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Business cycle synchronisation in the euro area: Developments, determinants and implications

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Business cycle synchronisation in the euro area

October 11, 2006

Developments, determinants and implications

The divergence of growth and inflation rates across EMU in recent years has reignited the debate as to whether Europe is really an “optimum currency area” in which monetary union yields net benefits. But answering this question is complicated inter alia by the further controversy over whether economic integration and, in particular, monetary union tend to cause convergence or divergence of business cycles. Past studies have found convergence under the Exchange Rate Mechanism (ERM) regime of the 1980s, but the final verdict on the 1990s and especially on the period since the start of EMU is still pending. Several studies, such as Böwer and Guillemineau (2006), compute the unweighted average of countries’ bilateral correlations and find convergence in the 1990s and divergence since then, but this is largely caused by an outlier in Greece.

We argue that similar to the treatment of inflation in monetary policy, for which a country’s inflation rates are weighted by the relative size of a country’s private consumption, one has to look at weighted GDP growth rates. Using these, we find synchronisation, i.e. a further increase in correlation, both during the 1990s and since the start of EMU, but only the former change is significant. These findings are subsequently confirmed by the development of inflation dispersion over time. We infer that, unlike during the run-up to EMU, the introduction of a common monetary policy itself has not brought about a great reduction in business cycle heterogeneity, and synchronisation will probably be limited in the coming years as well. This means that policy-makers at the national level need to do more to improve their economies’ flexibility, in order to make them better able to cope with the remaining heterogeneity in output and inflation.

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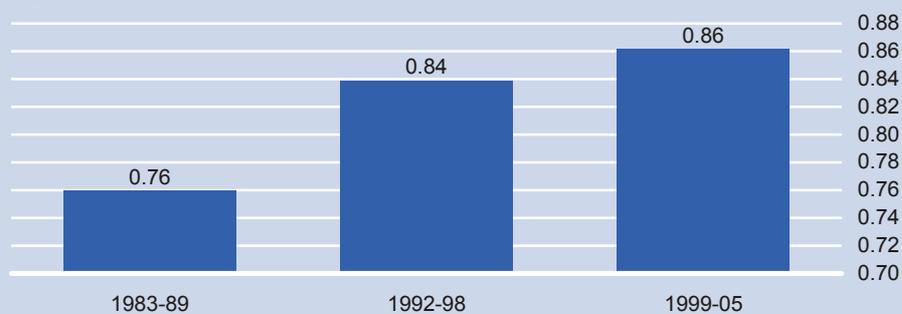
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Strong convergence of growth rates in the 1990s

Weighted average of EMU countries' GDP growth rates with that of the euro area as a whole

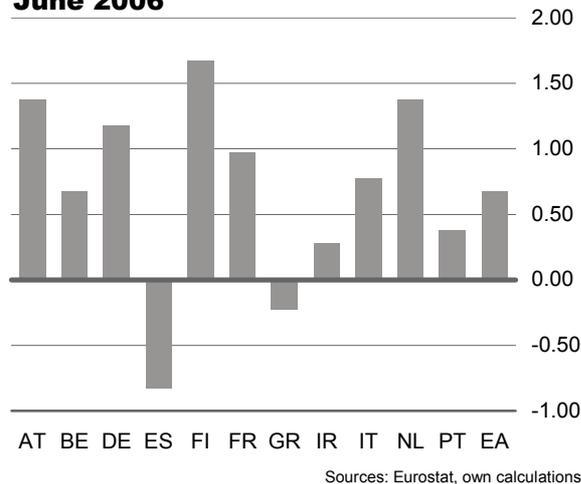


Sources: OECD Comparable Table, DB Research

1. Context: Without sufficient business cycle synchronisation, monetary union causes net losses

The recent divergence of GDP growth rates across the economies in the euro area has reignited the debate as to whether EMU business cycles are sufficiently synchronised to make the Economic and Monetary Union (EMU) yield net benefits.

3-month real interest rates in EMU June 2006



The vicious circle of real interest rate divergence

While faster-growing economies with higher inflation, like Spain, would need higher interest rates than their counterparts, such as Finland, different rates of inflation translate the common ECB nominal interest rate into lower – in some cases even negative – interest rates for them. This in turn stimulates their GDP growth and inflation, reinforcing the cycle divergences amongst EMU economies. Divergence is increased even further when higher tax revenues in face of the boom trigger tax cuts, as in recent years in Ireland.

Mundell: Costs of monetary union higher, the more business cycles differ

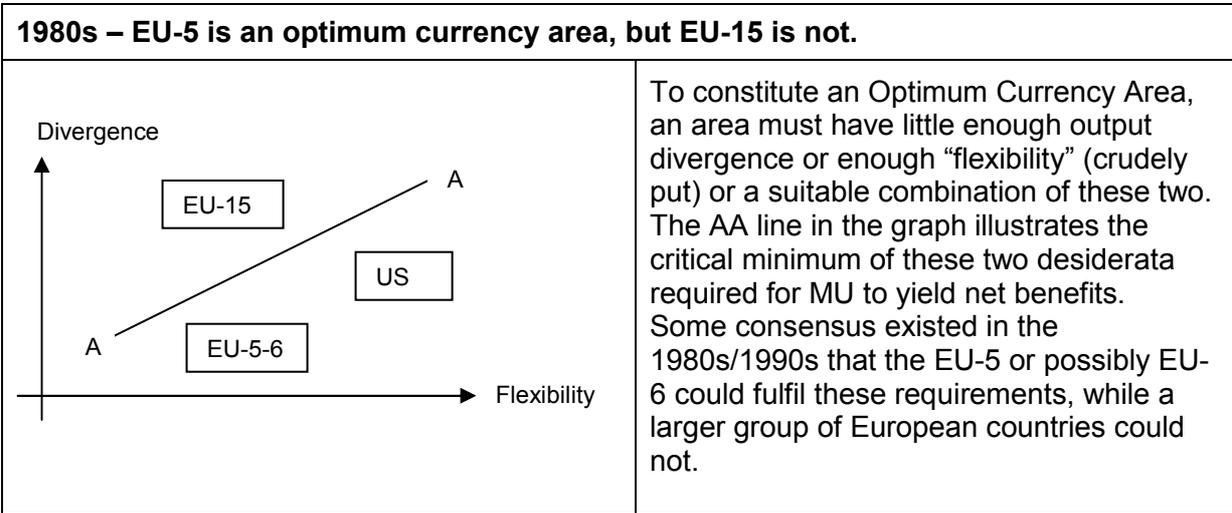
In academia, the debate on monetary union (MU) started with Robert Mundell's seminal article "A Theory of Optimum Currency Areas" (1961). He showed that, on the one hand, MU yields benefits by eliminating transaction costs, boosting price transparency and competition, eliminating exchange rate uncertainty, increasing the allocative efficiency of the price mechanism, lowering real interest rates, encouraging further FDI by maximising credibility of the exchange rate peg, and fostering further integration¹.

On the other hand though, costs arise as countries with different business cycles have to cope under the same monetary policy, which cannot be optimal for each of them individually. The magnitude of these costs depends on the degree of heterogeneity of countries' business cycles, as well as on the availability of alternative responses to idiosyncratic shocks. But the scope of alternative responses to asymmetric shocks is rather limited in Europe, especially when compared to the frequently cited benchmark United States. Labour mobility traditionally was and still is significantly lower, inter alia due to cultural and language barriers, as is the degree of financial integration between countries. At the same time, recent debates about the reform of the Stability and Growth Pact (SGP) have reminded us of economists' traditional wariness about smoothing output through fiscal policy, given reservations about its effectiveness, its political economy and, particularly in the case of monetary union, potential negative externalities on neighbouring countries.

