-material producing provinces of Alberta and Saskatchewan was higher than that observed between Germany, France, Italy and the United Kingdom. Similar studies using U.S. data, however, have found the opposite result. Both Eichengreen (1992), using regional CPIs, and Bayoumi and Thomas (1995), using regional GDP deflators, find variances across U.S. regions to be much lower than those across European countries. The Bayoumi and Thomas result is particularly notable as, like Polosz, they used GDP deflators as their measure of the price level. GDP deflators are a better measure of movements in underlying costs across regions, and hence of the disruption to production caused by movements in relative prices, than are CPIs, which are heavily affected by the level of goods market integration.

Bayoumi and Thomas paper were the only authors to relate these movements in relative prices to changes in output. They estimated underlying demand and supply curves for goods both for European countries and United States regions. They found that within the United States the larger relative price movements observed in the raw material producing regions of the United States largely

reflect the larger supply shocks that are prevalent in these regions.[24] By contrast, the much higher relative price movements observed within Europe compared to the United States reflected lower levels of integration on the demand and (particularly) the supply side across these economies. In the absence of greater integration, they concluded that large relative price movements are an important adjustment mechanism for coping with country-specific shocks to product markets within Europe.

Finally, von Hagen and Neumann (1994) and De Grauwe and Heens (1993) use relative price variability to gague which countries are most suited to enter EMU. Von Hagen and Neumann find Austria and the Benelux countries to be good candidates for EMU using CPI data (with several other countries becoming better candidates over time) while De Grauwe and Heens, using unit labor costs, add France and Denmark to the list of good candidates. More recently Bayoumi and Eichengreen (1996), who relate bilateral exchange rate volatility across industrial countries to optimum currency area considerations, also find the Benelux countries to be relatively well suited for monetary union with Germany. For the other European countries, however, they find that the observed exchange rate variability for the 1980s was below what might be expected from their model.

A basic concern with this entire line of research comparing relative price variability within and between countries is that it assumes that all observed movement in relative prices reflect beneficial responses to underlying real disturbances. However, there are many who believe that much of the actual variability of nominal exchange rates simply reflects market

[24]This may also help explain the very large relative price movements for Alberta and Saskatchewan within Canada.

froth, and hence that the exchange rate can itself become a source of economic disruptions. To the extent that this is true, the observation of that relative prices are more variable across countries with independent currencies than across regions within a currency union simply reflects the nature of the exchange rate regime and tells us little about the suitability of countries for a single currency. The truth presumably lies somewhere between these two extremes. While all movements in exchange rate may not be beneficial, it is difficult to believe that they are completely unrelated to fundamentals. The problem is that we have little information on the relative importance of these two factors, which makes it difficult to assess the information in comparisons of relative price adjustments across and within countries. While we have learned much about volatility of relative prices across different exchange rate regimes, the exact relationship to optimum currency area considerations remains unclear.

III. New Evidence: German Unification and Economic Integration

With this discussion as background, we will provide some new evidence on two topics involving dynamic aspects of optimum currency areas. Much of the existing work with respect to Europe focuses on the issue of whether Europe currently constitutes an optimum currency area. However, Europe is also in a process of change. Two of the more obvious dynamic aspects of the current situation are the collapse of communism, which has affected plans for EMU most directly through the unification of the two halves of Germany, and the increasing economic integration within Europe caused by the widening and deepening of the Union over time.

As discussed earlier, own earlier work on underlying disturbances within

Europe (Bayoumi and Eichengreen, 1992, 1993, and 1994) indicated the existence of a "hard core" of countries with relatively similar underlying macroeconomic disturbances, made up of Germany and her immediate neighbors--France, Belgium, the Netherlands, Denmark, Austria, Switzerland, and (possibly) Sweden--and a periphery made up of countries with significantly more idiosyncratic shocks--Italy, Spain, Portugal, Greece, Ireland, the United Kingdom, Norway, and Finland. The data we used in 1988, and hence did not include the effects of the reunification of east and west German in 1991. German unification has been generally interpreted as a large asymmetric shock to the anchor country in Europe, which led to policy divergences within Europe which were significant contributory factors in the exchange rate crises of 1992 and 1993. An asymmetric shock of such a magnitude might be expected to significantly alter estimated correlations of underlying disturbances across European countries.

