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Has the European Central Bank Followed a Bundesbank Policy? Evidence from the Early Years

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I. Introduction

One of the recurring issues in discussions surrounding the establishment of the European Central Bank (ECB) was the extent to which the ECB would and should be modelled after the German Bundesbank.[1] Today, European monetary policy is still frequently compared to what is believed the Bundesbank would have done in similar circumstances. Experience with ECB policy since January 1, 1999 is still limited, but the ECB has faced a some changes in economic conditions: periods of slow and faster economic growth, upward pressure in the rate of inflation, high monetary growth and cycles in exchange rates. With this experience of Euro-area monetary policy it is becoming possible to examine whether the ECB has in fact followed a typical Bundesbank policy.

To compare ECB and Bundesbank policy, I examine the extent to which the ECB has changed short-term interest rates according to a typical Bundesbank reaction function. Section II. briefly surveys previous research on the Bundesbank's reaction function. In section III. I re-estimate the Bundesbank reaction function as suggested by Clarida, Gali and Gertler (1998), using data through 1998. From 1999 actual and hypothetical Euro-area interest rates derived from this reaction function are compared to examine the level of congruence. Section IV. presents conclusions.

* I gratefully acknowledge suggestions by Casper de Vries, Ivo Arnold. All errors are my own.

[1] For a recent analysis and review of the literature, see *Debrun* (2001). Note that, technically speaking, Euro-area monetary policy is determined by the Eurosystem part of the European System of Central Banks (ESCB) and not the ECB. However, I will continue common practice and refer to the ECB. Official and semiofficial descriptions of ECB policy can be found in *ECB* (2001) and *Issing* et al. (2001).

II. Previous Estimates of the Bundesbank Reaction Function

A reaction function measures how the instruments of monetary policy, the vector I_t, react to the central bank's information about the economy, vector Z_t. Theoretically, a reaction function such as equation (1)

$$I_t = BZ_t \tag{1}$$

can be derived from an optimal-control problem where the policymaker has quadratic preferences over economic outcomes and a linear model of the economy. The reduced-form coefficients in matrix B incorporate the policymaker's model, as well as the policymaker's weights on achieving different objectives and the values of these objectives. In theory, the variables in the reaction function and its interpretation are clear. In practice, the choice of variables is flexible (or ad hoc) and estimated reaction functions are difficult to interpret, because the contributions of the model, preferences and target values cannot be clearly identified.[2] Despite these obstacles to interpretation, reaction functions are regularly estimated and used to analyse actual monetary policy and to compare monetary policy between countries.[3]

A reaction function requires an appropriate indicator of monetary policy actions. It is well known that the selection of such an indicator for monetary policy actions is not without problems. This issue permeates the large literature on VAR models and Granger-causality tests of monetary policy effects. In general, it is known that money aggregates such as M1, M2 or M3 make little sense as indicators of policy actions, except, possibly, in studies using low frequency data (e.g. annual) and when the monetary authority uses the money aggregate as an intermediate target. In the short run, money aggregates tend to reflect mostly endogenous responses to the state of the economy, money demand, and not policy actions, or money supply. Generally, any emphasis on single policy instruments, such as official interest rates, is also not correct because monetary authorities can use other instruments, such as open market operations or reserve requirements, to implement policy decisions. However, in many countries official interest rates are used as signalling de-

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2 Previous researchers have also stressed the possible temporal instability of the reaction function, caused by changes in the economy, the model and shifts in policy regime (preferences and target values). *Khoury* (1990), who examined 42 previously estimated reaction functions for the Federal Reserve, found them to be sensitive to arbitrary details of the specification.

3 For example, *Clarida*, *Gali* and *Gertler* (1998).

Table 1

Survey of Bundesbank reaction function studies

Study	Dependent variable	Sample period	Policy target variables						
			p	y	u	e	ca	r^{us}	m
Befahy (1972)	r^{dis}	61:I–71:I	++	0	0		--		
Black (1983)	r^{dis}	63:1–79:12	++		--		-	++	
Koskela, Virén (1990)	Δr^{dis}	68:III–89:I	++	++			--		
Schächter, Stokman (1995)	r^{dis}	75:II–90:IV	++[b]	++		0	--	++	0
Bernanke, Mihov (1997)	r^{lomb}	75:01–90:06	**[a]	0[a]		0[a]			**[a]
Willms (1983)	r^{3m}	62:II–82:II	++	0	0				
Hodgman, Resek (1983)	r^{3m}	68:II–81:IV	++	++		++		++	
Clarida, Gertler (1997)	r^{day}	74:09–93:09	++[a]	++					
Bernanke, Mihov (1997)	r^{call}	75:01–90:06	**[a]	0[a]		0[a]			0[a]
Clarida et al. (1998)	r^{day}	79:03–93:12	++[a]	++		++		++	0
Willms (1983)	ΔCBMS	73:I–82:II	--	-	0				
Laney (1985)	ΔCBMS	75:I–83:IV	--	0	--	0			
Trehan (1988)	CBMDEV	75:I–86:IV	--	++		--			
Von Hagen (1995)	ΔM3DEV	1979–1989	--			--			
Neumann (1997)	ΔM3DEV	1979–1994	--	0		--			

