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ABSTRACT

This paper studies the Deutsche Bundesbank's concept of monetary targeting. The concept comprises two strategies: (i) the attempt at anchoring the public's expectations at a low medium-run rate of inflation by the announcement of suitable midpoint target rates for money growth, and (ii) rule-based discretion as regards short-run deviations from targets. Evidence is presented that inflation is significantly linked to targeted rather than actual money growth. Moreover, the Bank systematically counters excess inflation, leans against the wind of exchange rate appreciation and accommodates money demand shocks. The paper also examines the Bundesbank's forecast errors as regards normal real growth and trend rates of change in the velocity of money stock M3. Finally, it is shown that the demand function for the target aggregate has shifted downward upon German unification.

KEY WORDS: Monetary targeting; Reaction function; Money demand function

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1. Introduction

Monetary targeting was considered an avantgardistic experiment when the Deutsche Bundesbank introduced this concept in late 1974 after having been freed of the chains of the Bretton-Woods system. Many central banks followed shortly. Today, in contrast, monetary targeting is widely viewed an outmoded procedure that has lost its pillar, a stable money demand function. For this reason, several countries, like Canada, New Zealand or the UK, have switched to the concept of direct inflation targeting, while other countries have reverted to pure discretion or continue pegging their currency to one of the key currencies or a currency basket. The Bundesbank, in contrast, holds on to her concept steadfastily and advertizes monetary targeting as a suitable concept of policy formulation for the future European Central Bank.

In this paper we examine the Bundesbank's concept of monetary targeting by drawing on and further extending the recent studies by von Hagen (1995) and by Neumann and von Hagen (1995). The Bank's concept is an intermediate approach to securing the internal value of money. The focus of the concept is on providing the monetary frame for zero or low trend inflation rather than on trying to directly control price movements in the short run. The concept can be summarized by two complementary strategies: (i) the attempt at anchoring the public's expectations as regards medium to long-run inflation by setting a consistent target rate for monetary growth, on the one hand, (ii) systematic short-run deviation from the mid-point target for the purpose of counteracting unanticipated shocks to prices and the exchange rate and for accomodating shocks to money demand.

The following section 2 considers the quantity-theoretic background of monetary targeting. The Bundesbank's targeting procedure is described in detail in section 3. An empirical evaluation of the performance record over the period 1979-94 is provided in section 4. There we present estimates of the conditioning role of the annual monetary targets for inflation and of the Bundesbank's reaction function. Since the trend rate of inflation exceeded the Bank's inflation objective, we also examine the Bank's targeting procedure in search for a built-in bias. It will be shown that rather than the Bundesbank's targets for current money growth the accustomed policy of deviating from target during the course of a year contains an upward bias. Section 5 looks into the issue of money demand

stability and examines the impact of German unification on the demand function of the Bundesbank's target aggregate. It will be shown that the unification resulted in a downward shift of the demand function for real M_3–balances. Section 6 provides concluding remarks.

2. The Analytical Background of Monetary Targeting

Monetary policy can serve competing objectives. The literature on the problem of time inconsistency in monetary policy has shown that a central bank will not provide stable money if this objective is put at an equal footing with other objectives, such as stimulating real growth, smoothing the business cycle or stabilizing the exchange rate. The Bundesbank Act provides a clear ranking of objectives. In section 3 the Act requires the Bank to "safeguard the currency" and as late as section 12 the Act stipulates that the Bank shall support the "general economic policy of the government, provided doing so is compatible with the predominant mandate" of section 3.

The Bundesbank's concept of monetary targeting echos this ranking of objectives by making the objective of zero or low inflation the cornerstone of annual targeting. The basic idea is straightforward. The quantity theory of money implies that providing stable money for the medium to long run requires selecting the appropriate money expansion path, for given trends of real growth and velocity. Moreover, by announcing the target path to the public and by explaining its derivation the public's inflation expectations will be anchored, provided the Bank enjoys credibility.

The equation of exchange can be written in first differences of logs as

$$\Delta p_t = \Delta m_t + \Delta v_t - \Delta y_t \qquad (1)$$

where p denotes the price level, m the money stock, v the income velocity of money, and y real income or output. Using this equation, the Bundesbank determines at the end of year t–1 the average target rate of money expansion for year t, Δm_t^T, as

$$\Delta m_t^T = \pi_t^T + E_{t-1}(\Delta y_t^* - \Delta v_t^*) \ , \qquad (2)$$

π^T is the Bundesbank's target rate of inflation, Δy^* denotes the growth rate of long–run equilibrium or normal output, Δv^* denotes the percentage rate of change of the long–run equilibrium or trend level

of velocity, E is the expectations operator.

Note that the target rate of monetary expansion is based on the Bundesbank's expectations about the rate of change of normal output and of the trend rate of change of velocity rather than on the expected actual changes of output and velocity. This signifies the medium- to long-run orientation of the Bundesbank's targeting concept. Equating actual and target money growth, equs (1) and (2), yields

$$\Delta p_t = \pi_t^T + (\Delta v - \Delta v^*)_t - (\Delta y - \Delta y^*)_t + f_t^v + f_t^y$$

$$\text{with:} \quad f_t^v = (\Delta v_t^* - E_{t-1}\Delta v_t^*) \qquad (3)$$

$$f_t^y = (\Delta y_t^* - E_{t-1}\Delta y_t^*)$$

where the Bank's forcast errors are denoted by f with superscripts v or y.

Thus, if the Bundesbank continously meets her monetary target, $\Delta m = \Delta m^T$, the actual rate of price change will move around the level of the Bank's inflation objective in response to the deviations of output and velocity growth from long-run equilibrium. Faster output growth in the short run tends to reduce actual inflation while faster velocity growth is inflationary. To be sure, the solution equation (3) is silent as regards the economic sources of such deviations from long-run equilibrium. They may be due to stochastic shocks to productivity or to money demand. In the case of sluggish price adjustment in the goods markets, those shocks will generate serial correlation in the temporary deviations of output and velocity from the equilibrium rates of change.

The price-gap model of Hallman, Porter and Small (1991) can be used to make the point. The Bundesbank has used this model recently to investigate the empirical relation between money growth and inflation.[1] The price-gap model states that the gap between the equilibrium price level, p^*, and the actual price level, p, equals the difference between the respective gaps for output and velocity. With all variables in logs we have

$$p_t^* - p_t = (y_t - y_t^*) - (v_t - v_t^*) \qquad (4)$$

Assuming that the actual rate of price change adjusts slowly to the price gap

$$\Delta p_t = \pi_t^* + \alpha\,(p_t^* - p_t)\;; \quad 0 < \alpha < 1 \tag{5}$$

and that the equilibrium rate of inflation has settled at the Bundesbank's inflation target rate, $\pi^* = \pi^T$, yields

$$\Delta p_t = \pi_t^* + \alpha\,[(y_t - y_t^*) - (v_t - v_t^*)] \tag{6}$$

This solution for the short-run rate of price change holds if prices adjust sluggishly while the alternative solution, given by equ. (3), holds generally. The solutions (3) and (6) are not in conflict but imply the following "stock" adjustment process

$$(\Delta y_t - \Delta y_t^*) - (\Delta v_t - \Delta v_t^*) = -\alpha\,[(y_t - y_t^*) - (v_t - v_t^*)] \tag{7}$$

Note that the forcast errors have been set at zero. The price-gap model assumes a process of reversion towards long-run equilibrium stretching over time. When the economy is in a boom and/or velocity is suppressed below equilibrium, short-run output growth will slow down, while short-run velocity growth will speed up. As a result, the actual rate of price change may exceed the equilibrium rate of inflation.