Funke (1995) provided some evidence that German unification did indeed have such an effect. Repeating the structural vector autoregression decomposition using data including German unification, he found that the correlations between the aggregate supply and demand shocks of Germany and other members of the EU were consistently lower than those reported in our original work, an effect which he interpreted as being due to German unification. His analysis, however, focused exclusively on the bilateral correlations of underlying disturbances between Germany and other European countries. Our own earlier work indicated that underlying disturbances are also highly correlated between other members of the core. A natural question to ask, therefore, is whether German unification disrupted correlations of underlying disturbances between third countries within Europe or not.

To answer this question, we reran our earlier estimation using data on 16 European countries.[25] The underlying data on real and nominal GDP used in the estimation, which come from the *OECD National Accounts*, cover the period up to 1994. The data for Germany require some explanation. Up to 1990 they refer to the former West Germany, while from 1991 onwards they represent the reunified Germany. As a result of this change in definition real output jumps significantly in 1991 while the price level (measured using the GDP deflator) stays relatively constant. This impact from unification is limited to 1991: afterwards the output (and price) series behave in a very similar manner to what is seen prior to unification.

We estimated the structural vector autoregressions for Germany with no adjustment for the change in definition between 1990 and 1991. The results from the estimation indicate that in 1991 Germany experienced a very large positive aggregate supply disturbance combined with a positive aggregate demand shock whose size is similar to those found in other years.[26] Such results appear to be a reasonable interpretation of the macroeconomic impact of German unification using the aggregate-demand-aggregate-supply framework. Unification added a large, and chronically under-capitalized, labor force to the existing west German economy. This can be seen as a large positive shock to aggregate supply, generating a rise in potential output and a fall in output prices. At the same time, this was accompanied by a significant

[25]The countries are 14 of the current 15 members of the EU (Luxembourg is excluded as it is so small) plus 2 non-members, Switzerland and Norway. These represent all of the significant European economies which are actual or prospective members of the EU over the estimation period.

[26]The impulse response functions for the aggregate demand and aggregate supply shocks generated by the estimation also appear reasonable. In particular, the short-term impact of an aggregate supply shock is to lower the price level.

expansion in aggregate demand through fiscal expansion and the chosen conversion rate of the east German currency, which negated the deflationary impact of the aggregate supply shock. Hence, the decomposition appears to provide a reasonable interpretation of the impact of unification on the German economy.

Table 1 reports correlations of the estimated aggregate supply disturbances between 1963 and 1994 across our sample of countries using these structural vector autoregressions. Correlations which are significantly different from zero at the 5 percent level are shaded.[27] So as to better gauge the impact of German unification, the bottom panel shows correlations using the same aggregate supply disturbances, but using only the estimated supply shocks from 1963-90, the period prior to German unification. We focus initially upon aggregate supply disturbances as they are less likely to be affected by macroeconomic policy decisions, and hence probably provide a better estimate of underlying behavior.

The results for the full 1963-94 period clearly illustrate the impact of German unification on the correlation of underlying disturbances between Germany and other countries in Europe. Only two of the bilateral correlations between Germany and other European countries are significantly different from zero, and even these are only very marginally so. By contrast, when the data are truncated in 1990 Germany has large and highly significant correlations with all of her immediate neighbors except Switzerland. German unification does not, however, appear to have significantly disrupted the cohesion of the

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[27] The statistic $1/2 \log((1+r)/(1-r))$, where r is the correlation coefficient, is distributed approximately normally with a variance of T-3, where T is the number of time periods in the data (Kendall and Stuart, 1967, pp 292-293).

other countries in the European core. All of the correlations between France, the Netherlands, Belgium, Austria and Switzerland are significant in both time periods. Indeed, the addition of the 1991 to 1994 data appears to have generally increased these correlations. Hence, while German unification clearly had an important impact on the estimated level of cohesion between Germany and her neighbors, it does not appear to have caused disruption within the later group. It was, in other words, an asymmetric shock which purely affected Germany.