Effects of policy target variables indicated as follows: ++ and -- significant effect at 5% level positive and negative, + and – significant effect at 10% level, 0 not significant at 10% level. ** and * refer to sign of effect unreported.
[a] Refers to expected, forward looking variables
[b] Price effect refers to asymmetric, positive deviations from target

vices to communicate important policy decisions. The current consensus in the literature is that short-term market interest rates represent the most appropriate single indicator of monetary policy actions. The degree of accuracy of this indicator depends very much on actual operational strategies of central banks, but at least from the early 1980s monetary authorities in most industrialised countries have chosen to target the average level of money market interest rates (see Kneeshaw and Van den Bergh, 1989; Borio, 1997).[4]

There exist a substantial number of empirical studies into the Bundesbank's reaction function. Table 1, adapted and updated from Schächter and Stokman (1995), presents the stylised results of a selection of these studies. Apart from differences in data periods, the studies also differ because researchers select different indicators of monetary policy ac-

[4] For a somewhat more detailed and complicated view see *Bernanke* and *Mihov* (1998).

tions, select different target or information variables as explanatory variables, use different transformations of the data (levels, growth rates, target/trend deviations), and use different approaches to non-linear policy responses (positive/negative, thresholds) and regime shifts (sample period, shift dummy). The summary of studies presented in Table 1 suggests that it is not easy to point to a single preferred reaction function to capture the monetary policy of the Bundesbank. For the purpose of this paper, we ignore the results of estimates for the monetary aggregates (central bank money stock CBMS, or aggregate M3). As mentioned before, they are relevant, at most, for low frequency policy strategy analysis, whereas our analysis deals with short-run monthly observations. Focusing, therefore, on the equations for official interest rates (discount rate r^{dis} or Lombard rate r^{lomb}) and market interest rates (3-month rate r^{3m} or call/day rate r^{call}) we find that inflation/prices p (either backward or forward looking), foreign interest rates r^{us} and the current account ca, are the variables that are consistent and significant in the studies that examine their effects. Across studies, the systematic reaction of the Bundesbank to economic activity variables y and exchange rate e is somewhat inconclusive. The effect of unemployment u and money m is found to be doubtful or negligible.

III. The ECB Interest Rate and Bundesbank Reaction Function

1. Estimating the Bundesbank Reaction Function

Despite the mixed results in the existing empirical literature, we must select one preferred equation to represent the reaction function of the Bundesbank. I choose to build on Clarida et al. (1998) and their estimation of the Bundesbank's reaction function in recent years. They assume that in more recent periods central banks in general have used a reaction function in which their target for the short-term money market rate depends mainly on expected future inflation and current economic activity. The target interest rate r^* follows

$$r_t{}^* = rr + \pi_t{}^* + \beta\,(E\,[\pi_{t+n}|\Omega_t] - \pi_t{}^*) + \gamma\,E\,[y_t|\Omega_t] + \xi\,E\,[z_t|\Omega_t] \qquad (2)$$

where $r_t, rr, \pi_{t+n}, \pi_t{}^*$ and y_t are the nominal money-market interest rate, the (constant) equilibrium real interest rate, inflation from time t to $t+n$, inflation target and the output gap. Variable z represents other factors that may influence monetary policy. $E[z_t|\Omega_t]$ denotes the expectation of variable z conditional upon information available at time t.

In addition, it is assumed that the actual interest rate partially adjusts to new information that changes the target, as

$$r_t = (1 - \rho) r_t^* + \rho r_{t-1} + v_t \tag{3}$$

Parameter ρ represents the degree of interest rate smoothing.

Clarida et al. estimate the model

$$r_t = (1 - \rho)\{\alpha + \beta E[\pi_{t+n}|\Omega_t] + \gamma E[y_t|\Omega_t] + \xi E[z_t|\Omega_t]\} + \rho r_{t-1} + \nu_t \tag{4}$$

In this case coefficient α is defined as $rr + (1 - \beta)\pi^*$, assuming a constant inflation target. For estimation the unobserved expected variables are replaced with their actual realizations and the expectations errors are relegated to the residual of the equation. An instrumental variables estimation technique (i.e. GMM) is used to obtain estimates of the coefficients $\alpha, \beta, \gamma, \xi$, and ρ.