For monetary policy this implies that keeping money growth at target secures that actual inflation will not permanently deviate from the desired path. However, departures from equilibrium may last quite some time. If this is unacceptable, monetary policy may deviate from the target path in a stabilizing fashion. Below we will see that the latter strategy is part of the Bundesbank's concept.

3. The Bundesbank's Concept

The Bundesbank's concept of monetary policy can be characterized by two consecutive steps: (i) at the end of a year t-1 the Bank computes a target rate of average monetary expansion for year t and translates this average target rate into a linear target rate of current money growth, measured from the 4th quarter of year t-1 to the 4th quarter of year t. The latter rate is publicly announced. (ii) During the course of year t the Bank uses the current target rate as a yardstick for steering money growth but the Bank deviates from target in a systematic fashion in response to observations on the

short-term evolution of prices, the exchange rate or money demand shocks.

Note that the Bundesbank frequently changed her policy concept during the early years of targeting. For example, the Bank started monetary targeting by announcing for the year 1975 a point target for current money growth. Thereafter the Bundesbank switched to announcing a target rate for average money growth. The concept we describe below is in effect since the late 1970s when the European Monetary System (EMS) came into effect. Therefore, we will concentrate on the period since 1979 in the empirical work of section 4 below.

3.1. Deriving the Monetary Target

As has been mentioned before, the Bundesbank uses the following equation for computing first a target rate of annual average money growth, Δm_t^T,

$$\Delta m_t^T = \pi_t^T + E_{t-1}(\Delta y_t^* - \Delta v_t^*) \quad , \tag{8}$$

Table 1 provides the Bank's numerical inputs for each year since 1979.

The inflation objective, π_t^T, applies to the deflator of GDP. It is a normative rate that signals the level of inflation the Bundesbank is willing to tolerate over the medium to long run. The Bank argues that a measured inflation rate of up to 2 percent is rougly compatible with an underlying true rate of inflation of zero because price indices cannot properly take into account the improving quality of goods in the basket or the occurrence of new goods.[2] In line with this reasoning, the inflation objective has been set at 2 percent since 1986; see Table 1. But note that the inflation objective served a different purpose during the early 1980s when the Bundesbank tried to sqeeze out the inflation inherited from the 1970s. During those years, the Bundesbank refered to the inflation objective as "the rate of unavoidable inflation" and used it as a signal of her intention to gradually reduce actual inflation. This was achieved by announcing each year an inflation objective somewhat below the most recent rate of actual inflation.

The Bundesbank approximates the expected equilibrium growth rate of output, $E_{t-1}\Delta y_t^*$, by the expected growth rate of potential output. The Bundesbank refers to it as 'production potential'.

Potential output is estimated by a CES production function that takes estimates of the capital stock and of the natural rate employment into account.[3] As can be read from Table 1, the expected growth rates have ranged between 1.75 and 3 percent.

Not much is known of how the Bundesbank forms her expectations about the equilibrium rate of change of the velocity of money, $E_{t-1}\Delta v_t^*$. Though it seems obvious that forecasts of the trend rate need to be based on estimates of a money demand or velocity function, it is not clear whether the Bank has gone at such pains in the early years of monetary targeting. Table 1 shows that the expected rate was set at zero for most of the time of the early 1980s, while later the declining trend of the velocity of the target aggregate was taken into account. We will come back to this question in section 4 below.

As regards the target aggregate, it is to be noted that the Bundesbank switched to the money stock M_3 in 1987. Until then the annual target had been set for an aggregate called 'central bank money stock', M_{CB}. It was defined as

$$M_{CB,t} = C_t + r^D_{1974} D_t + r^T_{1974} T_t + r^S_{1974} S_t \qquad (9)$$

where C denotes the currency holdings outside the banking system, D demand deposits, T time deposits with maturities below four years, and S savings deposits at statutory notice all held by domestic nonbanks. The deposits were weighted with constant coefficients, denoted by r; the coefficients were set at the 1974–values of the respective minimum reserve ratios.

Since 1988 the Bank's targets refer to the broad money stock M_3:

$$M_{3,t} = C_t + D_t + T_t + S_t \qquad (10)$$

Comparing equs (9) and (10), we see that the alternative aggregates sum the same components though with differential weights. While currency in circulation enters both aggregates with an absolute weight of unity, the deposits are counted in the central bank money stock with weights way below unity. When in late 1974 the Bundesbank introduced monetary targeting, the Bank rated the central bank money stock a target aggregate superior to any other monetary aggregate. In her Report for 1975, for

example, the Bank emphasized that the weighting of deposits with constant minimum reserve ratios "tends to take better account of the money-like character of these deposits than single addition does."[4]

This perception was put into the asides when in 1987 a political debate about introducing a withholding tax induced a flight from deposits into currency; the resulting large shift in asset demand was accomodated by the Bundesbank. As a result, the currency component grew much faster than deposits, blowing up the growth rate of the central bank money stock by much more than the growth rate of money stock M_3 (by 8.1 percent compared to 6.6 percent). This feature made the M_3-aggregate more attractive to the Bank: "the main reason for abandoning the central bank money stock ... was that currency carries a smaller (relative) weight in the money stock M_3, which shows a less marked response to interest-rate and exchange-rate-induced disruptions and extreme situations (such as had been seen in 1987 and were also expected for 1988) than does the central bank money stock."[5] As a matter of fact, the switch from central bank money to M_3 beared fruit immediately, as the differential growth of both aggregates continued through 1988 until the tax project was given up by the government.

