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The Practice of Monetary Targeting: A Case Study of the West German Experience

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Since the Bundesbank adopted monetary targeting in 1975, it has used two target variables — Central Bank Money and M3. We find both choices to have the properties required of a monetary target. However, the Bundesbank has not adhered strictly to its targets, retaining considerable discretion in its implementation of monetary targeting procedures. Changes in the dollar-deutschemark exchange rate have a significant impact on where the target variable ends up relative to the pre-announced range.

Rising inflation over the 1970s led to the adoption of monetary targets as a guide to monetary policy in a number of industrialized countries. The West German Central Bank (the Bundesbank) was the first central bank to announce a target for money growth. Since then, the rates of inflation that have prevailed in West Germany have been lower than those in most other industrialized nations. This paper examines the extent to which the Bundesbank has relied upon monetary targets to keep inflation under control as well as to achieve its other policy objectives.

Our analysis focuses upon two key questions. We ask whether the West German central bank's choice of a target variable has the properties required of such an aggregate. This question is especially interesting because from 1975 to 1987 the Bundesbank targeted a rather unusual monetary aggregate called Central Bank Money (CBM), which is a weighted average of the components of the broad monetary aggregate M3. Thus, we ask whether a stable relationship exists between CBM and key macroeconomic variables such as output, interest rates, and the price level. Our answer is yes.

We ask the same question for M3, which is the aggregate that the Bundesbank has announced it will target over 1988. Once again, the data is consistent with the existence of a stable relationship between key macroeconomic variables and this aggregate. In fact, the data suggests that CBM and M3 are rather similar.

We then look at the performance of the Bundesbank since the time that it began to target CBM. Despite the Bundesbank's success in keeping inflation low, it turns out that the Bundesbank's target variable has been outside the pre-announced range nearly as often as it has been within it. Furthermore, movements in the dollar-deutschemark exchange rate appear to be an important determinant of where the Central Bank Money Stock ends up relative to its target range. Clearly, the Bundesbank retains a considerable amount of discretion in its implementation of policy.

The rest of the paper is organized as follows. Section I presents a brief description of the institutional environment in which the Bundesbank operates. Section II describes the Bank's original target variable, CBM, as well as the factors that led to its choice. Section III continues the examination of CBM in a more formal way and also examines the properties of the more conventional monetary aggregates M1, M2, and M3.

Section IV looks at the conduct of monetary policy since the Bundesbank first announced a monetary target in 1975. It contains a brief description of the economic developments and some statistical analysis of the factors that have influenced monetary policy in the interim. A more detailed description of West German monetary policy since 1975 is presented in the Appendix. Section V presents the conclusions and discusses the implications of our analysis for the United States.

I. The Bundesbank and its Monetary Policy Objectives

The organization of the Bundesbank is similar to that of the Federal Reserve. The Central Bank Council is the policymaking body of the bank and is composed of the members of the directorate and the presidents of the eleven land central (that is, regional) banks. The directorate is the central executive organ, whose members are nominated by the federal government and appointed by the president of Germany after consultation with the Central Bank Council.[1]

The Bundesbank Act of 1957 emphasizes the Bank's role in ensuring the stability of the currency, which has been interpreted to include both a stable price level and a stable foreign exchange value for the deutschemark.

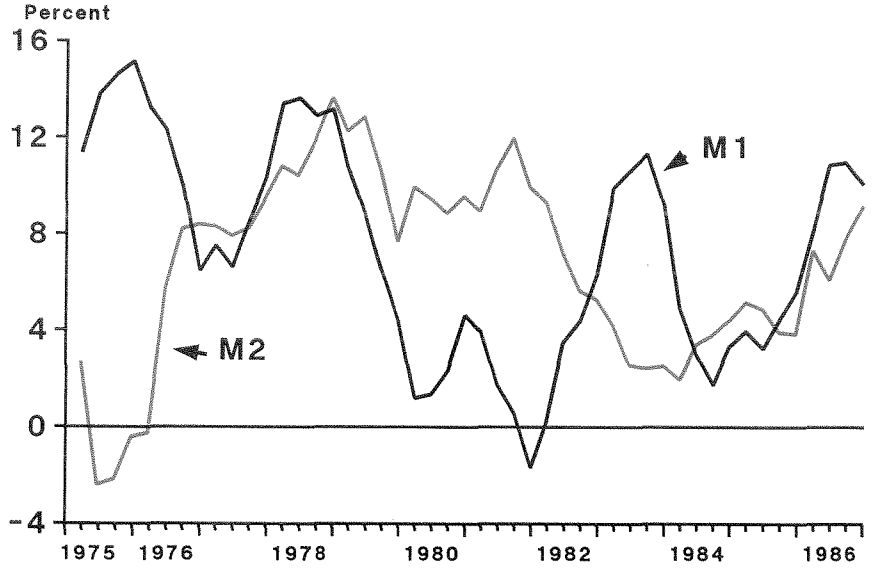
The Act allows the Central Bank a considerable degree of autonomy. While the Bundesbank is required to support the general economic policy of the government, it does not have to do so if such support were to threaten the stability of the currency. Members of the federal government are allowed to attend the policy deliberations of the Bundesbank. While they cannot vote, they can place items on the agenda and suggest that a policy decision be postponed for two weeks.

II. Choosing an Intermediate Target

Two criteria govern the choice of an intermediate target variable. The first is that the target variable be controllable by the central bank given the available instruments. The second is that its control should lead to stable and predictable effects on the economy.

The monetary aggregate called Central Bank Money (CBM) is a weighted average of the components of the broad monetary aggregate, M3. Currency is included and receives a weight of 1. The weights are .166 for demand deposits, .124 for savings deposits, and .081 for time

Chart 1
Opposite Movements in German M1 and M2*



* Growth rate is measured over the previous four quarters.

deposits. The weights on the various deposit accounts are actually the reserve requirements that were in effect in January 1974 and the weights have remained unchanged since then (although the actual reserve requirements have varied over time). CBM differs somewhat from the monetary base since it excludes excess reserves and includes only residents' holdings of deposit accounts. To understand why the Bank chose to target CBM rather than a more conventional aggregate, such as M1 or M2, it is useful to examine the circumstances leading up to its choice.

