Ten Years of European Monetary Union

David Mayes[*] and Matti Viren[†]

Abstract

Using a simple model of the euro area economy, we explore whether EMU has been associated with changes in behaviour both in the run up to Stage 3 and since it started operating. We find that some behaviour has indeed changed; expectations formation, inflation, country dispersion of behaviour, fiscal policy (although the run up to Stage 3 shows a greater change than within it) and monetary policy (with several caveats). However, EMU does not appear to be associated with changes in the labour markets; employment, output growth and productivity. Substantial caution is needed in attributing these changes to EMU as much of the rest of OECD enjoyed similar changes over the same period.

When the eurozone was envisaged the main point was to change economic behaviour for the better. While 'One Market, One Money' (European Commission, 1990) did not offer such a sweeping set of potential gains as the Cecchini Report (1988) on the 'completion' of the internal market it did anticipate a steady series of improvements. A study of the impact of stage 3 of Economic and Monetary Union in the EU, which is largely composed of the inception of the euro area and its attendant institutions, therefore needs to look over a number of years and not simply compare post-1999 with pre-1999. Stage 2 of EMU, which began in 1994 was explicitly a period of transition. Most importantly the member states were concerned to qualify for membership, by the qualifying dates of mid-1996 and ultimately mid-1998. At the very least therefore we can distinguish, three periods – pre-transition, up to around 1992, when many member states were forced out of their ERM parities, transition up to mid-1998 and post-transition from then to the present day. The post 1999 period also deserves closer scrutiny; in the case of fiscal policy in particular there are good reasons for believing that after the creation of EMU fiscal discipline may have started to revert to

[*] corresponding author. Europe Institute, University of Auckland and Bank of Finland, address: Suomen Pankki, PL 160, 00101 Helsinki, Finland; email david.mayes@bof.fi.
[†] Bank of Finland and University of Turku

that of earlier days. Therefore, there are good arguments for subdividing both the pre and post transition periods. 1987 seems to have been somewhat of a watershed, for example.

In this article we therefore look at a small number of key economic relationships in the euro area and explore the extent to which they have changed over the period since the beginning of the 1980s. We do this in the framework of a simple, widely-used model (see Mayes and Virén, 2005, for an exposition) that is applied to all of the euro area countries in balanced panel estimation. We consider inflation, output, unemployment and monetary and fiscal policy. Section 1 explains the model briefly, Section 2 considers the five relationships and the final section reflects on what this implies for the impact of the first 10 years of monetary union in Europe.

We find that in general the period since 1999 shows better determined relationships, no doubt in part reflecting the greater convergence among the member states, however, such findings also apply to countries that decided not to join Stage 3. Monetary policy appears to have a clearer effect and New Keynesian Phillips curves have the appropriate signs and magnitudes. What is particularly noticeable, however, is that with low and relatively constant inflation, simply monetary rules do not seem to work, and the Phillips curve is heavily flattened to the extent that high unemployment seems to have little impact. However, the Phillips curve remains a curve and a tight labour market is still reflected in rising inflation. This asymmetry across the cycle is also reflected in the relationship between output and unemployment. Low growth rates are associated with much more unemployment than high growth rates are with falling unemployment. For fiscal policy the picture is more complex and 1995-2001 appears to be the period of clearest change. In that period, qualification for membership was more of a live issue and efforts were made to reduce debt ratios. As with the Phillips and Okun curves, behaviour has been asymmetric across the cycle. Public spending has been noticeably counter-cyclical in downturns, but in upturns the relationship is weaker and governments have clearly taken advantage of 'good times' to lower taxation.

This coexistence of changes with the build up to Stage 3 of EMU, its coming into being and development do not necessarily imply causation. Indeed one major problem is the general onset of the ‘Great Moderation’ (Bernanke, 2004; Stock and Watson, 2003), which included the whole of the OECD and not just Europe over the same period. Thus one might plausibly suggest that much of the changes were externally driven. Certainly the changes in the conduct of monetary policy, in part aided by the switch to inflation targeting and the stressing of fiscal prudence will have done a lot to change the inflationary process. Similarly, technological shifts, such as the new economy and associated shifts from the ICT revolution have percolated round the globe rather faster in recent years, reflecting the progress of globalization.

1 A simple model

In order to examine whether macroeconomic behaviour appears to have changed in the face of EMU we use a simple and very conventional four equation model of the economy, consisting of an IS curve, a Phillips curve, and Okun curve and a monetary policy reaction function that we have employed earlier (Mayes and Virén, 2005).[1] Following Duguay (1994), Goodhart and Hofmann (2000), the IS curve is of the form

$$\nabla y_t = a_0 + a_1 \nabla y_{t-1} + a_2 \nabla y_{t-2} + a_3 rr_{t-i} + a_4 re_{t-j} + a_5 \nabla y^*_{t-k} \quad (1)$$

where ∇y is the deviation of output y from its Hodrick-Prescott filtered trend, rr is the real 3-month interest rate (i.e. the nominal rate of interest r less the annual rate of consumer price inflation p), re the real exchange rate with the US dollar (in logs) and ∇y^* the deviation of OECD output from its HP trend. (Lag lengths i, j and k typically vary from 1 to 3 quarters in estimation).

Equation (1) is the standard expectations augmented Phillips curve:

$$p = b_0 + b_1 p_{t-1} + b_2 p^e + b_3 p^* + b_4 U \quad (2)$$

p^e is expected inflation, p^* is the foreign price (in domestic currency) and U is unemployment. However, in common with many authors (Galí and Gertler, 1999) we typically use ∇y instead of U to represent the pressure on the economy. This then represents a form of the New Keynesian Phillips on the grounds that the output gap may move in step with marginal cost.[2] However, in the form set out in (2) the curvilinear property of the relationship is largely lost so we augment it to show two facets either side of a threshold, where ∇y^+ denotes the values of the output gap that exceed the threshold value. Accordingly ∇y^- denotes the remaining values of ∇y.[3]

$$dp = a_0 + a_1 dp_{t-1} + a_2 dp^* + a_3 \nabla y^+ + a_4 \nabla y^- + u \quad (3)$$

In its simplest form the Okun curve is

$$\Delta U = c_0 + c_1 y^+(\tau) + c_2 y^-(\tau) + c_3 \Delta pop + c_4 \varepsilon_{-1} + u_t \quad (4)$$

using an error correction format. Here y is the growth rate in GDP, pop the population of working age and ε the error correction term (lagged one period) and τ a threshold value for the asymmetry. Prachowny (1993) inter alia argues that some scaling of the labour variable in (6) is required we

[1] A three equation version, omitting the labour market has received considerable attention – Lindé (2005), Cho and Moreno (2006).

[2] This model is used by Goodhart and Hofmann (2005) successfully in examining both the euro area and the US.

[3] Obviously we could have more that two regimes (facets) for ∇y but since we have only limited numbers of observations we use this simple specification (which has been widely used elsewhere, see Yates (1998) for instance). Alternatively we could smooth the once-and-for-all regime shift in the threshold model by using the so-called smooth transition regression model (STR) (Granger and Teräsvirta, 1993), also used by Teräsvirta and Eliasson (1998). The lack of sufficiently long time series also made this alternative less appealing. Introducing a quadratic term in the output gap would also be a straightforward way of incorporating nonlinearity.

have also included population of working age in our formulation. Once again we use a threshold approach to the relationship to allow at least some approximation to a curvilinear relationship.

