
Convergence and Common Cycles in the European Union

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Abstract

An important question facing the European Union is whether the degree of economic convergence among the member states is sufficient to ensure the smooth operation of a unified monetary system. In this paper we use the common features test to identify the degree of short run (cyclical) convergence among the larger EU countries. Our results suggest that GDP growth, exchange rates and nominal interest rates exhibit common cyclical features (represented by common serial correlation features). In contrast, we find that there are generally no common features in real interest rate movements.

1. Introduction

As the prospect of full monetary integration in the European Union (EU) draws closer to reality, attention has focused on the difficulties that individual member states are likely to face after the adoption of a single currency and a common monetary policy. The implications of economic and monetary union in Europe have been discussed at length by numerous authors (see for example Shepherd 1990, Eichengreen 1993, and Goodhart 1995). As far as macroeconomic policy is concerned, one of the key questions is whether the various economies have achieved, or can achieve, a degree of convergence sufficient to ensure the smooth operation of a unified monetary system. The answer to this question

hinges on the nature of the shocks that affect each country and how they would be absorbed in the absence of exchange rate changes and independent monetary policy adjustments.

If wages and prices were perfectly flexible across all member states, and if labour and capital were highly mobile, the adoption of a single currency would in itself pose few problems for macroeconomic policy. Under these conditions, it would in principle be possible to achieve the appropriate adjustment to any demand or supply shocks via domestic wage and price movements, and labour and capital flows, rather than exchange rate realignments and independent monetary policy changes. In practice, it seems implausible to suppose that labour and product markets in the EU exhibit the above degree of flexibility and the important question which then has to be considered is whether recurring macroeconomic shocks are broadly symmetrical or asymmetrical across the member states.

Generally speaking, the pressures that lead to conflicts about the design and implementation of macroeconomic policy in a common currency area are greatly reduced if the participating countries face shocks that are broadly symmetrical, in the sense that they share a common time profile. Even in this case, it is important to recognise that the relative magnitudes of the shocks may differ across countries and that there are always likely to be disagreements about the required

strength of any policy response - the extent to which monetary policy should be tightened in response to rising inflation for example. Nevertheless, the presence of symmetry does at least imply an opportunity to secure general agreement about the appropriate direction of policy. In contrast, if the underlying shocks are asymmetrical (affecting different groups of countries at different times) it becomes extremely difficult to design policies that are uniformly appropriate to the needs of all and the potential for conflict is that much greater. An obvious example is the conflict over monetary policy that could arise if some countries entered a recession while others entered a boom.

When we consider the shocks that affect any group of economies, we are concerned not so much with the precise nature of the shocks themselves, but rather how they manifest in the form of time-movements in the key macroeconomic variables, such as output, employment, interest rates and the price level. The degree of convergence between the economies in question can then be identified by examining the degree of co-movement across the relevant time series. This problem can be approached from a long-run perspective, by considering the relationship between trend movements in the relevant variables. The degree of convergence over the long run can then be examined with the aid of cointegration tests or, more flexibly, with time-varying parameter techniques that allow for underlying changes in structure. For example, Hall, Robertson and Wickens (1997) use the time-varying parameter formulation, and estimation by Kalman filter methods, to examine the degree of long-run convergence exhibited by nominal exchange rates, nominal interest rates and inflation rates across the EU countries. An alternative approach is to consider how trend deviations in the variables are correlated

across countries (Backus, Kehoe and Kydland, 1995). The correlation coefficients then give some indication of the degree of co-movement in the series over the short run, but they do not say much about the underlying dynamics.

In this paper we concentrate on the short-run dimension of the convergence issue, by examining the extent to which the larger economies of the EU exhibit a common cyclical response to macroeconomic shocks. Our analysis is based on the work of Engle and Kozicki (1990) and Vahid and Engle (1993a). Starting with the idea that many economic time series exhibit features such as serial correlation, heteroscedasticity and seasonality, they develop a test to determine whether the identified features are common across any particular series. Although this 'common features test' was initially used to examine the synchronisation of output growth over the cycle for the G7 countries, it can also be applied to different sectors within an economy. For example, Vahid and Engle (1993b) and Lippi and Reichlin (1994) examine the existence of common trends and cycles to determine whether permanent and transitory components of income and consumption are positively related to the rate of output growth.

