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IN THE EMU AREA**

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# ABSTRACT

## The Taylor Rule and Interest Rates in the EMU Area*

We demonstrate that average interest rates in the EMU countries in 1990–8, with the exception of the period of exchange market turmoil in 1992–3, moved very closely in relation to average output gaps and inflation as suggested by the Taylor Rule.

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# NON-TECHNICAL SUMMARY

The establishment of the Euro on January 1, 1999, has raised questions regarding how the European Central Bank should conduct monetary policy. While there is little debate regarding the desirability of the ECB's adoption of price stability – defined as Euro-area wide inflation of between 0–2% – as its overriding policy objective, the exact policy framework used to pursue this goal is more controversial. The current policy framework is based on two 'pillars'. The first of these is a 'reference value' for the growth of M3, which is computed in much the same way as the Bundesbank computed its monetary targets. The use of the reference value has therefore been seen by some observers as providing continuity with the policy framework used by the Bundesbank, which is seen as helpful in light of the very low inflation rates Germany experienced in recent decades. In contrast to the Bundesbank, however, the ECB has made clear that the 'reference value' for M3 growth should not be interpreted as a monetary target. One interpretation of this announcement is that M3 is *primus inter pares* among the different indicators used in setting policy. The second 'pillar' relied on when setting interest rates is given by a broad-based assessment of the inflation outlook. A possible interpretation of this is that it constitutes an inflation-targeting component of the overall framework.

Recently several authors have discussed the potential use of the Taylor Rule – according to which the central bank increases interest rates by 150 basis points per percentage point increase in inflation, and by 50 basis points per percentage point increase in the output gap – when setting policy in the EMU area. Of course, there is no substitute for policy judgement when determining the stance of monetary policy, and such a rule could not be used in a mechanistic manner. However, it could nevertheless be used, it has been argued, as an informal benchmark when determining the appropriate level of interest rates. Thus, policy makers could use the Rule to get a sense of the plausible range for interest rates, but would be free to exercise their judgement and let policy-controlled interest rates deviate from the level suggested by the Rule.

There are three reasons why this approach may be attractive. First, there is a growing body of evidence suggesting that many central banks operating without an intermediate exchange rate objective do move interest rates in much the same way as suggested by the Taylor rule. It can, therefore, be argued that central banks in fact behave as if this rule is a good starting point when setting policy. Second, it has been demonstrated in the literature that within the framework of small econometric models for the EMU area and the US, the Taylor Rule provides a degree of macroeconomic stabilisation close to

that offered by an optimal rule. Third, using a rule known to the public may help reduce uncertainty about the future course of monetary policy and thus help avoid unnecessary macroeconomic instability.

The purpose of this short paper is to show that the Taylor Rule captures the behaviour of average interest rates in the countries constituting the EMU area in the 1990–8 period, with the exception of the period of exchange market turbulence in 1992–93, extremely well. Hence, adopting such a rule as a rough guideline for policy would lead to interest rates with the same correlation to average output gaps and inflation as in the past and would, in this sense, offer some continuity in the setting of monetary policy in the EMU area.

# 1.    Introduction

The establishment of European monetary union (EMU) raises important questions regarding how the European Central Bank (ECB) should conduct monetary policy. The ECB has announced that it will pursue its overriding objective of price stability using a policy framework consisting of three components: a numerical definition of price stability, a "reference value" for the growth of M3, and a broad-based assessment of the inflation outlook.[1] Recently several authors, including Peersman and Smets (1998) and Taylor (1998a,b), have discussed the potential usefulness of the Taylor rule (Taylor (1993), TR hereafter) as an informal benchmark for setting policy in the EMU area.[2] There are two reasons why this approach may be attractive. First, Peersman and Smets (1998) demonstrate that within the framework of a small econometric model for the EMU area (as Rudebusch and Svensson (1998) do for the US) a TR provides a degree of macroeconomic stabilisation close to that offered by an optimal rule. Second, using a rule known to the public may help reduce uncertainty about the future course of monetary policy and thus help avoid unnecessary macroeconomic instability.