Finally, we include a monetary reaction function in the form of a Taylor rule

$$r_t = \rho r_{t-1} + (1- \rho)(d_0 + d_1\pi_t + d_2\nabla y_t) \quad (5)$$

where the parameter ρ permits an element of interest rate smoothing and π is the deviation between inflation *p* and its target value (Huang *et al.* 2001).

This set of equations determines inflation, output, unemployment and the rate of interest. Foreign prices, foreign output and the exchange rate are treated as exogenous to the system.

We also consider the subject of fiscal policy as this is key to much of the structure of EMU. However, we do this separately as the fiscal cycle is largely annual and does not lend itself naturally to integration with the rest of our quarterly model. Here we deal with the relationship between the budget deficit and its revenue and expenditure components and the economic cycle and other financial pressures:

$$d/y^* = b_0 + b_1\, d/y^*_{-1} + b_2\, t + b_3\, \Delta y^- + b_4\, \Delta y^+ + b_5\, r + b_6\, D/y + u \quad (6)$$

where *d* refers to the measure of the deficit, *D* refers to debt, *y* to GDP, * indicates the trend value, *t* a time trend, *r* the nominal rate of interest and *u* an error term. Δ denotes a growth rate and -/+ whether the growth rate is below or above the threshold (normally zero). Again we consider whether the behaviour of the fiscal stance is symmetric over the cycle or whether governments behave differently depending on whether it is the up or down phase. Here we might expect a large change in behaviour as the excessive deficit procedure (Art. 104 in the Treaty on European Union) in the Stability and Growth Pact is itself one sided, trying to restrain the governments of the member states from running deficits of more than 3% of GDP. On the upside there is no matching concern over the size of surpluses – perhaps realistically as governments normally seek tax cuts if the balance of funding becomes favourable.

All reported estimated have been derived using a panel data and restricting the key parameters to be the same for all countries and periods (although, with some exceptions). All equations have been estimated with Least Squares (LS) and Generalized Least Squares (GLS). because all equations include lagged dependent variables (either directly or in the error-correction terms) we have also used the Arellano-Bond version of the Generalized Method of Moments Estimators (GMM). To illustrate the robustness of results, we try to present results from all estimators although for space reasons prevent a more complete report.

2 The nature of the impact

We can get a view of the likely changes that will be observed from simply examining the data. The period since the adoption of the euro has been characterized by a clear economic cycle (Figure 1). Whether unemployment or output gaps are used as an indicator, an initial period of growth was followed by a substantial downturn – a growth recession rather than an actual recession – which was relatively protracted. Only recently has growth reached what were traditionally average values. Over the same period inflation has remained slow and stable (and hence more predictable), a sharp contrast to the prolonged and steady falls in the years before Stage 3 started. Real interest rates continued to decline, reaching negative territory before the recent increases. As we discuss below, a major feature of this reduction in the median is a reduction in the skew. Some countries had low and stable inflation throughout. What characterizes the 1990s is the decline in inflation in the more inflationary countries to the levels prevailing in the least inflationary. This of course was precisely what the Maastricht convergence criteria required: convergence to within 1.5% of the average of the three lowest inflation rates among the EU member states[4] (Art. 121(1) of the Treaty on European Union).

However, other variables have remained quite volatile. The exchange rate for example depreciated by 20% before reversing its loss entirely and appreciating to around 20% above its starting value. The real fluctuations have been rather more limited. Fiscal policy has also shown a clear change. While the prolonged consolidation that preceded the start of Stage 3 continued in the early years it was reversed hand in hand with the economic downturn (Figure 2). However, it did not backtrack very far and has improved again towards the end of the period. This has resulted in debt ratios continuing to fall, although there was a pause during the recession. Interestingly enough, while expenditure reduction made an important contribution to fiscal consolidation in the period before Stage 3, it is rising taxation that has been the equilibrating factor once the economy turned round. There are some clear changes in behaviour here but a simple comparison with the United States shows that similar factors were at work there (Figure 3). Hence there is a strong incentive not argue post hoc propter hoc and to suggest that many of the changes reflect better fiscal and monetary policy rather than monetary union as such. In the subsequent subsections we look at facets of this behaviour in more detail.

[4] The exact words are 'best-performing'