Returning to our own contribution, we begin by describing the nature of the common features test and we then use it to investigate whether some of the key macroeconomic variables across the larger EU countries exhibit common cyclical features, even in the absence of full convergence. We concentrate on the larger countries because it is their performance that is most likely to dictate the future direction and success of any monetary union in Europe. The variables we consider are also those which are mostly directly related to the operation of monetary policy. Our results suggest that a common cycle can be identified for real GDP growth, nominal

exchange rates, nominal interest rates, and real exchange rates. In contrast, real interest rates do not appear to share common cyclical features. The paper ends with a brief discussion of the implications of our results.

2. The Common Features Test

The common features test provides a means of determining the degree of co-movement between a set of variables that may or may not exhibit cointegration. If a set of $I(1)$ variables are related in a stochastic macroeconomic model, it is well known that the trend component can be written as the sum of an $I(1)$ trend and an $I(0)$ cycle in an infinite number of ways. These non-stationary variables are said to be cointegrated when a linear combination of them generates a stationary (white noise) error term. In this case, the cointegrating vector effectively represents the common feature that explains the co-movement in the variables that renders the combined series stationary. The strength of the common features test is that it can also be applied to vector autoregressive systems that are not cointegrated. The test then gives an indication of the degree of co-movement over the short run, even in the absence of full cointegration. For example, the variables in question may not be cointegrated, but they may each exhibit a feature such as serial correlation. The common features test can then be used to determine whether the pattern of serial correlation is similar, indicating a degree of short run co-movement in the variables. Vahid and Engle (1993b) suggest that 'a serial correlation common feature exists when a linear combination of the series is unpredictable relative to the past history of the variables'. Note, however, that while serial correlation is used as the example, the test is quite general and the common feature could be one of the other statistical properties

of the series or a common exogenous factor. The important point is that the common features test provides a measure of the co-movement of sets of time series which is less stringent than cointegration.

To see the rationale behind the common features test, let us suppose that we have two time series y_{1t} and y_{2t} , and that a time-varying feature W_t is present in both series:

$$\begin{pmatrix} y_{1t} \\ y_{2t} \end{pmatrix} = \begin{pmatrix} \lambda \\ 1 \end{pmatrix} W_t + \begin{pmatrix} e_{1t} \\ e_{2t} \end{pmatrix} \quad (1)$$

We assume that the error terms are independent and that W_t represents some form of serial correlation.

The first step in the common features test is to establish whether or not a particular feature is present in both sets of data (if the feature is present in only one of the series there is clearly no point in testing for commonality). Having established the existence of a particular feature, the next step is to determine whether it is common. The obvious way to do this is to see whether there exists some combination of the original series that removes the identified feature. In our example, W_t represents a form of serial correlation and the test for a common feature is essentially a test of whether it is present in some linear combination of the original series, $u_t = y_{1t} - \lambda y_{2t}$. In other words, if the pattern of serial correlation is the same in both series (if it is a common feature) it should be cancelled out in the linear combination, leaving the combined series u_t serially uncorrelated. On the other hand, if the pattern is significantly different (if the feature is not common) the combined series u_t is likely to exhibit serial correlation.

A simple test procedure is to implement a version of the standard LM test using an

auxiliary regression. We can test for the presence of a feature W in a given variable y by estimating a model of the form $y_t = c + \gamma W_t + e_t$, where c is a constant and W_t may include the lag of y_t , or some other variables which captures the feature of interest. If the series y_t does not exhibit the feature we would expect γ to be insignificantly different from zero. The null hypothesis is then:

- $H_0: \gamma = 0 \Rightarrow$ No Feature
- $H_1: \gamma \neq 0 \Rightarrow$ Feature Exists

If $s(y)$ is the LM test statistic for the presence of a feature in a data series $\{y_t\}$, the null hypothesis of no feature is rejected when $P_{H_0} [s(y) > c] \leq 5\%$. In other words, we accept that the feature exists if $s(y) > c$ in the critical region for c at the 5% level. Note that the LM test statistic for this auxiliary regression can be calculated as $LM = TR^2$ (where T is the sample size and R^2 is the conventional coefficient of determination).