¹ The most recent instances of strife towards further integration include the "Single Euro Payments Area" (SEPA) and the "Financial Services Action Plan" (FSAP)

Studies in the 80s and 90s agreed: EMU worthwhile for EU-6, but not for EU-15

For monetary union to yield net benefits, so much was clear from Mundell’s 1961 article, Europe would need to have sufficiently homogeneous business cycles, i.e. there should be neither significant asymmetric shocks, nor too much heterogeneity in the propagation mechanism. To what extent either of these kinds of heterogeneity exists, Mundell concluded, “reduces to an empirical rather than a theoretical question”. As a result, the 1980s and 1990s saw a proliferation of studies comparing the degree of economic integration between European countries to that between the US or Canadian states. Not all methodologies used were uncontroversial, and yet some consensus emerged in the early 1990s, which implied that a core of European countries comprising Germany, France, the “BeNeLux” area and possibly Austria probably did fulfil the OCA criteria, whereas a larger group including also the countries at the “periphery” of Europe, such as Greece, did not².



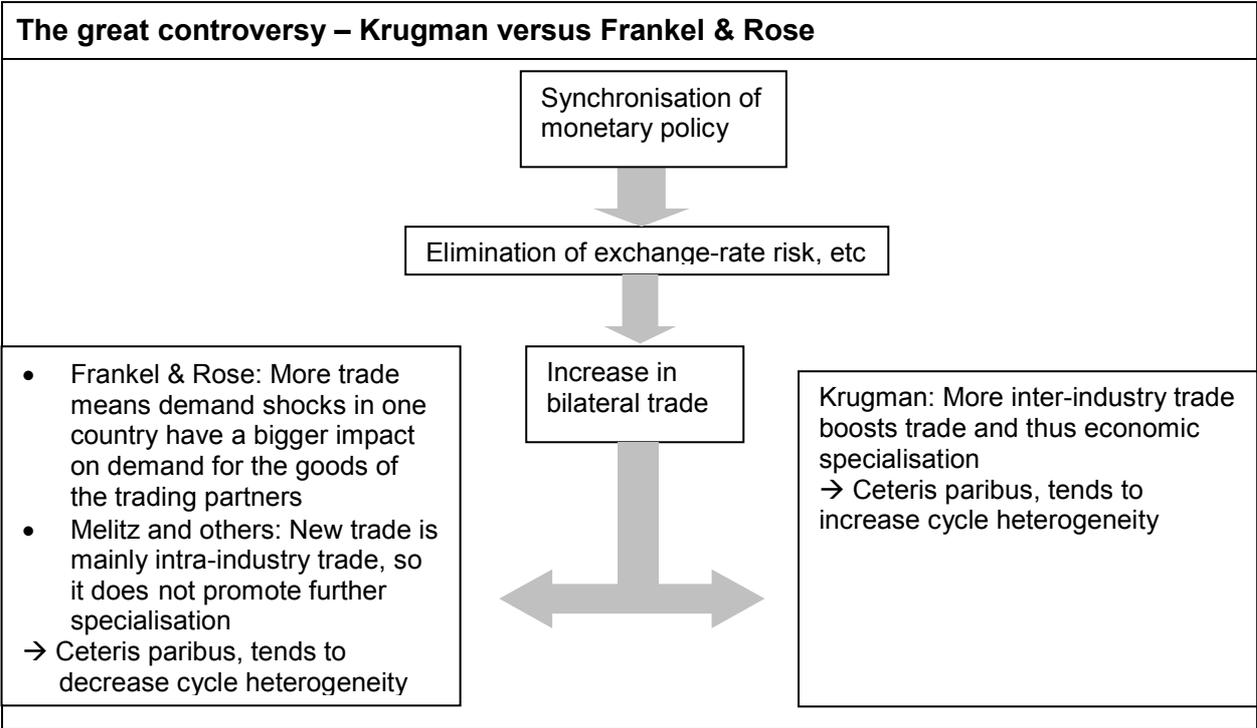
Frankel and Rose: Monetary Union promotes synchronisation

And yet the debate was not over at this point, as some economists suggested that the fulfilment of the OCA criteria might be endogenous. The most prominent proponents of this argument are Frankel and Rose (1998)³, who put forward two hypotheses. Firstly, they argued that, by eliminating exchange rate risk and bringing about greater economic and financial stability, monetary union will lead to an intensification of bilateral trade. Secondly, this increase in trade volume will lead to a more equal spread of demand shocks, as well as a greater correlation of policy shocks through more similar policies, which in turn will lead to greater synchronisation of business cycles. A slightly different channel is emphasised by Coe and Helpman (1995): As more trade leads to knowledge and technology spillovers, it will also lead to a more similar supply structure and will thus enhance output symmetry.

² This view is supported inter alia by Eichengreen (1990), Neumann & Van Hagen (1991), Bayoumi & Eichengreen (1993, 1997), De Grauwe & Heens (1993), De Grauwe & Vanhaverbeke (1993), Beine et al (2003); all are cited in De Grauwe, *The Economics of Monetary Union*, 5th edition, Oxford University Press 2003
³ Frankel, J. and Andrew Rose, *The Endogeneity of the Optimum Currency Area Criteria*, *The Economic Journal*, Vol. 108 (July 1998)

Krugman disagrees: Monetary union promotes *de*-synchronisation

However, Paul Krugman (1993)⁴, while granting that monetary union may intensify trade, argued that precisely this intensification of trade links might also intensify economic specialisation and could thus make business cycles more *heterogeneous*. In the worst case, this means that the costs of monetary union would rise faster than the benefits (which also increase with the intensification of trade). However, this scenario is rather questionable, as it has the absurd implication that a common currency would be most desirable for two countries that otherwise have nothing to do with each other. But there is a more plausible version in which costs still rise as economic integration proceeds, albeit less quickly than benefits. This would not imply that monetary union becomes less desirable over time, but it would mean that it would take longer for a region to endogenously become an Optimum Currency Area.



Synthesis: Synchronisation if enough of the additional trade is intra-industry

But is Krugman right? Two objections can be made against a scenario in which trade causes the costs of MU to rise over time. Firstly, more trade need not increase economic specialisation. Much trade between advanced countries is intra-industry trade, which would not lead to more heterogeneous shocks.⁵ In fact, Melitz (2004) argues that additional trade is more likely to concern price-elastic goods, i.e. more differentiated products, which results in more intra-industry trade. This presumption is confirmed by Imbs (2004) who finds that since 1999 the Euro area has experienced a significant increase in intra-industry trade. In the same vein, many specialised regions may transgress national borders, in particular between the smaller countries like Belgium and the Netherlands.

⁴ Krugman, P. (1993), *Lessons of Massachusetts for EMU*, in (eds.) Torres F. and F. Giavazzi: Adjustment and Growth in the European Monetary Union, Cambridge University Press
⁵ More specifically, intra-industry “horizontal” trade, such as engines for chassis, would not lead to an asymmetry of shocks, whereas trade in qualities, such as Fiats vs. Mercedes, still could do so in the presence of taste shifts; For details on this distinction, see: Fontagné and Freudenberg (1999)

A good example is automotive production in the “Euregio” region around the German city of Aachen. It includes the Ford plant in Cologne/Germany (producing Ford Fiesta), the Ford plant in Genk/Belgium (producing Ford Mondeo and Ford Galaxy), the DAF truck plant in Eindhoven/Netherlands, the Philips automotive electronics plant in Eindhoven/Netherlands, the NedCar/Mitsubishi plant in Born/Netherlands, and many component suppliers. Many of them cooperate with the various engineering research institutes connected to Aachen Technical University (RWTH). Changes in the world market demand for cars will thus simultaneously affect three countries, as specialisation does not stop at national borders.

