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Is European monetary policy appropriate for the EMU member countries?: a counterfactual analysis

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Bernd Hayo

**Is European Monetary Policy Appropriate
for the EMU Member Countries?
A Counterfactual Analysis**

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Is European Monetary Policy Appropriate for the EMU Member Countries? A Counterfactual Analysis

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Abstract

This paper analyses whether interest rate paths in the EMU member countries would have been different if the previous national central banks had not handed over monetary policy to the ECB. Using estimates of monetary policy reaction functions over the last 20 years before the formation of EMU, we derive long-run rules that relate interest rate setting to the expected one-year ahead inflation rate and the current output gap. These Taylor rules allow to derive long-run target rates which are employed in the simulation of counterfactual interest rate paths over the time period January 1999 to December 2004 and then compared to actual short-term interest rates in the euro area. It is found that for almost all EMU member countries euro area interest rates tend to be below the national target interest rates, even after explicitly accounting for a lower real interest rate in the EMU period, with Germany being the only exception.

JEL: E5

Keywords: Taylor rule, monetary policy, ECB, European Monetary Union

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1 Introduction

The creation of the European Monetary Union (EMU) is the most important event in monetary economics in the last decade. It led to at least two potentially important changes with respect to the setting of short-term interest rates in the EMU member countries. First, the European Central Bank (ECB) bases its monetary policy decisions on aggregate developments in the euro area, which may conceal diverse developments at the national level. Second, the weights on inflation and output in the ECB Taylor rule may deviate from those that were a good description of national interest rates in the pre-EMU phase. The core question of this paper is how appropriate the actual ECB interest rate setting is for each of the member countries compared to a (hypothetical) situation where national central banks are still responsible for monetary policy. This analysis may also yield some insights into the question of whether monetary policy can be blamed for the low GDP growth rate in a number of EMU member countries, e.g. Germany or Italy.

In this study we interpret short-term interest rates as the prime indicators of monetary policy. Estimated monetary policy reaction functions in the form of Taylor rules are often used as concise descriptions of the monetary policy stance. They explain how deviations of output from potential output and inflation from target affect the level of interest rates. To answer the above research question, we compare the actual short-term interest rate path in the euro area with simulated interest rate paths for the member countries in a counterfactual scenario.

The analysis should enable us to better understand how appropriate the centrally conducted monetary policy is for the respective member countries. If it turned out that the counterfactual national interest rate paths were relatively similar to the actual interest rate paths resulting from European monetary policy decisions, the cost of EMU from centralising monetary policy would be rather small. It would also be difficult to blame the ECB for contributing to the poor

growth performance. On the other hand, if we found noteworthy deviations in the interest rate paths for at least some economies, this might raise concerns about the net benefits these countries can expect from EMU membership.

The plan of the paper is as follows. Section 2 discusses the empirical approach and some specification issues. Section 3 presents and discusses the empirical results of the Taylor rule estimations. In section 4 we compare the money market rate in the euro area with counterfactual target rates based on the Taylor rule estimates from the previous section. Section 5 summarises the main points and concludes.

2 Empirical Set up and Econometric Methodology

It has become common to operationalise monetary policy actions by a short-term interest rate. This variable is easy to obtain, and setting interest rates is perceived as the common practice of central banks (Borio, 1997). John Taylor's (1993) attempt to describe interest rate setting in terms of a monetary policy reaction function has been widely adopted. In such a so-called 'Taylor rule', the short-term nominal interest rate, representing the central bank's monetary policy instrument, responds to deviations of inflation and output from their target levels.

In order to address the questions raised above we estimate Taylor rules for most of the member countries of EMU using monthly data from the formation of the European Monetary System (EMS) onwards (1979:4 – 1998:12). The central bank's target level for short-term nominal interest rates is modelled as a function of the deviation of current output from its trend and of the expected deviation of one year ahead inflation from its (constant) target:

$$\dot{i}_t^T = r^* + \pi^* + \beta (\pi_{t+12} - \pi^*) + \gamma y_t, \quad (4.1)$$

with: i^T = target nominal interest rate, r^* = long-run real interest rate, y = output gap, π = inflation rate, π^* = target inflation rate, β = inflation weight in the target interest rate, γ = output weight in the target interest rate.

The long-run level of the nominal interest rate when inflation is equal to its long-run target level and the output gap is zero is given by $r^* + \pi^*$. The constant of the target interest rate is given by:

$$\alpha = r^* + (1-\beta) \pi^*. \quad (4.2)$$

with: α = constant of the target interest rate.

Finally, we allow for interest rate smoothing by including a lagged interest rate term in the Taylor rule specification. Castelnuovo (2003) argues that the explicit modelling of a lagged interest rate term is preferable to an autoregressive errors specification. In the empirical estimations of the Taylor rules, we adopt the forward-looking specification first proposed by Clarida *et al.* (1998), which leads to the following equation:

$$i_t = \rho i_{t-1} + (1-\rho) \alpha + (1-\rho) \beta \pi_{t+12} + (1-\rho) \gamma y_t + \varepsilon_t, \quad (4.3)$$

with: i = nominal short-term interest rate, ρ = degree of interest rate smoothing, ε = error term.

The presence of interest rate smoothing implies that there is partial adjustment of nominal interest rates to their target level, with a fraction of $1-\rho$ of the difference between the target rate and last period's rate being eliminated each period.

A major problem when working with forward-looking and contemporaneous variables is that they may be correlated with the error term, leading to biased estimates of the coefficients of interest. Therefore, these variables must be instrumented. In addition, the error term may experience non-normality, autocorrelation and heteroscedasticity, causing problems with

respect to statistical estimation and inference. It is now common to use the General Method of Moments (GMM) estimator, as it accounts for endogeneity biases as well as non-spherical errors. However, while the GMM estimator possesses excellent asymptotic properties, it may perform poorly in small samples (see the special issue of the *Journal of Economics and Business Statistics* 1996).

A potentially important general estimation problem in this context is the choice of instruments. Good instruments are variables that are uncorrelated with the error term and highly correlated with the variable that needs to be instrumented. Thus, good instruments should on the one hand fulfil the orthogonality conditions between regressors and error term. Typically, this assumption is investigated using a test of the validity of over-identifying restrictions when there are more instruments than estimated coefficients (Davidson and McKinnon, 1993). However, it should be noted that the test of over-identifying restrictions in fact tests the joint hypotheses that the instruments are orthogonal to the error term *and* that the estimated model is correctly specified. Moreover, working with time-series data, it is easy to find instruments that pass this test. On the other hand, good instruments should be highly correlated with the instrumented variable. This aspect is almost never reported or even checked in applied empirical work, in spite of the fact that recent research shows that the use of weak instruments, i.e. instruments that do not contribute much to explaining the instrumented variable, can lead to substantial biases in both estimators and test statistics even in large samples (Hahn and Hausman, 2003, Stock *et al.*, 2002). Stock and Yogo (2003) propose a test for weak instruments based on the F-test value of the first stage regression in a two-stage least squares procedure.

However, one still has to solve the practical problem of choosing among a large number of potential instruments the ones that should be included. This instrument selection problem

follows Hayo and Hofmann (2006) by applying a recently developed automatic model selection algorithm called GETS (see Hendry and Krolzig, 1999). GETS starts from a general model and removes redundant instruments. While doing so, it searches all possible paths of the testing-down process and reports the most parsimonious model that does not violate a reduction test. Thus, the strongest instruments will be selected from a given choice of variables and their lags. This does not remove all arbitrariness, as, for instance, the researcher still needs to choose the potential instrumental variables and their maximum lag length, but it appears to be superior to the *ad hoc* methods typically employed in empirical research.

3 Empirical Estimation of National Monetary Policy Reaction Functions

To prepare the ground for the counterfactual simulations, we need to estimate the national Taylor rules before the start of EMU. The data utilised in the analysis are: money market rate for the interest rate, seasonally adjusted industrial production for output and annualised rate of change in the seasonally adjusted CPI for inflation.¹ As instruments, we use up to six lagged values of the interest rate, the inflation rate, the output gap, the growth rate of the effective real exchange rate, the growth rate of the oil price index in the local currency, and the monthly growth rate of narrow money. Following Clarida *et al.* (1998) the output gap has been constructed by taking the residuals of a regression of the industrial production series on a constant, a linear trend and a quadratic trend. Table 4.1 summarises the estimation results using the general method of moments (GMM). First, we should analyse the adequacy of the chosen instruments. As was expected, none of the instrument sets fails the J-test, the p-values of which are given in the last columns of Tables 4.1 and 4.2. Applying the weak instrument test by Stock and Yogo (2003) indicates that in almost all cases we can reject at a 5% significance level the hypothesis that the instrumental variable estimator experiences a 5% bias relative to the OLS estimator.