The results in Table 1 also broadly confirm our original analysis as to the existence of a European hard core and periphery. The correlations up until 1990 still point to an inner group of countries--Germany, France, the Netherlands, Belgium, Austria, and Switzerland--whose underlying disturbances are almost all significantly correlated. Denmark, Sweden, and (possibly) Italy also have reasonably high correlations with the larger members of the core, Germany, France, and the Netherlands. The underlying aggregate supply disturbances for the remaining countries show relatively little systematic correlation either with the core or with each other. Hence, with the potentially important exception of Italy, whose connection with the core appears somewhat closer than our earlier results would have suggested, the distinction of the core and periphery appear consistent with our earlier analysis.[28]

Truncating the data in 1990 represents one method of eliminating the impact of German unification from the data. Two other methods for achieving the same goal were also investigated. The first involved using the estimated

[28] In particular, the more positive assessment of the place of the United Kingdom within Europe found by Funke (1995) using data up to 1992 does not appear to hold over our somewhat longer sample period.

disturbances over the full 1963-94 but excluding the data for 1991 from the calculations of the underlying correlations. The second involved reestimating the German structural vector autoregression with dummy variables in the estimation for 1991, so as to exclude the effects of the 1991 structural break from the estimation. Both of these approaches gave very similar results to those reported in the lower panel of Table 1.

The correlations using the estimated aggregate demand disturbances are shown in Table 2. Confirming the results of our earlier work, the distinction between the core and the periphery is less clear, although there is still a tendency for correlations to become more prevalent in the upper left corner of the matrix. Another interesting feature of the results is that, unlike the results for the aggregate supply shocks, excluding the period after German unification has little impact on the analysis. As might be expected, unification is identified as an idiosyncratic aggregate supply shock.

The focus to date has been on analyzing correlations across the full 1963-1994 sample. However, it is evident that the level of integration of the European economy has changed greatly over the period. The EEC in 1963 contained only 6 members, compared to the EU's 15 currently, and intra-regional trade has risen steadily over time. It is of some interest, therefore, to consider whether the coherence of the underlying disturbances has risen over time. As estimates of individual bilateral correlations become highly unstable over short sample periods, we elected to use the explanatory power of the first principle component of the estimated underlying disturbances across various groupings of countries to analyze trends in the cohesion of disturbances.[29] To control for the impact of external trends in

[29] The same approach was used in Bayoumi and Eichengreen (1993b).

coherence caused by world events--for example, the oil price shocks in the 1970s--which affect all countries, we also include in the analysis a group of 5 non-European OECD countries (the United States, Japan, Canada, Australia, and New Zealand).

Table 3 shows the results from the analysis using the estimated aggregate supply disturbances.[30] It reports the percentage of the overall variance of the aggregate demand and aggregate supply disturbances explained by the first principle component for 4 country groupings over three approximately equal periods, 1963-73, 1973-83, and 1984-94. The country groupings are: the EU "core" (Germany, France, the Netherlands, Belgium, Austria, and Switzerland); an "extended core" which includes Denmark, Sweden, and Italy; the other EU members in the data set (excluding Luxembourg); the 14 members of the EU in the data set; and the 5 non-European countries discussed above. It should be noted at the outset that the explanatory power of the first principle component will generally fall as the number of countries increases, so the primary interest in the analysis is in changes in explanatory power within the same groups across time.

The four European groupings follow a fairly similar pattern. The percentage of the variance explained by the first principle component rises between 1963-72 and 1973-83 and then falls from 1973-83 to 1984-94, ending up in most cases higher in the 'eighties and 'nineties than it was in the 'sixties. By contrast, in the control group the percentage of the variance explained by the first principle component rises throughout the sample. Compared to the control, therefore, there appears to be little evidence that

[30] We focus on aggregate supply disturbances as the results for the aggregate demand disturbances appear less satisfactory, presumably because they include the effect of macroeconomic policies.

increasing close economic ties within Europe has promoted convergence in underlying disturbances. Indeed, if anything, the evidence points to the reverse, although with such a small control group we would certainly not wish to push such a conclusion too far.