At this point it is important to note that the focal point of the Bundesbank's concept is not the target rate of average money growth, Δm_t^T, as given by equ (8), but rather the target rate of current money growth. The latter is defined by the Bank as the rate of planned money growth from the fourth quarter of year t-1 to the fourth quarter of year t. Denote this rate by $\Delta m_{t,44}^T$. This target rate figures prominently in all policy discussions. The Bundesbank does not explain how the target for current money growth is derived from the average target rate though there is a mathematical relationship between both rates. Given that the current target rate equals the annualized quarter-to-quarter growth rate, $\Delta m_{t,\tau}^T$,

$$\Delta m_{t,44} = (1 + \Delta m_{t,\tau})^4 - 1 \qquad (11)$$

it can be derived by the following formula

The formula relates the targeted quarter-to-quarter growth rate $\Delta m_{t,\tau}^T$, to the planned average target

$$\sum_{\tau=1}^{4} (1 + \Delta m_{t,\tau}^{T})^{\tau} = \frac{1 + \Delta m_{t}^{T}}{1 + \Delta m_{t-1,44}} \sum_{\tau=1}^{4} (1 + \Delta m_{t-1,\tau})^{\tau} \qquad (12)$$

rate, Δm_t^T, and the previous actual growth rates, $\Delta m_{t-1,44}$ and $\Delta m_{t-1,\tau}$.

Finally, the Bundesbank specifies a target range for current money growth

$$c + \Delta m_{t,44}^{T} > \Delta m_{t,44}^{T} > \Delta m_{t,44}^{T} - c \qquad (13)$$

Table 2 informs about the target range and the midpoint target rate for each year since 1979. As column 1 of Table 2 indicates, the coefficient c was set at 1.5 percentage points during the early 1980s and at 1 percentage point for most years thereafter. Given that the money stock M_3 can only indirectly be controlled by changing nonborrowed reserves and administrative interest rates, a target range is indispensible though it does not serve just this purpose as we will see below.

3.2. Reacting to Short-term Events

While the basic idea of the Bundesbank's targeting approach is to influence the public's inflation expectations as well as actual inflation over the medium to long run by setting the appropriate target path for money growth, this does not restrict the Bank from deviating from the mid-point target rate at larger scale. On the contrary, the Bundesbank has repeatedly explained that she may have to deviate from the midpoint target rate to account for short-run events, such as sharp changes in the external value of the Deutsche Mark, an unexpected strong rise in the price level or shifts in money demand.

In the Report for 1980 the Bank explained this strategy as follows: ".. the flexibility with which the Bundesbank responds in the short run to unusual disturbances owes much to the fact that in the last analysis the monetary growth target is only an 'intermediate target variable', the final objective ... being to safeguard the currency. Although the longer-term curbing of the expansion of the money stock is essential for this purpose, ... it may become necessary to take short-term measures which in themselves could be regarded as a temporary departure from the path of medium-term expansion."[6] Specifically, the Bank considered an expansionary deviation from the midpoint target

rate appropriate "... if 'home-made' price and cost increases slackened, the exchange rate of the Deutsche Mark steadied and external disequilibrium lessened."[7] As regards the appropriateness of accomodating money demand shocks, the Report for 1991 states: "The Bundesbank tolerated this 'undershooting' of monetary growth, which was attributable to a shift in the demand for money in eastern Germany ... , as being consistent with its monetary policy objectives."[8]

Surprising as it may be to foreign observers, the Bundesbank does not lend her policy to activist stabilization of the business cycle. As a rule, this is not very clearly stated. For example, in the Report for 1982 the Bank writes "The Bundesbank's aim was to improve the monetary conditions for an economic recovery" but goes on "without overstepping the limits set to monetary policy or increasing the money supply to a greater extent than stabilization policy requirements warranted. The Bundesbank made this objective clear by announcing the monetary target for 1982."[9]

Two years later the Bundesbank clarified her principal position by stating that monetary targeting is to be equated with the mandate of having to support the general economic policy of the government. To quote from the Report for 1984: "In all the years in which monetary targeting has been practised, the economic data on which the Bundesbank has based its formulation of the monetary target have invariably been consistent with the macro-economic objectives outlined in the Federal Government's Annual Economic Report. Conversely, the Federal Government for its part has invariably accepted the annual monetary target as a fitting contribution by monetary policy to the implementation of the official annual forecast. This practice can be regarded as the fulfilment of the mandate assigned to the Bundesbank by law (section 12 of the Bundesbank Act)."[10]

Summing up, the strategy of deviating from target in the shorter run can be summarized by the following reaction function (Neumann and von Hagen, 1993):

$$\Delta m_{t,\tau} - \Delta m^{T}_{t,\tau} = - \beta_1 (\Delta p - \pi^{T})_{t,\tau} + \beta_2 (\Delta q - E_{t-1}\Delta q^{*})_{t,\tau} + \beta_3 \, my_{t,\tau} \qquad (14)$$

where q denotes the (log of the) real exchange rate of the Deutsche Mark and μ is a perceived shock to money demand. The reaction function implies that the Bundesbank counteracts excessive inflation, leans against the wind of real exchange rate appreciation and accomodates perveived shocks to money

demand.

This concludes the description of the Bundesbank's policy concept.

4. The Bundesbank's Performance

In this section we examine the policy record. The sample period is 1979 to 1994 and includes the eastern part of Germany from 1991. All time series have been adjusted for the unification effect.[11] Subsection 4.1 describes the characteristics of the money growth process, provides estimates of the Bundesbank's reaction function and checks on the conditioning role of monetary targets for inflation. Given that inflation has been higher on average than the Bundesbank's inflation objective implied, subsection 4.2, finally, examines if the actual money targets were biased upwards.

4.1. The Bundesbank's Reaction Function and the Impact of Target Announcement on Inflation

We begin with a few regressions that describe the properties of annual money growth, measured as percentage rates of change between the fourth quarters of adjacent years.

As a first observation we note that money growth is serially uncorrelated:

$$\Delta m_{t,44} = \underset{(2.7)}{3.84} + \underset{(1.4)}{0.32}\,\Delta m_{t-1,44} + \underset{(2.9)}{4.2}\,D_{92} \qquad (15)$$

$$\bar{R}^2 = 0.34 \quad DW = 1.72 \quad Q_4 = 7.68$$

Numbers in parentheses are t-ratios and Q_4 is the Ljung-Box Q-statistic for 4th order residual autocorrelation. The respective 5%-significance levels are 2.2 and 9.48. Neither the t-statistic for lagged money growth nor the Q-statistic is significant at the 5%-level. Note that the regression includes a dummy variable for the year 1992 when the Bundesbank was forced by an extreme wave of speculation against major EMS-currencies to let money growth go.

A second observation is that money growth is not correlated with the current midpoint target rate:

Finally, we observe that the target rates are correlated:

$$\Delta m_{t,44} = \underset{(2.7)}{6.23} - \underset{(-0.2)}{0.07}\,\Delta m^{T}_{t,44} + \underset{(2.5)}{3.67}\,D_{92} \qquad (16)$$

$$\bar{R}^2 = 0.33 \qquad DW = 1.65 \qquad Q_4 = 7.48$$

$$\Delta m^{T}_{t,44} = \underset{(3.5)}{2.34} + \underset{(4.1)}{0.52}\,\Delta m^{T}_{t-1,44} \qquad (17)$$

$$\bar{R}^2 = 0.53 \qquad DW = 2.43 \qquad Q_4 = 1.23$$

In sum, we find that the midpoint target rate has no predictive value for actual money growth in the short run and that the latter is serially uncorrelated.