Prior to 1973, the Bundesbank paid close attention to "free liquid reserves," which consisted of excess reserves of commercial banks, short-term foreign assets, and unused rediscount quotas. However, the relationship between this aggregate and bank lending weakened in the early 1970s. In particular, bank lending continued to grow significantly even when free liquid reserves were close to zero. Faced with this shift in behavior, the Bundesbank was forced to find alternative aggregates.

M1 was not a particularly attractive candidate because experience over the 1960s had shown that changes in policy did not have predictable effects on M1. Furthermore, the decontrol of interest rates over the 1965-67 period led to an increase in the degree of substitution between demand deposits and short-term deposits. As a consequence, the Bundesbank began to look at a somewhat broader concept of the money stock consisting of M1 plus time deposits of less than six months maturity. Underlying this step was the belief that demand deposits and short-term deposits had become close substitutes due to interest rate decontrol. This aggregate was later modified by including time deposits with maturities up to 3 months only, and was called $M1_a$.

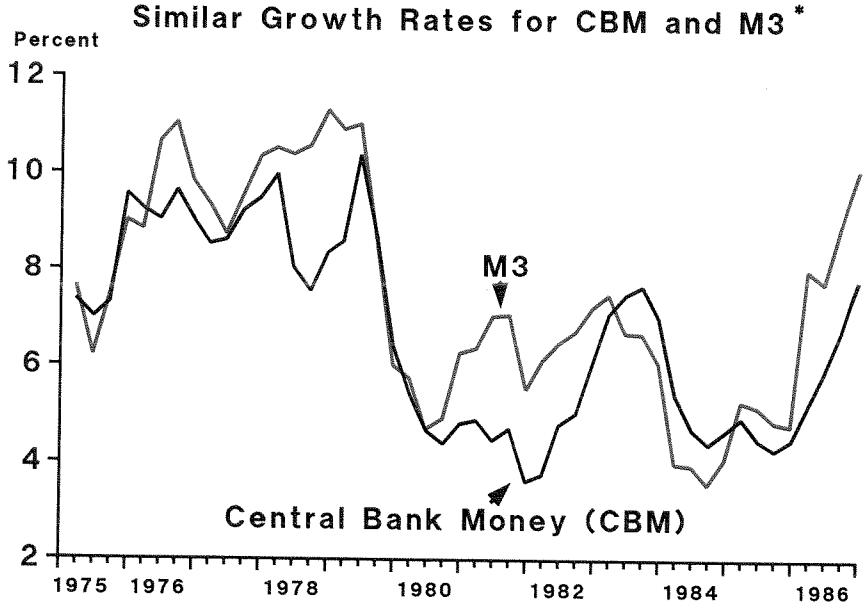
Unfortunately, sharp interest rate movements in the early 1970s demonstrated that $M1_a$ was an unstable indicator. For one thing, it turned out to have a positive interest rate elasticity. Consequently, a broader aggregate called M2 was introduced that contained M1 plus time deposits of up to 4 years maturity.[2]

However, M1 and M2 often moved in opposite directions, making it difficult to interpret what their movements really meant. Chart 1 illustrates that the high degree of substitution between M1 and M2 has continued over time. There is general agreement that these deposit swings are interest rate-induced. However, the problem for monetary policy has been the difficulty of predicting the extent of these movements.

Another margin of substitution that came to light as a result of the sharp interest rate swings of the early 1970s was that between savings and time deposits. As a consequence, the monetary authorities defined a new aggregate called M3 which consisted of M2 plus savings deposits. Although M3 was perceived to internalize the deposit shifts plaguing M1 and M2, the Bundesbank chose not to target this aggregate at that time, apparently on the

Chart 2

Similar Growth Rates for CBM and M3*



* Growth rate is measured over the previous four quarters.

grounds that assigning equal weights to demand, time, and savings deposits would exaggerate the "moneyness" of the latter two.[3]

Thus, the choice of CBM was motivated by the Bundesbank's belief that none of the existing monetary aggregates was likely to be useful as a target variable. Narrower aggregates such as M1 and M2 were likely to be afflicted by portfolio substitution, which would make it difficult to interpret movements in them, and the broad aggregate M3 was too imprecise a measure of transactions balances. A broad aggregate with more appropriate weights was, therefore, seen as the solution. This broad aggregate was expected to share some of the characteristics of M3 and, at the same time, reflect movements in transactions aggregates to a greater extent than M3.

The Bundesbank has mentioned this as the rationale for choosing CBM on several occasions:

> *The various types of deposits within the minimum reserve component of the central bank money stock (that is, savings, time and demand deposits) are consequently in a relation of roughly 4:3:2 to each other. This could approximate the varying degrees of moneyness or liquidity which the different categories of deposits are regarded as having.*[4]

Chart 2 plots the growth rates of Central Bank Money and M3 for the period 1975-1986. The growth rates of the two aggregates are close, suggesting that they do indeed have similar characteristics. We turn now to an examination of the relationship between these aggregates and various macroeconomic variables.

III. Analyzing the Monetary Aggregates

For an aggregate to be useful as a monetary target, there should exist some sort of equilibrium relationship between it and macroeconomic variables such as output, the price level, and the rate of interest. However, this requirement is more properly imposed upon the long-run behavior of the aggregate, since it would be unnecessarily stringent to require that equilibrium exist in every single period. Nevertheless the short-run behavior of the aggregate is not irrelevant. For policymakers, the usefulness of a long-run relationship between a particular monetary aggregate and key macroeconomic variables is likely to be severely impaired if short-run movements in the aggregate are largely uncorrelated with movements in those variables of policy concern.

This section presents an analysis of the properties of four alternative monetary aggregates — CBM, M1, M2 and M3. We begin by examining the nature of long-run movements in the various monetary aggregates and whether these movements are related to long-run movements in output, prices, and the interest rate. It turns out that there is no stable, long-run relationship between output, interest rates, and the real value of either M1 or M2.

We then go on to estimate money demand functions for the remaining two aggregates, CBM and M3. These demand functions allow for adjustment towards long-run equilibrium and also for the effects of short-run changes in the independent variables. The properties of the estimated demand functions provide essential information about the usefulness of these aggregates as target variables. For instance, a significant interest rate elasticity implies that the aggregate is subject to control through policy-induced interest rate movements. In addition, a stable demand function ensures that policy-induced variations in the target variable would have predictable effects on the economy.