Table 1: GMM Estimates of National Monetary Policy Reaction Functions

	\hat{i}_{t-1} (ρ)	π_{t+12} (β)	y_t (γ)	Constant (α)	No. of obs.	SE of regression	J-test (p-value)
Austria	0.89**	1.26**	0.31**	2.50**	237	0.46	0.15
Belgium	0.93**	1.23**	0.21	2.76**	237	1.01	0.51
Finland	0.97**	1.28*	0.39	3.01	237	0.68	0.90
France	0.93**	0.60**	0.45**	5.46**	234	0.64	0.81
France (sample 1987)	0.89**	1.61**	0.31**	3.04*	144	0.59	0.85
Germany	0.92**	1.25**	0.32**	2.56**	101	0.15	0.83
Ireland	1.08**	1.11**	0.28**	6.30**	234	3.77	0.99
Italy (sample 1987)	0.93**	1.87**	0.25	0.27	144	0.58	0.56
Netherlands	0.93**	2.99**	0.85*	-0.82	228	0.67	0.76
Portugal	0.97**	1.45	2.18	-1.67	191	2.23	0.96
Portugal (sample 1987)	Lag(1): 1.35**	1.97(*)	2.39	-2.63	144	2.20	0.97
	Lag(2): -0.39*						
Spain	0.97**	0.96**	0.19	5.23**	235	1.61	0.93
ECB	0.85**	1.48(*)	0.60**	0.32	53	0.16	0.06

Notes: (*), *, and ** indicate significance at a 10%, 5%, and 1% level, respectively. Standard errors for coefficient estimates are computed using the procedure by Newey and West (1987). The estimates for the ECB

Exceptions are inflation in Ireland (only rejection of a 20% bias) and the output gap in the Netherlands (only rejection of a 10% bias). Testing the bias in the size of the instrumental variable tests at a 5% level, we can reject the hypothesis of a 10% bias in most cases. Again

there are some problems, this time with inflation and the output gap in Belgium (only rejection of a 15% bias), inflation in Ireland (not even rejection of a 25% bias), and the output gap in the Netherlands (rejection of a 20% bias). All in all, we should consider the instruments to be appropriate for our purposes but have to be aware of potential bias problems in instrumental variable estimates of the countries mentioned.

For some countries, plausible estimates over the full sample period could not be found. Alternatively, Taylor rules were estimated from January 1987 onwards, omitting the first phase of the EMS. In addition, there were missing values for some series, which also led to differences in the respective sample sizes. Lagged interest rates turn out to be highly significant, indicating that interest rate smoothing is important in all cases of our sample. For most countries coefficients on expected inflation greater than unity can be found. The reaction function in France estimated over the full sample period is the only instance where we have to reject the hypothesis that the coefficient is greater than unity, i.e. the so-called Taylor principle is not fulfilled. This principle ensures that real interest rates rise in response to increases in inflation. In Portugal the coefficient is not significantly different from zero when using the longer sample period. The point estimates of the output gap coefficients are generally larger than zero and lower than unity. In half of the cases, however, they are statistically not significantly different from zero (Belgium, Finland, Italy, Portugal, Spain). For robustness purposes, the Taylor rules were re-estimated after imposing zero restrictions on the output gaps where appropriate. It turned out that the resulting paths for the long-term target rates were similar to ones based on the unrestricted estimates and thus could be omitted. The constant term varies greatly between the countries and it can even take on negative values. Note, however, that in a number of cases it is not precisely estimated.

A number of EMU countries were formerly members of the EMS. Germany was typically perceived as performing the role of a nominal anchor and dominating the system (Wyplosz, 1989; von Hagen and Fratianni, 1990). To account for such an influence, we re-estimate the Taylor rules allowing for the German interest rate to enter as an additional exogenous regressor. The long-run coefficients are then computed based on the equilibrium condition: $i_t = i_{t-1} = i_t^{\text{Germany}}$. It turns out that for some countries it is not possible to derive sensible monetary policy reaction functions within such a specification. The cases that yield reasonable estimates are summarised in Table 4.2.

It should be noted that the German interest rate is significant in very few countries only, namely Austria, Belgium and Ireland.² However, the result in Ireland is very much a reflection of the interest rate convergence occurring in the period preceding EMU.³ Interestingly, the German rate is not significant in the Taylor rule of the Netherlands, which kept a fixed rate to the DM since the breakdown of the Bretton-Woods system. Note that this is not an issue of collinearity with the lagged interest rate, as the estimated coefficient of this variable is virtually the same in the regression with and without the German interest rate.

Table 2: GMM Estimates of National Monetary Policy Reaction Functions (with German interest rate or start of sample in 1987:1)

	\dot{i}_{t-1} (ρ)	π_{t+12} (β)	y_t (γ)	German interest rate	Constant (α)	No. of obs.	SE of regression	J-test (p- value)
Austria	0.63**	1.08*	0.50**	0.28**	3.61*	237	0.43	0.37
Belgium	0.70**	2.24**	0.11	0.22**	2.56*	236	0.97	0.80
France	0.93**	0.54**	0.43**	-0.02	5.17**	234	0.65	0.88
Ireland	0.66**	1.29(*)	1.21(*)	0.29**	24.8*	222	2.02	0.99
Italy (sample 1987)	0.93**	1.48**	0.07	-0.05	0.81	144	0.61	0.63
Netherlands	0.93**	3.89**	-1.03*	0.02	-2.59	228	0.67	0.74
Spain	0.88**	1.89(*)	0.44	0.07	6.9	234	1.61	0.92

Notes: (*), *, and ** indicate significance at a 10%, 5%, and 1% level, respectively. Standard errors for coefficient estimates are computed using the procedure by Newey and West (1987).

In the counterfactual analysis below, the long-run coefficients β , γ , and α will be used to derive target interest rates that are interpreted as indicators of how national monetary policy would have been pursued if EMU had not come about. However, there is a substantial problem related to the constant term in this analysis. The national Taylor rules contain constant terms that deviate substantially from the α estimated for the ECB Taylor rule. We can derive the implied long-run real interest rate by re-arranging equation (4.2):

$$r^* = \alpha - (1-\beta) \pi^*. \quad (4.4)$$

If we assume an inflation goal of 2%, the implied long-run real interest rate recovered from the Austrian Taylor rule in Table 4.1 is about 2%. Assuming the same inflation goal for the ECB, we get a lower implied long-run real interest rate of 1.28%. This difference in implied real interest rates between the two regimes may reflect lower real interest rates under the EMU regime due to the process of fiscal consolidation in the 1990s, but probably also due to

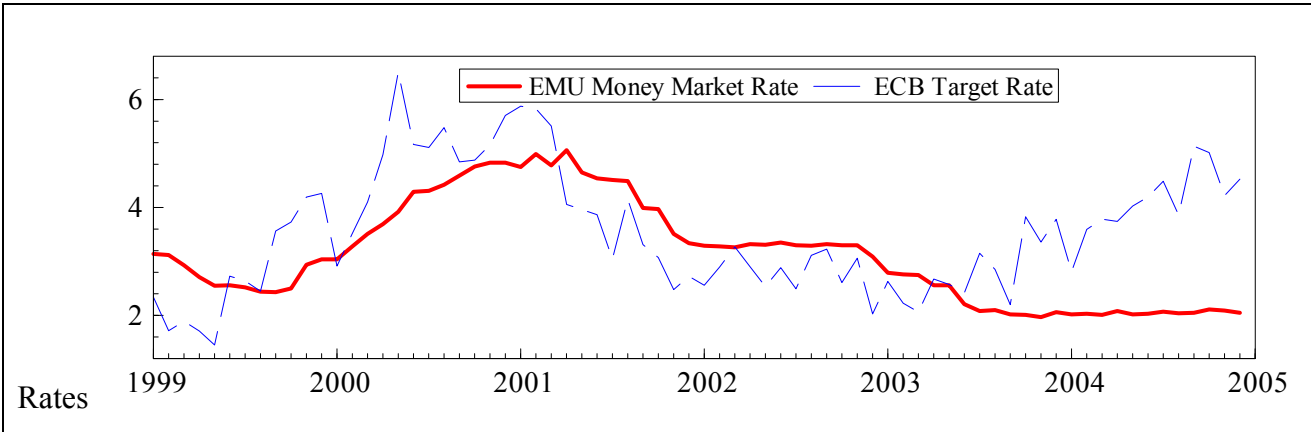
lower levels of potential real growth in a number of EMU countries. Hence, the constant α may also have been lower under a counterfactual national monetary policy regime after 1999. For instance, in the case of Austria we get as an adjusted constant term:

$$\alpha^{adj} = r_{ECB}^* + (1 - \beta_i)\pi^* = 1.28 + (1 - 1.26)2 = 0.76 \quad (4.5)$$

Note that due to the large standard error of α in the ECB Taylor rule, the implied real interest rate is also very imprecisely measured. Furthermore, since there is (almost) a zero probability of observing a nominal interest rate very close to the real rate, r^* is not on the support of the probability distribution. For these reasons it seems advisable to look at the target rates based on both the originally estimated constant terms and the adjusted constant terms. It turns out, however, that in all cases the target rates based on the non-adjusted constant terms are way above the interest rate prevailing in EMU. It is very unlikely that the monetary policy of the ECB is too loose for every member of EMU. Therefore, in the following graphical comparisons, we show the target rates based on the adjusted constant terms only.