But even if trade alone tends to make business cycles more heterogeneous via specialisation, it is not the only factor at play after the establishment of a monetary union. Other factors include the further integration of legal systems, of labour markets and financial markets, all of which will more plausibly tend to promote cycle synchronisation. In short, the theoretical prediction rather points towards synchronisation, but some ambiguity remains. Furthermore, a priori considerations alone cannot tell us how strong the drive towards synchronisation is. Therefore, an empirical answer is needed.

Predictions in 1980s/1990s pointed towards further synchronisation

First indicative findings were already made ex ante, based on studies of the business cycle synchronisation that occurred during the 1980s, presumably as a consequence of more correlated monetary policy under the Exchange Rate Mechanism (ERM) of the European Monetary System (EMS). Artis and Zhang(1995)⁶ find that in the course of the 1980s the business cycles of all EC members, including the Southern countries, became more correlated. In concordance with that, Eichengreen observes that returns on Paris- and Dusseldorf-listed shares showed a strong convergence from the 1970s to the 1980s⁷. The presumption in the 1990s was that these developments would continue or even accelerate, given the establishment of the Single Market in 1992, a more homogeneous fiscal policy to fulfil the Maastricht criteria for entry into EMU and the common monetary policy after 1999.

Kontolemis & Samiei: Policy synchronisation can cause cycle *de*-synchronisation

But there were also other voices, such as those of Kontolemis and Samiei (2000)⁸, who showed that greater policy homogeneity could also decrease cycle synchronisation by restricting countries’ ability to offset asymmetric shocks. This worry has been shared in recent years by critics of the Stability and Growth Pact (SGP), which restricts the range of fiscal deficit sizes countries are allowed to have. Critics of the Pact, many of whom accept in general the need for protection against fiscal profligacy, argue that this restriction inhibits countries’ ability to offset asymmetric shocks through automatic fiscal stabilisers. In recent years, they saw their worries confirmed by the dichotomy between solid growth in some EMU members, such as Spain or Ireland, and sluggishness in others, such as Germany or

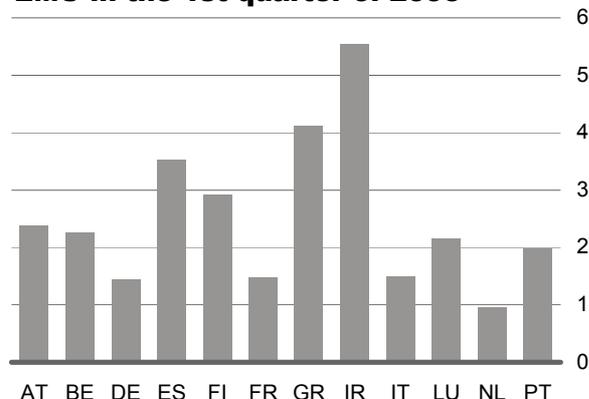
⁶ M. Artis and W. Zhang, *International Business Cycles and the ERM: Is there a European Business Cycle?*, published in *International Journal of Finance and Economics*, 1997

⁷ Eichengreen, *Is Europe an Optimum Currency Area?*, NBER Working Paper, 1991

⁸ Kontolemis Z. and H. Samiei, *The UK Business Cycle, Monetary Policy and EMU Entry*, published as IMF Working Paper WP/00/210, 2001

Italy, and the dilemma in countries like Germany between fiscally offsetting the sluggishness and observing the SGP.

Divergence of GDP growth rates across EMU in the 1st quarter of 2006



In the first quarter of 2006, GDP growth rates versus the same quarter of the previous year range from 1.0% in Portugal to 5.6% in Ireland.

Now only painful adjustment via the real exchange rate

In such a situation, the only adjustment mechanism is the real exchange rate. With the nominal exchange rate being fixed, uncompetitive economies have to keep increases in unit labour costs below those of their peers. First signs of long hoped-for improvements in the German job market this summer show that this mechanism can work, but the preceding years have also demonstrated that this process is a long and painful one, as it implies depression of domestic demand and thus slower growth in the short-run.

Permanently lower interest rates destroy old equilibrium

Adjustment is complicated and protracted further by the fact that the change of various parameters triggered by entry into EMU has resulted in structural breaks for many countries, where the adjustment process has yet to be completed. A case in point is Spain, where permanently lower interest rates under EMU have caused a boom in the mortgage market and triggered a house price bubble. The expected burst of this bubble is currently the biggest downside risk for the Spanish economy.

2. Existing findings on the development of synchronisation

Now enough data available to also analyse post-EMU developments

First investigations of whether heterogeneity has changed after EMU and whether such changes are statistically significant have become possible only very recently, given the need for a sufficiently large post-1999 dataset. Indeed, several studies on this issue have been published as ECB Working Papers since the start of this year. In the following, we shall give an overview over the methodologies and results of existing studies and shall subsequently see how they can be complemented and improved.

Better data on industrial production, but GDP is what we are interested in

Existing studies differ firstly as regards the data they use and secondly as regards their methods. Due to the availability of monthly data for all EMU countries, many studies look at industrial production data, such as the OECD's "Index of Industrial Production" (IIP), rather than at GDP. The use of this data as a proxy for GDP is justified by a historically strong correlation between the two, yet industrial production does not cover all of GDP. And while we expect synchronisation to occur more quickly in industry than in the economy as a whole, as the former accounts for the majority of international trade, ultimately our concern in the context of monetary union is GDP as a whole.

Mean correlation is a good indicator of convergence

Massmann and Mitchell consider not only the mean bi-variate correlation with Germany or the euro area, but the *whole distribution* of bi-variate correlations of *all* ERM member state dyads⁹ and then look for evidence of *decreased cyclical disparity*. The advantage of looking not only at the mean but also at the variance of bilateral correlation coefficients is that one obtains a better understanding of how significant changes in the former are. Massmann and Mitchell thus find that rises in the mean tend to be accompanied by falls in the variance and fewer movements in the ranking of different country pairs' correlations. This confirms that rises in the mean do indeed signify periods of convergence, whereas falls signify divergence.

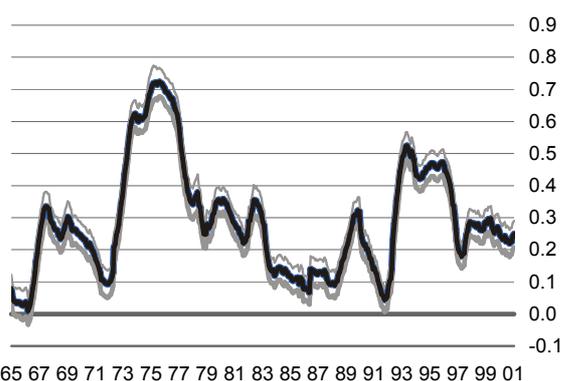
Correlation highly volatile

Massmann and Mitchell's examination of the development of the mean correlation over time, using not fixed but rolling windows of 3.5-year length¹⁰, reveals that periods of convergence and divergence alternate every 2-3 years. Furthermore, their occurrence can be related to the operation of different exchange rate regimes and other common key macroeconomic policies. Thus one observes a decline in the mean correlation after the 1973 collapse of the Bretton Woods system of fixed exchange rates, a rise in the early years of the ERM (early 1980s), subsequently a fall in the face of frequent exchange rate realignments, a rapid slump in the aftermath of German reunification and the ensuing currency crisis, and then again a rise as the impact of the currency crisis seems to be dominated by the establishment of the Single Market and the preparation of EMU. For the most recent years, Massmann and Mitchell offer no results, as their method of business cycle filtering requires the availability of a number of lead observations. Overall, their findings do not render observation of longer periods redundant, if we are interested in longer-run developments, but they alert us to the fact that correlation measures obtained for fixed windows of longer duration depend somewhat on the exact start and end dates of these windows. These findings notwithstanding, however, Massmann and Mitchell admit that the fit of their proxy "industrial production" for the really interesting variable "GDP growth" seems to have loosened somewhat in recent years. It is therefore worthwhile to look at some studies that are based on GDP data.