Clarida et al. estimate the Bundesbank reaction function for the period 1979:03–1993:12. The starting date March 1979 is when Germany entered the ERM and a regime shift or structural break in de reaction function is considered likely. Their sample ended with 1993 for two reasons. First, the possibly complicating effects of German unification caused Clarida et al to be reluctant to extend the analysis too far beyond 1990. They preferred to restrict their analysis to the data available for West Germany. Second, 12-months of data is required for the forward-looking inflation rate (n=12 months) which also limits the sample period. The estimates of Clarida et al. show that the Bundesbank systematically raised (real) interest rates when the expected annual inflation and/or the output gap increased. Lagged inflation and the money supply were found to be insignificant. The US federal funds rate and the (real) DM/$ exchange rate were found to be significant, but with only small effects.

I estimate the Bundesbank reaction function for the sample period extended to 1998.12. All the basic data correspond to the data used by Clarida et al. Inflation, output and the interest rate are measured by the consumer price index, industrial production, and the call money rate. The data for West Germany and unified Germany were ratio spliced together to obtain time series for the whole period.[5]

[5] In a preliminary investigation (results not reported here), I found no evidence that the results for the extended sample 1979–98 were very much different from those for the sample truncated in 1993 and using the data for West Germany only. In the extended sample, the Bundesbank's responses to expected inflation and

I also make some more fundamental changes to the estimation approach taken by Clarida et al. A different method is used to obtain measurements of the output gap. The Hodrick-Prescott filter with a smoothing parameter of 14400 for monthly data is used rather than a quadratic time trend.[6,7] Also, instead of assuming a constant target inflation rate as in Clarida et al., I will use the available data on the actual target rate. Published information shows that the target inflation rate (or 'unavoidable inflation') of the Bundesbank changed between 1979 and 1998, from 4% to 1.75%. The reaction function is rewritten as

$$\begin{aligned}(5)\qquad r_t - \pi_t^* = (1-\rho)\{rr + \beta\,(E\,[\pi_{t+n}|\Omega_t] - \pi_t^*) + \gamma\,E\,[y_t|\Omega_t] + \xi\,E\,[z_t|\Omega_t]\}\\ +\rho\,(r_{t-1} - \pi_t^*) + \nu_t\end{aligned}$$

There are two advantages to this change. First, because we will use this equation later as a benchmark for ECB policy, it requires a more explicit approach to any changes in the inflation target of the two central banks. In anticipation of this, we know that the inflation targets of the Bundesbank in the final years of the estimation period closely resemble the current inflation target of the ECB. However, in the early years of the estimation period this was not true. Consequently, we would bias the constant term of the equation and bias the comparison between Bundesbank and ECB policy. Second, preliminary examination of the data for stationarity failed to confirm Clarida et al.'s claim that inflation and the short-term interest rate are I(0) in the sample period 1979–98. In fact, standard ADF and Phillips-Perron test statistics only rejected the unit root hypothesis for the HP-filtered output gap and the gap between money stock and money target. Results for the money market rate and the quadratic trend based output gap were mixed, depending on the test statistic and the selection of lag lengths. The performance of the unit root tests on the quadratic trend based output gap demonstrates the well known poor power performance of these tests, particularly in short sam-

output are estimated to be a few basis points larger and smaller respectively, but not significantly.

6 A quadratic trend may sometimes provide a better in-sample fit than a linear trend. However, estimates show that in the case of German industrial production the quadratic curvature of the trend is reversed in the short and extended samples, invalidating the concept of a stable deterministic trend. Second, the quadratic trend implies explosive increases or decreases in economic growth, which is simply not plausible.

7 The literature provides no consensus on how to adjust the H-P filter smoothing parameter for the frequency of observations. Suggestions for monthly data range from 4800 to 129600. See *Ravn* and *Uhlig* (1997).

ples. By rewriting the reaction function as equation (5) the data problem can be mitigated, but is not completely solved. Nevertheless, I prefer to estimate the reaction function in levels. Besides invoking the argument of low power of the unit root tests, an important reason is to maintain comparability with Clarida et al.[8] The identification of policy is also an important argument. The short-term interest rate is closely, but not perfectly controlled by the central bank. Using first-differences of the interest rate with monthly data is likely to greatly increase the relative importance of short-term 'noise' or demand effects in the interest rate variable, and decrease the identification of systematic policy actions. Bernanke and Blinder (1992), in their canonical paper on the federal funds rate as an indicator of monetary policy, also suggest that first-differencing interest rates is not very sensible.

In Table 2 the estimation of the baseline equation indicates that the Bundesbank raised the *real* interest rate by 73 basispoints for each 1-percentage point increase in expected inflation. A 1-percentage point increase in the output gap raised the real interest rate by 45 basispoints.[9] Bundesbank policy was highly persistent; each month the interest rate is adjusted with only 10 percent of the gap between the previous actual and current target interest rate (a half-life of 7 months). The baseline equation exhibits significant serial correlation and heteroscedasticity of the residuals. The standard errors of the coefficients presented in Table 2 are assumed to be robust to the heteroscedasticity and serial correlation after Newey-West correction. The Chow breakpoint test indicates a significant difference between the pre- and post-1993:12 reaction function of the Bundesbank. However, this test may be doubling as evidence of the heteroscedasticity indicated by the White test. Finally, the J-test statistic indicates that the overidentifying restrictions of the baseline model are not rejected.