Finally, it should be pointed out that there is likely to be a difference between long-run target rates and actual interest rates. For example, Figure 1 shows the target rates for the ECB together with the actual money market rate.

Figure 1: ECB Target Rates and EMU Money Market



Apparently, the actual interest rates deviate from the estimated Taylor rule, particularly during the last part of the sample, where the monetary policy reaction function would recommend raising interest rates while the ECB kept rates constant.⁴ Hence, the comparison of counterfactual interest rate paths and actual EMU interest rates shown in following section should be interpreted with caution.

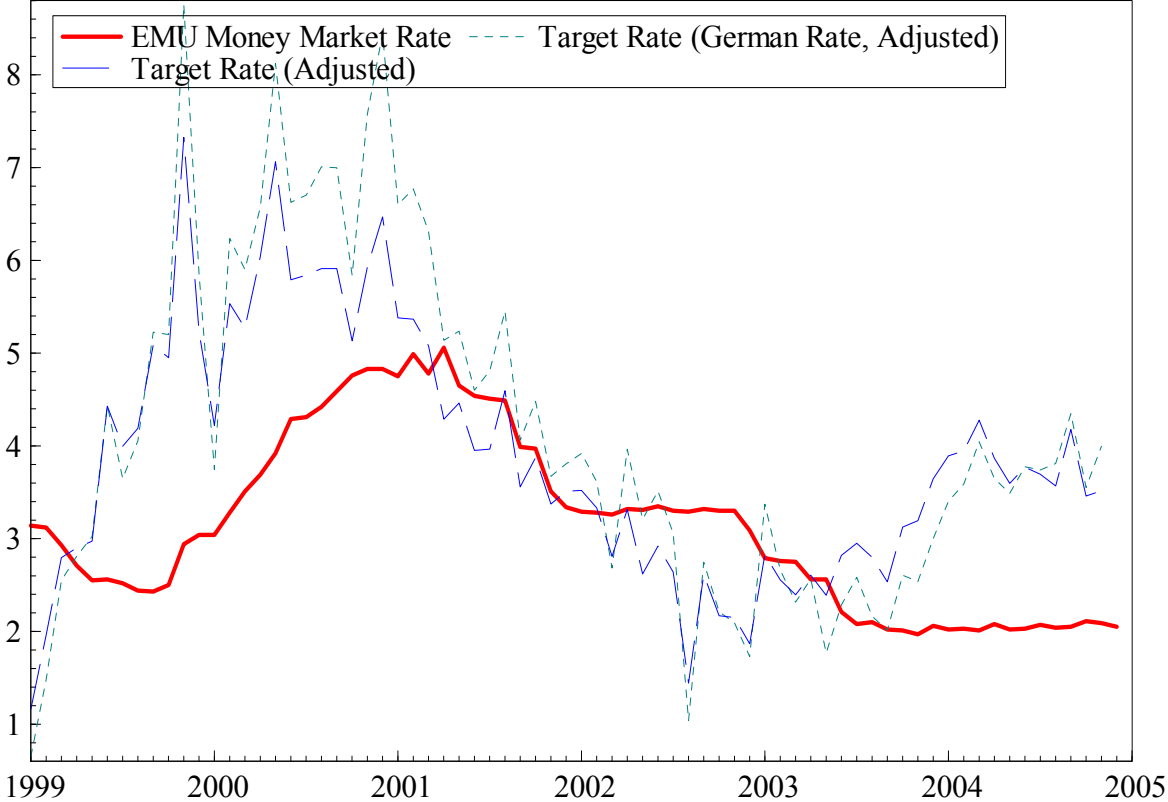
4 Comparing Counterfactual Interest Rate Paths

This section compares in a counterfactual simulation analysis target rates based on national Taylor rules and national variables with the actual money market interest rates in the euro area. Actual interest rate paths appear to be more useful for this comparison than ECB target rates for two reasons. First, they describe an actual development and not a counterfactual scenario. Second, it can be seen from Figure 1 that at the end of the sample period actual rates and target rates deviate substantially, which undermines the usefulness of ECB target rates in this context. An alternative approach would be to compare dynamic simulations based on the national estimated Taylor rules with actual interest rates (see, for example., Hayo and Hofmann, 2006). However, simulated interest rate paths tend to become rather implausible after only a few interactions. Moreover, a serious dynamic simulation study would need to take into account the data generating mechanism of the other variables in the model, in particular the output gap and the inflation rate. Finally, there is the issue of comparing the significance of target rates using confidence bands. As has been shown in, for example, Clausen and Hayo (2004), these tend to be extremely wide and interest rate setting would need to be of an extreme nature to violate the 95% bands. Thus, we concentrate on the estimated coefficients bearing in mind that these are estimated with considerable uncertainty.

Figure 2 presents the static simulations for Austria based on the estimated target rates. The graph suggests that for most of the time in 1999 and 2000, interest rates would have been

substantially higher under a continuation of the national monetary policy regime. With the exception of the second half of 2002, actual interest rates were very close to the target rates for Austria until the end of 2003. From 2004 onwards, interest rates in Austria would have risen under the hypothetical monetary policy regime. It is interesting to note that these conclusions are quite robust with respect to estimating the Taylor with or without the German interest rate.

Figure 2: Austria: Target Rates and Euro Area Money Market Rate (in %)



In Figure 3, the simulations for Belgium are presented. The counterfactual target rates indicate that the ECB-controlled interest rates were too low for Belgium during the course of 1999 but were relatively adequate in 2000. Interest rates should have been lowered much faster during 2001 than they were by the ECB. In 2002 and the first half of 2003, actual and target rates are

pretty close together. From mid-2003 onwards, the counterfactual Belgian central bank would have raised interest rates continuously, leading to a considerable gap between actual rates and target rates at the end of the sample period. Again, target rates estimated with and without a German interest rate are relatively close together most of the time.

Figure 3: Belgium: Target Rates and Euro Area Money Market Rate (in %)