Figure 1 Median of key macro variables before and after the EMU

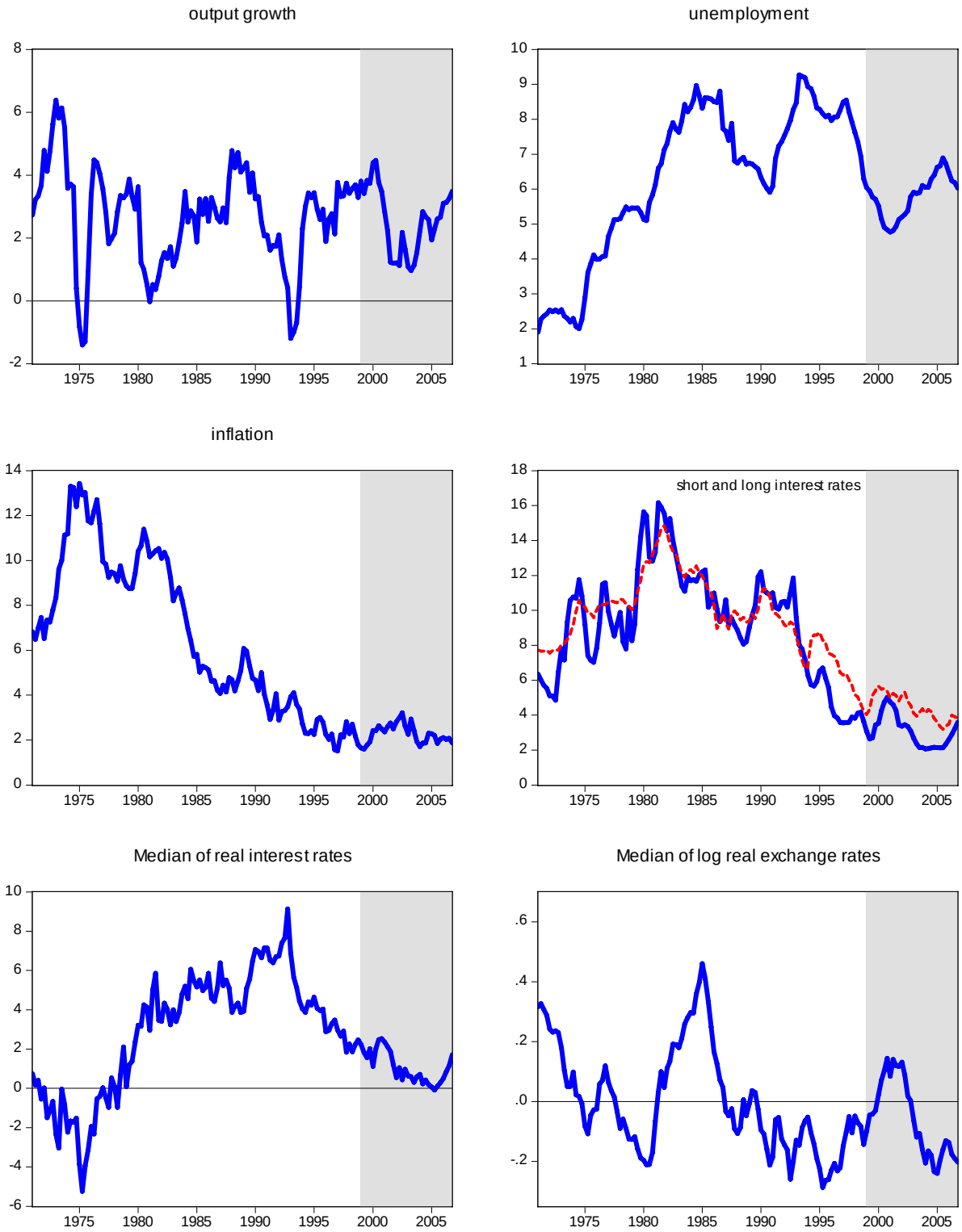


Figure 2 Median of fiscal variables before and after the EMU

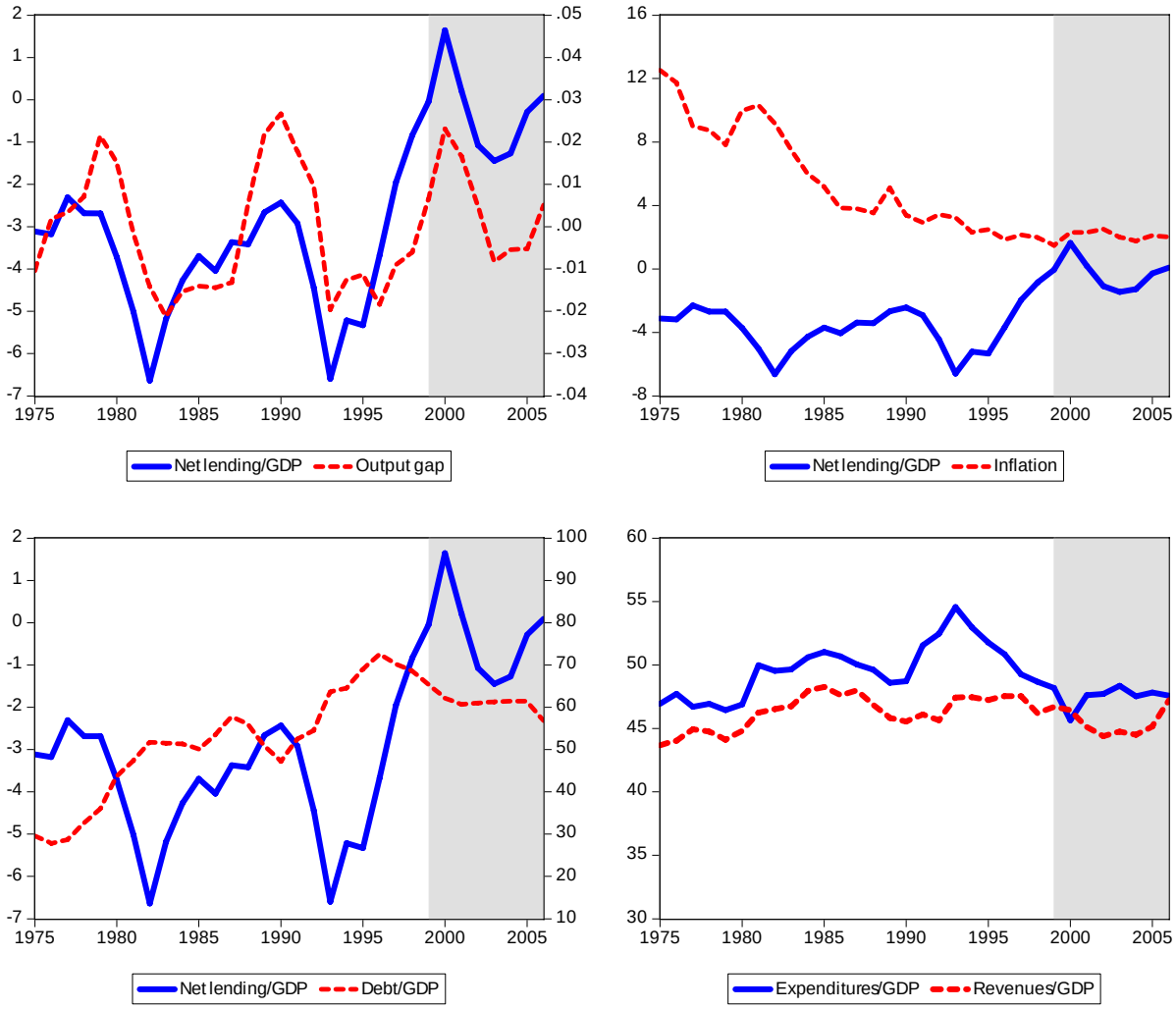
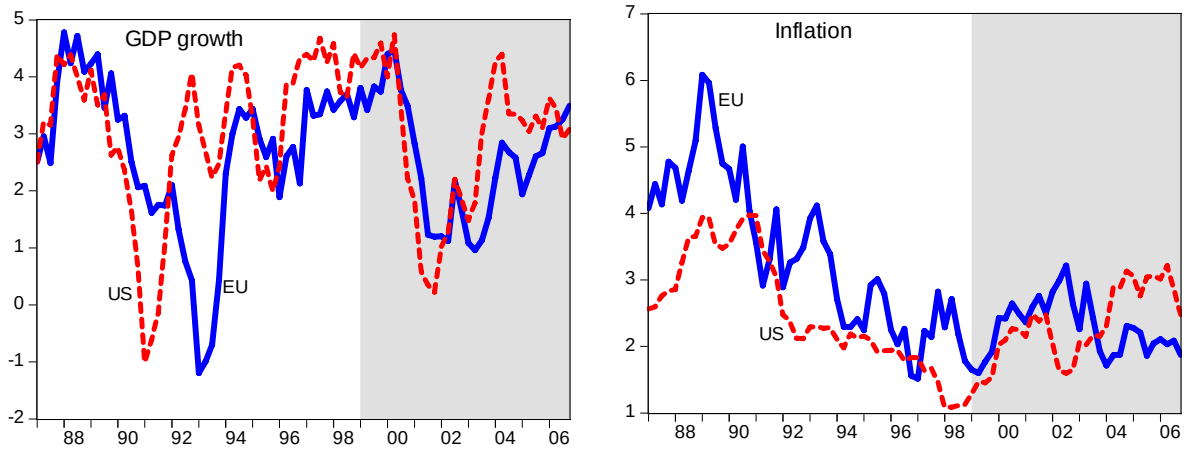


Figure 3 Similarities in (a)Growth and (b) Inflation Performance in the Euro Area and the US



2.1 *An IS Curve*

As might be expected, the impact of foreign GDP on euro area output has increased as time has passed (Table1). Although shares of intra-euro area trade in total trade also increased during the period the increase in overall trade is considerably greater. The same result is reflected in the real exchange rate effect, whose value has risen as the economies become more open, especially since the 1980s.[5] The impact of monetary policy through the real interest rate is also increased. In fact, the real interest rate effect is clearly significant only for the EMU period. This is perhaps rather more surprising. If the formation of the euro area had made monetary policy more credible, then one might expect that smaller shifts in the policy instrument are necessary to have a given effect. However, this result is likely to be stronger with respect to inflation than real output. In this connection it is worthwhile to notice that there has been noticeable convergence in Euro-area output growth rates and inflation (Figure 4). Thus compared with the pre-1999 period, there is a striking difference at least in the sense that there have not been deep recessions (not extreme growth rates). This might be a sign that the Euro Area is beginning to behave more like one big country.