The above procedure can be used to determine whether the feature is present in both y_1 and y_2 . We can then test whether there is some combination of the series that eliminates the feature. The test proceeds by constructing a variable u , where $u = y_1 - \delta y_2$, and δ is chosen so as to minimise the test statistic $s(u)$. The distribution of $s(u)$ over δ satisfies a simple inequality:

$$S(\hat{u}) = S(y_1 - \delta y_2) = \underset{\delta}{\text{Min}} S(y_1 - \delta y_2) \leq S(y_1 - \lambda y_2) = S(e_1 - \lambda e_2) \quad (2)$$

$$P_{H_0} [S(\hat{u}) > c] \leq P[S(e_1 - \lambda e_2) > c] \leq 5\% \quad (3)$$

The statistic $s(\hat{u})$ is asymptotically distributed as Chi Square and δ is approximated by λ , which can be estimated via limited-information maximum likelihood (LIML), two stage least squares (2SLS) or direct minimisation of $s(u)$. The significance (or

insignificance) of the estimate of λ then indicates the presence (or absence) of the common feature. Of the three methods for estimating the significance of λ , the most accurate is the direct minimisation of $s(u)$. The 2SLS approach involves the regression of y_1 on y_2 or y_2 on y_1 and we would expect the resulting estimates to differ slightly from those obtained via LIML because of the different normalisations imposed in the 2SLS regressions (according to whether y_1 or y_2 is on the left-hand side). Although Engle and Vahid (1993a) suggest that 2SLS and LIML in practice give similar results, and that they have the advantage of computational ease, both of these approaches provide only an approximation to the true minimum obtained via direct minimisation. To get some idea of how the estimates from these different methods compare, we have used all three in our test procedures.

3. Testing for a common cycle in GDP

We begin by examining the behaviour of output relative to trend for the six largest EU countries, which are Germany, France, Italy, Spain, Austria and the UK. Our objective is to determine whether common business cycle features can be identified for these countries. The analysis uses quarterly real output data (seasonally adjusted) and we measure the trend deviations in terms of the first differences of the series. There are of course other filtering methods available and it is worth noting that the results of this kind of exercise may be sensitive to the precise method employed (King and Rebelo, 1993). For the tests on the GDP data, we have truncated the sample period at the end of the 1980s in order to avoid any potential distortion arising from the impact of German re-unification.

Table 1 shows the output-growth correlation between these six largest countries.

Table 1. Output Growth Correlation Coefficients: 1980Q1-1989Q4

Country	Germany	France	Italy	Spain	UK
France	0.64				
Italy	0.68	0.60			
Spain	0.37	0.66	0.47		
UK	0.61	0.49	0.27	0.49	
Austria	0.67	0.80	0.73	0.53	0.28

Table 2. Unit Root Tests for Quarterly GDP with Respect to Germany

Country	France (67-89)	Italy (70-89)	Spain (70-89)	UK (65-89)	Austria (72-89)
ADF(1)	-3.35	-2.72	-1.63	-1.33	-3.17

Critical Value for ADF(1) = -3.40

Although the correlation coefficients are positive, on their own they do not provide sufficient information to determine whether the cycles in growth are common or unsynchronised.

Before we consider whether a set of variables share a common feature, it is important to know something about the long-run structure of the data, and in particular whether the variables are cointegrated (whether they move together in the long run). In the present context, a simple procedure is to calculate the difference in real GDP between each country and Germany and then test for the presence of a unit root in the residual. Table 2 reports the relevant ADF statistics. For this exercise it is desirable to have as long a sample period as possible, but the choice of periods is constrained to some extent by the availability of suitable data. The results suggest that there are no cointegrating

relationships with respect to Germany, although France is close to the test borderline.