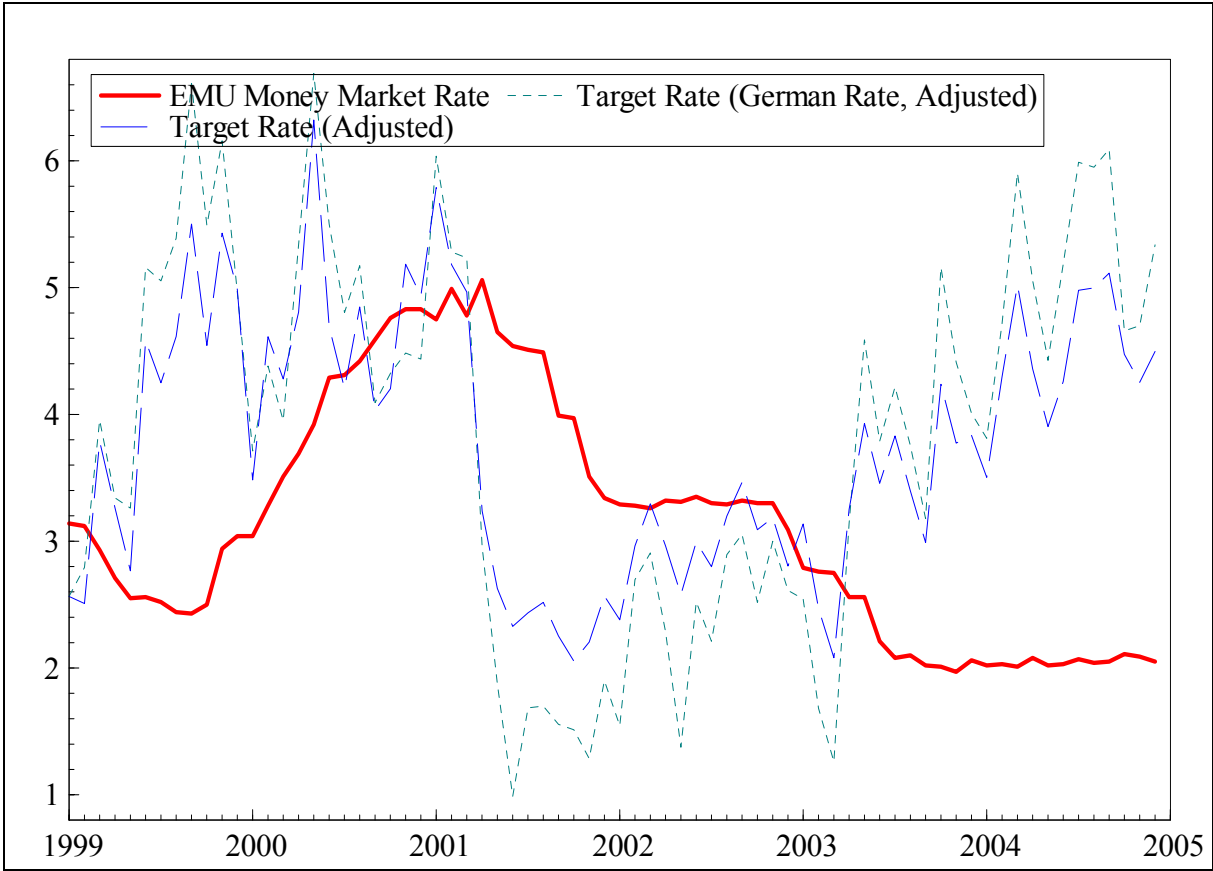
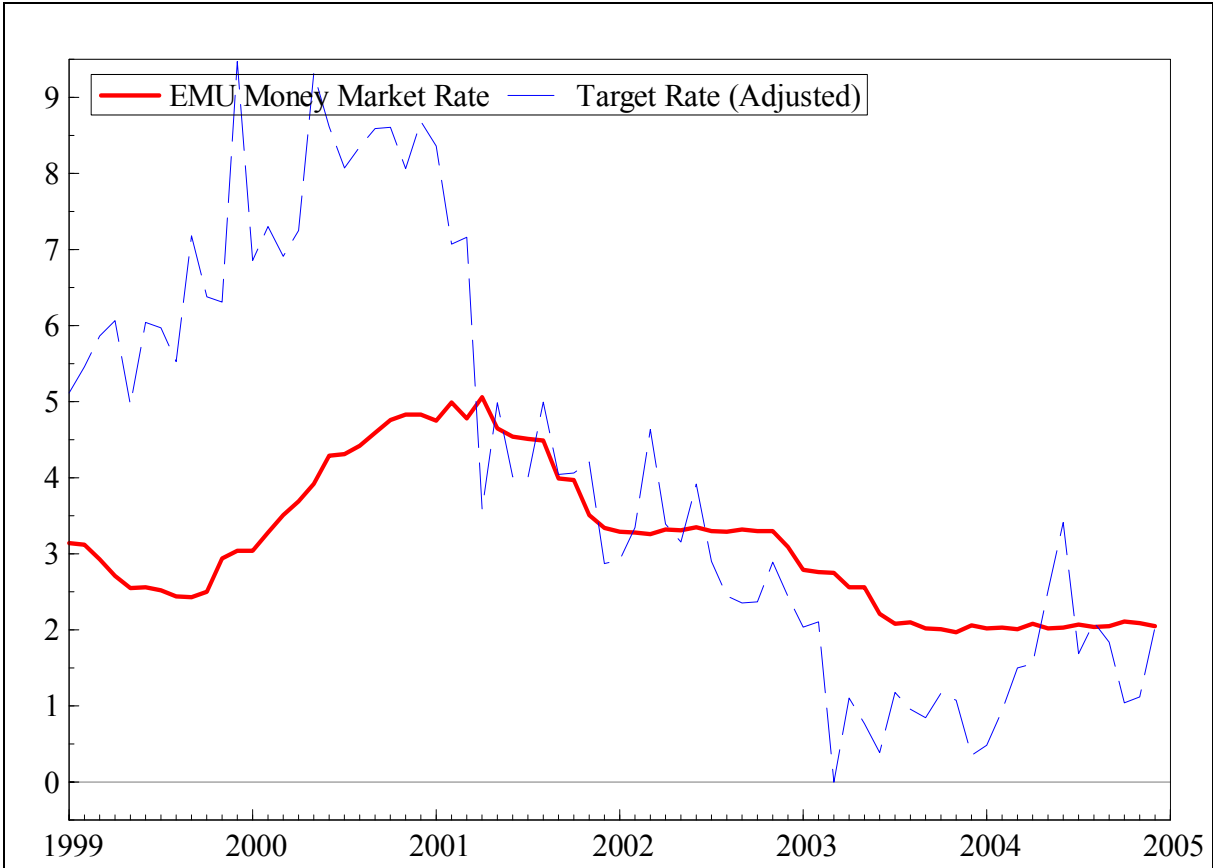


Figure 4 shows the counterfactual scenario for Finland. Here only the Taylor rule without the German interest rate yielded reasonable estimates. The counterfactual target rates indicate that over the period from the start of 1999 to the end of 2000 nationally determined interest rates would have been much higher than those prevailing in the euro area. In 2001 and 2002, target and actual rates are very close, while in 2003 a continuation of the Finnish monetary policy

rule would have led to lower rates. For 2004, the simulations suggest that the euro area interest rate is relatively adequate for Finland.

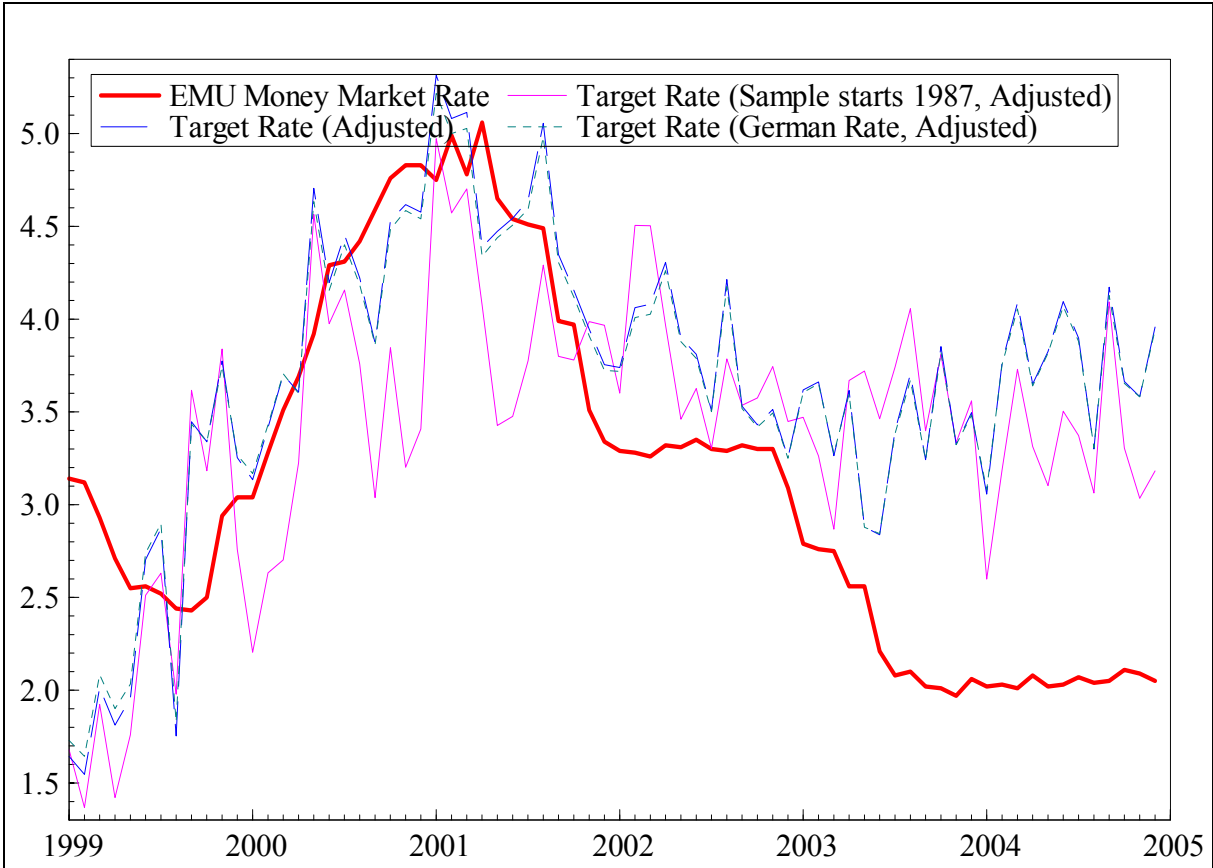
Figure 4: Finland: Target Rates and Euro Area Money Market Rate (in %)



The situation in France is described in Figure 5 using three alternative long-run target rates. The target rate estimated over the shorter sample period suggests that a somewhat lower rate would have come about in 2000 and 2001 but otherwise it is quite close to the other two rates that move almost synchronously. The French central bank would have set lower interest rates during the first part of 1999 but otherwise would have followed a course similar to that pursued by the ECB. However, while interest rates fell in the euro area over the course of