In addition to increasing trade between regions, economic integration will also increase the specialization of production. This specialization of production may well explain why there appears to have been no move towards greater correlation of underlying disturbances within Europe over time. To the extent that disturbances are industry-specific, greater specialization of production will tend to make underlying disturbances across regions less similar (Krugman, 1993). Much of the discussion of this issue, reviewed earlier in this paper, has focused on the degree to which specialization across regions of the European Union compare with specialization across US regions. Estimates of trends in the degree of industry specialization over time, by contrast, has attracted less attention.

Table 4 shows some estimates of how the level of industrial specialization in the EU has changed between the 1970s and the 1980s for eight industries. For each industry the level of specialization is calculated as the coefficient of variation of the share of that industry in total output for each of across eight EU countries.[31] The more diverse the shares of output across countries, and hence the greater the amount of regional specialization of production, the larger is the coefficient of variation (the coefficient of

[31] The data come from the *OECD National Accounts*. The eight industries are agriculture, construction, manufacturing, transportation, wholesale and retail trade, finance, other private services and government. The eight EU countries are Austria, Belgium, Denmark, Germany, Greece, Italy, Netherlands, and the United Kingdom (constraints on data availability led us to exclude other important European countries such as France). See Bayoumi and Prasad (1995) for more details about the data.

variation -- i.e. the standard deviation divided by the mean of the observations -- was used in the calculations some industries were significantly larger than others). To control for general trends in geographic specialization caused by factors such as technological innovation the bottom half of the Table reports the calculations for the same industries across 8 US regions.[32]

The results from the Table indicate some trend toward greater specialization across EU countries (for further empirical evidence on increasing specialization in Europe see the discussion in the paper by Venables in this volume). All five of the industries in the EU which had a change in their coefficient of variation of more than 0.01 between 1971-79 and 1980-87 showed an increase in regional specialization. By contrast, within the United States over the same period in six of the eight industries the coefficient of variation across regions fell (construction and transportation bucked this trend), which is consistent with the view that easier communications have increased the attractions of locating in more peripheral regions. Thus, over a period in which regional specialization in the United States appears to have been declining, specialization within the EU appears to have increased.

While acknowledging the limitations of this exercise, in particular the very broad definitions of industries being used in the calculations, these results support the notion that increasing economic integration has been

[32]The US data come from the *Gross State Product Accounts* of the Bureau of Economic Analysis (BEA). The industry groupings for the EU and US are as closely lined up as is possible given the fact that the US gross state product data use slightly different industrial definitions from the OECD. The eight US regions are the standard BEA classifications: New England, Mid-East, Great Lakes, Plains, South-East, South-West, Rocky Mountains, and Far-West.

accompanied by a measurable in rise in economic specialization. If anything, this process has generated some decrease in the correlation of underlying disturbances, a result which is in line with the analysis provided in Krugman (1993).

IV. Conclusion

Empirical analyses building on the theory of optimum currency areas have come a long way since the Delors Report and its background studies (European Commission, 1990). Relatively successful techniques have been developed for measuring the size and correlation of underlying disturbances across different regions, the role of role of labor mobility in restoring equilibrium within existing currency unions, and the level of insurance provided by federal tax systems. More generally, the criteria identified in the theoretical literature -- asymmetric shocks, labor mobility and fiscal transfers -- do indeed appear to matter in actual currency unions. There may not be agreement on answers, but the questions have gained definition. There is, in short, a framework for debate.