Because there has been no major recession during the EMU period we cannot really say much about eventual changes in nonlinearity in the IS curve. Our previous analyses suggested that there were important nonlinear features in employment, inflation and fiscal behaviour (Mayes and Virén, 2005). Perhaps the most important nonlinearity has been the behaviour of the housing market. While house price inflation has been largely nonexistent in Germany and Austria it has been strong in Spain and Ireland (and also in the UK). Thus, the estimates of a simple IS curve (without the wealth variables) probably give a conservative estimate of the impact of EMU.[6]

[5] See Mayes and Virén (2000) for a discussion of the plausible relative impact of the real exchange rate and real interest rate variables.

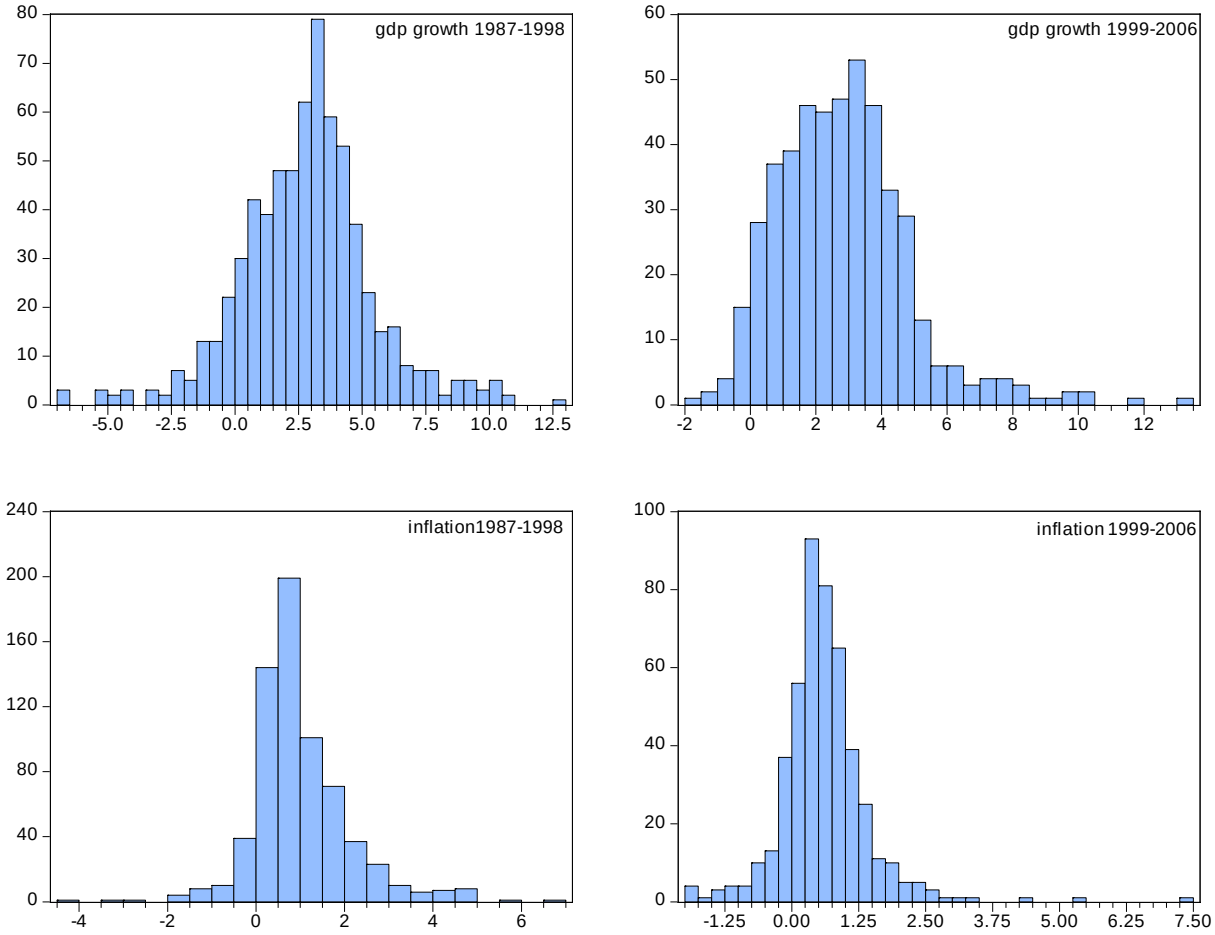
[6] In Mayes and Viren (2002) we show that both stock prices and house prices have a significant and economically meaningful effect on output in Europe for the 1987-2000 period. One might speculate that this effect is still present, or is even stronger, and if we take into account the effect of monetary policy on wealth prices this would further reinforce the monetary policy effect of output.

Table 1 IS curve estimates

	1	2	3	4	5	6
World gdp	.359	.570	.371	.429	.401	.498
	(14.46)	(10.81)	(2.37)	(14.20)	(9.11)	(13.21)
Lagged dep.	.700	.579	.720	.697	.765	.541
	(40.58)	(16.44)	(42.96)	(34.70)	(29.49)	(16.29)
Real ex.	.182	.407	-.018	.259	.913	.761
rate/100	(2.03)	(0.65)	(0.13)	(2.05)	(3.98)	(3.97)
Real int. rate	-.009	-.035	-.017	-.010	-.009	-.049
	(1.69)	(1.22)	(1.88)	(1.58)	(0.80)	(2.46)
R^2	0.751	..	0.788	0.800	0.825	0.805
SEE	0.010	0.010	0.014	0.008	0.009	0.006
DW	2.087	..	1.969	2.207	2.055	2.407
Data	Gap	Gap	GDP growth	Gap	Gap	Gap
Period	1971-2006	1971-2006	1971-2006	1987-2006	1987-1998	1999-2006

The dependent variable, defined in the penultimate line of the Table, is either the growth rate of GDP or the output gap. (the World GDP is accordingly transformed). Equations 1 and 3-6 are estimated by the GLS estimator using fixed country effects. Equation 2 is estimated by the GMM & Arellano-Bond estimator with first differences. The J test for over-identifying restrictions J(14) = 10.76 which is clearly below conventional critical values. Corrected t-ratios are in parentheses, R^2 is the unadjusted R-squared and SEE the standard error of regression

Figure 4 Comparison of GDP growth rates and inflation over 15 EU countries



All values are annual percentage growth rates.

2.2 *An Okun Curve*

The EU has continued to struggle with the problem of unemployment and until recently has found it quite difficult to obtain reductions (Figure 5). It is perhaps no surprise therefore that the relationship between output and unemployment has been largely unchanged by monetary union (Table 2). One feature which does come through, however, is that the theoretical curvilinear aspect to the relationship does hold. The impact of changes in output on unemployment is much greater in the down phase of the cycle than it is in the up phase, and if anything this dichotomy has strengthened since the start of stage 3. Thus the increase in output following a decline needs to be three times as large to restore unemployment to its previous level. This is a strong effect and reflects the difficulty the EU has faced in reducing unemployment. In this regard there seems to be little difference between the EU as a whole and the euro area, which is perhaps a little surprising as the employment record of the UK in the last 10 years has been considerably better than the EU average.