⁹ From 12 countries, they obtain $(12^2 - 12)/2 = 66$ country pairs (dyads) and thus for each period 66 correlation coefficients; Of these, they compute both the mean and the variance

¹⁰ Provision of the data from Massmann and Mitchell, Figure 2, is gratefully acknowledged.

Frequent change between convergence and divergence



Correlation mean and 95% confidence interval, computed by Massmann & Mitchell with an "Unobserved-Components"-filter for business cycle dating and 3.5-years rolling windows

Artis and Zhang (1995): Synchronisation with Germany under 1980s ERM

Artis and Zhang (1995) look at *bi-variate correlations* of the cyclical parts of countries' IIP data vis-à-vis Germany on the one hand and vis-à-vis the United States on the other hand. They find that under the Exchange Rate Mechanism (ERM, 1979-93), under which member states restricted the fluctuation of their Deutschmark exchange rate, member states' business cycles became less correlated with that of the US and more with that of Germany. Although Artis and Zhang cannot check on all other factors influencing the business cycles and although their findings do not explicitly prove any causality, the findings nevertheless lend further support to the theoretical presumption that small open economies under an exchange rate peg will be forced to import the shocks occurring in the anchor country: A well-known example is the aftermath of German reunification, when the Bundesbank, due to high inflation in Germany, raised interest rates and other central banks had to follow although they were at best experiencing a small part of the German reunification boom.

But Artis (2003): No evidence of further convergence in the 1993-2001 period

In a 2003 study¹¹ however, Michael Artis revisits his 1995 findings, now using quarterly GDP data until 2001. Again, he investigates affiliations with Germany on the one hand and with the US on the other hand. As a benchmark, he compares developments in euro-area economies to those of several non-euro OECD economies. His verdict is that, in contrast to the ERM period examined in his 1995 study, the period 1993-2001 is not characterised by further convergence with the German cycle. There is evidence of the existence of a common cycle shared by Germany, Austria, Switzerland and the Netherlands, as well as a second one shared by France, Spain, Belgium, Italy and Denmark. The countries in the second group, however, are not more closely associated with each other than with, for example, Japan. The UK, Ireland and Norway are not found to be associated with either of these two groups. Like Massmann and Mitchell (2003), Artis concludes that the process of business cycle convergence is by no means a monotonous one.

Artis' identification of Germany and France as belonging to different groups comes as a surprise, given the huge importance of their bilateral trade. A possible explanation though is that after the collapse of the ERM in the aftermath of German reunification France decoupled its monetary policy and thus its business cycle more from

¹¹ Artis, *Is there a European Business Cycle?*, CESifo Working Paper No. 1053, October 2003

Germany than, for instance, the Netherlands, which did not widen its exchange rate band with the Deutschmark after the 1992/93 ERM crisis.

Benalal: Dispersion of GDP growth rates is now historically low

Benalal et al (2006)¹², looking first at the degree of dispersion between GDP growth rates, find that since 1990 and even more since 1999 the dispersion in annual average terms has declined and that the current (2004) level of dispersion is historically low, though still higher than within the US or former West Germany. These results are confirmed when the fixed periods are replaced by 8-year moving averages and are even stronger when only the cyclical components of GDP growth rates are used. They are also confirmed by an investigation of the degree of co-movement (correlation) of cycles¹³, which is found to have increased. The significance of this is underlined by the fact that no such development is found for 12 non-European OECD economies. Looking at the *sources* of remaining heterogeneity, they reach the conclusion that since 1990, observed dispersions largely reflected the trend rather than just cyclical differences. Of these, a fair share can be explained by different demographic developments, given different birth and immigration rates.

Giannone & Reichlin: Growth rate gaps have reached historical low

Giannone and Reichlin (2006)¹⁴ look at output (per capita) levels as well as growth rates and business cycle timing. They find that gaps between output *levels* are persistent¹⁵, whereas *growth rates* and recession timing indicate significant synchronisation over the recent years. In fact, the variance of growth rate gaps has now reached a historical low. Growth correlations within the euro area are also higher than between the euro area and the US, supporting the notion of a unique European business cycle.

Böwer & Guillemineau: Greece reduces average correlation under EMU

Böwer and Guillemineau (2006)¹⁶, separating their dataset into the three 8-year sub-periods 1980-88, 1989-96 and 1997-2004, find that between these periods the average correlation first increased from 0.42 to 0.65, then fell to 0.62. This decline, however, is observed only if the outlier Greece¹⁷ is included in the sample, otherwise the mean correlation rises monotonously.

Concluding this section then, it can be said that the majority of studies find a monotonous increase in business cycle synchronisation, both before and after EMU, although Artis (2003) is more sceptical for his 1990s period.

¹² Benalal, Diaz del Hoyo, Pierluigi and Vidalis, *Output Growth Differentials Across the Euro-zone Countries. Some Stylised Facts*, ECB Working Paper No. 45, May 2006

¹³ Co-movement is investigated through Business Cycle Dating, based on a dual-state model in which in each period each economy is either in expansion or in contraction, to isolate business cycle duration from amplitude.

¹⁴ Giannone, Domenico, and Lucrezia Reichlin (2005), *Trends and Cycles in the Euro-zone: How much Heterogeneity and should we worry about it?*; Published as ECB Working Paper No 595, March 2006

¹⁵ The exception to this is Ireland, whose income level has been converging to the levels of richer EMU states

¹⁶ Böwer, Uwe, and Catherine Guillemineau, *Determinants of Business Cycle Synchronisation across Euro-zone Countries*, ECB Working Paper No 587, February 2006

¹⁷ Greek GDP growth was subjected to various shocks in the post-1999 period, including its difficult entry into EMU in 2001, a massive boom in the run-up to the 2004 Olympic Games in Athens and again a slump thereafter.

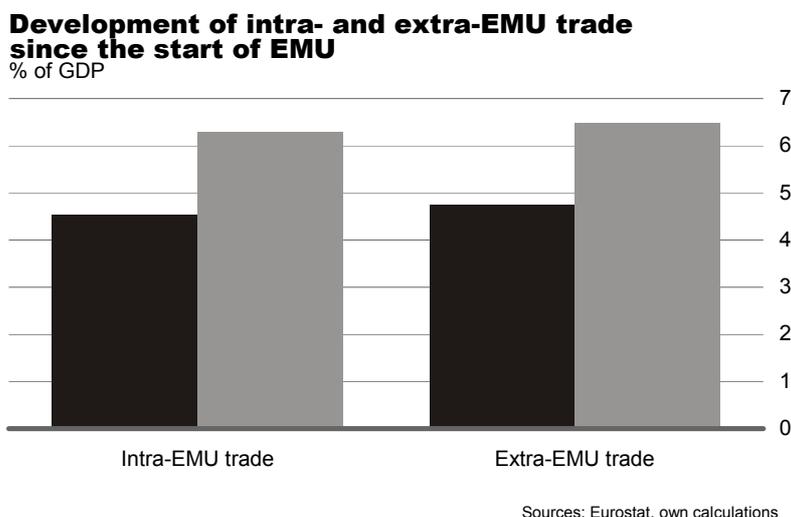
3. Existing findings on the determinants of synchronisation

Robust¹⁸ determinants of cycle synchronisation vary over time

After computing the average correlation of GDP growth rates, Böwer and Guillemineau (2006) regress their measure of synchronisation for each period on potential determinants, applying Newey-West corrections for both Heteroskedasticity and Autocorrelation¹⁹. They investigate first the traditional core explanatory variables trade, trade specialisation and economic specialisation, and then look at the roles of both policy and structural variables. Conducting an Extreme-Bounds-Analysis (EBA)²⁰, they find that the set of robust determinants has varied over time.