Of the variables added to the baseline equation in columns 3–6 of Table 2, lagged inflation and money-stock deviations from target are not significant. The federal funds rate and the real exchange rate are individually significant in the reaction function at resp. 5% and 1% levels.

[8] The alternative would be turn to a cointegration and error correction framework.

[9] Both the estimated response to expected inflation and the response to the output gap are larger than those reported by Clarida et al., i.e. 31 bp for expected inflation and 25 bp for the output gap. Because the output gap from the HP-filter trend is normally smaller than a linear or quadratic trend, the larger coefficient is to be expected.

Table 2

Bundesbank reaction function, 1979.03–1998.12

		Adding variables			
	Baseline	Lagged inflation[a]	Money supply[b]	Fed funds rate	Real DM/US$ rate[c]
constant	3.32	2.80	3.39	1.54	–0.13
	(0.26)	(0.52)	(0.34)	(0.83)	(0.89)
ρ	0.91	0.90	0.92	0.92	0.90
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
β	1.73	1.49	1.66	1.47	1.81
	(0.25)	(0.29)	(0.24)	(0.21)	(0.26)
γ	0.45	0.42	0.49	0.52	0.49
	(0.17)	(0.16)	(0.18)	(0.19)	(0.15)
ξ	...	0.20	–0.07	0.23	0.06
		(0.19)	(0.17)	(0.12)	(0.02)
Adj R^2	0.978	0.978	0.979	0.980	0.979
SEE	0.317	0.315	0.311	0.300	0.311
LM(12)	[0.067]	[0.059]	[0.200]	[0.539]	[0.260]
White	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Chow break 1993.12	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
J-stat	[0.798]	[0.798]	[0.469]	[0.005]	na

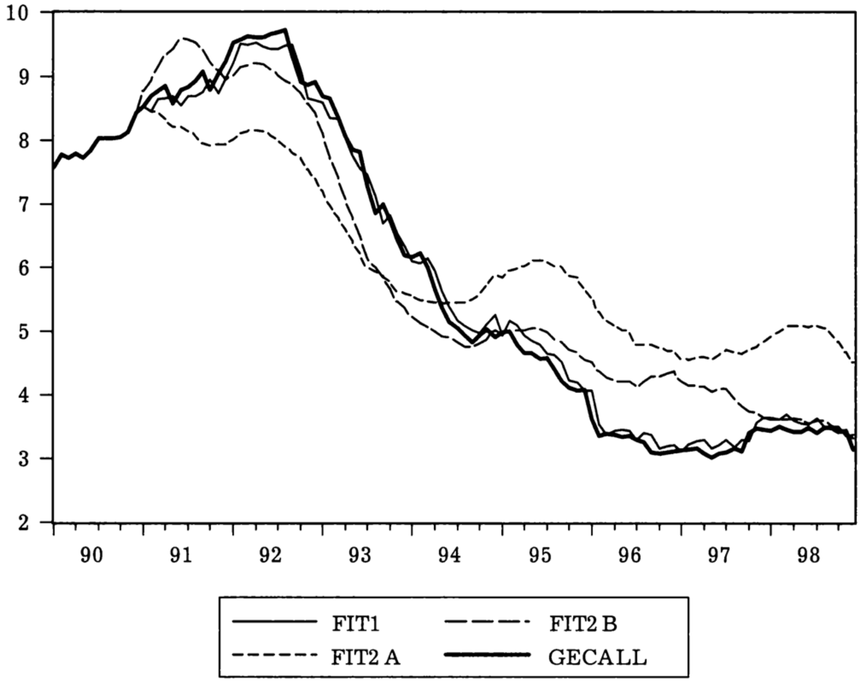
Estimated with TSNLS. Instruments are 1, y_{t-1} to y_{t-6}, y_{t-9}, y_{t-12}, Δp_{t-1} to Δp_{t-6}, Δp_{t-9}, Δp_{t-12}, r_{t-1} to r_{t-6}, r_{t-9}, r_{t-12}, Δo_{t-1} to Δo_{t-6}, Δo_{t-9}, Δo_{t-12}, Δq_{t-1} to q_{t-6}, Δq_{t-9}, Δq_{t-12}, z_{t-1} to z_{t-6}, z_{t-9}, z_{t-12}, where Δo is the log difference of a world commodity price index, Δq is the log difference of the dm/$ real exchange rate. Newey-West heteroscedastic and autocorrelation consistent standard errors in parentheses. Probability values in brackets for LM(12) Breusch-Godfrey test for serial correlation (12 lags), White (LM) test for heteroscedasticity, Chow (LR) test for structural break in 1993.12, and J-test (LM) for overidentifying restrictions.
[a] 12-month change in log CPI.
[b] Log difference between money stock and announced target path. Central Bank Money Stock before 1988, M3 after.
[c] Log dm/$ real exchange rate.