In this paper we show that a TR captures the behaviour of average interest rates in the EMU area in the 1990–1997 period, with the exception of the period of exchange market turbulence in 1992–93, extremely well. Hence, adopting such a rule as a rough guideline for policy would lead to interest rates with the same correlations with average output gaps and inflation as in the past and would in this sense offer some continuity in the setting of monetary policy in the EMU area.

# 2.    Preliminaries

The TR is given by:

$$(1) \qquad i_t = r^{eq} + \pi_t + 0.5\big\{ y_t + ( \pi_t - \pi^{ob} ) \big\}$$

where $i_t$, $r^{eq}$, $\pi_t$, $\pi^{ob}$ and $y_t$ denote the nominal interest rate, the equilibrium real interest rate (assumed constant), the rate of inflation over the past year, policymakers' inflation objective, and the output gap, respectively. To calculate the interest rate implied by the TR, we need data on EMU-wide output gaps and inflation, and assumptions regarding the policymakers' inflation objective and the equilibrium real interest rate.

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[1]    The ECB has made clear that the "reference value" for M3 should not be interpreted as a target.

[2]    Of course, if such a rule were adopted, it should be used in a flexible manner, and interest rates should be allowed to deviate from it in response to major unexpected disturbances.

*Inflation and output gaps in the EMU area.* Quarterly data on the output gaps for the EMU countries were constructed by interpolating annual/semiannual data on output gaps from the OECD. Inflation was defined as the annual change in quarterly averages of national consumer price indices. Aggregation for the EMU area was done using fixed weights provided by the OECD (GDP for 1990 expressed in US dollars at PPP exchange rates).[3] Graph 1 shows the resulting measures of CPI inflation and the output gap for the EMU area (except Luxembourg).

*Inflation objective and equilibrium real interest rate.* We assume that the inflation objective in the EMU area during the period under consideration was 2%, as did Taylor (1993). Estimating the equilibrium real interest rate is more difficult. One possibility is to use a weighted average of ex post real interest rates. However, since countries in which the credibility of monetary policy is low have had relatively high ex post real interest rates, this strategy will lead to an overestimate of the likely equilibrium real interest rate in the EMU area. We therefore attempt to purge the part of the domestic ex post real interest rate that may be due to low credibility. To do so, we compute the average realised real interest rate – calculated as the three-month nominal interest rate minus the rate of CPI inflation over the past year – over the period 1982–1997, and the average depreciation of the nominal exchange rate against the Deutsche mark over the same period for 13 European countries.[4] Regressing the average real interest rate on a constant and the average rate of depreciation (dep), we obtain:

$$\text{real rate} \quad = \quad 3.55 \quad + \quad 0.56 \quad \text{dep} \quad + \quad \text{Error}$$
$$(10.4) \qquad (3.83)$$

(t-statistics in parenthesis) with $\overline{R}^2 = 0.53$. The "credibility adjusted" equilibrium real interest rate is given by the fitted value, assuming no depreciation vis-à-vis the Deutsche mark. The resulting estimate is 3.55%, with a standard error of 0.96%.

Graph 2 shows that the interest rate implied by the TR and a weighted three-month interest rate for the EMU-area are very close, except for the period around the turmoil in the European foreign exchange markets in 1992–93, and a brief spell in late 1994–early 1995.[5] Of course, since the TR was originally developed to capture the setting of policy rates in a closed economy, it is by no means surprising that the rule fails to account for the movements in the EMU-11 interest rate during the period of exchange market turmoil.

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[3] The weights are as follows: Austria, 2.9%; Belgium, 3.7%; Finland, 1.9%; France, 22.6%; Germany, 28.7%; Ireland, 0.9%; Italy, 21.2%; Netherlands, 5.5%; Portugal, 2.1%; and Spain, 10.5%.

[4] All western European countries for which data were available were included in the sample. The sample thus included both the EMU countries (except Luxembourg, Finland and Portugal, due to data constraints) and Denmark, Norway, Sweden, Switzerland and the United Kingdom. The real interest rates were calculated on the basis of three-month eurorates, which typically did not deviate very much from the policy rates in the different countries.

[5] The observation for 1999:1 is given by the actual three-month Euribor rate.