The presence of a unit root in the residuals suggests that we can estimate a bivariate VAR(1) model in first difference form. Common serial correlation features then indicate the degree of persistence and comovement in the system and can be interpreted as evidence of common business cycle features. The test for serial correlation is essentially a test of whether the past growth rates of GDP are significant. In other words, if y_{1t} and y_{2t} represent the log of GDP for two countries, the presence of serial correlation is indicated by a significant LM test statistic, calculated as TR^2 in the regression $\Delta y_{1t} = c + \alpha \Delta y_{2t}(-1) + \beta \Delta y_{1t}(-1) + e_t$. The joint LM tests for a set of Bivariate VAR(1) models are presented in Table 3.

Table 3 shows that, from the 30 least square regressions, 25 suggest evidence of a

Table 3. Bivariate VAR(1) for GDP: 1980Q1-1989Q4

Country	Germany	France	Italy	Spain	UK	Austria
Germany		9.18	8.58	4.84	7.45	6.65
France	21.60		15.04	17.48	4.35	8.63
Italy	20.28	24.25		24.84	30.08	24.07
Spain	65.52	77.35	77.26		77.35	69.72
UK	9.36	9.44	10.20	10.40		9.60
Austria	3.70	3.62	7.06	6.81	5.24	

5% critical value with 2df = 5.99. Dependent variables are in the first column.

Table 4. The Common Features Test for GDP Growth: 1980Q1-1989Q4

Country		Germany	UK	Austria	Spain	France
UK	$s(u)$	0				
	λ	-0.46				
AU	$s(u)$	0	0			
	λ	-0.14	-1.33			
SP	$s(u)$	0	3.55	0		
	λ	-0.59	-0.99	-1.73		
FR	$s(u)$	0	0.02	0	0	
	λ	-3.04	-3.82	-2.28	-1.30	
IT	$s(u)$	0	0.01	0	0	0.14
	λ	-1.69	-2.84	-3.96	-1.28	-0.63

5% critical value = 3.84

cycle by rejecting the hypothesis that both coefficients together are insignificantly different from zero at the 5% level. Ten of the possible 15 pairs show the presence of serial correlation in both countries. Given that there appears to be some sort of cycle in each country, the next step is to examine whether the cycles are a common feature.

Following the procedure described by equation (2), we derive a new variable (u) given from the function $u_t = \Delta y_{1t} + \lambda \Delta y_{2t}$ where λ is chosen so as to minimise the statistic $s(u)$ derived as TR^2 from the auxiliary regression $u_t = c + \delta u_{t-1}$. The presence of a common serial correlation feature is then indicated when λ is insignificantly different from zero (i.e. when

Table 5: 2SLS Common Features Test for GDP Growth: 1980Q1-1989Q4

Country	Germany	UK	Austria	Spain	France	Italy
GE $s(u)$		0.05	0.04	0.10	0.02	0.14
λ		-0.24	-0.05	-0.58	-0.21	-0.52
UK $s(u)$	1.67		1.71	0.91	2.01	2.09
λ	-0.03		-0.07	-0.29	-0.12	-0.11
AU $s(u)$	0.02	0.19		0.20	0.09	0.01
λ	-0.06	-0.24		-0.71	-0.02	-0.04
SP $s(u)$	2.66	1.18	1.86		2.39	2.51
λ	-0.007	-0.11	-0.05		-0.03	-0.01
FR $s(u)$	0.31	0.003	0.02	0.05		0.04
λ	-0.06	-0.02	-0.0	-0.42		-0.09
IT $s(u)$	0.22	0.25	0.12	0.13	0.13	
λ	-0.09	-0.28	-0.03	-0.49	-0.03	