Long-run Behavior

Recent work in econometrics has shown that it is important to determine correctly the nature of the long-term movements of a variable before attempting to carry out any estimation. Specifically, it is necessary to determine whether random disturbances have permanent effects on the level of the variable. A variable that exhibits no tendency to return to its original value following a disturbance it said to be nonstationary. Conversely, if the effects of the random disturbance were to die out over time, the variable would be said to be stationary. Of course, the variable still could be growing around a trend, in which case the series is said to be trend-stationary.[5]

The point is that conventional econometric techniques require stationarity. For example, if output, interest rates, and the monetary aggregates were stationary, then we could estimate money demand functions directly. Things are not as straightforward if some (or all) of these variables were nonstationary. We return to these issues below.

To determine whether the variables that are of interest to us are stationary (or trend-stationary, as the case may be), we use the Dickey-Fuller test for unit roots, which is described in Fuller (1976). The test consists of regressing the first difference of the variable in question on its own lagged level plus a constant, a time trend, and lagged first differences as appropriate. The null hypothesis that the

series contains a unit root (in other words, that random disturbances permanently alter the level of the series) implies that the coefficient on the lagged level should be zero. The test statistic is just the ratio of the estimated coefficient to its standard error, except that under the null hypothesis this statistic does not have the usual t-distribution. Critical values for this statistic are tabulated in Fuller.

Table 1 presents the results of this test for the levels and differences of the logs of real GNP, the real values of the four monetary aggregates,[6] and the interest rate variable (which is the rate on three-month bank loans). The sample period is 1975Q1 to 1986Q4. In each case, we have included two lags of the first difference of the dependent variable to capture the short-run dynamics. The first half of the table shows that we cannot reject the hypothesis of nonstationarity (or nontrend-stationarity, as the case may be) at even the 10 percent level for any of the series. By contrast, we can reject the hypothesis of nonstationarity at the 5 percent level for the first difference of all the series in the table.

Our findings suggest that the levels of all the variables in question contain unit roots. A variable that contains a unit root has no tendency to return to any "average" value over time (or to return to any trend value). Thus, for an equilibrium relationship to exist between a particular aggregate and variables such as output, interest rates, etc., the disturbances that cause nonstationary behavior in the monetary aggregate must also influence the latter set of variables. If the nonstationarity in the aggregate does not arise from the same sources as the nonstationarity in output, etc., the monetary aggregate will tend to drift away from the other variables.

Recent developments in econometrics provide a means of determining whether there is a long-run relationship between variables that contain unit roots. It turns out that we can test for the existence of a long-run relationship between such variables by estimating an ordinary least squares regression and examining the residuals from this regression for stationarity. A finding that the residuals are stationary means that even though the variables included

Table 1

Tests for Non-Stationarity

(1975Q1 - 1986Q4)

A. Tests for Levels of Variables*

	CBM	M1	M2	M3	Real GNP	Interest Rate
Constant	.76	.53	.18	1.0	1.52	.16
	(2.26)	(2.01)	(2.14)	(2.54)	(2.48)	(1.96)
Trend	.001	.001	–	.001	.001	–
	(1.94)	(1.88)		(2.18)	(1.95)	
Coefficient on lagged level	−.15	−.10	−.03	−.15	−.21	−.10
	(−2.23)	(−2.00)	(−2.03)	(−2.51)	(−2.46)	(−1.97)

B. Tests for Differences of Variables*

	CBM	M1	M2	M3	Real GNP	Interest Rate
Constant	.006	.003	.008	.007	.005	–
	(2.79)	(1.57)	(3.10)	(2.58)	(2.21)	
Lagged Level	−.90	−.52	−.83	−.75	−.94	−.60
	(−3.57)[2]	(−3.10)[3]	(−3.67)[1]	(−3.06)[3]	(−3.03)[3]	(−3.22)[1]

** Regressions were estimated after taking logs of all series. Each regression contains two lags of the 1st difference of the dependent variable.*

Notes: [1]Significant at 1%
[2]Significant at 2.5%
[3]Significant at 5%
[4]Significant at 10%

in the regression are nonstationary, there exists a linear combination of the variables that is stationary. Put differently, the variables will not drift away from each other. Such variables are said to be cointegrated. (See Granger and Engle, 1987.)

Table 2 presents the results of regressing the logs of the real values of each of the monetary aggregates on the logs of real GNP and the interest rate. We present two alternative test statistics. The row labelled "Dickey-Fuller Test" presents the results of the Dickey-Fuller test for stationarity of the residuals. As discussed, this test involves regressing the first difference of the residual series from the regression on its lagged level. The test statistic is the ratio of the estimated coefficient to its standard error, as before. The Durbin-Watson statistic for the original equation also can be used to test the hypothesis that the variables are cointegrated. If the variables were not cointegrated, the residuals would be nonstationary and the Durbin-Watson statistic would be close to zero. Thus, the null hypothesis of no cointegration (or alternatively, that the residuals are nonstationary) would be rejected if the Durbin-Watson statistic were large enough. Critical values for both tests are reported in Engle and Yoo (1987). Note, however, that the critical values of the Durbin-Watson statistic reported there are for cointegration in the bivariate case only.[7]

The results in Table 2 show that we can reject the hypothesis of no cointegration between CBM, real GNP, and interest rates at the 5 percent level on the basis of the Dickey-Fuller test. The Durbin-Watson statistic is also reasonably large. The Dickey-Fuller test does not allow us to reject the hypothesis of no cointegration between M3 and the other two variables at even the 10 percent level. However, the Durbin-Watson statistic for this regression is significant at the 10 percent level. For M2 and M1, we cannot reject the null of no cointegration on the basis of either test.

Although none of the more conventional monetary aggregates (M1, M2 or M3) is cointegrated with income and interest rates taken together, it is possible for them to be cointegrated with income alone. The results of the tests for cointegration between each of these aggregates and real GNP are presented in Table 3. We can reject the null hypothesis of no cointegration between M3 and real GNP at the 10 percent significance level using either the Dickey-Fuller test or the Durbin-Watson statistic. However, we cannot reject the null of no cointegration either between M1 and real GNP or between M2 and real GNP.

