Investigating the Monetary Policy of Central Banks with Assessment Indicators††

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October 2, 2008

Abstract
This paper outlines a new method for analyzing the monetary policy strategy of central banks. Using cardinal assessment indicators extracted from a central bank’s statements a monetary policy rule is estimated. This approach allows to directly capture policymakers’ assessments of macroeconomic variables that are relevant for its decision making process. As an application the monetary policy of the Bundesbank is re-investigated. The analysis gives evidence that the Bundesbank took into consideration the development of monetary aggregates since 1975, but also focused on real economic activity and inflation.

JEL classification: E52, E58, N1

††The author is grateful to Professor Michael Binder and Professor Stefan Gerlach for valuable comments.
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1 Introduction

Empirical analysis of monetary policy is usually characterized by estimating an interest rate rule for a central bank. In the according literature a central bank’s instrument rate is mostly expressed as a function of data on macroeconomic variables.\textsuperscript{1} But a small strand uses qualitative information to capture policymakers’ assessments of macroeconomic variables that are important for the decision making process. The analysis in this paper extends the latter literature and outlines how cardinal indicators generated from a central bank’s statements about economic and monetary developments can be used to estimate a monetary policy rule.

As an application of the proposed method I re-examine the monetary policy strategy of the Bundesbank. The Bundesbank’s monetary policy continues to be considered as a benchmark for many central banks in light of the Bundesbank’s success in maintaining price stability. One distinctive feature was the Bundesbank’s strategy of monetary targeting which it officially applied since 1975. The outcome of the analysis proposed shows that the Bundesbank indeed took into consideration monetary aggregates but also real economic activity and inflation developments in its monetary policy strategy since 1975.

A policymaker’s assessments of macroeconomic variables are not available when estimating monetary policy rules only as a function of macroeconomic variables. For example, a central bank might think that a shock to variables that play an important role for its monetary policy is of temporary nature only. In this case its decisions are most likely not influenced to a large extent by the shock. In contrast, if a central bank judges it to be of permanent nature its actions are likely to be shaped (partly) in response to the shock. Depending on its assessment of the shock, the central bank will take decisions and communicate the reasons to the public. In a related analysis Gerlach (2007) constructs quantitative indicators of the ECB Governing Council’s assessment of economic conditions to analyze its interest rate decisions.\textsuperscript{2} Another field of research related to this paper in the context of policymakers using qualitative information is an indicator that captures the ECB president’s statements concerning risks to price stability set up by the Eidgenössische Technische Hochschule Zürich. The statements are translated into an index that contains information about the future path of the monetary policy of the ECB. In a broader sense this paper is also related to what is called the ‘narrative approach’ - the identification of monetary shocks through non-statistical procedures. This literature involves historical records that outline the reasoning which led to decisions by monetary authorities. For example, Romer and Romer (2004) use quantitative and narrative records to infer the Federal Reserve’s inten-

\textsuperscript{1}Svensson (2003)
\textsuperscript{2}Gerlach (2007)
tion for its target rate.
The paper is organized as follows: Section two describes the construction of assessment indicators from a policymaker’s statements. Section three provides an analysis of the Bundesbank’s monetary policy using the proposed method and section four concludes.
2 Construction of Assessment Indicators

A central bank uses its periodic bulletins, inter alia, as a means of communication with the public. It explains the reasons for its monetary policy decisions in coherence with the announced policy strategy. Given the importance of periodic economic statistical bulletins for a central bank’s communication the analysis in this paper is focussed on the information about the central bank’s assessment of macroeconomic variables based on the statements given in its periodic economic statistical bulletins. However the analysis outlined in this paper is not restricted to using only a central bank’s peridoic bulletins but could theoretically be extended to any policy relevant statements such as those made during press conferences etc. Central bank’s periodic bulletins have an outstanding position in the field of economic statistical publications. For most central banks they are the most important element of communication with policymakers, markets, media and researchers. The basic role of economic statistical bulletins is to provide a “reference point and general orientation to the public”, and “promotion of economic education and research”. In addition, specific to the case of central bank’s economic statistical bulletins, an important aspect is to explain monetary policy decisions to the public, on the one hand in order to be transparent and on the other hand to guide expectations, in particular those of markets. If central bank communication is regarded as an unconditional announcement of future decisions and explanation of current decisions, markets reflect these in their expectations. Economic statistical bulletins provide the public with an understanding of economic issues. To enhance the understanding of economic aspects in the public, economic statistical bulletins contain ”some descriptive commentary and analysis that go beyond data dissemination”. Most central bank’s bulletins consist of a statistical section with economic key figures and a section in which these key figures are interpreted with respect to the overall economic situation, the achievement of the central banks’ goals, and ultimately in light of the monetary policy decisions taken by the central bank.