## 3.      Econometric estimates

Next we regress the actual interest rate in the EMU area on the EMU output gap and inflation rate, and include dummies for the period 1992:3–1993:3 to control for policy responses to intra-European exchange market pressures in this period. The first column of Table 1 shows that the weight on the gap (0.45) and the weight on inflation (1.58) are strikingly close to those of the TR and highly significant. Not surprisingly, a Wald test does not reject the joint ("Taylor") hypothesis that the coefficient on the output gap is 0.5 and the coefficient on inflation is 1.5 (p = 64.1%). Furthermore, the dummies are strongly significant, and indicate that during the period of exchange market turmoil the weighted EMU-11 interest rate peaked in the fourth quarter of 1992 at a level 3.2% above the level expected on the basis of the TR. Since the Q-statistic reveals strong serial correlation, we re-estimated the equation allowing for AR(1)-residuals.[6] The results in the second column are similar to those in the first except that the Q-statistic no longer indicates any autocorrelation of the residuals. The estimate of the autocorrelation coefficient, $\rho$, is 0.32, indicating that half of a deviation is undone in about 0.47 quarters.

We end the empirical section by following Clarida, Galí and Gertler (1998, CGG hereafter) and estimate reaction functions of the type:

$$(2) \qquad i_t = \alpha + \beta E_t \pi_{t+4} + \gamma y_t + \theta z_t + \delta i_{t-1} + \varepsilon_t$$

where $z_t$ denotes an additional variable.[7] As in CGG, we let this be either the lagged inflation rate ($\pi_{t-4}$), the federal funds rate, money growth or the change in the real euro/US dollar exchange rate over four quarters. The results are available in Table 2. The "benchmark" results shown in the first column of the table indicate that the inflation rate is highly significant and the short-run elasticity is 1.51. The short-run elasticity of the interest rate with respect to the output gap is 0.28 and significant at the 10% level. While this significance level is lower than the estimates for the Bundesbank reported by CGG, it should be remembered that the estimation period used here is much shorter.

Calculating the long-run elasticities, we note that they are 1.84 for inflation and 0.34 for the output gap. The fact that the coefficient on inflation is larger, and the coefficient on the output gap is smaller, when <u>future</u> rather than <u>current</u> inflation enters the regression suggests that central banks react to the output gap because it contains information about future price pressures. Since the results also indicate somewhat surprisingly that the lagged interest rate is not significant, the long-run elasticities provided

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[6]   This serial correlation may be due to omitted variables, or gradual responses of central banks to output and inflation.

[7]   We are grateful to an anonymous referee for suggesting this exercise. The equations are estimated using GMM, with $\pi_{t+4}$ instrumented by a constant, the current inflation rate, the current output gap, the lagged interest rate and any other variable entering the model. Following CGG, we also use the lagged level of the real exchange rate in the regression in which the change in the real exchange rate enters among the regressors. Instead of using dummies for the 1992:3–1993:3 period, we drop these observations from the estimation period.

in the lower panel of the table are quite imprecisely estimated and it is not possible to reject the hypothesis that they are 1.5 and 0.5 as posited by Taylor (1993).

We next follow CGG and include a further variable in the analysis. In the second column of the table we add the inflation rate at time t–4 among the regressors; in the third column the growth rate of M3 in the euro area; in the fourth column the current federal funds rate; and in the fifth column the change over four quarters in the real euro/US dollar exchange rate. The future inflation rate remains strongly significant, except when money growth enters the equation. The output gap is typically also significant. While the coefficient on the federal funds rate is significant (but negative), the other variables are in all cases insignificant. All in all, these results suggest that the benchmark specification in the first column of the table does a good job of capturing the evolution over time of the EMU-11 interest rate.[8]

# 4.    Conclusions

The results presented suggest that if the ECB were to conduct monetary policy using the TR, it would in fact not deviate much from past (weighted) interest rate setting behaviour in the countries forming the EMU area.

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[8]    The fact that the Q-statistic indicates some fourth-order serial correlation may be because of the overlapping prediction interval arising from the use of inflation expected four quarters ahead, or because of an omitted serially correlated variable.