These results have important implications for the choice of target variable. Our evidence suggests that the real values of both M1 and M2 are subject to random disturbances that permanently alter the levels of these aggre-

Table 2

Tests for Cointegration - I

(1975Q1-1986Q4)

	CBM	M3	M2	M1
A. Estimated Equations				
Constant	−4.22	−5.02	−6.39	−3.58
	(−20.7)	(−15.1)	(−10.39)	(−9.79)
Real GNP	1.28	1.59	1.69	1.25
	(44.9)	(34.2)	(19.7)	(24.6)
Interest Rate	−0.02	−0.01	.06	−.04
	(−3.2)	(−0.96)	(3.36)	(−4.33)
B. Test Statistics				
Dickey-Fuller Test	−4.58[2]	−3.47	−2.81	−2.90
D. W. Statistic*	1.22[1]	.77[3]	.33	.58

**Critical values are only available for cases where regression contains one explanatory variable.*

Notes: [1]Significant at 1%
[2]Significant at 5%
[3]Significant at 10%

gates but that do not have similar effects on either income or interest rates. This makes it undesirable to use M1 and M2 for monetary targeting, since they exhibit no tendency toward a stable relationship with key macroeconomic variables. One implication of this finding is that if a money demand function were estimated for either of these aggregates, the absence of an equilibrium relationship likely would show up as permanent "shifts" in the estimated function.

By contrast, our results show that permanent disturbances to the real value of CBM are related to permanent disturbances to output and interest rates. The finding that CBM is cointegrated with real GNP and interest rates has an intuitive interpretation. It implies that even though these three series are subject to random disturbances that have permanent effects, these disturbances are not independent. Thus, long-run movements in the real value of CBM will tend to be closely associated with movements in output and interest rates. We also find that permanent disturbances to the real value of M3 are related to permanent disturbances to output (although the evidence here is weaker). Thus, long-run movements in M3 will mirror movements in output.

Table 3

Tests for Cointegration - II

(1975Q1 - 1986Q4)

A. Estimated Equations

	M3	M2	M1
Constant	−4.94	−6.94	−3.16
	(−15.39)	(−10.59	(−7.61)
Real GNP	1.57	1.77	1.18
	(35.70)	(19.71)	(20.75)

B. Test Statistics

Dickey-Fuller Test	−3.35*	–	−2.37
Augmented Dickey Fuller Test	–	−1.87	–
D. W. Statistic	.74*	.29	.41

**Significant at 10%*

Estimating Demand Functions

The existence of a cointegrating regression is not sufficient to ensure that either CBM or M3 will be useful as monetary aggregates since it tells us only about long-run relationships. We need to examine the behavior of these two aggregates over the short-run as well. It is tempting to do so by estimating money demand functions in the first differences of the variables, since first differencing purges the data of long-run movements. However, such a step is inappropriate when the variables are cointegrated because it means ignoring the long-run relationship that exists between them.

The appropriate way to proceed is to estimate an error correction model which forces gradual adjustment of the dependent variable toward some long-run value while explicitly allowing for short-run dynamics.[8] For example, our finding of cointegration implies that the difference between the actual value of CBM and that suggested by the cointegrating regression will tend to move back towards zero following a random disturbance. This suggests that the discrepancy between the actual and equilibrium value of CBM is likely to be one of the factors that determines the growth of CBM at any time. Of course, the growth rate of CBM also is likely to be influenced by various temporary disturbances to the other variables in the regression.

These considerations suggest that the equation to be estimated should be of the form:

$$CBM_t = a + b_i \sum_i \Delta \text{ Real GNP}_{t-i} + c_i \sum_i \Delta \text{ INT}_{t-i} + d\ EC_{t-1}$$

where Δ denotes the first difference,

INT is the interest rate, and,

$EC_t = CBM_t + 4.22 - 1.28\,RGNP_t + 0.02\,INT_t$ is the error-correction term.

The error-correction term is constructed using the coefficients from the cointegrating regression shown in Table 2. The first differenced terms capture the effects of short-run disturbances to output and interest rates while the error correction term captures the adjustment towards long-run equilibrium. A similar equation is estimated for M3, with the error-correction term obtained from the cointegrating regression shown in Table 3.

The estimated demand functions for CBM and M3 are shown in Table 4. The functions were first estimated with 8 lags of both the first difference of real GNP and the interest rate. Lags that were insignificant were then eliminated, taking care that this did not induce residual autocorrelation. The coefficient on the error-correction term in the CBM equation reveals that approximately one-fourth of

the previous quarter's discrepancy between the actual and equilibrium value of CBM is corrected each quarter. Short-run movements in real GNP and interest rates also have a significant impact on CBM growth.

The equation for M3 reveals that the previous period's discrepancy between actual and equilibrium values is a significant factor in explaining M3 growth as well. Further, while there is no long-run relationship between M3 and the rate of interest, the growth rate of M3 is temporarily affected by interest rate movements.

A Chow test was carried out to test the stability of each of the estimated demand functions. The sample was divided into two subsamples, the first extending over 1975Q1-1979Q4 and the second extending over 1980Q1-1986Q4. The breakpoint was chosen on the basis of the dollar-mark exchange rate: the dollar reached its low point against the mark in 1979Q4 and began to appreciate after that. For CBM, the computed value of the F(9,28) statistic is 1.48, which has a marginal significance level of .20. The computed value of the F(5,38) statistic for the M3 equation was 0.68, which has a marginal significance level of .64.[9] Thus, neither the demand function for M3 nor that for CBM exhibits any evidence of instability over the 1975Q1-1986Q4 period.

To summarize, the evidence presented in this section suggests that the real value of CBM has had a stable relationship with real income and interest rates over the period that the Bundesbank has been targeting CBM. Real output and the real value of M3 also appear to be similarly related. However, no stable, long-run relationship exists for either M1 or M2.