These observations on the characteristics of money growth suggest that indeed the Bundesbank flexibly deviates from the midpoint target rate in response to short-run events. Therefore, we estimate reaction function (14) in a first step as follows:

$$(\Delta m - \Delta m^{T})_{t,44} = \underset{(3.6)}{1.02} - \underset{(-3.3)}{0.65}\,(\Delta p - \pi^{T})_{t,44} + \underset{(2.7)}{0.21}\,\Delta q_{t,44} - \underset{(1.2)}{0.19}\,(\Delta y - \Delta y^{*})_{t,44} + \underset{(2.6)}{3.39}\,D_{92} \qquad (18)$$

$$\bar{R}^2 = 0.71 \qquad DW = 1.29 \qquad Q_4 = 2.53$$

In this estimate the price level is represented by the CPI, the real exchange rate by an index of the weighted real exchange rate of the Deutsche Mark vis-a-vis 18 industrialized countries, and output by real GDP.[12]

The estimate supports the conjecture that the Bundesbank deviates from the announced target growth in order to fight excess inflation and to lean against the wind of exchange rate appreciation. The size of the estimated coefficients suggests that the Bundesbank's response to such events is moderate. To test for the specific conjecture that the Bank does not respond to the business cycle the regression includes the deviation of GDP growth from normal. The estimated coefficient is not significant at conventional significance levels confirming our conjecture.

The estimate of the reaction function still misses a potentially important element, namely the hypothesized accomodation of perceived shocks to money demand, denoted in equ. (14) by μ_t. Since

those shocks are not directly observable, we approximate them by the residuals from log–linear estimates of the velocity of central bank money (sample period 1970–1987) and of the velocity of money stock M_3 (sample period 1970–1994).[13] Of the first estimate we use the residuals for the period 1979–1987, of the second estimate the residuals for the period 1988–1994.[14] Reestimating the reaction function with this additional regressor and eliminating the insignificant business cycle variable yields

$$(\Delta m - \Delta m^T)_{t,44} = \underset{(5.6)}{0.94} - \underset{(-5.4)}{0.60}(\Delta p - \pi^T)_{t,44} + \underset{(3.5)}{0.16}\Delta q_{t,44} + \underset{(6.8)}{5.93}D_{92} + \underset{(5.1)}{0.59}\, my_t \qquad (19)$$

$$\bar{R}^2 = 0.90 \quad DW = 1.99 \quad Q_4 = 2.25$$

Thus, we find that adding the proxy for money demand shocks as a regressor improves the estimate considerably. The adjusted R^2 rises from 0.71 to 0.90 and the residuals of the regression remain well–behaved. Also note that the estimated coefficients as regards the response to excess inflation and changes in the real exchange rate do not change significantly, while the significant coefficient multiplying the proxy variable for money demand shocks has the expected positive sign and is significantly smaller than unity. This suggests that money demand shocks are not fully accomodated.[15]

Figure 1 shows how actual and predicted money growth, $\Delta m_{t,44}$, developed relative to the target range. The predicted values were computed from regression (19). They track quite well. Since 1982 money growth moves in the upper half of the target range. Both times when it came to an overshooting of the target range, it lasted for two to three years. The 1986–88 episode is of particular interest. As has already been mentioned, the overshooting of 1987/88 was largely due to an accomodation of shifting asset demand from deposits into currency. The preceeding dramatic jump of money growth in 1986 from 4.5 to 7.8 percent, in contrast, entirely reflects a leaning against the wind of exchange rate appreciation. The appreciation of the Deutsche Mark in 1986 was extreme, amounting to 6.4 percent to be compared to 0.3 percent on average over the 1979–94 period. The second overshoot of 1992–93 was largely due to the Bundesbank's response to the crisis, if not break–

down, of the European Monetary System (EMS).

It remains to check on whether the announced monetary targets play the strategic role the Bundesbank ascribes to them. A basic tenet of the Bank's concept is that the target announcement provides information that impacts on the inflation expectations of the public. We test for this information effect in an indirect fashion by regressing the rate of price change alternatively on actual money growth and on the target rate of money growth. To rule out spurious regression, the money growth rates will be lagged by one year. This gives

$$\Delta p_{t,44} = \underset{(0.6)}{0.11}\ \Delta m_{t-1,44} \qquad \bar{R}^2 = 0.42 \qquad \rho = \underset{(6.4)}{0.83} \qquad (20)$$

and

$$\Delta p_{t,44} = \underset{(2.9)}{0.55}\ \Delta m^{T}_{t-1,44} \qquad \bar{R}^2 = 0.50 \qquad \rho = \underset{(2.8)}{0.62} \qquad (21)$$

where ρ is the coefficient of the AR(1)-term. The estimates indicate that in contrast to actual money growth the midpoint target rate contributes to explaining the rate of price change. Alternatively, we may regress the rate of price change on its own lag

$$\Delta p_{t,44} = \underset{(1.5)}{1.05} + \underset{(3.4)}{0.67}\Delta p_{t-1,44} \qquad (22)$$

$$\bar{R}^2 = 0.42 \qquad DW = 1.47 \qquad Q_4 = 2.52$$

and add the midpoint target rate

$$\Delta p_{t,44} = \underset{(-1.9)}{-3.82} + \underset{(2.5)}{0.48}\ \Delta p_{t-1,44} + \underset{(2.6)}{1.05}\ \Delta m^{T}_{t,44} \qquad (23)$$

$$\bar{R}^2 = 0.58 \qquad DW = 2.11 \qquad Q_4 = 0.50$$

Again we find that the midpoint target rate significantly contributes to the explanation of the rate of price change. Thus, the estimates lend support to the Bundesbank's view on the importance of target announcements.

4.2 Excess Inflation and Monetary Targets

Though inflation has been lower in Germany than in most other countries, it has been higher than the Bundesbank had desired. Measured over the sample period 1979–94, inflation averaged at close to 3.2 percent, while the Bundesbank's inflation objective had been set by 0.6 percentage points lower, at 2.6 percent on average.[16] Excess inflation in the short run can be due to many factors, excess inflation in the long run, however, presupposes an excessive trend growth of the money supply.

Why has this happened? Did the excessive trend growth of money result from an upward bias in the Bundesbank's monetary target rates? To check for this, we investigate the Bank's forecast errors as regards potential output growth and the velocity trend as well as whether the current money targets were in line with the underlying average target rates.