Their inclusion solves the problem of serial correlation. However, the R-square and standard error of the equation show that they contribute little to the explanation of the German interest rate beyond the explanatory power of the lagged interest rate, expected inflation and the output gap. When the federal funds rate and exchange rate are added to the model together (results not shown), their coefficients are not significant. This suggests that the federal funds rate and the exchange rate contribute more or less similar information. The J-test for the funds rate model indicates that the overidentifying restrictions are rejected. Apparently, lagged values of the federal funds rate contribute towards the explanation of Bundesbank behavior in ways other than through the federal funds rate in the Bundesbank's target value for the German call rate.

The model that includes the federal funds rate as an additional variable appears to be the preferred model in terms of explanatory power, albeit that the proper way to introduce the federal funds rate in the model is open to further examination. Figure 1 presents some perspective on the explanatory power of this Bundesbank reaction function in the period 1990–1998. The values of fit1 are the fitted (structural) values of the TSNLS procedure. Fit1 closely follows the actual German call rate, but this is very much a result of the strong smoothing effect incorporated in the lagged call rate. Values of fit2a and fit2b represent the result of a dynamic simulation using the fitted rather than the actual value of the lagged call rate. Future inflation is measured alternatively as actually realized future inflation (fit2b) and forecasted inflation (fit2a) derived from the series of monthly Consensus forecasts published in The Economist.[10] The use of actual future inflation is normally defended by an appeal to the rational expectations hypothesis. However, the literature is very critical of the rational expectations hypothesis or 'perfect-forecast-with-error' model as an adequate approach to real world expectations. Empirical studies frequently reject the testable implications of the rational expectations hypothesis. As an alternative to the rational expectations hypothesis fit2a is based on the coefficients estimated with the implicit statistical model of inflation expectations (i.e. the first-stage regression of the TSNLS) that covers the full estimation period, in combination with the inflation forecasts from The Economist that are available monthly from September 1990.

The series fit2a and fit2b in Figure 1 display broadly similar cyclical movements. However, fit2b is clearly superior in explaining the actual call rate. Of course, this result is somewhat biased because the TSNLS estimation produces an optimal in-sample fit based on the same actual

[10] Note that there exist no time series for monthly observations on 12-month inflation forecasts or expectations. The Economist publishes Consensus forecasts on annual average inflation rates. To obtain a proxy for 12-month inflation forecasts one or two of the annual values from The Economist are combined as a weighted average, using the remaining months from each year within the 12-month horizon as weights.



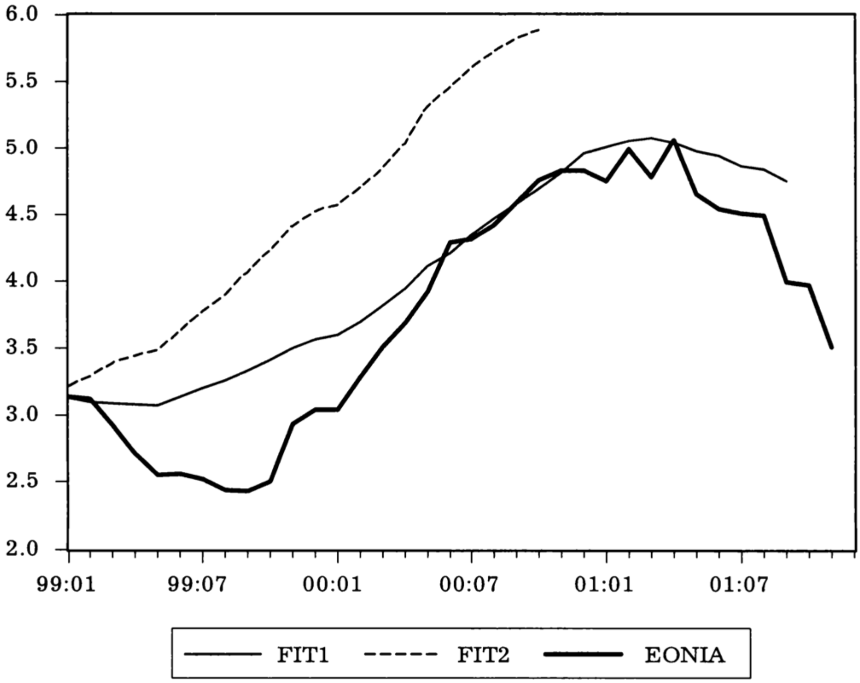
Notes: Fit1 are the fitted values from the TSNLS estimation in Table 2 (fed funds rate). Fit2a and Fit2b are dynamic simulations from 1991.01 using fitted (not actual) values of the lagged call rate. Fit2a for 12-month inflation forecasts derived from The Economist Consensus forecasts. Fit2b uses realized future inflation.