EMU has boosted intra-EMU trade by 40%

Let us first look at the most frequently discussed connection between monetary and business cycle synchronisation – trade. In the first 6 years of EMU, intra-EMU trade as a percentage of GDP grew from 4.5 %-points to 6.3 %-points, i.e. by some 40%. This increase in intra-EMU trade is particularly noteworthy as in the same period further globalisation and the entry of China and India into the world market gave significant impetus to trade between advanced economies and the Asian emerging market economies and as intra-EMU trade had already been high at the start of EMU.



¹⁸ A variable is “robust” if its statistical significance is not conditional on the information set, i.e. on which other economic variables are included in the equation

¹⁹ Heteroskedasticity occurs when the variance of the error and thus of the dependent variable of the regression varies with the explanatory variable, Autocorrelation (Serial Correlation) is correlation between the error terms in different periods; Both phenomena impair the reliability of inferences made on the basis of the regression, but this can be corrected by using “robust standard errors”, as proposed in: Newey, W.K., and K.D. West, *A Simple, Positive Semi-Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix*, *Econometrica*, 55(3), May 1987

²⁰ Details are on pp. 19-23 of Böwer and Guillemineau, as well as in Leamer (1981), Sala-i-Martin (1997) and Baxter and Kouparitsas (2004)

Frankel & Rose beat Krugman: Trade specialisation increased synchronisation

More interesting than the increase in trade is, of course, its impact on cycle synchronisation, i.e. the question as to whether Frankel and Rose or Krugman got it right. The answer, as pointed out above, depends on how much of the additional trade is intra-industry. In their study of the determinants of business cycle synchronisation, Böwer and Guillemineau (2006) conclude that both the trade volume and the specialisation pattern have positive impacts on cycle synchronisation.²¹ The relationship with the trade *volume* is robust over the whole period, as well as over the pre-EMU sub-period, but not over the post-EMU sub-period, whereas that with trade *specialisation* is robust only in the EMU sub-period. This suggests that in the EMU period trade content matters more than volume. And the fact that the impact of this pattern is positive suggests that a lot of the additional trade is indeed intra-industry.

Key policy variable before EMU was fiscal policy, now it is monetary policy

Next, Böwer and Guillemineau look at policy variables. They find fiscal policy, as measured by fiscal deficit differentials, to be a key driver of cycle synchronisation before EMU, whereas since then monetary policy heterogeneity, measured by interest rate differentials, is found to be more important. For the possible reasons, please see the empirical part below.

The more similar economic structures, the closer the business cycles

Finally, considering the structural variables, bilateral differences in competitiveness²², stock market indices²³ and labour market flexibility²⁴ all show the expected signs, i.e. the more the countries differ on these accounts the less correlation is observed between their business cycles.

However, competitiveness is robust only over the sample as a whole. The total stock market index is not robust, only that for cyclical services (includes retail firms, hotel chains, media corporations). Labour market flexibility is not robust over any period, but this may well be due to difficulties of measurement. To control for exogenous factors, Böwer and Guillemineau also include the “gravity variables” – geographical distance and differences in population size – among the regressors and find the former, but not the latter, to be significant and robust in the EMU period.

Euro area cycle lags US cycle—with less volatility, but more persistence

Before concluding this section, it is worth looking at Giannone and Reichlin’s (2006) investigation of how the Euro area’s cycle is influenced by that of the US. Their verdict is that, while intra-US and intra-euro area gaps in output levels are non-stationary, those between the US and euro area aggregates are stationary: As the aggregation averages out idiosyncratic influences, these two roughly follow a

²¹ The same is true for financial integration, measured as the size of bilateral bank flows

²² Each country’s indicator of competitiveness is constructed from its HICP-deflated exchange rate, weighted by trade shares; as a measure of the distance between two countries, they compute the bilateral differences of the countries’ competitiveness indicators and take the absolute value of the sample mean

²³ They take the difference between nominal-GDP-scaled stock market values, given by the Datastream Total Market Index and the Cyclical Services Index (CYSER)

²⁴ The indicator of labour market flexibility uses the bilateral differences of union density and of the OECD strictness-of-employment-protection-legislation-index (0-5) from the OECD Labour Market Statistics

common trend. In fact, the common euro area cycle is found to lag the US cycle, to which it responds with less volatility but more persistence than is found in the US cycle. These results are confirmed by data on business cycle timing. While they are consistent with Canova et al's (2004)²⁵ conclusion that global (US) shocks explain much of the fluctuation also in the euro area, they emphasise that the latter is characterised by different propagation.

4. Existing findings on impact and importance of heterogeneity

Most output volatility symmetric, so remaining heterogeneity not tragic

When analysing the economic significance of remaining output heterogeneity, Giannone and Reichlin (2006) realise that this accounts only for a small share of countries' total output volatility, the remainder is due to common fluctuation. This suggests that the remaining heterogeneity is not that tragic after all.

Plus: Ever-better opportunities for volatility insurance through financial market

While Giannone & Reichlin find no clear sign of output level or growth convergence, output-conditional consumption since the early 1990s has not converged, i.e. proceeding financial market integration allows for increasingly better risk-sharing.²⁶ This is another reason why we should not worry too much about persisting output heterogeneity.

Giannone & Reichlin emphasise shock; Artis, propagation asymmetry

Looking at how remaining cycle heterogeneity can be reduced, it is necessary to identify to what extent asymmetries are driven by asymmetry of shocks and to what extent by asymmetric propagation of common shocks. Giannone and Reichlin thus ask what, counter-factually, correlations between countries' and the euro area growth rates would have been in the absence of country-specific shocks and find them to be very high and stable. This suggests that growth heterogeneities are mostly explained by idiosyncratic shocks rather than by asymmetric propagation. The same conclusion holds for the US.

The opposite, however, is concluded by Artis (2003), using OLS regression. He argues that asymmetric propagation is more important, based on differences in financial structures, in the share of manufacturing in GDP and in the relative share of oil imports in GDP. Labour market flexibility again fails to prove significant.²⁷ The reason why findings on the main source of heterogeneity differ and which one is more informative has yet to be found.

²⁵ Canova, Fabio, Matteo Ciccarelli and Eva Ortega, *Similarities and Convergence in G7 Cycles*, CEPR Discussion Papers, 2004

²⁶ This confirms the results obtained by Kalemli-Ozcan et al, 2004

²⁷ Note, however, that the measure used, the NAWRU (Non-Accelerating-Wage Rate of Unemployment), is only one out of various possible indicators, none of which is without caveats; Furthermore, the NAWRU has changed a lot over the period under consideration, questioning the usefulness of using its period-average as a regressor

5. Data and methodology of our own study

Look at co-movement of GDP growth and at the dispersion of inflation

For the present study, we use two sets of data. Firstly, we look at the degree of co-movement between quarterly rates of GDP growth and secondly at the dispersion of national inflation rates. This choice has been made with a view to why we are studying business cycle synchronisation, which is the fit for each country of the common monetary policy under EMU. The main indicator the European Central Bank (ECB) looks at when fixing interest rates is the “Monetary Union Index of Consumer Prices” (MUICP), a weighted average of member states’ “Harmonised Indices of Consumer Prices” (HICP). Inflation itself depends on the one hand on structural factors specific to the respective country, dealt with below, on the other hand on the country’s position in the business cycle, the best indicator of which is the rate of real GDP growth. So we look first at GDP growth and then at the actual dispersion of national inflation rates. Finally, we briefly investigate the dispersion of two indicators of policy variables which we suspect to have a major impact on business cycle synchronisation: Dispersion of real interest rates as a measure of monetary policy heterogeneity and dispersion of structural deficits as a measure of fiscal policy heterogeneity.