Suppose the Bundesbank had committed no forecast errors as regards the growth rate of long–run equilibrium or normal output, Δy_t^*, and the long–run equilibrium or trend rate of change of velocity, Δv_t^*. Call the implied average target rate of money growth the full information target, $\Delta m_t^{T,FI}$. This gives

$$\Delta m_t^{T,FI} = \pi_t^T + \Delta y_t^* - \Delta v_t^* \ , \qquad (24)$$

or, since the trend rate of change of velocity depends on the real income elasticity of money demand, η, and the equilibrium growth rate of income,

$$\Delta m_t^{T,FI} = \pi_t^T + \eta \Delta y_t^* \qquad (25)$$

Subtracting the full information target for average money growth from the Bundesbank's actual average target, Δm_t^T, gives the forecast error.

Table 3 provides the full information target rates in column (2) and the total forecast errors in column (3). The full information target rates werde calculated using equ. (25). The equilibrium rates of change of output are approximated by the actual growth rates of potential output, recently published by the Bundesbank.[17] The income elasticity of money demand was reestimated for each year from a conventional money demand function, letting the sample period run from 1960 until two years before the target year. The procedure serves to allow for gradual changes in the estimated

income elasticity and for the availability of this information at the time when the Bundesbank chose a particular target rate.

The calculated total forecast errors are negative for most years, averaging at – 0.7 percentage points over the sample period 1979–94. Thus, we find that the average target rates were not biased upwards but downwards. The dominante source of the errors is a systematic underestimation of the trend decline in the velocity of money. It accounts for about 80 percent of the total forecast error, on average; see columns (4) and (5) of Table 3.

Next we check if the Bundesbank's midpoint target rates for current money growth, asgiven by column (2) of Table 2, were set in line with average target rates, printed in column (4) of Table 1. This is done by applying formula (12). Column (3) of Table 2 provides the corrected midpoint target rates. For most years we find that the announced target rate for current money growth did not adequately reflect the Bundesbank's average target rate. In ten out of sixteen years the announced current target rate was set too high relative to what the Bundesbank had planned for average money growth. On average over the sample period 1979–94 the upward bias amounts to 0.8 percentage points; see column (4) of Table 2.

In sum, we find that the two types of error about cancel over the sample period. While the average target rate was chosen too low, by 0.7 percentage point per year, this was made up for by setting the announced target rate of current money growth too high, by 0.8 percentage points per year. It follows that the excess inflation mentioned above of 0.6 percentage points per year was not enforced by excessive targets for current money growth.

Given that the targets for current money growth were about right on average, the excess inflation must be have been fueled by faster money growth than was targeted. As a matter of fact, average annual money growth, as given by column (5) of Table 1, exceeded the average full information target (5.85 percent) by 0.45 percentage points per year. The excess of current (4th–quarter–to–4th–quarter) money growth over the current midpoint target, for comparison, amounted to 0.9 percentage points per year; see columns (2) and (5) of Table 2. Finally, note that the respective estimate of the constant in the reaction function (19) does not significantly differ from the annual

excess inflation of 0.6 percentage points.

5. Is the Demand Function of the Target Aggregate Stable?

Monetary targeting requires a stable money demand function for the target aggregate. Early studies of German money demand concluded that the demand for money functions of money stocks M1 and M3 were stable, except for the possibility of a break in 1973.[18] More recent studies with data that include the German unification of 1990 present conflicting results. For example, von Hagen (1993) finds that the stability of the money demand function must be rejected for money stock M_3 but not for M_1, while Hansen and Kim (1995) find a break for both aggregates in 1990.

Since the Bundesbank used the central bank money stock CBM as a target aggregate until 1987 and money stock M_3 thereafter, we estimate with annual data log–linear error correction models (ECM) for the real demand of both aggregates as functions of real GDP, y, and a long–term public bond yield, r. By means of Augmented–Dickey–Fuller tests it can be shown for both monetary aggregates, deflated by the GDP–deflator, that they are integrated variables of order one with real GDP.

For the (log of the) real central bank money stock, denoted by cbm, we estimate with data of 1960–87

$$(1 - \underset{(2.0)}{0.40}L^1)\,\Delta cbm_t = \underset{(2.1)}{0.01} + \underset{(2.7)}{0.59}(1 - \underset{(2.6)}{0.71}L^1)\,\Delta y_t - \underset{(2.6)}{0.010}\Delta r_t$$

$$- \underset{(-4.5)}{0.93}\,[cbm_{t-1} + \underset{(28.0)}{2.92} - \underset{(75.6)}{1.12}y_{t-1} + \underset{(6.4)}{0.019}r_{t-1}] + v_t \qquad (26)$$

$$\bar{R}^2 = 0.58 \qquad DW = 1.73 \qquad Q_4 = 2.67$$

$$Breaktest\ 1973: \quad F = 5.27^* \quad Log\ likelihood = 30.73^*$$

$$1978: \quad F = 0.53 \quad Log\ likelihood = 5.32$$

We first note that the adjustment coefficient multiplying the error correction term is rather high due to the use of annual data. The null hypothesis of no cointegration is rejected at the 5 percent significance level according to the critical values of McKinnon's table (critical t–value: – 4.07).

Applying the Chow break test, we find that a break cannot be rejected at the 5 percent level of significance for 1973, confirming results of the early literature.

Next we estimate an ECM for the real demand for M_3. The sample period is 1970–94. The time series for M_3 and GDP include East Germany from 1990. To account for unification-induced shifts we use two dummies in the cointegration equation denoted by D_{90} and D_{91-94}; the dummies have value one in the years indicated and zero otherwise. This gives

$$\Delta m_{3,t} = \underset{(3.1)}{0.01} + \underset{(9.1)}{0.97}\Delta y_t - \underset{(3.1)}{0.009}\Delta r + u_t$$

$$- \underset{(4.9)}{0.95}\ [m_{3,t-1} + \underset{(18.1)}{5.07} - \underset{(44.9)}{1.59}y_{t-1} + \underset{(3.8)}{0.012}r_{t-1} + \underset{(3.3)}{0.08}D_{90} + \underset{(6.5)}{0.11}D_{91-94}]$$

$$\bar{R}^2 = 0.81 \quad DW = 1.94 \quad Q_4 = 4.04$$

$$\textit{Breaktest}\ 1978: \quad F = 0.17 \quad \textit{Log likelihood} = 1.00$$

$$1990: \quad F = 2.93^* \quad \textit{Log likelihood} = 13.21^*$$

(27)

Again we find a high adjustment coefficient. In this case the null of no cointegration is rejected at the 10 percent level of significance only (critical value: – 4.6). The Chow break test rejects a break for 1978. However, not unexpected we cannot reject a break at the 5 percent level of significance for the unification year 1990.