Figure 1: Performance of the Bundesbank's reaction function

inflation data. However, it may also be suggestive of the possibility that the Bundesbank based its policy on inflation forecasts superior to the Consensus forecasts published in The Economist. Whereas the explanatory power for fit2b is generally very good, we also observe a substantial gap between fit2b and actual interest rates in the period 1996–97 (approx. 100 basispoints). Recall that the statistical results in Table 2 showed the presence of significant heteroscedasticity in the reaction function.

2. *ECB Monetary Policy Since 1 January 1999*

To examine the extent to which since 1 January 1999 the ECB has followed a typical Bundesbank monetary policy, we compare the actual Euro money-market interest rate EONIA with the hypothetical interest rate derived from the Bundesbank's reaction function. The coefficients



Notes: Simulated values from the Bundesbank reaction function (Table 2, fed funds rate) with Euro-area data. Fit1 for 12-month inflation forecasts derived from The Economist. Fit2 uses actual future inflation.

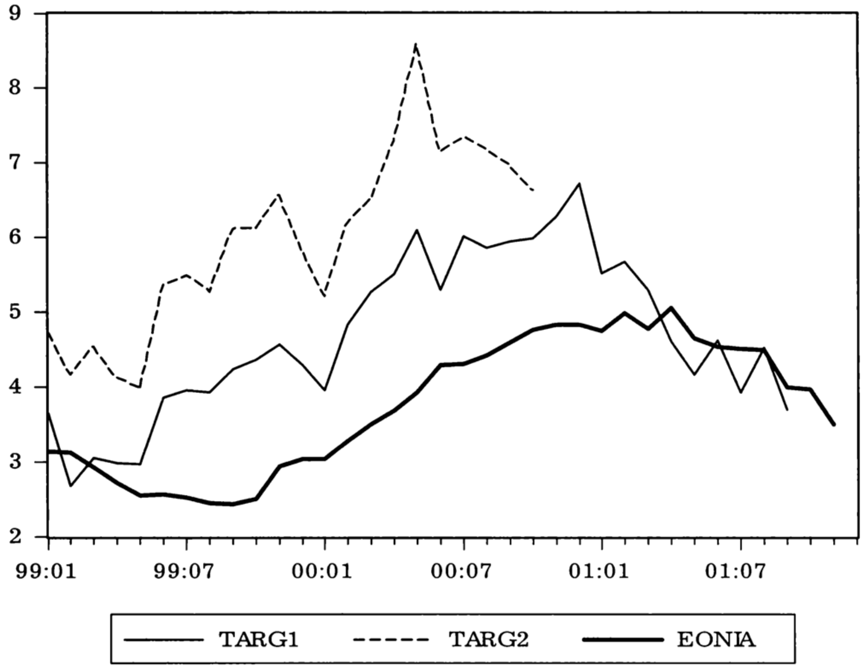
Figure 2: ECB policy and Bundesbank reaction function

are taken from the estimates in Table 2 using the model including the federal funds rate. The output gap is calculated from Euro-area industrial production and a Hodrick-Prescott filter trend. The appropriate value of the expected Euro-area inflation rate provides more problems. As before, two alternative measures are used: actual future inflation and the forecasts derived from The Economist's monthly poll of forecasters.

Figure 2 presents the actual Euro-area interest rate and the calculated values for the hypothetical Bundesbank policy. Because interest-rate smoothing introduces a very large effect of the *actual* lagged interest rate a simple fit of the model will always appear to be very good. Therefore, Figure 2 compares the actual EONIA rate with the dynamically simulated values of the Bundesbank's reaction function that uses the fitted rather than the actual lagged interest rate (starting with the actual value of December 1998). The evaluation of ECB policy depends very much on the chosen measure of expected inflation. The rational expectations hypothesis, using actual future inflation (fit2), produces a large gap between the actual ECB and hypothetical Bundesbank policy. The mean error for the data available through 2000.10 is 1.164 (116 basis points). In contrast, the Economist's Consensus inflation forecast (fit1) produces a much better fit. The mean error for the data available through 2001.09 is 0.320 (32 basis points). According to the fit1 result it took some time, in fact until June 2000 or 18 months, before the ECB finally raised Euro-area interest rates to the level consistent with a Bundesbank policy. During those months interest rates were up to 90 basis points lower than expected. From mid-2000 the Euro-area interest rate appears to follow the Bundesbank's reaction function quite well. Furthermore, the early gap of 90 bp is not extraordinary considering the results in Figure 1 for actual Bundesbank policy which also show some periods of larger gaps between actual and explained policy. The standard error of the reaction functions in Table 2 is estimated at 30 bp, but subject to heteroscedasticity which allows a significantly wider confidence interval in some periods.