These results are consistent with the argument that the narrower aggregates are subject to random portfolio disturbances that prevent them from having a stable relationship with output. These disturbances appear to be internalized within the broader aggregate M3 to an extent that interest rate fluctuations do not appear to have any long term impact on it. The evidence also suggests that aggregate CBM has characteristics more like those of the broad monetary aggregate M3 than the relatively narrow aggregates M1 and M2. This implies that the weights attached to savings and time deposits in CBM are sufficient to offset the impact of portfolio disturbances that afflict M1 and M2 and to ensure a stable relationship between real output, the interest rate, and the real value of CBM. Thus, our analysis suggests that both CBM and M3 possess the characteristics required of a target variable.[10]

We now turn to the second issue that is of interest, namely, an examination of the actual conduct of policy since the Bundesbank began to target CBM.

Table 4

Error-Correction Specifications for Money Demand

(1975Q1 - 1986Q4)

Dependent Variable	Δ CBM_t*	Δ $M3_t$
Constant	.003	.01
	(1.94)	(7.80)
Δ Real GNP_t	.47	–
	(4.11)	
Δ Real GNP_{t-1}	−.20	−.21
	(−2.26)	(−2.05)
Δ Real GNP_{t-5}	.26	–
	(2.69)	
Δ Real GNP_{t-8}	.22	–
	(2.20)	
Δ Interest $Rate_{t-1}$	−.02	–
	(−2.16)	
Δ Interest $Rate_{t-2}$	–	−.02
		(−2.12)
Δ Interest $Rate_{t-3}$	−.03	−.03
	(−3.40)	(−3.49)
Δ Interest $Rate_{t-6}$	−.02	–
	(−2.78)	
Error Correction Term	−.24	−.20
	(−2.63)	(−3.10)
$R^2/\bar{R}^2$	.63/.53	.37/.31
Durbin-Watson Statistic	2.02	1.79
Q Statistic (Marginal Significance Level of Statistic)	23.7(.16)	17.1(.51)

**Equation contains constant dummies for 1978Q2 and 1978Q3*

Δ denotes first difference
t− statistics are shown in parenthesis

IV. West German Monetary Policy since the mid-1970s

In this section, we examine West German monetary policy since the Bundesbank began to target CBM in 1975. We begin by describing the factors that the Bundesbank takes into account in setting the target range each year, and then look at how the CBM target has varied over the years. Finally, we look at how successful the Bundesbank has been at achieving these ranges and the factors that have played a role in determining where CBM ended up relative to its target range.

By announcing a CBM target for 1975, the Bundesbank became the first central bank to announce a money growth target. In the beginning, the Bundesbank's discussion of a desirable rate of CBM growth was couched in terms of the expected growth of capacity, the desired change in capacity utilization, and the expected development of the "velocity of circulation."[11] The Bundesbank also made an allowance for the "unavoidable" rate of inflation, which was defined as "price rises which have already entered into decisions and arrangements in the economy." However, the Bundesbank stopped using the term unavoidable in 1985, explaining that "Given the large measure of price stability achieved, it would have been difficult to explain credibly why this concept should be retained."[12]

Recent discussions of the target range for CBM have been cast in terms of the growth rate of the nominal "production potential", which is further broken down into the growth rate of real production potential and a "tolerated" rate of inflation. The rate of inflation that the Bank allows for has been declining over time. For example, it was between 4 to 5 percent in 1976, between 3.5 to 4 percent in 1981, and 2 percent in 1986. The Bundesbank also retains the option of revising targets at mid-year, but has not done so until now.

Table 5 presents the target ranges as well as actual growth of CBM since 1975. The Bank announced single-valued targets for the first four years, but (convinced perhaps by the size of the errors) has been expressing its targets as ranges since 1979. It is notable that the upper bound of the target range decreased steadily from a high of 9 percent in 1979 to 5 percent in 1985. However, it went up by a half-percentage point in both 1986 and 1987. The width of the range also was narrowed to 2 percentage points beginning in the target year 1984, but was widened back to 3 percentage points for 1987. We discuss the significance of these changes below.

The Bundesbank's record in achieving its target ranges has been mixed. CBM growth was above target from 1975 to 1978 — the four years for which the target consisted of a single number. However, for two of those years the discrepancy was only around one percentage point. CBM growth did not exceed the upper bound of its target range for the next six years, actually ending up below the lower bound in 1980 and 1981. However, the target was overshot in both 1986 and 1987.

An examination of the conduct of monetary policy since 1975 provides interesting insights into how the Bundesbank reacts to different economic developments and helps explain the Bank's record of monetary targeting. (A description is contained in the Appendix.) It is quite evident that the Bundesbank attaches a great deal of importance to price level stability. But exchange rate stability — especially the stability of the mark-dollar rate — has always been an extremely important consideration. While the exchange rate is important because Germany's foreign trade comprises a significant proportion of its GNP, the focus on the dollar is probably the result of the fact that the mark is one of the most important reserve currencies in the world after the dollar. Consequently, the least sign of instability in the value of the dollar sets up

Table 5

Actual and Target Values of the Growth Rate of Central Bank Money

(Percent annual rates)

Period	Target	Actual
December 1974-December 1975	8.0	10.0
1976	8.0	9.2
1977	8.0	9.0
1978	8.0	11.4
1978Q4-1979Q4	6.0-9.0	6.3
1979Q4-1980Q4	5.0-8.0	4.9
1980Q4-1981Q4	4.0-7.0	3.6
1981Q4-1982Q4	4.0-7.0	6.1
1982Q4-1983Q4	4.0-7.0	7.0
1983Q4-1984Q4	4.0-6.0	4.6
1984Q4-1985Q4	3.0-5.0	4.5
1985Q4-1986Q4	3.5-5.5	7.7
1986Q4-1987Q4	3.0-6.0	8.1

speculative movements in the mark. In addition, a significant amount of world trade is invoiced in dollars.

The strong correlation between movements in the mark-dollar rate and how well the Bundesbank performed relative to its target range, in fact, allows us to divide the period under review into three sub-periods. The first covers the years immediately following the adoption of the CBM target, that is, approximately 1975 to 1979. The dollar tended to depreciate over this period and the Bundesbank generally allowed CBM to exceed its target.

The mark fell relative to the dollar over the first half of the 1980s. Over that period, CBM ended the year below the lower bound of its target range twice and was below the midpoint once. It never ended the year above the upper bound of its target range.