Much of the dispute which remains revolves around the issue of the inferences that can be validly drawn from historical data. Monetary unification, in Europe as elsewhere, will be a structural break. It will alter market structures and policy processes. Correlations that held in a past of segmented national markets and independent policies may not hold in the integrated Europe of the future. Some authors have taken this point on board by searching for changes in economic relationships over the period when European integration has deepened and by comparing Europe with existing monetary unions like the United States. Others, including ourselves in this

paper, have attempted to look at the impact of changes over time within Europe on optimum currency area criteria. But whether either of these approaches provide the guidance needed to forecast the changes that will take place with EMU remains an open question, and one on which reasonable people can (and do) disagree.

Despite these concerns, the impact of economic change on optimum currency area criteria is clearly becoming an increasingly important issue. The implication is that future empirical work is likely to be increasingly concerned with these dynamic aspects of optimum currency areas, and in particular with the interaction between economic integration and the net benefits from adopting a currency union. In addition to being central to much of the debate about EMU, such issues have a much wider resonance in an world of increasing globalization. If the next five years of empirical work on optimum currency areas are as productive as the last five, the progress will be impressive indeed.

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Table 2. Correlation Matricies of Aggregate Demand Shocks

1963-1993

	GE	FR	NT	BE	AT	SZ	DE	SW	IT	UK	IR	FI	SP	PO	NO
GE															
FR	0.28														
NT	0.19	0.32													
BE	0.20	0.51	0.48												
AT	0.35	0.31	0.21	0.58											
SZ	0.23	0.34	0.38	0.25	0.41										
DE	0.24	0.21	0.02	0.19	0.23	0.09									
SW	0.25	0.25	0.23	0.31	0.02	0.06	0.08								
IT	0.37	0.56	0.26	0.43	0.51	0.37	0.02	0.17							
UK	0.12	-0.02	0.21	0.03	-0.25	-0.11	-0.18	0.43	-0.06						
IR	-0.03	-0.00	0.43	0.03	-0.18	0.18	0.16	0.19	-0.09	0.50					
FI	-0.05	0.29	0.20	0.40	0.24	0.25	0.14	0.03	0.44	0.10	-0.02				
SP	0.01	0.53	0.08	0.20	0.34	0.14	-0.03	0.10	0.37	0.06	-0.09	0.17			
PO	0.24	0.28	0.04	0.30	0.51	0.36	-0.04	0.20	0.58	0.08	0.01	0.25	0.42		
NO	0.32	-0.00	0.21	0.26	0.17	0.17	0.34	0.23	0.36	-0.00	0.17	0.05	-0.11	0.10	
GR	0.17	0.05	0.11	0.04	-0.03	0.08	-0.15	0.32	0.05	0.32	0.26	-0.32	0.16	0.46	-0.02

1963-1990

	GE	FR	NT	BE	AT	SZ	DE	SW	IT	UK	IR	FI	SP	PO	NO
GE															
FR	0.29														
NT	0.18	0.28													
BE	0.25	0.48	0.47												
AT	0.36	0.27	0.18	0.57											
SZ	0.19	0.30	0.35	0.23	0.41										
DE	0.26	0.19	0.00	0.18	0.20	0.09									
SW	0.21	0.11	0.15	0.28	-0.10	-0.14	0.07								
IT	0.33	0.55	0.22	0.43	0.50	0.32	0.01	0.02							
UK	0.17	-0.13	0.16	-0.04	-0.32	-0.23	-0.21	0.33	-0.14						
IR	0.01	-0.03	0.44	0.00	-0.18	0.17	0.18	0.17	-0.10	0.48					
FI	0.03	0.29	0.20	0.39	0.29	0.25	0.17	-0.03	0.49	-0.01	-0.10				
SP	-0.09	0.48	-0.02	0.12	0.27	0.03	-0.09	-0.26	0.31	-0.07	-0.14	0.19			
PO	0.21	0.27	-0.01	0.28	0.56	0.35	-0.05	-0.01	0.62	0.08	-0.01	0.33	0.28		
NO	0.29	-0.04	0.19	0.26	0.19	0.10	0.38	0.12	0.33	-0.09	0.15	0.02	-0.23	0.05	
GR	0.06	0.03	0.12	0.03	-0.11	0.03	-0.17	0.32	-0.04	0.52	0.36	-0.32	0.01	0.25	-0.08