Thus, our estimates with annual data support the results of von Hagen (1993) and of Hansen and Kim (1995) who used quarterly data. Apparently, the German unification induced a shift in the money demand function for M_3. The two dummies used in regression (27) above already indicate that the stock demand for M_3 has shifted downwards by a sizeable amount. To further investigate this shift, we replace the two dummies by a structural break variable. The variable is defined as the product of GDP of total Germany times a dummy D_{90-94}; the dummy is set at value one for the years indicated and at zero otherwise. Reestimating the cointegration equation for the sample period 1970–94 gives

$$m_{3,t} = \underset{(-17.6)}{-5.10} + \underset{(43.4)}{1.59}y_t - \underset{(-3.4)}{0.011}r - \underset{(-6.1)}{0.01}\,(y_t * D_{90\text{-}94}) \qquad (28)$$

$$\bar{R}^2 = 0.99 \qquad DW = 2.49 \qquad Q_4 = 9.37$$

The estimate shows that the income elasticity of stock demand is significantly lower since German unification. Note that a similar check for a significant change in the interest elasticity is negative.

The size of the downward shift is given by the product of the structural break variable times the estimated coefficient. Averaging over the years 1990–94, we find that the downward shift amounts to 9.7 percent.

An alternative approach of estimating the size of the shift is estimating regression (28) for the shorter sample period 1970–89 and computing the out–of–sample predictions with the GDP–data for total Germany. Figure 2 shows that since 1990 real M_3–balances are "missing" and Figure 3 indicates that the downward shift amounts to about 10 percent.

The question is what this large shift does reflect. To some extent it may result from biased national accounting. According to national accounts, East German GDP equals about 8 percent of West German GDP. If the true relative size is 2 instead of 8 percent, the estimated downward shift of money demand vanishes. However, East German GDP cannot be that small. Therefore, we conclude that the observed downward shift of the stock demand for real M_3–balances reflects a lower income elasticity of East German money demand.[19] This conjecture is in line with estimate (28). Finally, it may be noted that the stock demand function for the more narrow aggregate M_1 has shifted, too, since unification though into the opposite direction. To be sure, an upward shift of the demand function for M_1 is compatible with a downward shift of the demand function for the more broadly defined M_3. All it needs is the following rank order of income elasticities of money demand, where superscripts W and E denote West and East Germany, respectively:

$$\epsilon(m_1, y)^W < \epsilon(m_1, y)^E \leq \epsilon(m_3, y)^E < \epsilon(m_3, y)^W$$

It reflects the fact that in comparison to West Germans East Germans still find cash and demand deposits more attractive than time deposits.

The apparently different allocation of balances between M_1 and the additional components of M_3 in the eastern region of Germany will not stay for ever but vanish over time, though presumably very slowly as it is likely to depend on the level of wealth. Consequently, the estimated downward shift of M_3–demand for total Germany will decline gradually. This leads us to conclude that the reliability of the Bundesbank's annual monetary targeting of M_3 has not seriously been impaired by the German unification.

6. Concluding Remarks

Monetary targeting is an intermediate approach towards securing the internal value of money. Rather than promising the control of inflation over the shorter run, the focus is on setting the monetary frame for low trend inflation. Conse–quently, the monetary targets are derived from assumptions about the trend rates of change of the velocity of money and of normal output while changes of capacity utilization are disregarded. An important aspect of the concept is the public announcement of the monetary target. The information about the target and the explanation of its derivation serve to influence the public's inflation expectations, this way annual wage negotiations as well as the the budget planning at the different levels of government. In this paper, we have provided some evidence that supports the importance of target announcement as an informational device.

Monetary targets are useless if they are not credible. It may seem that keeping credibility requires meeting the announced targets year by year. However, as a rule the Bundesbank deviates from the midpoint target growth and has even overshot the target range twice since 1979 by a large margin and for longer than one year. Yet the Bank does not appear to have lost her credibility, neither domestically nor internationally. This may be puzzling. The explanation, we believe, is twofold.

First, in the short run the Bundesbank does not follow a policy of unpredictable pure discretion but a policy of rule–based discretion. Since the early 1980s the Bundesbank has explained to the public that her concept of monetary targeting includes deviating from midpoint target in response to excess inflation, appreciation of the Deutsche Mark and perceived shocks to money demand. We have estimated a reaction function that reflects this "systematic discretion." Second, by

legal set–up the Bundesbank is a relatively independent central bank and the public perceives that the central bankers are eager to keep this independence from government. There is a continous flow of confirming evidence as the Bundesbank comments in public on budget policies as well as on issues of the government's general economic policies. Of course, what counts in the last analysis is keeping trend inflation low.

All in all, this has been achieved. It does not mean that the Bundesbank has made no mistakes nor that the practice of monetary targeting cannot be improved upon. We have presented some evidence that the targets for monetary growth have not always been adequate. Yet, it is to be acknowledged that our investigation bypasses any psychological consideration that may have played a conditioning role at the time when a specific target had to be set. In actual policy making such considerations may be justified provided they do not serve as an excuse for letting money growth getting out of hand in the long run.

Table 1: Targeting Average Expansion

Percent p.a.

Year	Inflation objective (1)	Expected growth of potential output (2)	Expected growth of trend velocity (3)	Average target (4)	Actual growth (5)
1979	3.5	3.0	>0	6.5	9.1
1980	~ 4	3.0	1.0	6.0	4.8
1981	3.75	2.5	1.0	5.25	4.4
1982	3.5	1.75	0	5.25	4.9
1983	3.5	1.75	0	5.25	7.3
1984	3.0	2.0	0	5.0	4.8
1985	2.25	2.25	0	4.5	4.6
1986	2.0	2.5	0	4.5	6.4
1987	2.0	2.5	0	4.5	8.1
1988	2.0	2.0	- 0.5	4.5	6.4
1989	2.0	2.25	- 0.5	4.75	5.7
1990	2.0	2.5	- 0.5	5.0	4.5
1991	2.0	2.5	- 0.5	5.0	4.8[a]
1992	2.0	2.75	- 0.5	5.0[b]	8.2
1993	2.0	3.0	- 1.0	6.0	7.9
1994	2.0	2.5	- 1.0	5.5	9.0
Mean	2.6	2.4	- 0.15	5.15	6.3

Note: a) Corrected for unification effect: 14.6 percent. -
b) Downward adjustment by 0.25 percent "in view of high liquidity".

Table 2: Announced Targets for Current Money Growth*

Percent p.a.

Year	Target range (1)	Midpoint target Actual (2)	Midpoint target Corrected (3)	Difference (4)	Actual growth (5)
1979	6-9	7.5	3.3	4.2	6.4
1980	5-8	6.5	5.8	0.7	4.9
1981	4-7	5.5	5.5	0	3.6
1982	4-7	5.5	6.3	- 0.8	6.1
1983	4-7	5.5	4.7	0.8	6.9
1984	4-6	5.0	3.9	1.1	4.6
1985	3-5	4.0	4.4	- 0.4	4.5
1986	3.5 - 5.5	4.5	4.5	0	7.8
1987	3-6	4.5	2.6	1.9	8.0
1988	3-6	4.5	3.3	1.2	6.8
1989	~ 5	5.0	3.6	1.4	4.6
1990	4-6	5.0	5.2	- 0.2	5.3
1991	4-6	5.0	4.8	0.2	4.8
1992	3.5 - 5.5	4.5	4.9	- 0.4	9.6
1993	4.5 - 6.5	5.5	4.0	1.5	7.7
1994	4-6	5.0	4.3	0.7	5.7
Mean		5.2	4.4	0.8	6.1

Note: * Measured from the previous 4th quarter to the current 4th quarter.