5% critical Value = 3.84

Table 6: LIML Common Features Test for GDP Growth: 1980Q1-1989Q4

Country	Germany	UK	Austria	Spain	France
UK $s(u)$	1.90				
λ	-0.23				
AU $s(u)$	0.99	3.38			
λ	-0.19	-0.46			
SP $s(u)$	2.17	1.86	4.18		
λ	0.50	-0.82	-0.56		
FR $s(u)$	0.027	1.18	0.61	0.57	
λ	-2.87	-0.33	-0.07	-0.42	
IT $s(u)$	0.53	0.80	1.41	0.18	0.42
λ	-3.33	-1.76	-66.57	-0.50	-0.82

5% critical value = 3.84

$s(u) < 3.84$, which is the 5% critical value of the chi-square distribution for 1df). Table 4 presents the common feature estimations where λ is obtained by minimisation of $s(u)$.

The insignificance of the λ coefficient in the first column of table 4 indicates the presence of a common business cycle feature for each country with respect to Germany (in

Table 7. Unit Root Tests for Nominal and Real Exchange Rates

Country	Nominal Exchange Rate		Real Exchange Rate	
	DF	ADF	DF	ADF
FR : 1972Q1-1994Q3	-1.88	-1.89	-2.63	-2.89
IT : 1980Q1-1993Q4	-1.82	-2.21	-2.35	-2.43
SP : 1972Q1-1993Q3	-1.61	-1.98	-1.79	-1.96
UK : 1972Q1-1994Q3	-1.84	-2.17	-1.63	-2.06
AU : 1972Q1-1994Q3	-2.23	-2.46		

Critical Value for ADF(1) = -3.40

Table 8. LM Tests for Bivariate VAR(1) Features in Nominal Exchange Rates

Country	GE	FR	IT	SP	UK	AU
GE		14.82	10.58	11.05	4.29	7.03
FR	7.92		10.78	11.66	4.68	7.31
IT	7.23	14.82		11.23	4.99	6.10
SP	7.22	13.85	9.74		3.71	7.14
UK	6.23	14.88	10.69	11.73		6.11
AU	6.96	13.50	8.68	11.20	3.36	

5% critical value=5.99 (10% =4.61). Dependent variables are in the first column.

the sense that there are common serial correlation features). In addition, the negative sign attached to the λ coefficient suggests that real GDP growth for these countries moves in a pro-cyclical manner with respect to Germany. The significance levels reported for the other cross-country pairs also suggest the presence of common serial correlation (business cycle) features, of a pro-cyclical form.

The results shown in table 4 are obtained via direct minimisation of the $s(u)$ function.

By way of comparison, tables 5 and 6 show the results of the common features test using the LIML and 2SLS approximations, where the instruments are the constant and lags of GDP growth in the two countries.

Although the results shown in tables 5 and 6 point in the same direction as those obtained via direct minimisation, the 2SLS and LIML approximations give much larger test values for $s(u)$ and generally lower significance levels for λ . It also appears that the different normalisations do have a

significant impact on the 2SLS estimates. The implication is that the results from the LIML and 2SLS approximations are far less robust than those obtained via direct minimisation. Comparisons of the three methods for the interest rate and exchange rate variables yielded similar conclusions and in the remaining sections we report only the results obtained via the direct numerical minimisation procedure.

4. The Common Features Test for exchange rates and interest rates

In this section we consider whether common cyclical features in exchange rates and interest rates can be identified for the larger EU countries. Starting with exchange rates, we examine the behaviour of the real and nominal exchange rate for each country, using the rate against the US dollar as the common unit of measurement. Following the same procedure as before, table 7 shows the stationarity tests for each country with respect to Germany, for as long a sample as data availability permits. The relevant ADF statistics suggest that nominal and real exchanges exhibit no cointegrating relationship with respect to Germany.

The next step is to examine whether VAR(1) features are present in the bivariate models for nominal and real exchange rates. The relevant LM test statistics are reported in tables 8 and 9.