The last two years or so constitute the final sub-period, where the mark has been appreciating against the dollar again. And in both 1986 and 1987, CBM has grown above the target range. Thus, the target has been exceeded despite the fact that the Bundesbank increased the upper bound of the target range half a percentage point each year.

This is not to say that the Bundesbank cares only about stabilizing the exchange rate. As mentioned above (and described in the Appendix), the Bank is extremely concerned about price level stability. And the Bundesbank has from time to time, adjusted its policy stance to take the level of real activity directly into account. To obtain a more accurate idea of the importance that the Bundesbank attaches to various objectives, a monetary policy reaction function was estimated for the years 1975-1986.

The reaction function was estimated in terms of the deviation of CBM from the midpoint of the announced target path.[13] This variable — denoted by CBMDEV below — is preferable to using (either the level or the growth rate of) CBM directly, since using CBM may result in confounding the demand function for the aggregate with the Bundesbank's reaction function. The explanatory variables in the regression are the growth rate of real GNP (RGNP), the rate of inflation (GNPDEF), and the growth rate of the deutschemark-dollar exchange rate (DM$RATE), which is expressed in dollars per mark.[14]

The estimated equation is:

$$\begin{aligned}\text{CBMDEV}_t = {} & \underset{(2.96)}{1.52} + \underset{(.39)}{.01\ \text{RGNP}_t} \\ & \underset{(-.32)}{-\ .01\ \text{RGNP}_{t-1}} + \underset{(1.58)}{.05\ \text{RGNP}_{t-2}} \\ & \underset{(-1.32)}{-\ .03\ \text{RGNP}_{t-3}} - \underset{(-3.02)}{.18\ \text{GNPDEF}_t} \\ & \underset{(-3.32)}{-\ .19\ \text{GNPDEF}_{t-1}} + \underset{(.96)}{.006\ \text{DM\$RATE}_t} \\ & + \underset{(.62)}{.004\ \text{DM\$RATE}_{t-1}} \\ & + \underset{(.93)}{.005\ \text{DM\$RATE}_{t-2}} + \underset{(3.19)}{.02\ \text{DM\$RATE}_{t-3}}\end{aligned}$$

$R^2/\bar{R}^2 = .65/.53$; D.W. = 1.75; Rho = .58 (3.88)

From the test statistics, we can reject the null hypothesis that the coefficients on the current and lagged values of real GNP growth are zero at the 5 percent level of significance. However, the sum of the coefficients on real GNP is .02, and has a marginal significance level of .84. The coefficients on the inflation rate are significant at the 1 percent level, and their sum is −.37, which also is significant at the 1 percent level. We can reject the hypothesis that the coefficients of the current and lagged values of the exchange rate are zero at the 5 percent level of significance. The sum of these coefficients is .03 and is significantly different from zero at the 5 percent level as well.

These results are consistent with our earlier discussion. The estimates suggest that the Bundesbank responds immediately to changes in inflation. An increase in inflation leads to a contemporaneous reduction in CBM growth relative to the mid-point of its target range as well as a reduction in CBM growth over the next quarter. When the mark appreciates against the dollar, policymakers respond by pushing CBM above the midpoint of its target range. However, this response is slower than the response to inflation. Finally, the measured response to GNP is ambiguous. Thus, the Bundesbank apparently attaches the greatest importance to the rate of inflation and to stabilizing the exchange rate.[15]

We have examined how the Bundesbank sets its monetary targets and how successful it has been in attaining these targets. We saw that the target is missed fairly often, and that large misses are associated with variations in the dollar-mark exchange rate. These casual observations are supported by the results from the estimated reaction function.

However, the fact that the Bundesbank often gives up on its monetary target in pursuit of exchange rate stability has not called into question its commitment to price level stability. This appears to be the result of the relatively low rates of inflation that have prevailed in West Germany over the period. For example, Germany's GNP deflator increased by approximately 3 percent over 1986, after increases of approximately 2 percent over each of the previous two years. While the rate of inflation did go up following the 1979 oil price increase, the highest annual increase in the GNP deflator recorded since 1979 was the 4.8 percent inflation rate during 1981.[16] These relatively low rates of inflation imply that the Bundesbank's practice of giving up on its monetary target to focus on stabilizing the deutschemark has not imposed large costs in terms of price level stability. As a consequence, the Bank's anti-inflation stance remains credible.

V. Conclusions

This paper has focused on two aspects of the process of monetary targeting in Germany since 1975. The first concerns the choice of a target variable. Our results suggest that CBM has characteristics similar to the broad aggregate M3, and that neither is susceptible to the portfolio disturbances afflicting M1 and M2. We found evidence that the real value of CBM is cointegrated with real output and interest rates and (weaker evidence) that M3 is cointegrated with output. Cointegration between these variables allowed us to employ an error-correction specification to estimate demand functions for CBM and M3. These demand functions were robust to a simple test for nonstability. These results imply that both CBM and M3 satisfy the requirements for a target variable.

The finding regarding the nature of CBM has potentially important implications for the U.S. as well. Until recently, U.S. monetary policy has placed the most emphasis on the narrow monetary aggregate, M1. However, the behavior of M1 over the past few years has been largely at odds with the behavior of output and inflation. In fact, U.S. policymakers today are faced with a dilemma that is similar to that faced by West German policymakers during the mid-1970s. The policy of targeting the narrow aggregate M1 has been rendered infeasible by the increased substitutability between various types of deposit accounts both inside and outside M1.[17] While the broad aggregates M2 and M3 do not appear to have been as susceptible to the random portfolio disturbances that have afflicted M1 in recent years, movements in them are not likely to be closely related to movements in macroeconomic variables that are of interest to policymakers. As such, it may be useful to examine the relationship between output, inflation, and some aggregate similar to the West German Central Bank Money Stock with a view to obtaining a more suitable monetary target.

The second part of the paper examined the conduct of monetary policy in Germany since the Bundesbank began to target a monetary aggregate. The Bundesbank obviously places a great deal of emphasis on inflation. This is reflected in the estimated reaction function. It is also evident in the low rates of inflation in Germany over this period, rates that clearly have been lower than those that prevailed in most industrialized nations.