Using the Phillips curve

When we take a look at GDP growth, we do so because we are interested in how GDP growth rates influence a country’s inflation rate’s deviation from the country-specific mean, which is determined by various structural factors dealt with below. A relationship between GDP growth and inflation, along the lines stipulated by Alban Phillips (1958)²⁸, can be considered to hold in the short-run, even though Robert Lucas (1976) has shown its breakdown in the long-run. Over our horizon of interest, 7-year-periods, GDP can thus be considered a major determinant of inflation.

The Pearson product-moment correlation as a measure of co-movement

We are interested in how these GDP growth rates move together, and the most obvious measure of such co-movement is the Pearson product-moment correlation, i.e. the co-variance normalised through division by the two growth rate series’ standard deviations. The co-variance measures how one variable fluctuates as the other one does and thus describes the strength of association between the two variables. The normalisation allows us to scale the resulting index values to lie between -1 (perfect negative association) to zero (no linear association) to +1 (perfect positive association). Three things are worthwhile noting here. Firstly, the correlation coefficient is entirely symmetric, i.e. there is no meaningful distinction between a dependent and an independent variable. Secondly, one must bear in mind

²⁸A.W. Phillips, in *The relationship between unemployment and the rate of change of money wages in the UK 1861-1957*, *Economica*, 1958, noticed an empirical negative relationship between unemployment and wage inflation; Since the former is positively correlated with GDP growth and the latter with consumer price inflation, a negative relationship between those two was subsequently inferred. Robert Lucas in 1976 famously showed that this relationship breaks down in the long-run, as governments try to exploit it for policy-making, but the relationship can be considered to hold in the short-run. Economists today still disagree on whether the causality in this short-run tradeoff works from output growth to inflation (roughly the New Keynesian position) or rather the other way round (roughly the Monetarist position), but for the present purpose only the existence of a positive relationship is relevant, regardless of the direction (or even the mere existence) of causality.

that the Pearson correlation will pick up only linear but not non-linear relationships. Thirdly, while correlation supports the notion of causation, it does not prove it. Frequently, we encounter “spurious correlation”, where both variables are simultaneously caused by a third variable. Bearing these three features in mind, Pearson’s r is indeed an appropriate measure for our present purposes, since we are at this stage only interested in how closely business cycles move together, and not in any causal mechanism. Its suitability as a measure of convergence or divergence is furthermore confirmed by the findings of Massmann and Mitchell (2003), as pointed out above, that rises (falls) in the average bilateral correlation coincide with decreases (increases) in the standard deviation of correlations.

Separate the time series into “ERM”, “Maastricht” and “EMU” periods

To gauge the impact of different stages of European integration, as determined by political decisions, we have separated our sample into three periods: 1983-89, 1992-98 and 1999-2005. The first phase captures most of the Exchange Rate Mechanism (ERM) period, the second captures the Single Market and EMU preparation period starting with the Treaty of Maastricht, and the third captures the first seven years of EMU. All three periods thus last seven years. Unfortunately, we are unable to also compare the ERM period to pre-ERM (i.e. pre-1979) times, as we do not have suitable data. Furthermore, following Giannone and Reichlin (2005), we ignore the years 1990-91, which are characterised by outliers due to German reunification and its aftermath and are thus not representative of the general development in EMU. Finally, note that for reasons of data availability our sample does not include Luxembourg and includes Ireland only as of 1997.

Weight countries’ correlations with the same weights as used for ECB policy

After computing for each country and each period the Pearson product moment correlation between the country’s quarterly GDP growth rates and those of the euro area as a whole, we take the weighted average correlation for each of the three periods and see how this average changes across the periods. It is in computing these averages where our study differs most from the previous studies on GDP growth rates quoted above. While these compute only the unweighted average of countries’ correlation coefficients, we consider it more appropriate to weight these coefficients in the same manner as the ECB weights national inflation rates when computing the “Monetary Union Index of Consumer Prices” (MUICP) used for monetary policy. This makes sense because our concern about business cycle heterogeneity is its adverse impact on the monetary policy fit. Since we are interested in the net gains of welfare for the EMU area as whole, it would – to put it informally – be wrong to give equal weight to – say – a few Greeks suffering from a monetary policy that is not well-suited for them as to the benefits many more French are enjoying from monetary union. If we were interested in the balance of benefits from the point of view of Greece alone, we would have to look only at Greece’s individual deviation from the euro area aggregates, but this is not the issue of this study. The weight of each country is based on its share of private domestic consumption expenditure in private consumption in the euro area. Weights for 1996-2005 have been obtained directly from the ECB, those for 1990-1995 have been estimated by

Eurostat. For the years prior to 1990, we use the same weights as for 1990.²⁹ To show what difference the use of these weights makes, we have also computed the unweighted averages.

Test for significance of changes in the mean correlation

After finding out how our summary measure of business cycle synchronisation changes across periods, we also test the significance of these changes. We want to test the null hypothesis that the correlation in the population has not changed against the two-sided alternative hypothesis that it has changed in either direction. To be able to conduct such a test, we need to know the sampling distribution of correlation coefficients. It turns out that, unless the true population coefficient equals zero, this distribution is skewed towards zero, which is undesirable for an exact hypothesis test. Fortunately though, Fisher (1921) has suggested a remedy: By transforming all correlation values according to the formula $z = 0.5 \ln\left(\frac{1+r}{1-r}\right)$, we obtain a transformed set of values, the sampling distribution of which is asymptotically normal. We can then compute the test-statistic Z by taking the difference between the z-values for the two periods, standardising by dividing it by the factor $s = \sqrt{\frac{1}{n_1-3} + \frac{1}{n_2-3}}$, and taking

the square root. The resulting statistic, $Z = \frac{z_1 - z_2}{s}$, follows a Standard Normal

Distribution, so that for a two-sided test values greater than 1.96 indicate that the change in the correlation across periods is significant at the 5% level.³⁰

For inflation, look at dispersion rather than co-movement

In the case of GDP growth, we were interested in the degree of co-movement as a measure of the synchronisation of business cycles, because of the impact on countries' inflation rates. We looked at the degree of co-movement rather than at the degree of GDP growth dispersion at any point in time, acknowledging the fact that countries' GDP growth rates fluctuate around different means (with the exception of Irish GDP growth, which fluctuates around a catch-up trend).

In the case of inflation rates, however, we must look directly at the degree of dispersion at each point in time, as the ECB bases its monetary policy directly on inflation, rather than on its development over time or just on its cyclical part. To evaluate the fit of monetary policy to each country's individual needs, only dispersion at that moment matters, while a high degree of co-movement alone is of no value. Thus it would be possible for two countries' inflation rates to move perfectly in line with each other, yielding a correlation coefficient of 1.0, even if one fluctuated around a mean of say 1.5% and the other around 4%. The observation of a perfect correlation in this case would indicate a high synchronisation of business cycles and

²⁹ This means that we give slightly "too little" weight to the small countries that experienced above-average growth in this period. This mistake would, if at all, be significant only for Ireland, which is not included in our first sub-period anyway.

³⁰ To compute the Z-statistic for the change in average correlation, we take the weighted averages of the individual-country coefficients for each period and use $11 \cdot (7 \cdot 4) - 11 \cdot 3 = 275$ degrees of freedom for computing the standardisation factor s

yet the situation would not be comforting with a view to the common monetary policy, which is based on the weighted average of national inflation rates.

The reason for this ambiguity between dispersion and co-movement is that inflation rates are determined not only by the country's position in the business cycle, but also by various other factors. The best-known of these is inflation expectations, which have converged strongly since the start of EMU, but there are various other factors which lead to persistence of inflation heterogeneity across countries. These include inter alia the convergence of price levels within EMU, the adjustment of indirect taxes or administered prices, a diverging development of productivity levels (the "Balassa-Samuelson-effect") and heterogeneity in house price developments.³¹ These factors cause heterogeneity in inflation rates, but they do not impair their co-movement, which to the extent that these factors remain unchanged is based on synchronised business cycles. On the other hand, different propagation of common oil price and external exchange rate changes does impair the co-movement of business cycles.