Although there are some marginal cases, particularly with respect to the UK, the LM test statistics reported in tables 8 and 9 suggest that serial correlation features are generally present in both nominal and real exchange rates. To see whether these features are common, we apply the common features test to the logarithmic first differences of the nominal and real exchange rate series. The results obtained via the direct minimisation

approach are shown in tables 10 and 11.

In general there appear to be common cyclical features in the nominal exchange rate relationships, with the exception of Italy in relation to France. For real exchange rates, five of the test statistics reject the presence of a common cycle, all involving a pairwise comparison with Italy. These results suggest that both the nominal and real exchange rate in Italy appear to be subject to cyclical patterns that are significantly different to those of the other main European countries.

Turning next to the behaviour of interest rates, we first repeat the test procedures for the case of long-term nominal interest rates over the same sample period. The LM test results for the bivariate VAR(1) relationships shown on table 12 suggest that serial correlation features are present in most of the series, but not all. The results shown in table 13 indicate that, in those cases where the feature is present, it appears to be a common feature.

Finally, we complete our investigation of common features by considering the behaviour of long-term real interest rates over the period. As usual, table 14 shows the LM test statistics for the preliminary VAR(1) model.

The results from the VAR(1) estimates suggest that real interest rates in most cases do not exhibit the required serial correlation features and hence the common feature test is not generally appropriate. The LM test statistics indicate that a serial correlation feature is present on both sides of the relationship only for the UK and Germany. Although we don't report the results, the common features test for the UK and Germany indicates a common pro-cyclical relationship between long-term real interest rates for those two countries.

Table 9. LM Tests for Bivariate VAR(1) Features in Real Exchange Rates

Country	GE	FR	IT	SP	UK	AU
GE		6.72	12.04	12.60	2.61	4.76
FR	8.73		6.71	12.69	3.34	10.44
IT	8.01	12.51		12.20	2.43	4.57
SP	7.83	12.78	7.28		2.39	9.13
UK	5.65	4.71	8.82	13.18		2.18
AU	6.29	6.61	5.25	6.86	5.38	

5% critical value = 5.99 (10% =4.61). Dependent variables are in the first column.

Table 10. The Common Features Test for Nominal Exchange Rates

Country	GE	UK	AU	SP	FR
UK $s(u)$	1.80				
λ	-0.63				
AU $s(u)$	0.23	1.57			
λ	-1.03	-0.69			
SP $s(u)$	1.88	2.21	1.62		
λ	-1.29	-0.42	-1.31		
FR $s(u)$	0.16	0.69	0.46	2.53	
λ	-1.25	-0.61	-1.27	-0.93	
IT $s(u)$	3.42	1.33	0.12	2.05	4.62
λ	-0.79	-0.62	-0.39	-1.13	-1.40

5% critical value =3.84

Table 11. The Common Features Test for Real Exchange Rates

Country	GE	UK	AU	SP	FR
UK $s(u)$	2.16				
λ	-0.39				
AU $s(u)$	0	0.87			
λ	-0.79	-0.59			
SP $s(u)$	0.19	0.95	2.26		
λ	-0.11	-1.64	-1.01		
FR $s(u)$	0.28	0.22	0.33	1.07	
λ	-1.18	-0.67	-0.95	-0.91	
IT $s(u)$	4.20	0.62	5.55	5.54	5.39
λ	-3.28	-1.53	-0.68	-0.21	-0.77

5% critical value = 3.84

Table 12. LM Tests for Bivariate VAR(1) Features in Nominal Interest Rates

Country	GE	UK	SP	FR	IT
GE		11.64	14.34	26.35	11.64
UK	3.01		9.16	21.35	10.57
SP	1.95	2.39		8.55	3.92
FR	2.30	5.61	13.05		16.15
IT	1.99	7.08	11.70	21.17	

5% critical value = 5.99. Dependent variables are in the first column.