Germany's concern over inflation has not bound it to strict adherence to monetary targets, since the target has been missed frequently. Our finding of a stable CBM demand function suggests that the deviations from target are not due to "shifts" in the demand for CBM. Instead, the deviations demonstrate that the Bundesbank has retained a considerable level of discretion in the implementation of monetary targeting. Our examination of episodes of deviation from target shows that fluctuations in the exchange rate were a major determinant of where CBM ended up relative to its target. This practice has not had adverse effects on inflation because the Bundesbank has reacted symmetrically to increases and decreases in the value of the mark — easing when the mark tended to appreciate and tightening when it tended to depreciate.

APPENDIX

German Monetary Policy Since 1975

To provide greater insight into the discussion and conclusions in Section III, this appendix provides a brief description of German monetary policy since the Bundesbank began to target CBM.*

December 1974-December 1975

Monetary policy relaxed substantially in 1975, the first year that a target was announced. Real GNP had begun to contract in mid-1974 and fell by approximately 5 percent over the next four quarters. The Bundesbank's tendency to ease was reinforced early in the year by the falling dollar, which fell to the then-postwar low of 2.28 marks in March. When economic activity showed no sign of picking up by mid-1975, the Bundesbank eased policy even further. The discount rate stood at 3½ percent in September — half the level in September 1974.**

The monetary easing had the expected impact on CBM growth. The level of CBM in December 1975 was 10 percent above that in December 1974, or 2 percent above target. The Bundesbank responded to this overshooting by redefining the target year. The CBM target growth rate would henceforth be measured on a year-over-year basis, instead of December-over-December. The justification for dropping the old method was that it exaggerated the role of temporary factors. The targeted growth rate of CBM was set at 8 percent for 1976.

1976-1977

The economy rebounded over the next couple of years, while the rate of inflation declined. Domestic demand grew strongly in 1976 and real GNP increased by around 5.5 percent. The rate of inflation fell to 4 percent per year. Real GNP grew at a 2.5 percent rate the following year although unemployment did not fall much. Although the cost of living index for 1977 was 3.9 percent above 1976 levels, inflation was clearly slowing down over the course of the year.

The dollar, after recovering over mid-1975 and staying relatively stable over the first half of 1976, started falling against the mark in the second half. It fell throughout 1977, with the rate of depreciation accelerating considerably after October. On March 1, 1978 the dollar stood at 1.99 marks, having fallen 19 percent over the previous 14 months. The Bundesbank eased substantially over 1977, causing CBM to grow rapidly. CBM grew at a 12 percent annual rate over the second half of the year, but the 9 percent rate of growth for the year as a whole was just 1 percent above the target.

1978

The depreciating dollar was perhaps the most important reason behind the Bundesbank's maintaining its easy policy stance over 1978. Real GNP grew by 3.5 percent over the year and the rate of unemployment fell to 3.7 percent. Thus, the level of domestic activity suggested no need to ease. However, the mark was appreciating significantly against the dollar, so that by October 1978, the dollar stood at 1.78 marks. The attempt to stabilize the mark caused policy to remain accommodative, with the discount rate held at 3 percent over the year. This stance was facilitated by a still-declining rate of inflation — the 2.6 percent increase in consumer prices over 1978 was the lowest since the end of the 1960s. Easy policy did lead to a surge in CBM growth, with CBM growing 11 percent over the year, while the target rate was 8 percent.

The size of the miss appears to have been responsible for a redefinition of the target year once again, as the Bundesbank decided to target CBM growth on a fourth quarter over fourth quarter basis from the following year.

1979

The dollar-mark exchange rate was relatively stable over 1979. Accordingly, the Bundesbank focused on domestic conditions. Inflation was picking up gradually: while the cost of living index in 1979 was just 4.1 percent above 1978, its value in December 1979 was approximately 5.5 percent above year-ago levels. Economic activity was strong, with real GNP rising at a 4.5 percent rate and the unemployment rate averaging 3.3 percent.

The Bundesbank therefore tightened policy. The discount rate was raised to 4 percent in March and to 5 percent in July. CBM remained above target till May. At mid-year

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* *This description is not meant to be exhaustive. For a detailed discussion, see various issues of the OECD's Economic Surveys on Germany and the Bundesbank's Annual Reports.*

** *In Germany, the discount rate is not a penalty rate as it is in the U.S. Instead it is the rate at which commercial banks borrow against rediscount quotas established by the Bundesbank. For a description of policy instruments and operating procedures, see Deutsche Bundesbank (1982).*

the Bank decided to aim for the lower half of the CBM target range and policy was tightened further over the second half of 1979.

1980

A depreciating mark and rising inflation came together to determine the tight monetary policy stance that prevailed over 1980. Consumer prices were approximately 5½ percent above 1979 levels, while the mark fell by around 13 percent against the dollar. Although real GNP grew by nearly 2 percent over the year, this growth lay almost entirely in the first quarter, with output actually declining over the second half of the year. In February, the Bundesbank announced that it would keep CBM around the middle or perhaps in the lower half of its target range. Attempts to revive CBM growth, and thereby to increase real activity, during the summer were dropped when the mark began to depreciate. Signalling a continuation of its tight monetary policy stance, the Bundesbank reduced the target range for the next year by 1 percent.

1981

1981 was a year of contracting output and rising inflation. Real GNP fell 0.3 percent over the year, while the cost of living index rose by nearly 6 percent. The mark fell sharply against the dollar early in the year. By mid-February, it had fallen by about as much again as it did over all of 1980.

The Bundesbank reacted with a severe tightening of policy. The mark recovered in response and began to appreciate against the dollar in the latter half of the year. As a consequence, interest rates began to decline in late 1981. CBM growth was on target until mid-year but then slowed and actually declined for a while towards the end of the year.

1982

The worldwide recession in 1982 and the consequent decrease in German exports combined with stagnant domestic demand to cause a decline in real GNP of over 1.5 percent, while the unemployment rate rose from 5 to 6.5 percent. Although consumer prices increased by 5.3 percent during 1982, the pace of inflation was clearly slowing over the year. When the mark stabilized in early 1982, the Bank announced that CBM growth around the middle or in the upper half of the target range would be acceptable.