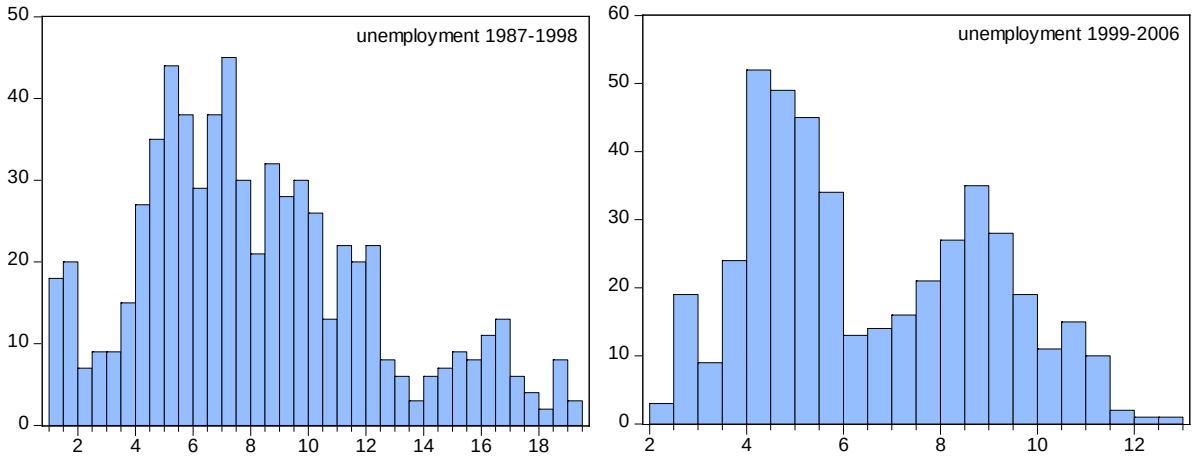
What is noticeable from Figure 5 is that the highest levels of unemployment have been eliminated and if anything two groups of higher and lower unemployment are emerging.

Table 2 Estimates of an Okun curve

	1	2	3	4	5	6	7
Δlog(pop)	.083	.104	.128	.042	.079	.044	.007
	(1.50)	(1.69)	(1.86)	(0.76)	(0.77)	(0.70)	(0.12)
g	-.113	-.073					
	(10.03)	(7.00)					
g|g<0			-.374	-.192	-.153	-.221	-.232
			(4.10)	(2.27)	(1.74)	(1.38)	(1.38)
g|g>0			-.120	-.106	-.121	-.068	-.065
			(7.94)	(9.51)	(7.54)	(6.67)	(6.31)
Error	-.013	-.018	-.012	-.014	-.013	-.019	-.018
correction	(3.337)	(1.83)	(1.96)	(3.37)	(2.22)	(1.76)	(1.65)
R^2	0.146	0.202	0.174	0.159	0.173	0.222	0.263
SEE	0.322	0.238	0.323	0.320	0.260	0.234	0.232
DW	1.386	1.659	1.518	1.406	1.340	1.713	1.711
Data	EU	EU	EU	EU	EU	EU	Euroland
Period	1987-06	1999-06	1987-06	1987-06	1987-98	1999-06	1999-06

The dependent variable is Δ(UN). All estimates except for equation 3 are GLS estimates with fixed country effects. Equation 3 is estimated by least squares. g is the GDP growth rate, POP denotes the working-age population and UN the standardized unemployment rate.

Figure 5 Convergence of Unemployment in the EU



2.3 *The Phillips Curve*

There is no shortage of estimates of Phillips curves in recent years. Estimating the conventional New Keynesian hybrid equation gives the result that forward and backward looking inflation expectations are equally important and that a perverse sign is achieved for the output gap. In part this stems from trying to estimate the curve as if it were a straight line. As soon as even a two part linear specification is permitted the sign is corrected and the slopes for positive and negative output gaps are clearly different. In particular, when the output gap is negative and the economy is characterized by slack capacity the Phillips curve is nearly horizontal. This flattening confirms the flattening that has been observed more generally as inflation rates fall. However, it is important to see that this feature does not apply to positive output gaps. In the case of the Phillips curve differences between the euro area and the rest of the EU do matter. Elsewhere inflation is not so responsive, in part perhaps because the economies are more open to the world outside the euro area.

The nature of results changes considerably if we consider forward-looking expectations and estimate the New Keynesian hybrid Phillips curve using the Generalized Method of Moments in a dynamic panel framework (Arellano and Bond, 1991). The results (Table 3) clearly indicate that the role of the lagged inflation term (inflation persistence) diminishes over time and is relatively unimportant for the 1999-2006 period. By contrast the role of output gap becomes more prominent. Contrary to the 1987-1998 period, the coefficient is clearly significant. Thus, for the EMU period, the New Keynesian hybrid Phillips curve work reasonably well; it is only that the sum of the inflation coefficients fall short of one, which suggests that there are some problems in the modelling inflation expectations with the REH assumption under the GMM orthogonality restrictions.

However, in earlier work (Paloviita, and Mayes, 2005; Paloviita and Virén, 2005) we have found that the rational expectations formation is a rather strong assumption and that if instead we use OECD forecasts or Consensus Economics survey data, we get a better determined equation and

a much larger forward-looking weight, more in line with what is expected from the New Keynesian model.[7] This is again true here (Table 4). The model becomes around 60% forward-looking throughout and the output gap becomes significant and correctly signed once we restrict estimation to the monetary union era. However, simply assuming that that monetary union can best be represented by the period from 1999 onwards does not seem the best explanation. Taking the starting date backwards in time progressively (Table 5) suggests that the change in behaviour occurs around 1996. This break-point is more or less the same for the two data sets used in estimating the New Keynesian Phillips curve. Thus it is when the member states were trying to converge under Stage 2 of EMU that their behaviour changed and this change has continued thereafter.

Prior 1995 or so, the New Keynesian Philips curves perform rather badly in the sense that, according to the coefficient estimates, inflation seemed to be more or less unrelated to output gap (or other cyclical variables). Along with the EMU, the theory-consistent role of output gap experienced a new come-back (Tables 3 and 4). This is not so much because of the output gap variable itself but because of the new role of inflation expectations. Before the EMU there was no genuine monetary-policy-anchored European view of future inflation developments. Nevertheless, there could some more technical reasons for the observed pattern of results. After the early 1990s both inflation and inflation expectations have been stationary which makes estimation of Philips curves much easier, although there are no guarantees that the estimates do not represent some spurious correlations. For the data of the 1970s and 1980s inflation and inflation expectations seemed to have some trend while the output gap variable is 'by construction' a stationary variable (Baxter, 1994).

One interesting feature is that the year 1999 creates some problems to the all expectations oriented Phillips curves (Figure 6). Thus, in the New Keynesian Phillips curve, the expectations channel appears to be temporary out of use for 1999 but start being operative since that. Price developments in 1999 were largely independent of the future inflation expectation. This could be interpreted in two ways: either there has been a lot of noise in inflation in 1999 (due to adoption of the euro) or there has been a lot uncertainty in terms of future monetary policy and inflation regime. Perhaps this is all a coincidence but that would be surprising.

[7] We use both the June and December forecasts for the following year but the results are fairly similar in character.

Table 3 GMM estimates of a New Keynesian Phillips curve

	$\Delta_4 p(-1)$	$\Delta_4 p(+1)$	gap	SEE	J(6)
1975-1998	.533	.430	.003	.0127	9.49
	(65.81)	(9.64)	(0.16)		
1987-2006	.423	.422	.035	.0136	13.66
	(186.74)	(75.24)	(3.35)		
1987-1998	.502	.370	.067	.0130	11.08
	(17.61)	(20.30)	(0.78)		
1999-2006	.267	.397	.114	.0135	11.95
	(65.08)	(59.15)	(5.39)		

All estimates are Arellano-Bond GMM estimates with current and lagged values of import prices as additional instruments (in addition to the lagged values of the right-hand-side variables). First differences are used to take into account the cross-section fixed effects. Estimates are based on quarterly OECD data. None of the values of the J test are significant at conventional levels of significance. The data come from EU15.