Table 13. The Common Features Test for Nominal Interest Rates

Country		GE	UK	SP	FR
UK	$s(u)$	0			
	λ	-0.37			
SP	$s(u)$	0	0		
	λ	-0.96	-0.46		
FR	$s(u)$	0.28	0.21	0.97	
	λ	-0.56	-0.57	-0.78	
IT	$s(u)$	0.54	0	0.33	0.38
	λ	-1.99	-0.79	-0.71	-0.95

5% critical value = 3.84

Table 14. LM Tests for Bivariate VAR(1) Features in Real Interest Rates

Country	GE	UK	SP	FR	IT
GE		12.11	2.14	3.91	1.86
UK	8.46		0.27	3.06	1.12
SP	1.30	11.04		21.42	23.11
FR	1.62	17.22	0.12		2.21
IT	5.77	20.24	0.058	2.21	

5% critical value = 5.99. Dependent variables are in the first column.

5. Summary and Conclusions

The extent to which the EU is likely to face conflicts in the design and implementation of monetary policy after the adoption of a single currency depends in part on the degree of economic convergence achieved by the member states. In this paper, we have used cointegration and common features tests to examine the degree of long-run (trend) and short-run (cyclical) convergence exhibited by GDP, exchange rates and real and nominal long-term interest rates across the larger countries of the EU. Our brief consideration of the cointegration properties of the data suggests the absence of any long-run convergence with respect to Germany. Although the absence of common trends points to potential difficulties in the design of long-run policy co-ordination, the optimistic result from our applications of the common features test is that most of the key monetary policy variables appear to exhibit a degree of short-run (cyclical) convergence. The exact nature of this cyclical convergence needs further investigation, but our preliminary results indicate the presence of common cyclical features (represented by common serial correlation features) in all of the key monetary policy variables, with the exception of long-term real interest rates. Taken together, our convergence results suggests that monetary policy co-ordination among the member states of the EU may have been achieved with respect to the economic cycles in each country. We do not find long run convergence over the past, but this may be due either to one of shocks or the process of convergence itself. We would argue that the convergence of the cyclical behaviour of the economies may be more important and more indicative of the future stability of EMU than the simple long run cointegration analysis. Finally, as a matter of technical interest, we have also considered the efficiency of the

different methods available for constructing the common features test. The results suggest that the approximations based on 2SLS and LIML can be misleading and that they are far less robust than those obtained via direct minimisation.

Endnotes

1. London Business School, Centre for Economic Forecasting (Bai and Hall); Imperial College, University of London (Hall and Shepherd).

References

- Backus D K, Kehoe P J and Kydland F E (1995) 'International Business Cycles: Theory and Evidence', in T F Cooley (ed) *Frontiers of Business Cycle Research*, Princeton N J: Princeton U P.
- Eichengreen B (1993) 'European Monetary Unification', *Journal of Economic Literature*, XXXI, 1321-1357.
- Engle G F and Kozicki S (1990) 'Testing for Common Features', University of California, San Diego, Department of Economics, Discussion paper 90-23, June.
- Goodhart C A E (1995) 'The Political Economy of Monetary Union', in P B Kenen (ed), *Understanding Interdependence: the Macroeconomics of the Open Economy*, Princeton N J: Princeton U P.
- Hall S G, Robertson D and Wickens M (1997) 'Measuring Economic Convergence', *International Journal of Finance and Economics*, 2 (2), 131-145.
- King R G and Rebelo S T (1993) 'Low Frequency Filtering and Real Business

- Cycles', *Journal of Economic Dynamics and Control*, 17, 208-231.
- Lippi M and Reichlin L (1994) 'Common and Uncommon Trends and Cycles', *European Economic Review*, 38, 624-635.
- Shepherd D (1990) 'Economic Issues in European Monetary Union', *European Business Journal*, 2, 8-16.
- Vahid F and Engle G F (1993a) 'Common Trends Common Cycles', *Journal of Applied Econometrics*, 8, 341-360.
- Vahid F and Engle G F (1993b) 'Non-Synchronous Common Cycles', University of California, San Diego, Department of Economics, Discussion paper 93-55, December.