# Table 1

## Sample period 1990:1–1998:4

Dependent variable: level of EMU-11 interest rate

| | | |
|---|---|---|
| Constant | 2.40*** | 2.65*** |
| | (0.30) | (0.39) |
| $y_t$ | 0.45*** | 0.49*** |
| | (0.06) | (0.12) |
| $\pi_t$ | 1.58*** | 1.51*** |
| | (0.09) | (0.11) |
| Dummies | | |
| 1992:3 | 2.30*** | 2.37*** |
| | (0.36) | (0.35) |
| 1992:4 | 3.24*** | 3.28*** |
| | (0.35) | (0.37) |
| 1993:1 | 2.70*** | 2.80*** |
| | (0.37) | (0.40) |
| 1993:2 | 1.63*** | 1.73*** |
| | (0.38) | (0.41) |
| 1993:3 | 0.55 | 0.63 |
| | (0.39) | (0.38) |
| $\rho$[1] | | 0.32* |
| | | (0.19) |
| Q-stat.[2] | 1.8% | 9.0% |
| Wald test[3] | 64.1% | 97.7% |
| Adj. R-squared | 0.98 | 0.98 |

Note: */**/*** denote significance at the 10%/5%/1% level, standard errors in parenthesis.

[1] First-order autocorrelation coefficient for errors. [2] p-value, null hypothesis of no fourth-order serial correlation. [3] p-value, null hypothesis that coefficient on income is 0.5 and on inflation is 1.5.

**Table 2**

**Sample period 1990:1–1998:1**

**(dropping 1992:3–1993:3)**

Dependent variable: level of EMU-11 interest rate

| | | | | | |
|---|---|---|---|---|---|
| | 1.95*** | 2.36** | 1.76*** | 3.68** | 1.40** |
| | (0.62) | (0.95) | (0.44) | (1.53) | (0.57) |
| $\pi_{t+4}$ | 1.51** | 1.62*** | 0.98 | 1.54** | 1.20* |
| | (0.44) | (0.47) | (0.64) | (0.72) | (0.70) |
| $y_t$ | 0.28* | 0.22* | 0.32** | 0.29 | 0.23** |
| | (0.16) | (0.11) | (0.14) | (0.21) | (0.11) |
| $i_{t-1}$ | 0.18 | 0.34** | 0.46 | 0.15 | 0.34 |
| | (0.20) | (0.14) | (0.30) | (0.36) | (0.32) |
| Additional variable | — | Lagged inflation | Money growth | Fed. funds rate | Real euro/\$ rate |
| | | –0.56 | –0.07 | –0.28** | –0.03 |
| | | (0.56) | (0.07) | (0.13) | (0.02) |
| Q-stat.[1] | 1.3% | 5.5% | 3.0% | 2.7% | 17.8% |
| Adj. R-squared | 0.91 | 0.91 | 0.94 | 0.92 | 0.95 |

Implied long-run elasticities
(with p-values for tests of the hypotheses that the long-run elasticities equal 1.5 and 0.5 respectively)

| | | | | | |
|---|---|---|---|---|---|
| $\pi$ | 1.84 | 1.61 | 1.81 | 1.81 | 1.82 |
| | (25.7%) | (76.6%) | (41.7%) | (36.5%) | (41.4%) |
| $y$ | 0.34 | 0.33 | 0.59 | 0.34 | 0.35 |
| | (54.5%) | (45.6%) | (84.4%) | (59.1%) | (63.1%) |

Note: */**/*** denote significance at the 10%/5%/1% level. The equations are estimated using GMM, with $\pi_{t+4}$ instrumented by a constant, $\pi_t$, $y_t$, $i_{t-1}$ and any other variable entering the model. Money growth and the real euro/US dollar rate are measured as a change over four quarters.

[1] p-value, null hypothesis of no fourth-order serial correlation.