Two recent other studies have also examined the relationship between ECB and Bundesbank policy. Gali (2001) presents a simplified Taylor-type rule calibrated to represent historical Bundesbank policy. His rule only allows the interest rate to respond to inflation, using a coefficient of 1.5, with no influence of the output gap and no interest rate smoothing. The rule is evaluated for different measures of the inflation variable (lagged inflation, core inflation, inflation forecast). The rules with lagged inflation and core inflation show a substantial gap with actual Euro-area interest rates. The forecast-based rule shows that by mid-2000 the ECB policy stance had caught up with the rule and remained close to the rule until the final observation in December 2000. This last result corresponds to the evidence produced by the reaction function estimated in this paper and presented in Figure 2. However, the simplified Taylor rule used by Gali is actually more the steady state target in the reaction function used here. Values of the steady state target of the reaction function with forecasted inflation are shown in Figure 3 (series targ1). The mean error of targ1 in the period 1999.01–2001.09 is 0.914. In Figure 3 the gap between ECB and Bundesbank policy persists until the first months of 2001. If we were to use the steady state target value as our key test, it creates a much larger and more persistent gap between actual and hypothetical policy of the ECB than the reaction function that includes the interest rate smoothing effect.

Faust et al. (2001) provide an updated estimate of the baseline reaction function from Clarida et al. (1998). In their subsequent analysis of ECB

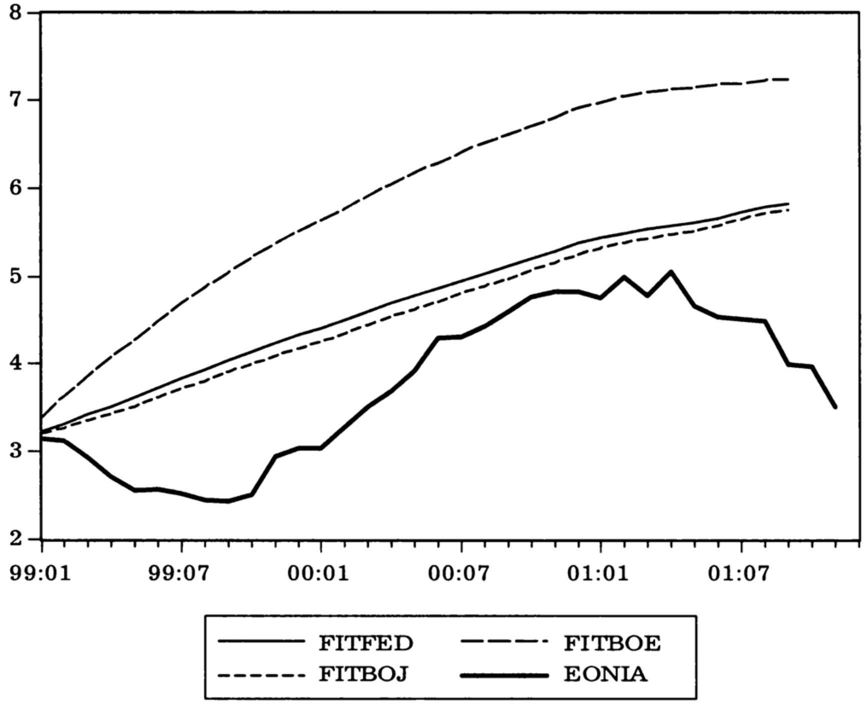


Notes: Steady state target values from figure 2. Targ1 uses 12-month inflation forecasts from The Economist. Targ2 uses actual future inflation.

Figure 3: Steady state target values

policy they ignore the smoothing aspect of interest rate policy and concentrate on the implied steady state target values. Faust et al. conclude that in the first months of 1999 the ECB interest rate was well below the prediction by the Bundesbank's rule. Their result corresponds closely to the comparison between the targ2 series and actual interest rates in Figure 3. The mean erorr of targ2 in the period 1999.01–2000.10 is 2.665. Two choices appear responsible for their results. First, their emphasis on the steady state target value while ignoring the effect of interest rate smoothing. Second, the use of actual future inflation by invoking the rational expectations hypothesis. Figure 2 suggests a much closer resemblence between actual and hypothetical ECB policy.

Although the ECB policy from January 1999 resembles the hypothetical Bundesbank policy prior to 1999, one final question that may be raised is whether the Bundesbank's policy rule was anything special. Perhaps many central banks implement similar policy rules, in which case it is somewhat misleading to refer to a "Bundesbank" policy.[11] Al-



Notes: FitFed, FitBoJ, FitBoE are simulated values for EONIA using reaction functions of the Federal Reserve, Bank of Japan, Bank of England.

$$r_t = (1 - \rho)\{rr + \pi_t^* + \beta(\pi_{t+n}^e - \pi_t^*) + \gamma y_t\} + \rho r_{t-1}$$

Parameters ρ, β, γ and rr estimated by Clarida et al. (1998, baseline). π^* ECB inflation target. π_{t+n}^e Euro-area inflation forecast derived from The Economist Consensus forecasts.