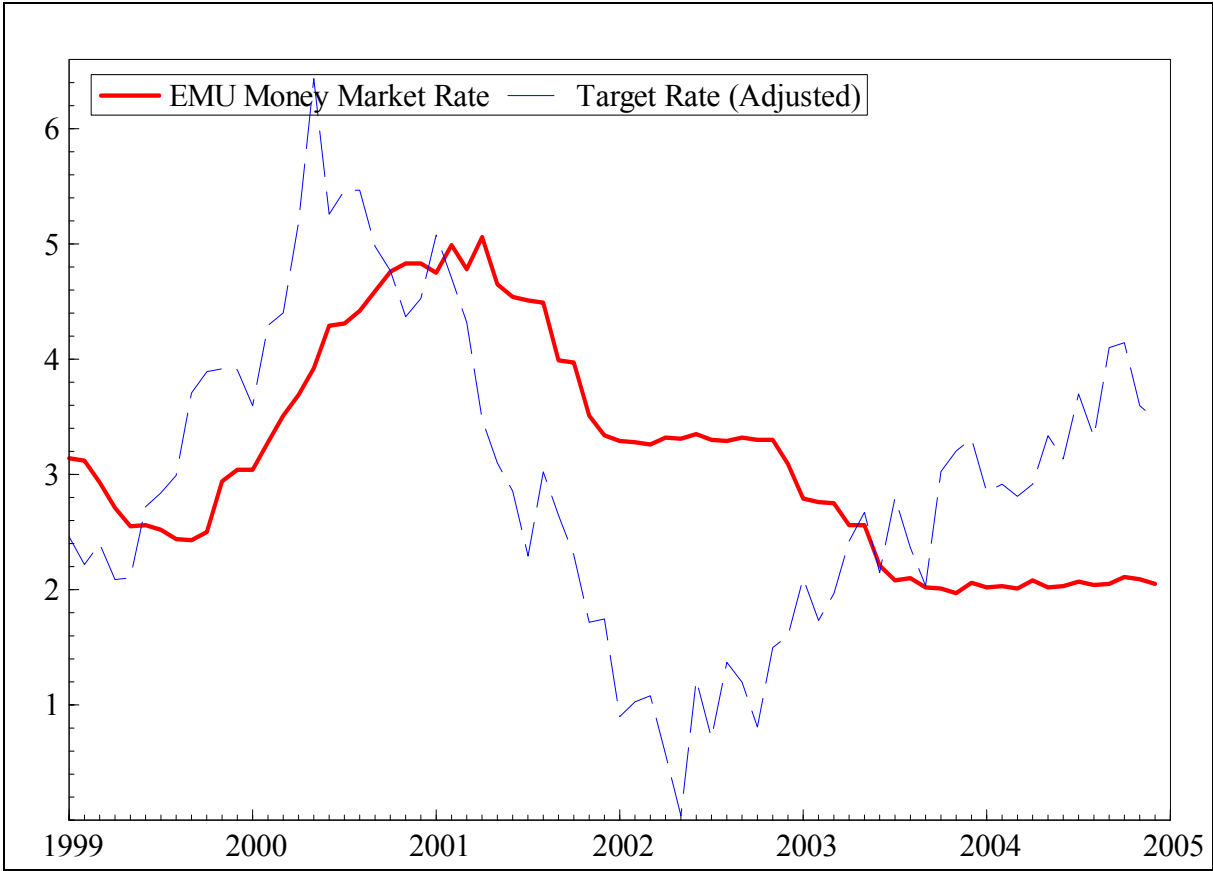
2003, in the counterfactual national regime target rates would have remained stable at the level reached at the end of 2002.

Figure 5: France: Target Rates and Euro Area Money Market Rate (in %)



Analysing the results for the simulations in the case of Germany given in Figure 6, we find that the Bundesbank would have kept interest rates somewhat higher during 1999 and clearly higher over the first half of 2000. The downswing of interest rates in 2001 would have come half a year earlier and been much more pronounced in the counterfactual German monetary policy regime. Over the second half of 2002 and the first half of 2003 we see a convergence of rates, with actual euro area rates falling and German target rates rising. During the course of 2004 it is apparent that our counterfactual Bundesbank would have raised rates further, while the ECB held rates constant.

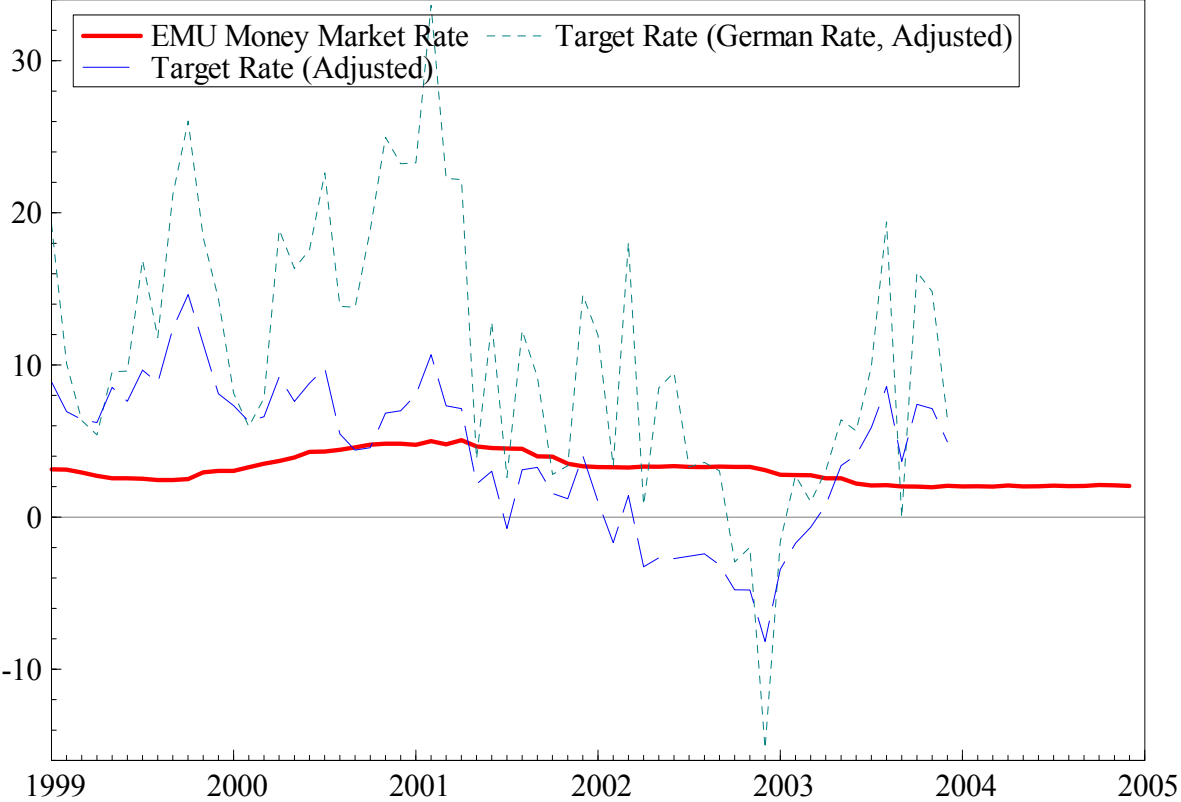
Figure 6: Germany: Target Rates and Euro Area Money Market Rate (in %)



As can be seen in Figure 7, there is a lot of volatility in the target rates for Ireland. This may be due to the fact that the relatively more volatile producer prices are used instead of consumer prices. Moreover, in the second half of 2002 target rates become negative, which is clearly not plausible. The target rates based on the estimates without the German rate indicate that in the counterfactual situation the Irish central bank would have set interest rates much higher than euro area rates in 1999. There is some convergence over the course of 2000, where on average the euro area rate is only slightly below the target rate. However, euro area rates appear to be too high in most of 2001, 2002, and 2003 for Ireland, which seems unlikely. The target rates for Ireland based on the estimates including the German interest rate are far above the actual money market rates in the euro area over the first two years. In 2001, the target rates move closer to the actual euro area rates. In the second half of 2002, the rates even

become negative for a few months. This counterfactual scenario suggests that on average the euro area rates were quite appropriate for Ireland until the autumn of 2003. At the end of the present sample (which stops at the end of 2003 due to limited data availability), the target rates are already above the EMU money market rates. All in all it appears to be the case that actual rates were below the ones that would have been set under a national monetary policy regime in Ireland.

Figure 7: Ireland: Target Rates and Euro Area Money Market Rate (in %)