Need to compute weighted dispersion of inflation rates

Just as we decided to compute the weighted rather than the unweighted average of GDP growth rate correlations, we now compute the weighted rather than the unweighted standard deviation of national inflation rates.³²

The exact formula for computing the weighted standard deviation for each month is:

$$sd_w = \sqrt{\frac{\sum_{i=1}^{12} w_i (x_i - \bar{x}_w)^2}{(N'-1) \sum_{i=1}^{12} w_i / N'}} , \text{ where } x_i \text{ are the inflation rates in the countries } i=1, \dots, 12, \text{ and}$$

w_i are the weights each country has in the respective month (adjusted yearly). \bar{x}_w is the weighted mean of inflation rates and N' is the number of non-zero weights in each month. In addition, we have also computed the unweighted standard deviation, the

formula for which is simply $s = \sqrt{\frac{\sum_{i=1}^{12} (x_i - \bar{x})^2}{12 - 1}}$.

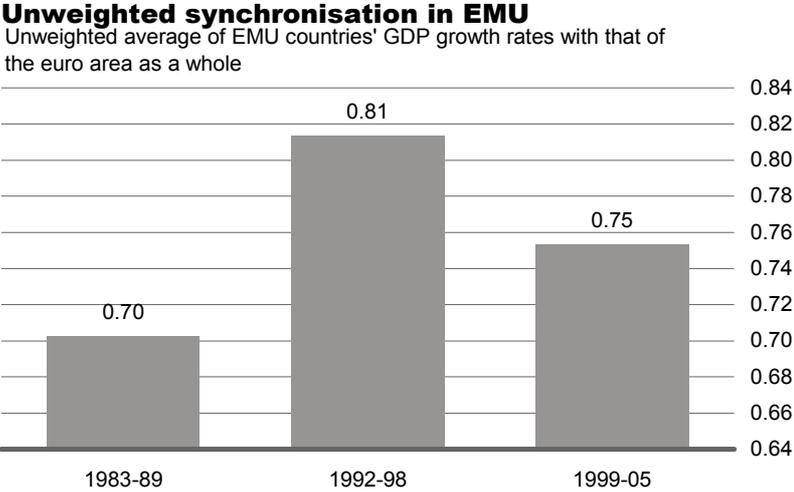
³¹ For details see: Sachverständigenrat zur Beurteilung der gesamtwirtschaftlichen Entwicklung, *Die Chance nutzen--Reformen mutig voranbringen. Jahresgutachten 2005/06*, 624ff., Wiesbaden, December 2005

³² For the standard deviation of inflation rates, the same choice is made by the German Council of Economic Experts in: Sachverständigenrat zur Beurteilung der gesamtwirtschaftlichen Entwicklung, *Erfolge im Ausland--Herausforderungen im Inland. Jahresgutachten 2004/05*, 120ff., Wiesbaden, December 2004

6. Results

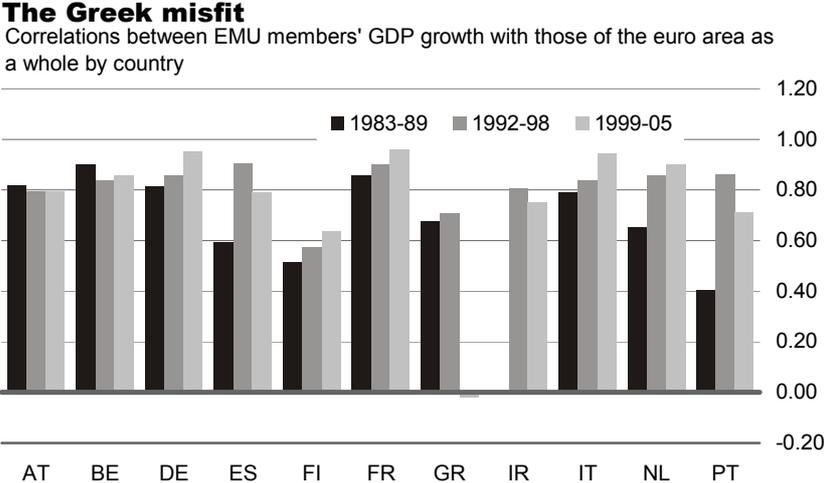
Unweighted correlation average first rises, then falls—solely due to Greece

To start with, we present the unweighted averages of GDP growth correlations.



Source: OECD Comparable Table, DBResearch

With this measure, we find that the mean correlation has risen (and significantly so) in the Maastricht period, but has fallen back somewhat under EMU. The same trend was observed by Böwer and Guillemineau quoted above. To see why the average correlation has declined under EMU, we look at developments by country, realising that the key determinant behind this development of the aggregate is the landslide fall of the correlation measure for Greece.



Source: OECD Comparable Table, DBResearch

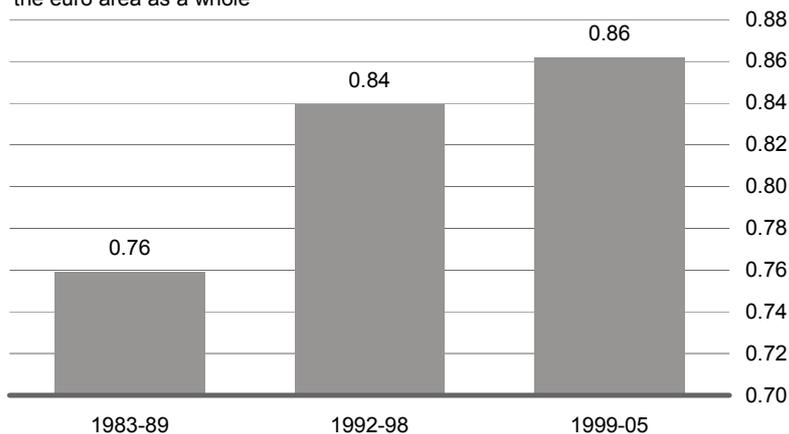
In the EMU period, the correlation between Greek and euro area GDP growth is not only very low, but even negative, at a value of -0.02. If we were to drop the Greek outlier from our sample, we would observe a monotonous rise in the average correlation. This is done by Böwer and Guillemineau, after making the same observation. The question that comes up then is which development should count, that with or that without Greece.

Weighted average shows: Monotonous convergence

Fortunately, this problem disappears when one uses our methodology of computing the weighted average of countries' correlations. With a justification well-rooted in theory, the Greek development is now down-weighted relative to developments in the larger economies. As a result, we now observe a monotonous increase in the average correlation. For the same reason, we observe higher correlation levels in all three periods.

Strong growth rate convergence in the 1990s

Weighted average of EMU countries' GDP growth rates with that of the euro area as a whole



Sources: OECD Comparable Table, DBResearch

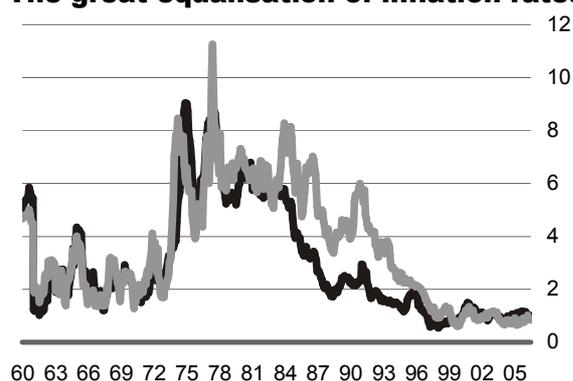
But only Maastricht rise proves significant

Besides the fact that the correlation now rises at both period transitions, it stands out that the increase under EMU is much smaller than the one observed in the run-up to EMU. Possible explanations of this result and its implications are considered in the final section below. Whatever the explanation, the relatively small size of the post-1999 change alerts us to the need to test the significance of the observed changes. The finding is a clear significance of the 10.5%-change after 1992, with a test-statistic of 2.62, but a t-value of only 0.95 for the second, 2.4%, change. We therefore fail to reject the null hypothesis of no change between the pre- and post-EMU periods. It remains to be seen whether a clearer picture of post-EMU developments will emerge when this study is repeated with another two or more years of data.