In the following I first describe how to identify statements to be taken from a central bank’s economic statistical bulletin and how these statements can be allocated to categories that are judged to be of potential importance for a central bank’s policy decisions. Second I outline how these categorized statements can
be assigned ordinal index numbers, and third, how these ordinal indices can be transformed into cardinal assessment indicators. Figure 1 gives an overview of the approach pursued throughout this chapter.

**Figure 1:** Overview of the approach to generate cardinal assessment indicators

<table>
<thead>
<tr>
<th>Monthly bulletin at time $t$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statements containing assessment(s) of category $j$ at time $t$</td>
</tr>
<tr>
<td>Ordinal Index for assessments of category $j$ at time $t$</td>
</tr>
<tr>
<td>Transformation method</td>
</tr>
<tr>
<td>Cardinal assessment indicator of category $j$ at time $t$</td>
</tr>
</tbody>
</table>

### 2.1 The Statement Data Set

In line with monetary policy rules estimated in the literature, sensible assessment indicators should capture ‘real economic development’, ‘price development’, ‘fiscal development’, ‘foreign trade development’ and ‘monetary development’. The categories of importance for a central bank’s monetary policy decisions can also be inferred from the structure of its monthly bulletin. For example, the ECB subdivides the economic analysis in its monthly bulletins into ‘monetary and financial developments’, ‘price developments’, ‘output, demand and labour market developments’, and ‘exchange rate and balance of payments developments’.

Statements very often do not touch directly upon a category (e.g. ‘Real activity is very low.’) but instead use variables to give an assessment about the category (e.g. ‘Industrial production is very low’). For example, the category ‘real activity’ is usually assessed with variables like ‘investment’, ‘industrial production’, and ‘employment’. I assume that each statement gives a hint as to how the central bank assesses (part of) the information that is available about the state in the according category at the time the assessment is given.

Assessments might often refer to variables’ past developments or their expected developments in the future. Nevertheless I assume that all variables evaluated in a category reflect the underlying reasons for the central bank’s monetary policy decisions at the time the assessment is given. This means, if a central bank assesses at time $t$ a variable at time $t-1$ (e.g. because it is the most actual number provided
by the statistical office) from category x, this assessment will be used to calculate the assessment indicator at time t.

The number of variables evaluated in a category varies over time because the central bank might not always receive data in time or because variables are only analysed from a certain point in time onwards. However, this is not a major problem as effectively more statements at a given point in time in a category make the generated assessment indicators less coarse.

Having collected numerous statements for each category at each point in time, the next subsection will outline how an ordinal index mark can be assigned to each statement.

2.2 The Index

To set up an ordinal index for the collected statements it is important (i) to determine whether a statement suggests that a variable is out-of-trend (deviates from its normally expected value), and if so (ii) whether the variable mentioned has positive or negative influence on the category (is positively or negatively correlated with the category). In the following I will explain when a variable is assessed to deviate from its normal state and how its influence on the according category can be inferred.

Statements using keywords like 'high', 'weak', 'markedly', 'extraordinarily', or alike, i.e. keywords that put emphasis on the central bank’s assessment of the variable under consideration to assess a variable are judged to be out-of-trend. To find out whether a variable has a positive or a negative effect on the according category one needs to determine when the category positively or negatively deviates from trend. For example, it is sensible to define the category 'real activity' to positively (negatively) deviate from trend if economic activity is higher (lower) than normal. The effect of a variable on the according category depends on whether an out-of-trend state of the variable influences the category into the same direction (positive influence) or into the opposite direction (negative influence). For example, the variable 'unemployment rate' has negative influence on the category 'real activity' if it is defined as above. A high unemployment rate signals that the economy might be in a recession. In contrast the influence of the variable 'industrial production' on the category 'real activity' is positive because high industrial production hints that at least part of the economy is doing fine.

Having outlined the relation between variables and their according category, the next paragraph outlines, following the scheme depicted on figure 2, how each statement is assigned an ordinal index mark. First of all one infers whether a

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8For example, when growth in money funds became very large in the 1990s the Bundesbank created a new monetary aggregate for analysis, 'M3 extended', that contained these funds.
statement suggests that the subject variable deviates from its normal state. If it
does not the statement is assigned a '0' in the according category [case A]. If the
statement suggests that the variable deviates from its normal state one has to figure
out the variable’s influence on the according category: If the variable positively
deviates from its normal state and has positive (negative) influence the statement is
assigned a ’1’ (’−1’) [case E(D)]; if the variable negatively deviates from its normal
state and its influence is positive (negative) the statement is assigned a ’−1’ (’1’)
[case C(B)]. In the following the evaluations ’1’ and ’−1’ are denominated out-of-
trend marks. Furthermore, deviation from normal state, deviation from long-run
trend, and gap will be treated interchangeably.