Table 4 Estimates of a Phillips curve with the OECD forecast data

	Δp_{-1}	Δp^{e}_{+1}	gap	R^2/SEE	DW/J-statistic
F1, 1980-1998	0.380	0.684	-0.002	0.944	2.287
OLS	(7.45)	(11.53)	(0.03)	1.376	
F1, 1999-2006	0.347	0.649	0.121	0.600	1.760
OLS	(3.55)	(5.78)	(1.86)	0.835	
F1, 1980-1998	0.453	0.547	0.023	0.938	2.250
OLS	(8.98)		(0.51)	1.441	
F1, 1999-2006	0.345	0.655	0.119	0.600	1.761
OLS	(3.65)		(2.03)	0.831	
F1, 1980-1998	0.414	0.629	0.042	0.949	2.167
GLS	(10.73)	(13.01)	(1.20)	1.165	
F1, 1999-2006	0.402	0.604	0.118	0.702	1.935
GLS	(5.34)	(6.87)	(2.31)	0.831	
F1, 1980-1998	0.318	0.707	-0.072	..	..
GMM-AB	(4.92)	(9.27)	(1.08)	2.016	43.80
F1, 1999-2006	0.223	0.622	0.228	..	..
GMM-AB	(2.74)	(2.07)	(6.36)	1.187	25.49
F2, 1976-1998	0.424	0.618	-0.26	0.933	2.493
OLS	(8.21)	(9.94)	(0.55)	1.566	..
F2 1999-2006	0.244	0.762	0.088	0.706	1.909
OLS	(3.16)	(9.67)	(1.90)	0.716	..

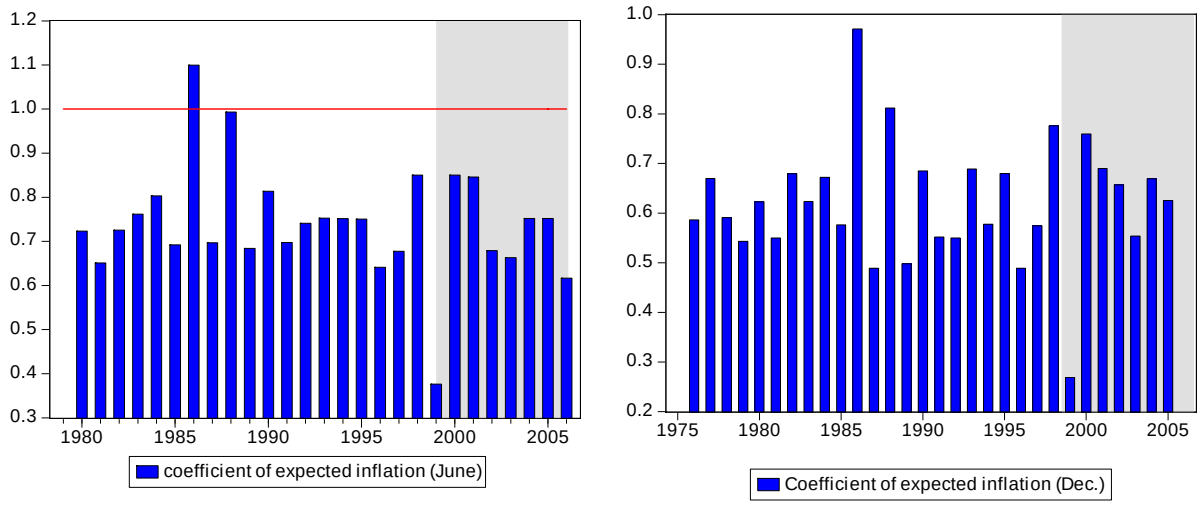
F1 denotes the inflation forecast from June forecast and F2 the inflation forecast from December forecast. OLS denotes panel Least squares estimates (no fixed effects) and GLS generalized panel least squares (with cross-section weights) estimates. In the GMM Arellano-Bond estimation, the set of additional instruments include both the lagged values of the right-hand side variables and lagged values of F2. The instrument rank with the J-test is 12. Thus, the both J-statistics are significant although the one with the EMU sample has a marginal significance level over 1 per cent. With equations on lines 3 and 4, the sum of inflation variable coefficients is set to one. The data are annual and consist of the EMU countries only.

Table 5 When did the EMU show up?

	Quarterly data with GGM estimates		Annual data with OECD forecasts	
Starting year	Coefficient of Δp_{-1}	Coefficient of gap	Coefficient of Δp_{-1}	Coefficient of gap
1999	0.265 (65.08)	0.114 (5.39)	0.345 (3.65)	0.119 (2.03)
1998	0.209 (28.37)	0.055 (2.08)	0.420 (4.56)	0.130 (2.20)
1997	0.284 (29.30)	0.097 (7.32)	0.397 (4.83)	0.130 (2.29)
1996	0.293 (21.65)	0.065 (3.42)	0.373 (4.47)	0.147 (2.76)
1995	0.294 (7.15)	0.095 (2.09)	0.352 (4.31)	0.108 (1.89)
1994	0.342 (13.76)	0.058 (1.38)	0.361 (5.26)	0.091 (1.76)
1993	0.326 (8.87)	0.011 (0.15)	0.384 (6.09)	0.077 (1.58)

Selected parameter estimates for equation 4 in Tables 3 and 4. In all cases, the last period is 2006(Q4).

Figure 6. Expected Inflation



2.4 *A Taylor Rule*

Although none of the central banks in the EU claims to be following a Taylor Rule, it was normally possible to approximate policy reasonably by such a rule. This is clear from our own work (Table 6, columns 1 and 2). However, if one just looks at the since the introduction of Stage 3 (columns 3-5) this is no longer true. Whether one looks at the EU as a whole, the euro area or the non-euro area member states, the relationship between inflation and interest rates seems to have disappeared. This is clearly not because inflation is no longer the focus of policy but simply because policy has been so successful. If there had been more variance in prices during the period then something other than a general response to the economic cycle would have been needed. In effect we face the same sort of identification problem which was acknowledged already a long time ago by Blinder and Solow (1973). This suggests that the nature and performance of monetary policy cannot easily be measured with a single equation model. Rather a complete CE model is required.

A second possible explanation is that because policy tends to be forward-looking with respect to inflation, that this simple formulation of the Taylor Rule using current inflation misses the link because a lead should have been used. Huang et al. (2001) show that a short lead does improve the fit of a Taylor Rule in New Zealand but the differences are not large.

Inflation has become less persistent (Table 7) but GDP growth has retained roughly the same autocorrelation structure. If we extend the EMU period backwards progressively from 1999 to 1987 the coefficients change but only slowly. There is no obvious break point. EMU may therefore have reinforced a trend rather than constituting a major change in its own right.