Table 3. Coherance of Aggregate Supply Disturbances: 1963-94

(Percentage of variance explained by the first principle component)

	1963-72	1973-83	1984-94
EU core	44	66	53
Extended core	37	52	45
Other EU	40	41	35
Total EU	26	38	32
Control group	47	50	57

Notes: EU core refers to Germany, France, the Netherlands, Belgium, Austria, and Switzerland. The extended core adds Denmark, Sweden, and Italy. The other EU refers to the United Kingdom, Ireland, Spain, Portugal, Greece, and Finland. The EU refers to the 14 current members of the EU in the data set (ie. the EU 15 excluding Luxembourg). The control group is made up of the United States, Japan, Canada, Australia, and New Zealand.

Table 4. Trends in Regional Specialization of Production for the European Union and the United States: 1972-87

(Coefficient of variation across 8 countries/regions)

	1971-79	1980-87	Difference
European Union			
Primary goods	0.67	0.67	0.00
Construction	0.18	0.21	+0.03
Manufacturing	0.23	0.22	-0.01
Transportation	0.15	0.19	+0.04
Retail and wholesale trade	0.22	0.21	-0.01
Finance	0.33	0.36	+0.03
Other private services	0.64	0.73	+0.09
Government	0.17	0.23	+0.06
United States			
Primary goods	0.92	0.80	-0.12
Construction	0.14	0.20	+0.06
Manufacturing	0.32	0.26	-0.06
Transportation	0.09	0.12	+0.03
Retail and wholesale trade	0.08	0.04	-0.04
Finance	0.15	0.09	-0.06
Other private services	0.18	0.16	-0.02
Government	0.15	0.13	-0.02

Notes: The EU data consists of Austria, Belgium, Denmark, Germany, Greece, Italy, the Netherlands, and the United Kingdom. The US data consists of the 8 standard BEA regions. For details about the data see Bayoumi and Prasad (1993).

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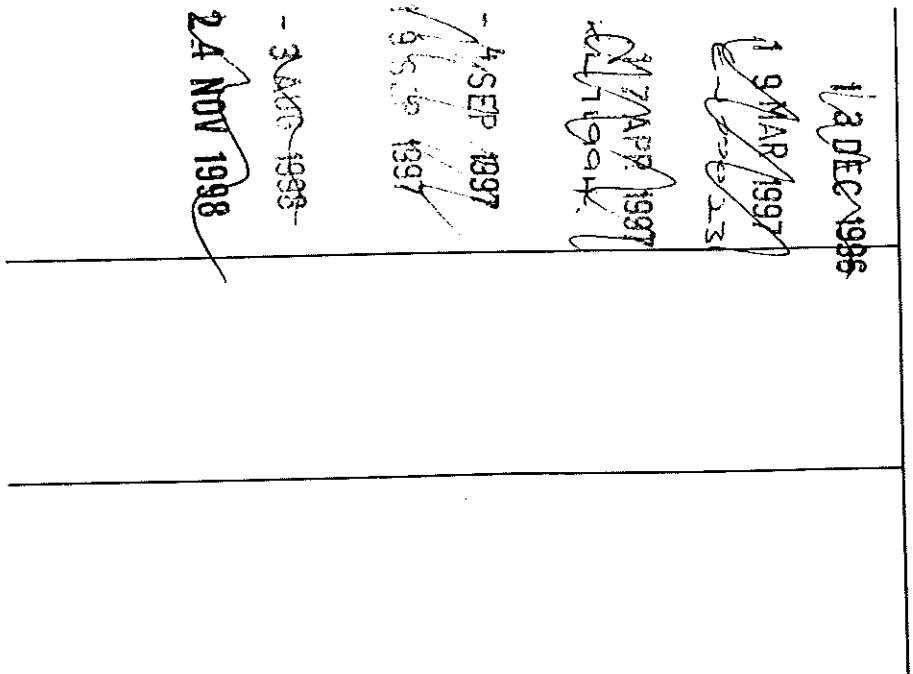

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