Table 3: Errors in Average Money Targets

Percent p.a.

Year	Actual target	Full information target	Total error	of which: Underestimate of Potential growth (+)	of which: Underestimate of Fall in velocity (-)
	(1)	(2)	(3) = (1)-(2)	(4)	(5)
1979	6.5	6.7	- 0.2	0.0	- 0.2
1980	6.0	7.5	- 1.5	- 0.2	- 1.3
1981	5.25	7.0	- 1.7	- 0.4	- 1.3
1982	5.25	6.4	- 1.1	- 0.9	- 0.2
1983	5.25	5.7	- 0.5	- 0.3	- 0.2
1984	5.0	5.2	- 0.2	0.0	- 0.2
1985	4.5	4.4	0.1	0.3	- 0.2
1986	4.5	4.5	- 0.0	0.2	- 0.2
1987	4.5	4.2	0.3	0.5	- 0.2
1988	4.5	5.8	- 1.3	- 0.5	- 0.8
1989	4.75	5.2	- 0.5	0.1	- 0.6
1990	5.0	6.2	- 1.2	- 0.3	- 0.9
1991	5.0	6.5	- 1.5	- 0.5	- 1.0
1992	5.0	6.7	- 1.7	- 0.5	- 1.2
1993	6.0	5.8	0.2	0.5	- 0.3
1994	5.5	5.6	- 0.1	0.1	- 0.2
Mean	5.15	5.85	- 0.69	- 0.13	- 0.56