Table 6 Estimates of a Taylor rule

	1	2	3	4	5
Constant	0.198	0.078	0.745	0.735	0.762
	(5.04)	(2.07)	(10.54)	(9.09)	(4.81)
Gap	0.140	0.124	0.225	0.216	0.271
	(8.80)	(6.49)	(11.79)	(9.77)	(6.89)
Inflation	0.059	0.050	-0.006	-0.005	0.010
	(6.94)	(3.53)	(0.47)	(0.38)	(0.27)
Lagged rs	0.932	0.951	0.762	0.757	0.779
	(121.21)	(101.62)	(37.03)	(30.65)	(20.15)
			.		
R^2	0.969	0.975	0.923	0.905	0.948
SEE	1.157	0.838	0.353	0.368	0.285
DW	1.822	1.781	1.622	1.671	1.274
Data	EU	EU	EU	Euro area	UK, DK,SW
Period	1971-2006	1987-2006	1999-2006	1999-2006	1999-2006

The dependent variable is the short-run interest rate rs. All estimates GLS estimates with fixed country effects. Corrected t-ratios are in parentheses

Table 7 Autocorrelation of inflation

Sample period	Data points	Quarter to quarter	Over 4 quarters
1970Q1-2006Q4	2,070	0.606 (20.78)	0.961 (114.45)
1987Q1-2006Q4	1,146	0.139 (3.32)	0.888 (41.88)
1999Q1-2006Q4	474	-0.256 (2.03)	0.499 (5.62)

The data are derived from all EU countries; corrected (White) t-ratios are in parentheses.

2.5 *Changes in Fiscal Policy*

Fiscal policy is a good candidate for changes in behaviour in a reasonably complex manner. Qualifying successfully for membership of Stage 3 entailed limiting deficits and, for countries with debt ratios over 60% of GDP, making an adequate attempt to bring them down. Once membership was achieved, the sanctions became different. Countries could be subject to an Excessive Deficit Procedure under the terms of the Stability and Growth Pact (SGP). Thus far no sanctions have been applied and the SGP itself was revised in 2005, making the occurrence of an excessive deficit less likely, nevertheless, the chances are that countries would become increasingly concerned to control deficits as they rose as a proportion of GDP. We do not have enough data to determine all these possible break points in behaviour but we can explore whether there is a change in behaviour in 1995 when convergence began in earnest, rather than one simply in 1999 (Table 8).

From the first eight rows of Table 8 it appears that the disciplining effect of debt on deficits is if anything a little lower after the start of Stage 3. This is surprising as not only is there the traditional constraint from the increased cost of servicing but the Maastricht converge criteria, continued into an ongoing commitment also tried to keep debt ratios below 60% of GDP and encourage steady improvement in fiscal prudence, thus doubling up the incentives. However, the clearest change in

behaviour is in the period 1995-2001, when the member states needed to qualify and then before the performance of the euro area began to weaken.

Estimates of the disciplinary effect of debt vary a lot depending on the specification estimated and on the time period. The EMU period appears to be somewhat different from earlier periods e.g. in terms of cyclical sensitivity and the role of inflation but it appears that the disciplinary role of debt is not very significant. In fact, it is the late 1990s which appears to be somewhat different in this respect. The difference can be seen quite clearly by computing a time-varying coefficient for the lagged debt/GDP ratio (Figure 7). On the basis of the Figure one might say that it is 1995 or 1996 when fiscal behavior changed towards more disciplinary direction but already in 2002/2003 some deterioration took place. (It is also clear from the Figure that each of the oil crises, 1975, 1981 and 1995 caused a step up in impact of debt, only first of which was reversed.)

The nature of the change may be better understood by scrutinizing the behaviour of expenditures and revenues (see the subsequent four rows in Table 8). As these rows show, the effect is not symmetric on expenditures and revenues. Expenditures fell quite strongly compared to GDP when growth rates rose before Stage 3 but the effect was clearly more limited thereafter. Before Stage 3 tax revenues were if anything pro-cyclical.

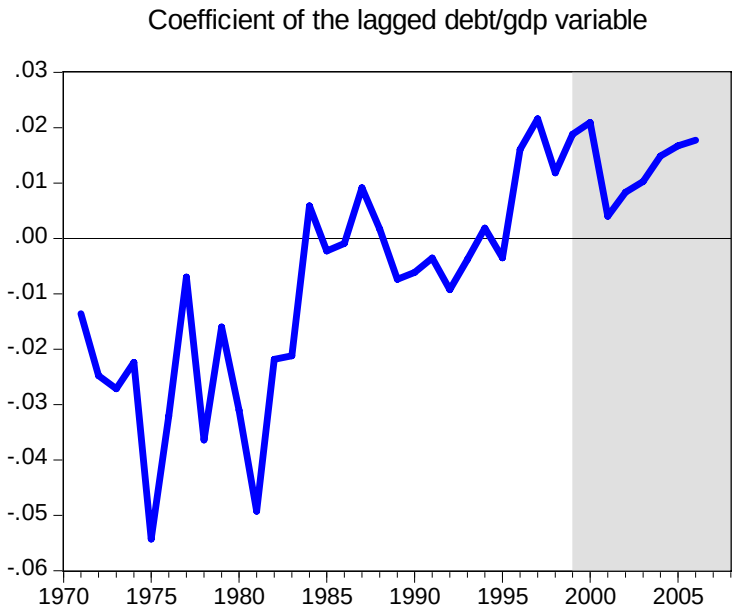
We can see the extent of the asymmetry if we allow the coefficient on the growth rate to be different in down and up phases of the cycle (the last two rows of the Table). In the period before Stage 3 there was indeed asymmetry with the response being less when output gaps were negative. In Stage 3 this effect has become stronger (the hypothesis of symmetry can be rejected more decisively) . This does imply that the expected effect has occurred and there has been a stronger attempt to contain deficits in downturns.

Table 8 Evidence of Changing Fiscal Behaviour

Sample Dep.var	g	lagged def/y	$debt_{-1}$	Δp	R^2/SEE	DW J-stat(DF)	Estimator
1971-2006	0.461		-0.024	0.055	0.403	0.621	GLS
def/y*	(6.78)		(3.33)	(1.33)	2.881		
1971-2006	0.385	0.830	0.017	0.023	0.853	2.00	GLS
def/y*	(8.44)	(16.07)	(3.20)	(0.88)	0.015		
1971-1998	0.243	0.652	0.064	0.120	..	..	GMM/AB
def/y*	(5.39)	(16.74)	(5.77)	(3.11)	0.021	38.8(35)	
1999-2006	0.556	0.610	0.021	-0.104	..	..	GMM/AB
def/y*	(5.52)	(5.45)	(1.06)	(0.97)	0.017	13.1(16)	
1995-2001	0.402	0.673	0.046	-0.264	..	..	GMM/AB
def/y*	(3.66)	(10.84)	(2.09)	(2.87)	0.017	18.1 (15)	
1970-1998	-0.897		0.095	-0.332	0.722	0.332	LS
exp/y*	(7.45)		(4.68)	(3.44)	0.037		
1999-2006	-0.221		0.059	0.102	0.970	0.897	LS
exp/y*	(2.68)		(2.91)	(0.70)	0.012		
1970-1998	-0.431		0.069	-0.167	0.834	0.375	LS
tax/y*	(4.88)		(5.81)	(2.70)	0.026		
1999-2006	0.324		0.044	-0.079	0.971	0.904	LS
tax/y*	(3.58)		(2.33)	(0.44)	0.012		
	g|gap<0	g|gap>0	$debt_{-1}$	Δlog(P)	R^2/SEE	DW	LS
1970-1998	0.349	0.552	-0.024	0.154	0.492	0.518	LS
def/y*	(2.59)	(4.97)	(1.78)	(2.19)	2.844		
1995-2001	-0.058	0.542	-0.024	-0.531	0.632	1.157	LS
def/y*	(0.22)	(2.74)	(0.53)	(1.90)	2.024		
1999-2006	0.157	0.519	-0.027	-0.377	0.746	1.302	LS
def/y*	(0.81)	(4.47)	(1.29)	(1.25)	1.450		