Weighted dispersion lower than unweighted dispersion

Let us now look at the dispersion of inflation rates across countries, for which we have data ranging back to the year 1961. As with our measure of GDP correlation, we find that regarding almost all observations the weighted measure paints a more positive picture than the unweighted measure, as weighted dispersion lies almost always below the unweighted measure of dispersion. This is what is to be expected, since the former measure down-weights the more extreme developments in the smaller countries on the European periphery such as Greece. Both measures, however, follow largely the same trends.

The great equalisation of inflation rates



Weighted and unweighted standard deviations of national inflation rates across the euro area, 1960-2006

Sources: Eurostat, own calculations

Furthermore, we observe an explosion of the degree of dispersion in the 1970s, reflecting differences in the strength of impact of the oil price shocks across countries, depending inter alia on their dependence on oil imports and on the degree to which monetary policy institutions were willing to accommodate the rises in inflation that followed the oil price hikes after the two oil crises.

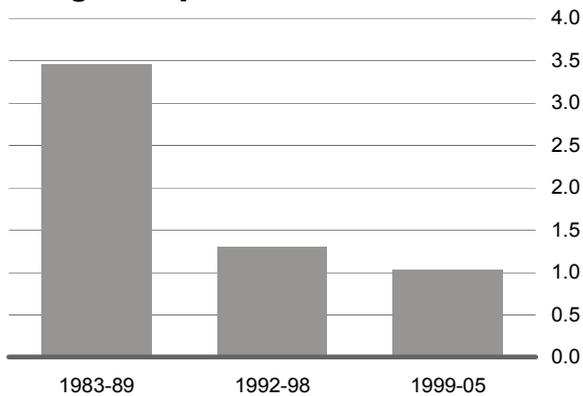
By the start of EMU, inflation dispersion has fallen to historically low levels

Most interesting for our present purposes is, of course, the observation that the long-run trend for the degree of dispersion, on either measure, has seen a strong decrease between the mid-1970s and the mid-1990s. The last drop is witnessed in the final phase of preparations for EMU, i.e. between 1996 and 1999, and since then dispersion has remained largely stable at a relatively low level. It is now similar to inflation dispersion between the 14 US Metropolitan Statistical Areas (MSAs) and only slightly higher than that between the four US Census regions³³, although differentials within the euro area tend to be somewhat more persistent.

To see how this development fits with our results on GDP growth rates, we compute the dispersion averages for each of our three periods. As with GDP growth rates, we see a significant drive of convergence in the Maastricht period, followed by a further, not significant convergence under EMU.

³³ The four US Census regions are: West, Midwest, Northeast and South

The great equalisation under EMU



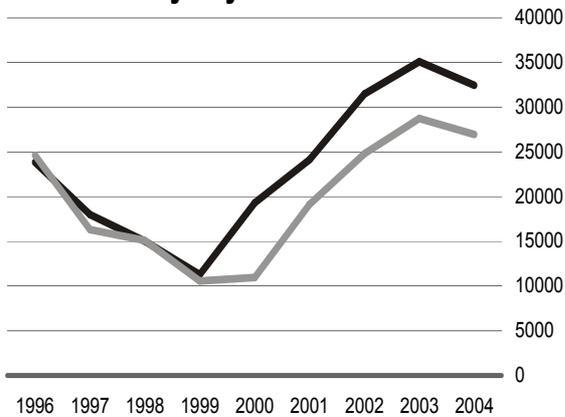
Average degree of dispersion of national inflation rates in the ERM, Maastricht and EMU periods

Sources: Eurostat, own calculations

Fiscal policy: "I still do it my way"

Before concluding the results section, let us have a look at the two policy variables, which Böwer and Guillemineau regarded as robust determinants of business cycle synchronisation, monetary policy heterogeneity and fiscal policy heterogeneity. A good measure of the former is given by the divergence of real interest rates. In a monetary union with a common nominal interest rate, correlation and dispersion of real interest rates are of course the same as those of inflation rates, dealt with above.

"I still do it my way"



Weighted standard deviations of EMU states' structural deficits, 1996-2004 declined in the run-up to EMU; but have since risen again.

Sources: Eurostat, own calculations

An issue not yet dealt with, however, is the heterogeneity of countries' fiscal policy stances, as measured by their structural deficits. As a measure of the heterogeneity of countries' fiscal policy stances, we have computed the weighted and unweighted standard deviations. Since we have complete data ranging back only to 1996, no more than indicative findings can be made.

The verdict is that on both measures dispersion fell until the start of EMU in 1999, but rose again until 2003. This reflects the fact that while countries' eagerness to achieve admission to EMU made them restrict their degree of fiscal policy activism before EMU, these restrictions were not as effective afterwards, as evidenced by the manifold breach of the SGP in recent years.

7. Interpretation and implications of the results

The results of our study confirm the general trend towards greater synchronisation of business cycles, as well as a fall in the dispersion of inflation rates, both of which one is happy to see when thinking about the welfare effects of common monetary policy in a monetary union. In contrast to the earlier period, however, the synchronisation drive so far observed since the start of EMU cannot – or at least not yet – be shown to be significant.

A priori, three not mutually exclusive explanations suggest themselves. Firstly, it may be that the potential for synchronisation had already been largely exhausted in the run-up to EMU. Secondly, there is the possibility that it simply takes some more time for the whole impact of EMU to materialise. Thirdly, the reason may be that some necessary further steps towards economic and financial integration have yet to be taken. As so often, the truth is probably a combination of the three explanations.

When considering what further developments we expect for the coming years, it is worthwhile to distinguish two possible impact channels between monetary union and business cycle synchronisation. On the one hand, there are the direct impacts of monetary union in the sense of a common monetary policy.³⁴ On the other hand, there is an indirect impact in that monetary union politically facilitates the implementation of further integration-promoting policies, such as the Single European Payments Area (SEPA), which is currently being discussed and promoted by the ECB, in particular, or in a wider sense the aim of the European Commission to move further towards the completion of a Single Market not only for goods but also for services.

Expectation for the coming decade: Further, albeit limited, synchronisation

Our expectation for the coming decade is that it is particularly through the second channel that further synchronisation may be promoted, although the potential for this seems limited compared to what we have seen in the past 20 years. Giannone and Reichlin have argued that the remaining heterogeneity is not tragic, as it accounts only for a limited proportion of countries' total output volatility, but then again the growth and inflation differences observed in recent years between Germany, France

³⁴ But note that a common nominal interest rate implies a common real interest rate only to the extent to which inflation rates have converged. We have seen that this has largely been the case, but also that so far some heterogeneity in real interest rates remains also under monetary union.

and Finland on the one hand and Spain or Ireland on the other hand suggest that this small proportion may still be annoying.

Given that potential for further integration-promoting policies at the European level is now limited, policy-makers at the national levels are now called upon to further reduce the costs of monetary union. As a significant proportion of growth differentials is not just cyclical but there are trend differences, not only macroeconomic, but also structural reforms are required. Particularly because potential for further cycle synchronisation is limited, they will need to improve their economies' flexibility and thus their ability to cope with the remaining heterogeneity. This includes the need for measures like the Services Directive or the unconditional implementation of the principle of the Free Movement of Labour also for citizens of the new (2004) member-states.

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