Fig.1: Target Range and Money Growth

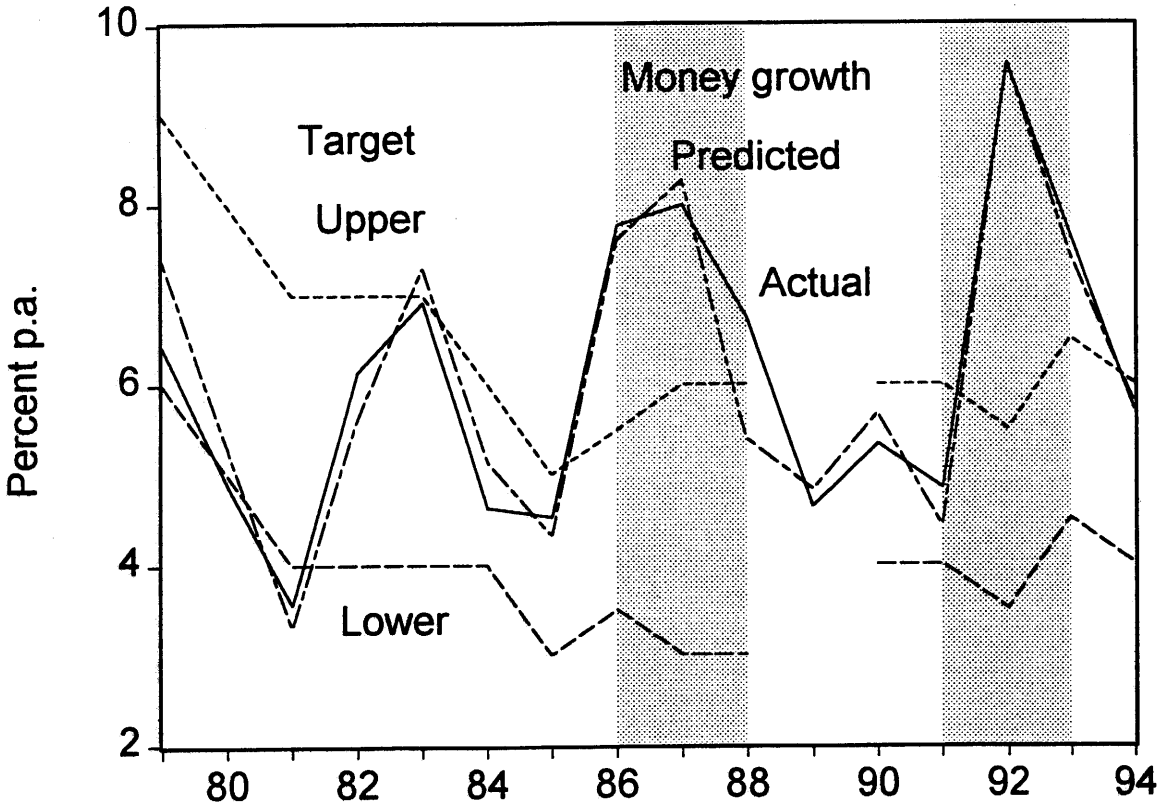


Fig. 2: Actual and Predicted Real Balances M3

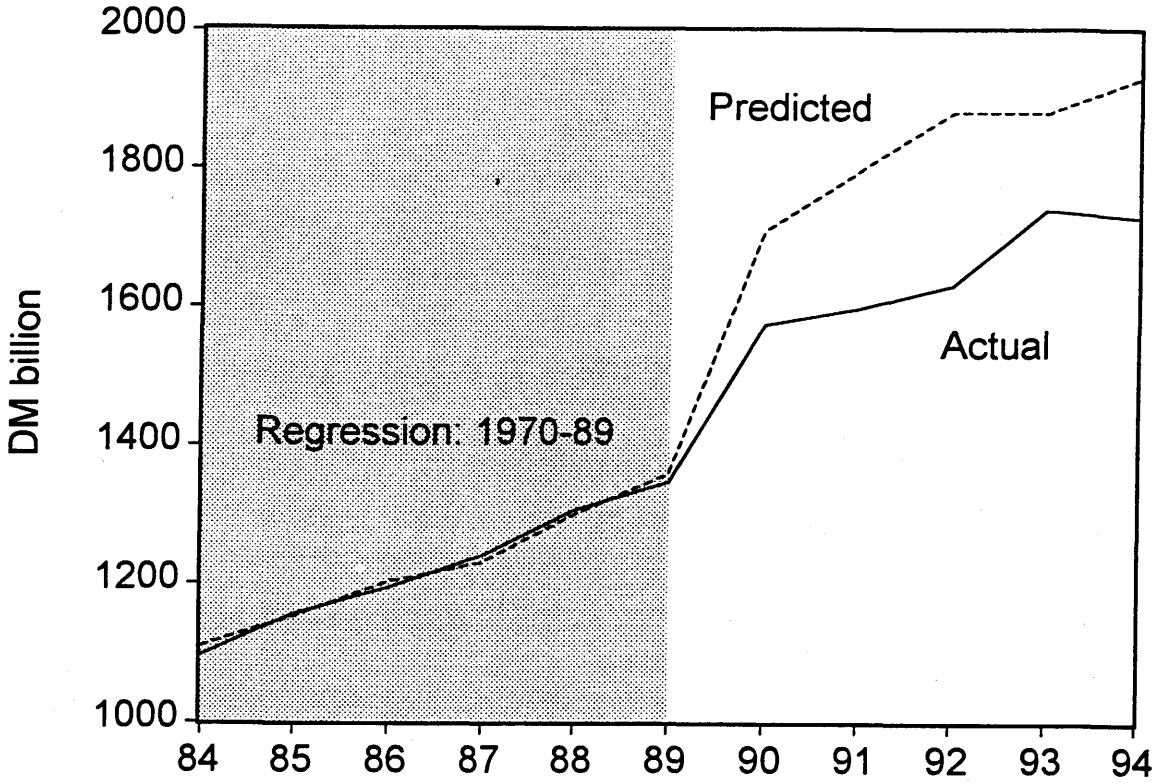
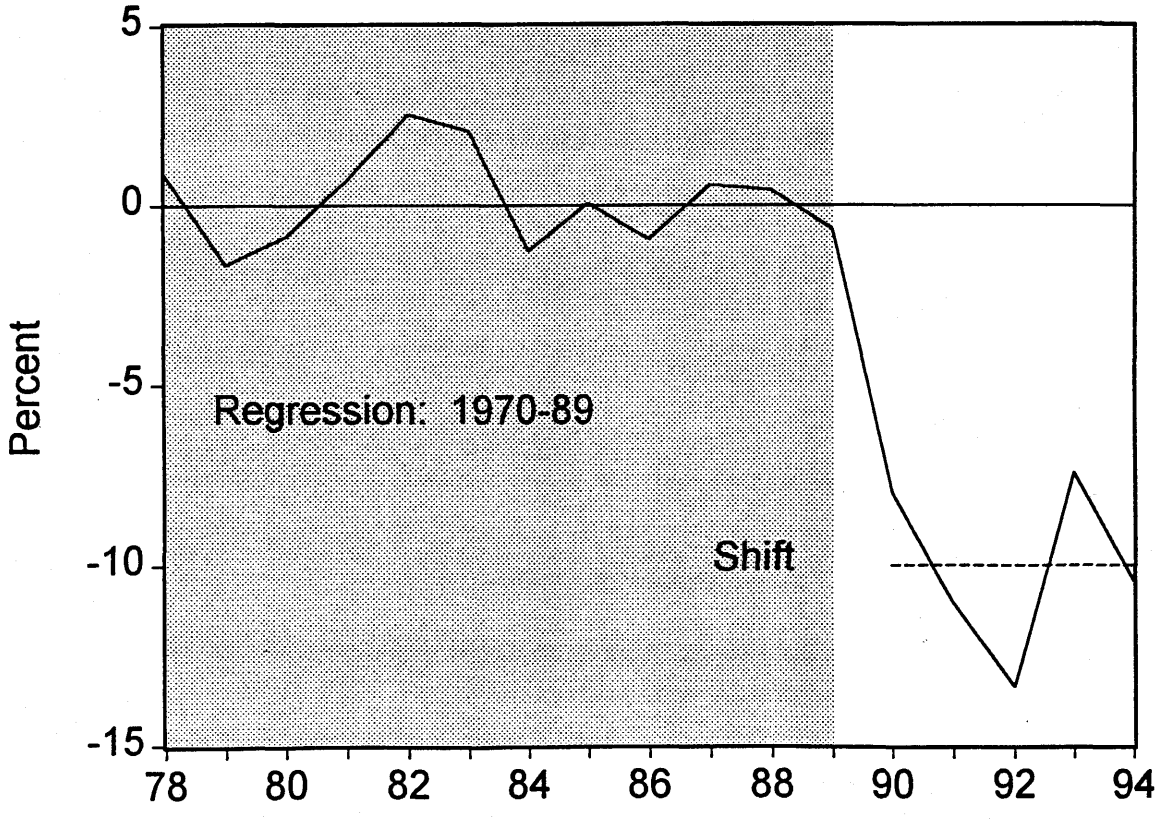


Fig. 3: Prediction Errors of the Real Demand for M3



Notes

1. See Deutsche Bundesbank (1992).

2. See Deutsche Bundesbank, Report for 1984, p. 40.

3. For details see Deutsche Bundesbank (1995).

4. Deutsche Bundesbank, Report for the Year 1975, p. 11. For an early critique of this weighting scheme see Neumann (1975).

5. Deutsche Bundesbank, Report for the Year 1988, p. 37. A detailed discussion of target aggregate M_3 is provided by Deutsche Bundesbank (1988).

6. Deutsche Bundesbank, Report for the Year 1980, p. 32.

7. Deutsche Bundesbank, Report for the Year 1980, p. 31.

8. Deutsche Bundesbank, Report for the Year 1991, p. 45.

9. Deutsche Bundesbank, Report for the Year 1982, p. 30.

10. Deutsche Bundesbank, Report for the Year 1984, p. 39.

11. Extending the currency area to East Germany raised the money stock M_3 by 14.6 percent in 1990.

12. Note that the expected equilibrium rate of change of the real exchange rate has been set at zero. The sample mean of the actual rate of change is – 0.3 percent.

13. Denoting the long-term yield of government bonds by r, the log of GDP by y, the log of the velocity of central bank money by v^{CBM}, and the log of the velocity of M_3 by v^{M3}, the following estimates served for deriving the proxy variable of money demand shocks:

1970-1987:

$$v_t^{CBM} = \underset{(12.3)}{3.73} - \underset{(-5.7)}{0.22}y_t + \underset{(4.1)}{0.013}r$$

$$\bar{R}^2 = 0.83 \quad DW = 2.16 \quad Q_4 = 5.63$$

1970-1994:

$$v_t^{M3} = \underset{(18.2)}{5.09} - \underset{(-16.7)}{0.59}y + \underset{(3.8)}{0.012}r + \underset{(3.3)}{0.08}D_{90} + \underset{(6.5)}{0.11}D_{91\text{-}94}$$

$$\bar{R}^2 = 0.97 \quad DW = 2.39 \quad Q_4 = 5.47$$

D_{90} and D_{91-94} are dummy variables to account for an unification-induced change in the level of velocity.

14. Note that the residuals have been multiplied by –1.

15. As a note of caution, our proxy variable is likely to mix in an unknown fashion shocks to money demand and innovations in the money supply.

16. As it happens, the result is the same for the CPI as well as for the GNP-deflator.

17. See Deutsche Bundesbank, Monthly Report August 1995, p. 42.

18. See OECD (1979), Boughton (1981), Neumann (1983), Buscher (1984), Neumann and von Hagen (1987).

19. Given the relative size of the East German GDP, an elasticity of 1.5 is consistent with estimate (28).

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