Def denotes net lending (thus positive values represent surpluses), y denotes GDP and t* trend GDP (constructed by the Hodrick-Prescott filter). exp denotes government expenditures and tax government revenues. Debt denotes general government debt in relation to GDP and P the GDP deflator. g denotes the growth rate of GDP. LS denotes panel least squares (with fixed cross-section effects) estimator, GLS the corresponding generalized least squares estimator and GMM/AM the Arellano-Bond GMM estimator with first differences. If one tests the hypothesis that the coefficients of g|gap<0 and g|gap>0 are equal with the last three equations, the F statistics and marginal significance values are: 2.76 (0.098), 16.67 (0.000) and 7.96 (0.006), respectively.

Figure 7 Change in the Responsiveness to the Debt Ratio



3 Reflection

The impact of Stage 3 of EMU in the EU has been characterized by three main features: a general improvement in monetary and fiscal policy among the OECD countries; a clear economic cycle, whose downturn appeared to reverse many of the gains made in the period of consolidation in an effort to qualify for admission to Stage 3 under the Protocol to the Maastricht Treaty; a clear change in behaviour, particularly in fiscal policy in recent years. However, many of these changes predate Stage 3 and began at the time of Stage 2 in 1995, when member states needed to prove their suitability to qualify. The clearest changes appear to have taken place in the determination of inflation and in monetary policy but to quite some extent the 'flattening of the Phillips Curve' represents the state of the economic cycle and a steeper segment is being revealed as the recovery continues. Expectations formation certainly seems to have changed and people have become more forward-looking. At the same time the distribution of behaviour among the various euro area countries has become smaller (see e.g. Figures 4 and 5). Thus Europe looks more like a single country than a group of different countries, even though there are still some striking differences. Even so, it is obvious that the role of monetary policy has rather increased than decreased, and, quite probably, the expectations channel has become more important. Labour market behaviour seems little changed over the period but then there is no experiment we can undertake which might have seen EU labour markets become even less responsive in the absence of EMU. It is thus very difficult to decide which of these features can be attributed to EMU as such, but none of the observed changes is counterintuitive. It would therefore stretch credibility to suggest that all of the changes were pure coinci-

dence. On the fiscal side we have some signs of a return to the previous regime – but unfortunately the data do not allow us to conclude whether this is indeed the case.

References

Arellano, M. and Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Econometric Studies,* vol.58, pp. 277–97.

Baxter M. (1994), 'Real Exchange Rates and Real Interest Differentials: Have we Missed the Business Cycle Relationship?', *Journal of Monetary Economics*, vol. 33, 5–37.

Bernanke, B (2004) 'The Great Moderation', Eastern Economic Association, Washington DC, February 20, available at http://www.federalreserve.gov/BOARDDOCS/SPEECHES/2004/20040220/default.htm.

Blinder, A.S. and Solow, R.M. (1973). 'Does Fiscal Policy Matter?', *Journal of Public Economics*, vol.2, pp. 319-337.

Cecchini Report (1988). *The European Challenge 1992*, Aldershot: Gower.

Cho S. and Moreno A. (2006). 'A Small-Sample Study of the New Keynesian Macro Model', *Journal of Money, Credit and Banking*, vol 38 (6), pp.1461-81.

European Commission (1990). "One Market, One Money: An Evaluation of the Potential Benefits and Costs of Forming an Economic and Monetary Union", *European Economy* 44 (October).

Duguay, P (1994) 'Empirical Evidence on the Strength of the Monetary Transmission Mechanism in Canada', *Journal of Monetary Economics*, vol 33, pp.39-61.

Galí, J. and Gertler, M. (1999). 'Inflation Dynamics: a Structural Econometric Analysis', *Journal of Monetary Economics* , vol.44, pp.195–222.

Goodhart, C and Hofmann, B (2000) 'Asset Prices and the Conduct of Monetary Policy', Sveriges Riksbank and Stockholm School of Economics conference on Asset Markets and Monetary Policy, Stockholm, June.

Goodhart, C and Hofmann, B (2005). 'The Phillips Curve, the IS Curve and Monetary Transmission: Evidence for the US and the Euro Area', CESifo Economic Studies, vol. 51 (4), pp.757–775

Granger, C.W.J. and Teräsvirta, T. (1993). *Modelling Nonlinear Relationships*, New York: Oxford University Press.

Huang, A., Margaritis, D. and Mayes, D. G. (2001). 'Monetary Policy Rules in Practice: Evidence from New Zealand', *Multinational Finance Journal*, 2001, vol. 5, no. 3, pp. 175–200.

Lindé, J. (2005) 'Estimating New-Keynesian Phillips curves: A Full Information Maximum Likelihood Approach', *Journal of Monetary Economics*, vol. 52, pp.1135-49.

Mayes, D G and Virén, M (2000) 'The Exchange Rate and Monetary Conditions in the Euro Area', *Weltwirtschaftliches Archiv*, vol. 136 (2), pp.1-33.

Mayes D. G., Virén M. (2002), *Financial Conditions Indexes*. International Economics 55, 521–550.

Mayes, D G and Virén, M (2005) 'Monetary policy problems for currency unions: asymmetry and the problem of aggregation in the euro area', *Economic Modelling*, vol.22(2), pp.219-251

Paloviita, M and Mayes, D G (2005) 'The Use of Real Time Data in the Estimation of Phillips Curves in the Euro Area', *North American Journal of Economics and Finance,* vol. 16(3), pp. 415-434.

Paloviita , M. and Virén , M. (2005). 'The Role of Expectations in the Inflation Process in the Euro Area', Bank of Finland Discussion Paper 6/2005.

Prachowny, M. F. J. (1993). "Okun's Law: Theoretical Foundations and Revised Estimates," *Review of Economics and Statistics* 75, May, pp. 331-6.

Stock, J. and Watson, M (2003). 'Has the Business Cycle Changed? Evidence and Explanations', prepared for the Federal Reserve Bank of Kansas City symposium, 'Monetary Policy and Uncertainty', Jackson Hole, Wyoming, August 28-30.

Teräsvirta T. and Eliasson, A. (1998), 'Nonlinear Error-correction and the UK Demand for Broad Money, 1878-1993', Stockholm School of Economics, Working Paper No. 265.

Yates, A (1998) 'Downward Rigidity and Monetary Policy' Bank of England Working Paper 114.

Data Appendix

The data came mainly from OECD data Bank (derived on August 9, 2007)

The data consist of the following (seasonally adjusted) time series for the period 1970Q1-2006Q4.

- y = GDP at constant or current market prices
- gap = output gap that has been computed by means of Hodrick-Prescott filter
- P =the price level =the GDP deflator
- P_{imp} = import prices = implicit deflator of imports
- y_w = World GDP weighted average of GDP from EU15, Japan and the USA.
- Un harmonized unemployment rate
- POP = working age population
- LF = labour force
- SR = short term (3 month) interest rate
- LR = long-term interest rate = yield on government bonds
- EX = nominal exchange rate vis a vis the US dollar