Monetary easing paused at mid-year as the mark fell against the dollar again. However, the worldwide reduction in interest rates towards the end of the year allowed German monetary authorities to ease domestic rates. The discount rate stood at 5 percent in December.

1983

The mark was relatively stable in early 1983 and the rate of inflation declined, allowing policymakers to focus on output growth. The Bundesbank indicated that, under these conditions, it would allow CBM growth in the upper half of its 4-7 percent target range over the year. Policy remained easy in the beginning, but the mark's depreciation later in the year led to a tightening of policy. Although the unemployment rate went up during 1983, the rate of output growth picked up over the course of the year. Real GNP increased by 1.5 percent over the year as a whole — the first increase since 1980.

1984

Real GNP grew by 2.5 percent in 1984, despite severe production losses due to strikes. Strong foreign demand contributed significantly to this increase. However, the unemployment rate stayed at 8.1 percent of the total labor force. Inflation continued on its downward trend as the cost of living index rose 2.4 percent compared to 3.3 percent in 1983. However, the mark fell by approximately 13.5 percent against the dollar over 1984, and this fall appears to have been largely responsible for halting the downward drift in interest rates.

1985

Interest rates actually increased around the time that the dollar peaked in February 1985. But the decrease in U.S. interest rates that followed triggered a marked decline in German interest rates as well. The upswing in real activity continued, with output growing at a 2.5 percent rate. Inflation slowed down further, with consumer prices increasing at a 2.2 percent rate over the year.

The upper bound of the CBM target range for 1984 had already been lowered to 6 percent on the grounds that the level of uncertainty about the economic environment had gone down. For 1985, the Bundesbank cited the prevailing low levels of inflation as the reason for lowering both the upper and lower bounds of the target range by 1 percent.

1986

The target range for 1986 was increased by half a percentage point on the grounds that the potential real output growth rate had increased. Prices were stable over the year, with some indices actually declining. Monetary

policy was dominated by the exchange rate again. The mark continued to appreciate against the dollar, and the Bundesbank responded with an accommodative policy. The discount rate was cut to 3.5 percent in March.

The accommodative policy stance was continued even when clear signs that CBM was overshooting its target emerged at mid-year. Thus, CBM growth for the 1986 target year was 7.7 percent, or more than 2 percentage points above the upper bound of the target range.

Uncertainty over the future course of exchange rates ("special uncertainties" in the Bundesbank's language) led to a widening of the 1987 target range by 1 percentage point.

Real output increased by 2.5 percent in 1986 due largely to an increase in consumption. However, growth began to slow from the middle of 1986, with production stagnating in the last quarter of 1986 and declining in the early months of 1987. The rapid deterioration was a surprise, being a consequence of sluggish exports and sharply increased import penetration. The volume of exports fell for only the third time in post-war history.

1987 on

Available data suggest that monetary policy continued to focus on the exchange rate over 1987. CBM grew 8.1 percent from the fourth quarter of 1986 to the fourth quarter of 1987, 2.1 percent above the 3.0-6.0 percent target range. In January 1988, the Bundesbank announced a 3-6 percent range for M3, citing the relatively large impact of (difficult to explain) currency movements on CBM as the reason for dropping that aggregate.

FOOTNOTES

1. Willms (1983) points out that the role played by the Central Bank Council in appointing new members has diminished over time, and that some members were appointed over the Central Bank's objections.

2. The West Germany definition of M2 is thus different from the U.S. definition. In the U.S., M2 contains M1, savings deposits, Money Market Deposit Accounts, Small Time Deposits (that is, time deposits containing up to $100,000), and some money market mutual funds.

3. See the discussion on pp. 71-82 of Deutsche Bundesbank, Special Series No. 7.

4. Deutsche Bundesbank, Special Series No. 7, p. 78.

5. Technically, we will be concerned with the existence of a "unit root." The simplest example of a process that contains a unit root is given by

$$y_t = y_{t-1} + u_t$$

where u_t is a stationary disturbance term. Such a process is called a random walk. This is a special case of a nonstationary process. For instance, the process

$$y_t = 2y_{t-1} + u_t$$

is nonstationary although it does not contain a unit root.

6. We look at the real values of the monetary aggregates because the objective is to estimate money demand functions in real terms. The GNP deflator has been used to convert nominal to real values.

7. Granger and Engle also present alternative tests for the null of no cointegration. One of these is the Augmented Dickey-Fuller test, which adds the lagged differences of the residual as additional right-hand-side variables to the regression used for the Dickey-Fuller test. The test statistic is the same as before. Results of this test are not reported here because the lagged differences of the residual were found to be insignificant.

8. For an earlier example of the use of an error-correction model to estimate a money demand function, see Hendry (1980). See also Motley (1988).

9. Splitting the sample into two equal sub-samples also does not suggest instability. For CBM, the computed F-statistic of 1.27 has a marginal significance level of .30. For M3, the F-statistic is .53, and has a marginal significance level of .75.

10. Needless to say, the Bundesbank's choice of CBM as the target variable has not been free from criticism. See, for example, Courakis (1980).

11. The following description is based on the discussions contained in various issues of the *Annual Report* of the Deutsche Bundesbank.

12. See the Bundesbank *Annual Report* for 1985.

13. Because the reaction function does not take into account the factors that go into setting the target ranges themselves, the results below are perhaps more appropriately interpreted as measuring the Bundesbank's response to unanticipated movements in output, the price level, and the exchange rate.

14. Since the explanatory variables are in growth rates, CBMDEV for a given quarter is actually measured as a percentage of the target level of CBM for that quarter. The estimated equation also contains a constant dummy for the second quarter of 1978 that is not shown below.

15. It should be pointed out that concern about the exchange rate ultimately does reflect concern about real GNP.

16. Since Germany is not an oil producer, the GNP deflator is not directly affected by oil prices. An alternative is to look at the Consumer Price Index. This index increased by 6.8 percent in 1981. The average rate over 1979-81 was 5.9 percent, while that over 1983-85 was 2.2 percent. The CPI fell by 1.1 percent over 1986.

17. See Judd and Trehan (1987) for a discussion of the recent changes in the behavior of various monetary aggregates in the U.S.

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