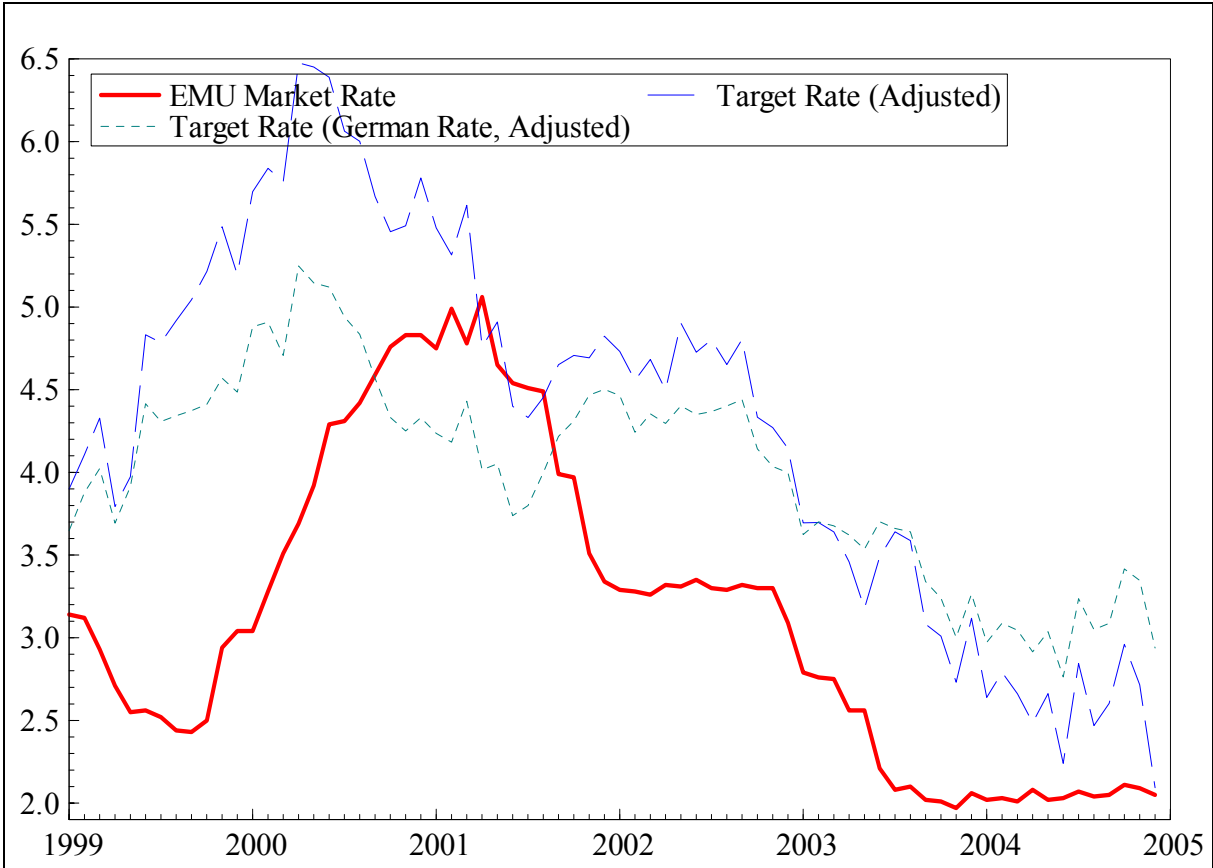


Notes: The inflation rate is based on the producer price index.

A similar conclusion but based on more plausible interest rate paths is found for Italy. Figure 8 shows that under both scenarios the target rates are above the euro area interest rates in the

first two years. This conclusion changes in 2001, where at least for the interest rate path based on the estimates with the German rate the EMU rates tend to be above what a counterfactual Italian central bank would have set. For the target rate derived from the estimations without the German rate, the euro area rates appear to be slightly too high in 2001. For the remaining years, however, both interest rate scenarios suggest that national rates would have been higher, with some convergence on actual money market rates occurring at the end of the sample period. The general shape of the EMU interest rate path on the other hand is very similar to what is suggested by the target rates.

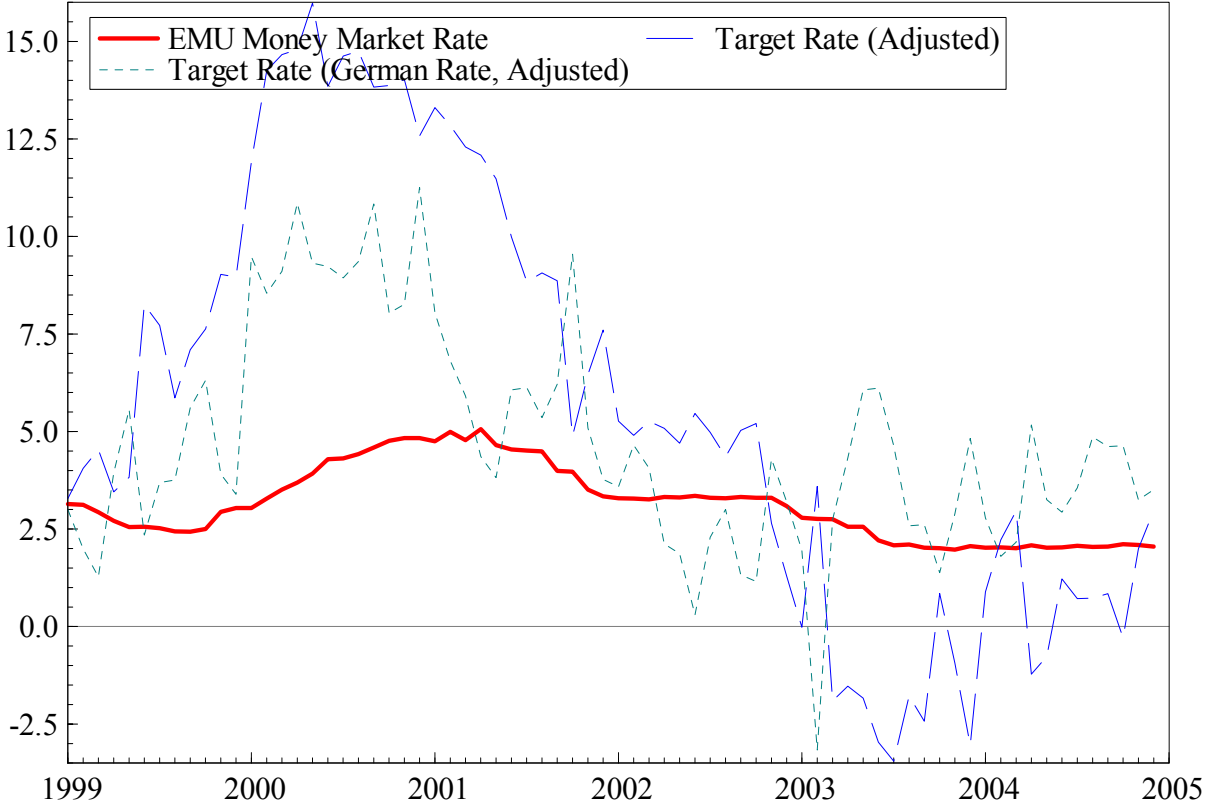
Figure 8: Italy: Target Rates and Euro Area Money Market Rate (in %)



The situation is relatively straightforward in the case of the Netherlands, as can be inferred from Figure 9. For the simulations which include the German interest rate, most of the time

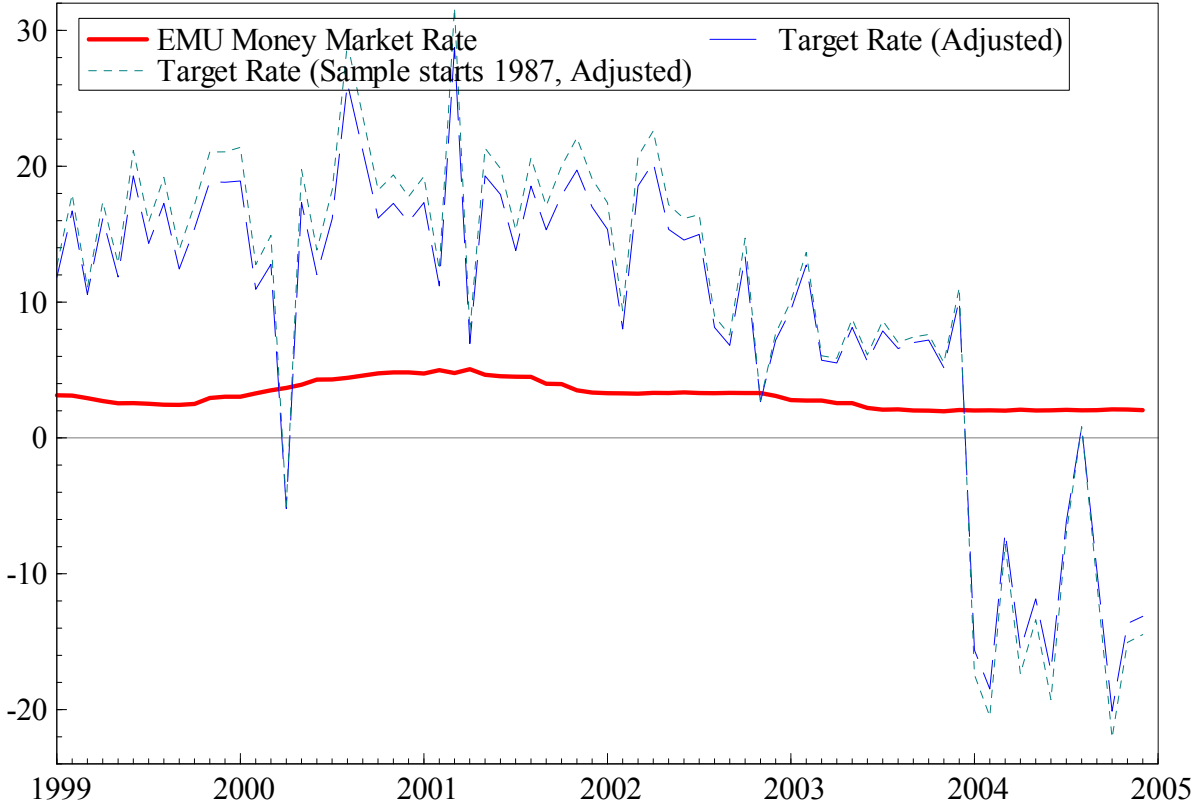
the euro area rate is quite close to the target rates. The exception is 2001, where a counterfactual Dutch central bank would have set a substantially higher interest rate. Since the target rate based on estimates without the German interest rate is more volatile and often becomes negative in 2003 and 2004 it does not appear to be very plausible.