Graph 1

GDP-weighted output gap and CPI inflation in the euro area
in percentages
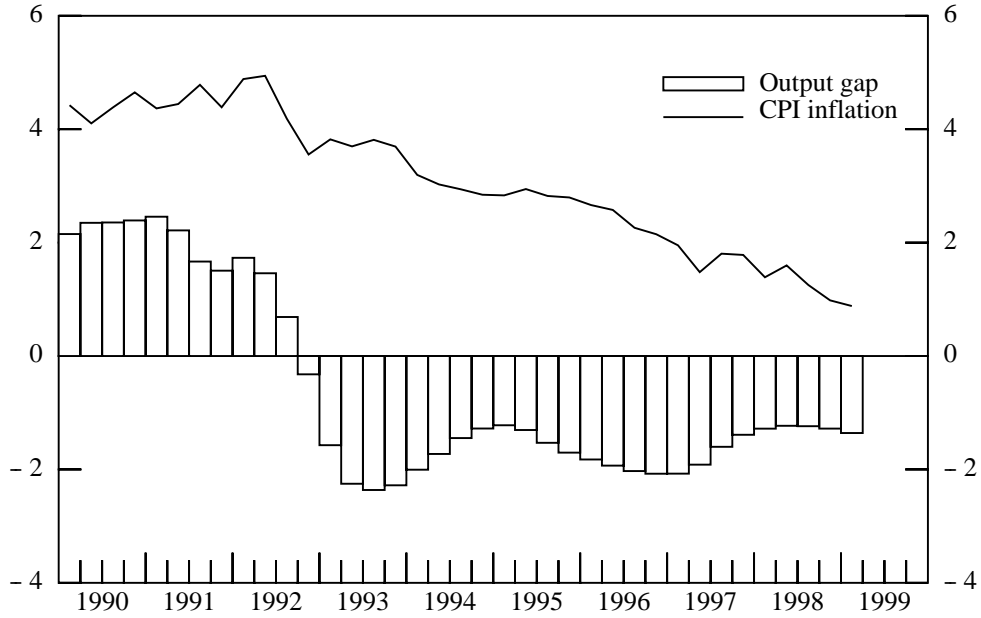


Graph 2

GDP-weighted three-month interest rate in the euro area together
with interest rate implied by the TR; in percentages
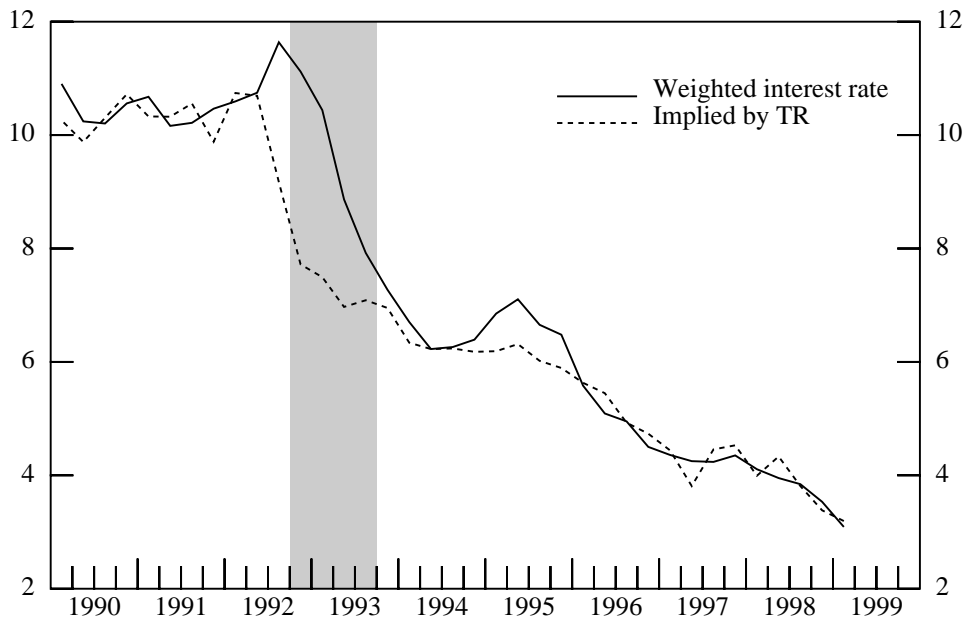


Note: The shaded area marks a period of exchange market turmoil.

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