Figure 4: Comparison with other central banks' reaction functions

ternatively, perhaps the confidence intervals surrounding the estimated reaction functions are simply too large to allow reliable inferences on statistical significance. For some perspective on this issue, Figure 4 presents the simulated values for the Euro-area interest rate when the ECB is assumed to follow the reaction function of the Federal Reserve, the Bank of Japan, or the Bank of England (see the baseline estimates provided in Clarida et al., 1998). These policy rules fit the actual development of EONIA less well than the comparable Bundesbank rule shown in Figure 2. Mean errors over the period 1999.01–2001.09 are 0.928, 0.810,

[11] This similarity in policy rules is suggested by the recent literature on Taylor rules. Empirical studies suggest that the Taylor rule captures the main features of interest rate developments in the U.S., Germany, U.K. and other countries.

2.132 for the Fed, BoJ and BoJ rules, compared to 0.320 for the Bundesbank rule.

IV. Conclusion

In this paper I compared the actual Euro-area money-market interest rate in the early years of ECB policy with the hypothetical rate derived from the pre-1999 Bundesbank reaction function. The overall conclusion of this paper is, that, after an initial period of lower than expected interest rates, the European Central Bank has at least since mid-2000 set the interest rate consistent with the Bundesbank's old policy rule. In the early period between January 1999 and mid-2000 the Euro-area interest rate is up to approx. 90 basis points lower than predicted. This gap remains unexplained in this paper but is not inconsistent with the empirical estimates of the Bundesbank reaction function.[12]

This paper shows that the comparison between Bundesbank and ECB policy is sensitive to the measure of expected inflation that is introduced in the reaction function. Bundesbank policy reacted to reasonably accurate inflation forecasts represented by the rational expectations hypothesis. In contrast, ECB policy is found to be more closely related to Euro-area inflation forecasts represented by The Economist Consensus forecasts. These forecasts clearly missed the recent upward cycle in Euro-area inflation. Consequently, imposing the rational expectations hypothesis on ECB behavior results in rather negative conclusion on the performance of the old Bundesbank rule.

One final caveat is that because the data on ECB policy is limited to 3 years, and given the confidence intervals of the estimated reaction functions and heteroskedastic standard errors, precise statistical inference is not yet possible. We need to update the analysis in the future and check whether the conclusion of this paper is robust.

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[12] Two plausible explanations can be put forward. One is that uncertainty about the effects of the regime shift in the 'new' Euro area, and the desire to make a trouble free transition to the Euro caused the ECB to be extra cautious. Another explanation is related to the widely publicized Asian and Russian financial crises of 1998. Expectations of possible adverse effects on economic growth caused the ECB to lower interest rates pre-emptively. In fact, the decrease in interest rates came in December 1998 as a concerted effort by the Bundesbank and the other national central banks of the Euro area. Some regard this to be the first, unofficial policy action of the ECB. In the end, the adverse economic effects failed to turn up and consequently the policy rule suggests to us that interest rates were too low.

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Summary

Has the European Central Bank Followed a Bundesbank Policy? Evidence from the Early Years

This paper compares the actual Euro-area money-market interest rate with a hypothetical rate derived from the pre-1999 Bundesbank reaction function. The conclusion is that, after an initial period of lower than expected interest rates, the ECB has at least since mid-2000 set the interest rate consistent with the Bundesbank's old policy rule. (JEL E 58, E 43)

Zusammenfassung

Hat die Europäische Zentralbank eine Bundesbankpolitik verfolgt? Beweise aus den ersten Jahren

Dieser Beitrag vergleicht die tatsächlichen Geldmarktzinssätze im Währungsgebiet des Euro mit einem hypothetischen Satz, der aus der Reaktionsfunktion der Bundesbank in der Zeit vor 1999 abgeleitet worden ist. Daraus ergibt sich, daß nach einem anfänglichen Zeitraum mit Zinssätzen, die niedriger als erwartet waren, die EZB mindestens ab Mitte 2000 den Zins auf einem mit der alten politischen Regel der Bundesbank konsistenten Niveau festgesetzt hat.

Résumé

La Banque Centrale Européenne a-t-elle suivi la politique de la Bundesbank? Evidence provenant d'années précédentes

Ce travail compare le taux d'intérêt réel sur le marché monétaire dans la zone euro avec un taux hypothétique dérivé de la fonction de réaction de la Bundesbank de 1999. Il tire la conclusion suivante: après une période initiale de taux d'intérêt plus bas que prévu, la BCE a fixé, le taux d'intérêt, du moins depuis la mi-2000, en accord avec la vieille règle de politique de la Bundesbank.