Figure 9: Netherlands: Target Rates and Euro Area Money Market Rate (in %)



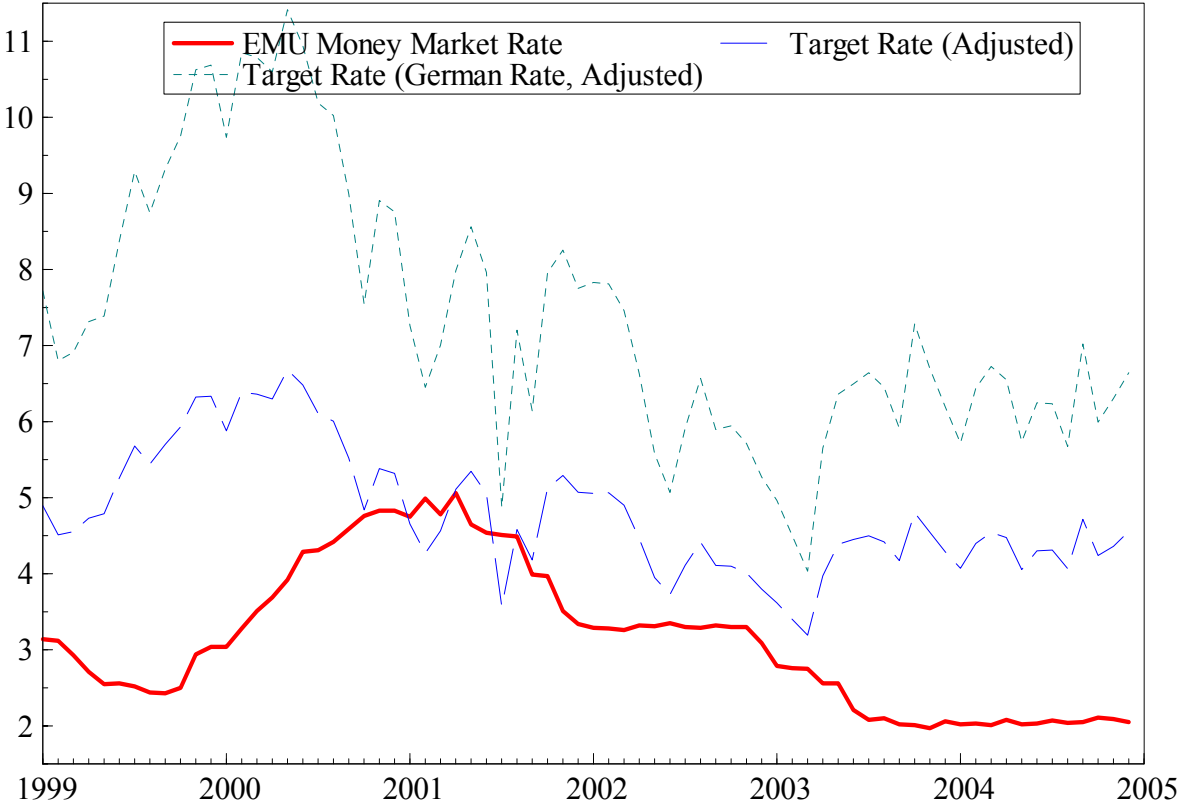
The simulations for Portugal in Figure 10 do not appear to be very plausible, especially in the later part of the sample. The rates are systematically above the euro area rate until they become negative from 2004 onwards. A look at the data indicates that the substantial drop of industrial production in combination with the excessively large coefficient on the output gap is responsible for this outcome.

Figure 10: Portugal: Target Rates and Euro Area Money Market Rate (in %)



Finally, Figure 11 displays the simulated interest rate paths for Spain. The target rates based on the estimates without the German interest rate are consistently above the euro area rate over the full sample. The alternative target rate indicates that euro area rates are below counterfactual Spanish rates in 1999 and the first half of 2000. In the following period until the end of 2001, actual interest rates appear to be extremely close to the target rates. In 2002 the target rates are somewhat higher and the fall in actual rates from 2003 onwards stands in contrast to an increase in the target rates, resulting in a notable gap at the end of 2004.

Figure 11: Spain: Target Rates and Euro Area Money Market Rate (in %)



Summarising these findings in a more quantitative manner, Table 4.3 shows the difference between the euro area interest rate and the respective target rates over countries and years for the target rate based on Taylor rule estimates without the German interest rate. Concentrating first on the country averages in the last column of the table, we find that in almost all countries actual euro area rates are below counterfactual target rates. There is one case where interest rates under the ECB regime are higher than under a continuation of its national monetary policy regime, namely Germany. This result is particularly affected by the year 2002, where counterfactual German target rates are more than 2 percentage points above the euro area rates. The biggest deviations in absolute values are computed for Portugal, followed by the Netherlands and Spain. Note that particularly in the case of the Netherlands, using the estimates including the German interest rate would result in lower deviations. Second,

analysing the results across years, we give the sum of these deviations over countries in a particular year in the second line from the bottom of the table. It becomes apparent that the largest deviations occur in the first two years, where euro area interest rates were particularly low compared to our estimates of the counterfactual national monetary policy regimes. In 2001 the average deviations across countries are smaller, in absolute terms, and they are close to zero in 2002. In 2004, the deviations turn positive but this is only due to the value for Portugal which has already been characterised as not particularly plausible. As indicated above, at least in 2003 the estimates for Ireland are also a bit dubious. The sum for every year without Ireland and Portugal, given in the last line of the table, yields a similar conclusion for the first two years of EMU: euro area rates are lower than what would have been set by national central banks on average. The average difference is only slightly negative in 2001, 2002 and 2003. For 2004, however, we can see that in a number of countries the target rates suggest that a tighter monetary policy would have been appropriate. This re-iterates the message from comparing ECB target rates and actual money market rates in Figure 1.

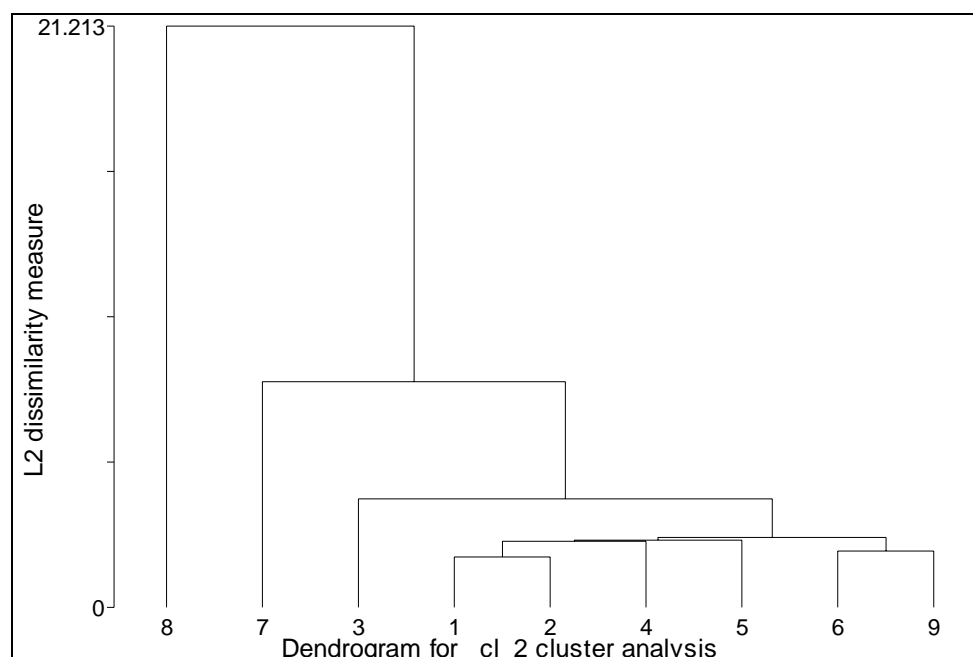
Table 3: Difference between EMU Money Market Rate and Adjusted Target Rates (in percentage points)

	1999	2000	2001	2002	2003	2004	Sum
Austria	-1.2	-1.6	0.1	0.7	-0.5	-1.7	-4.3
Belgium	-1.3	-0.5	1.2	0.3	-1.0	-2.4	-3.8
Finland	-3.5	-3.9	-0.6	0.2	1.3	0.4	-6.0
France	0.2	0.0	-0.2	-0.5	-1.1	-1.7	-3.2
Germany	-0.2	-0.8	1.3	2.3	-0.2	-1.3	1.1
Ireland	-6.4	-2.9	0.2	6.1	-1.0	n.a.	-4.0
Italy	-1.9	-1.8	-0.5	-1.3	-1.0	-0.5	-7.0
Netherlands	-3.4	-10.0	-5.4	-1.2	3.6	1.0	-15.4
Portugal	-12.6	-10.8	-12.6	-8.8	-5.3	14.3	-35.7
Spain	-2.6	-1.8	-0.4	-1.0	-1.8	-2.3	-9.9
Sum	-32.8	-34.1	-16.9	-3.3	-7.0	5.7	
Sum (without Ireland and Portugal)	-13.9	-20.4	-4.5	-0.5	-0.7	-8.5	

Note: This compares the simulated interest rate functions *without* the German rate only.

To get a better understanding of how the differences between the EMU money market rate and national target rates are related across time and countries, we make use of a statistical clustering method. Using the nearest neighbour technique we perform a hierarchical cluster analysis. In a first step, we look for particular clusters among countries over the time period (we drop Ireland due to missing observations in 2004). The resulting dendrogram is given in Figure 12.

Figure 12: Dendrogram of Country Clusters



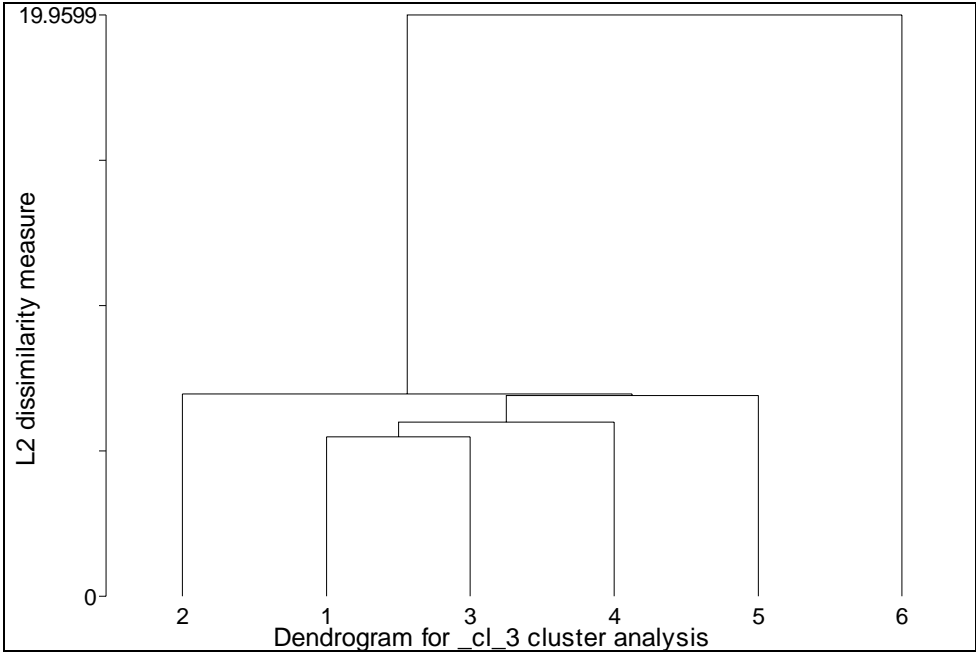
Notes: Country codes are: Austria: 1, Belgium: 2, Finland: 3, France: 4, Germany: 5, Italy: 6, Netherlands: 7, Portugal: 8, Spain: 9. This compares the simulated interest rate functions *without* the German rate only.

The deviations of target rates from actual interest rates in Austria, Belgium, France, and Germany are particularly similar over the time period. Italy and Spain form a relatively close cluster. The Netherlands, Finland, and particularly Portugal are the outliers.

Looking for particular clusters with regard to the deviations of adjusted target rates from the EMU money market rate among the various years of our sample period, we get the dendrogram in Figure 13. The years 1999 and 2001 form a cluster, and 2002 is still quite close. 2003 and 2000 are different. The deviations of the adjusted target rates from the EMU money market rate are particularly different in 2004 compared to the other years. This is due

to the fact that in this year the target rates of many countries tend to be well above the actual EMU money market rate.

Figure 13: Dendrogram of Country Clusters



Notes: Year codes are: 1999: 1, 2000: 2, 2001: 3, 2002: 4, 2003: 5, 2004: 6. This compares the simulated interest rate functions *without* the German rate only.

5 Conclusions

In this paper, we ask the question whether interest rate paths in most of the current member countries of EMU would have been different if the previous national central banks had not given up control over monetary policy. Using estimates of monetary policy reaction functions over the last 20 years before the formation of EMU, we derive long-run Taylor rules for interest rate setting conditional on the expected one-year ahead inflation rate and the current output gap. These Taylor rules are employed in the simulation of counterfactual interest rate paths over the time period January 1999 to December 2004, which are then compared to actual short-term interest rates in the euro area. This study does not address the question of

whether the deviations from the *optimal* interest rate paths are higher under EMU than they were during the respective national regimes.

The estimation of monetary reaction functions follows Clarida *et al.* (1998), where a single equation is estimated using GMM. In contrast to their approach, the present study applies a novel way of selecting instruments that avoids weak instrument biases and removes some arbitrariness in the selection process. In an alternative specification, the German short-term interest rate is also included in the analysis to account for the membership of some countries in the EMS. It turns out that the estimations of reaction functions are sometimes not robust or even plausible; for instance, the results for Ireland and Portugal raise some questions.

With respect to the core research question, we can summarise the results as follows. Perhaps not surprisingly, most countries would have set interest rates differently to what the ECB did over sometimes prolonged periods of time. More specifically, ECB interest rates tend to be below the national target interest rate even after explicitly accounting for a lower real interest rate in the EMU period. This is particularly true for the years 1999 and 2000, while the actual euro area rates were more appropriate for most countries in 2001 and 2004, and on average very close to the target rates in 2002 and 2003. However, for Germany the sum of actual money market interest rates over this five year period is higher than the sum of the counterfactual national target rates. Under a counterfactual Bundesbank regime, the interest rates would have been below euro area rates in 2001 and especially in 2002. There is a cluster of countries that experience relatively similar deviations of national counterfactual target rates from actual interest rates, consisting of Austria, Belgium, France, and Germany. Portugal and to a lesser extent the Netherlands tend to show a strikingly different pattern in this respect. Clustering over years indicates that 2004 is the main outlier, particularly due to a number of

national target rates suggesting an increase in interest rates, while euro area rates remain unchanged.

To conclude, almost all countries in our counterfactual simulation realise lower nominal interest rates by being members of EMU when compared to a continuation of the previous national monetary regime. In other words, if EMU had not come about, the respective countries would have experienced more restrictive monetary policies than under the ECB regime. This gain in terms of lower interest rates is a result of the high credibility imported by becoming a member of the ECB. Thus, it seems implausible to explain the rather disappointing average GDP growth rates by pointing to excessively high euro area interest rates. On the other hand, these results do not answer the question of whether the deviations from an optimal interest rate path are now lower than they were under the national regimes.

The only exception is Germany, which may have had to cope with a somewhat higher interest rate under the ECB regime compared to a continuation of the former Bundesbank regime. The explanation of this outcome is straightforward: German interest rates were already low before the creation of EMU but due to a substantial negative output gap in some years it found the ECB rates relatively too high. So while it is difficult to argue that the common monetary policy was the cause of the dismal growth performance of the German economy, as it benefited from relatively lower rates in 1999 and 2000, it may be the case that in some years EMU exacerbated the situation to a certain extent. It is important to note that this does not prove that Germany is relatively worse off as a member of EMU, as the other countries' interest rate levels would have been higher under a continuation of the former national monetary policy regimes. The interest rate impulse generated by joining EMU is likely to have affected economic growth positively in these countries. The export-oriented economy of Germany would have participated from this relative expansion of the other European

economies, which would have helped to stabilise German output. However, within the current framework, we cannot analyse the net result of these two diverging effects. Finally, it is interesting to note that in 2004 German target rates would have been about one percentage point higher than the actual euro area rates. Even given the increase in the euro area money market interest rate at the end of 2005 to about 2.5%, this suggests that for the last two years the ECB regime has provided an additional stimulus for Germany too.

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Notes

¹ The data source is the *International Financial Statistics* (online access) published by the International Monetary Fund. In the case of Ireland, due to data availability, producer prices were used instead of consumer prices. Interest rates were missing in the case of France from 1986:3 to 1986:6. Values were added based on a linear adjustment between these dates.

² Clausen and Hayo (2006) estimate a small-scale macroeconomic model of Germany, France and Italy based on quarterly data that allows for a simultaneous influence of the German interest rate on the monetary policy reaction functions in the other countries. They find a significant impact at the 10% level of the German rate on the dynamic French reaction function but no significant effect in Italy.

³ It may also be the case that the exchange rate plays a much larger role for monetary policy in the smaller countries of our sample and thus using a standard Taylor rule is not appropriate.

⁴ Note that the estimates for the ECB are taken from Hayo and Hofmann (2006), who use a sample from 1999:1 to 2004:5.