Figure 2: Assignement of index marks

\[\text{Figure 2: Assignement of index marks}\]

\[\text{Is the statement’s variable out-of-trend?}\]

\[\text{no}\]

\[\text{Statement is assigned a ‘0’ in the according category (Case A)}\]

\[\text{Yes}\]

\[\text{Is the variable above or below trend?}\]

\[\text{below}\]

\[\text{Is the variable positively or negatively correlated with the category?}\]

\[\text{−}\]

\[\text{Statement is assigned a ‘1’ in the according category (Case B)}\]

\[\text{above}\]

\[\text{Is the variable positively or negatively correlated with the category?}\]

\[\text{+}\]

\[\text{Statement is assigned a ‘−1’ in the according category (Case C)}\]

\[\text{−}\]

\[\text{Statement is assigned a ‘−1’ in the according category (Case D)}\]

\[\text{+}\]

\[\text{Statement is assigned a ‘1’ in the according category (Case E)}\]

Note that deriving a central bank’s assessment systematically from its statements
might be problematic because there is much room for arbitrariness. However the
approach taken here – using keywords and only three-option indices – tries to take
out arbitrariness as much as possible.
The next section describes the method that is used to transform the ordinalized
data into cardinal assessment indicators.

### 2.3 Transformation of the Index into Assessment Indicators

A central bank normally does not give quantitative indications about its assessment of unobservable indicators like ‘real development’. However, in the economical statistical bulletin it assesses numerous variables that are contained in these unobserved indicators. The ordinal statement data set described previously has arranged this information in an accessible way. In the following each statement is treated analogously to a response of the central bank under consideration about its assessment of the state in part of the according category. This ordinal statement dataset will be transformed with a technique that is also used in public survey analyses.

Surveys are an important source to measure expectations – or, as in the case of this analysis, assessments – directly and offer up-to-date information about the state of the economy. They can be broadly put into two classes, namely quantitative and qualitative surveys.\(^9\) Quantitative surveys require precise quantitative answers. An example is the ECB’s Quarterly Survey of Professional Forecasters which, inter alia, asks the participants for point estimates of Euro Area inflation expectations.\(^10\) In contrast, qualitative surveys do not directly ask the respondents for a precise figure concerning the variable under consideration. Instead respondents are asked to give a qualitative indication. The latter is widely used in surveys because responses to qualitative questions are more reliable than more precise questions, there is believed to be some sort of trade-off between the loss of information consequent on qualitative questions and the cost in terms of response rate and therefore possible bias from asking more precise questions.\(^11\)

A special form of qualitative survey is the business tendency survey which asks respondents about the current situation of their business and about their plans and expectations for the near future. One example for this kind of survey is the Industrial Confidence Indicator published by the European Commission.\(^12\) For example, respondents are asked whether they consider their current stock of finished products to be 'too large (above normal)', 'adequate (normal)', or 'too small (below normal)'. Another question asks respondents whether they expect their production to 'increase', 'remain unchanged', or 'decrease' over the next 3 months. The former question concerns the level of a variable while the latter question asks for the

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\(^9\)Pesaran (1987)  
\(^10\)Garcia (2003)  
\(^11\)Pesaran and Weale (2005)  
\(^12\)An overview on the methodology and the Confidence Indicators of the European Commission is given in European Commission (2007)
change of a variable. The ordinal index set up in this paper is built in the spirit of such a tendency survey as it also consists of three-option replies and can contain statements related to levels as well as to changes. In the following I will outline the method to transform the ordinal dataset into cardinal data.

There exist mainly three approaches to convert qualitative survey data into cardinal data: The balance statistic approach, the regression approach and the Carlson-Parkin method.\textsuperscript{13} While the latter two are complex and based on distributional assumptions the balance statistic approach is not outperformed as there is a very high correlation between the balances and alternative methods when three-option replies are used.\textsuperscript{14} To set up the Industrial Confidence Indicator the European Commission makes use of the balance statistic. This transformation method is also used to transform the ordinal dataset into time series of assessment indicators. It is calculated as follows:

\[ b_{sjt} = u_{jt} - d_{jt} \]  

where

- \( u_{jt} \) denotes the proportion of statements that indicate a positive deviation from trend in category \( j \) at time \( t \), and
- \( d_{jt} \) denotes the proportion of statements that indicate a negative deviation from trend in category \( j \) at time \( t \).

Proceeding in this fashion one obtains cardinal assessment indicators restricted to the interval (-1,1) for the categories of interest. If no statements are available in a category I assume that it is in line with trend, i.e. the indicator is assigned a value of '0'.

Note that the information content in the assessment indicators is limited – not at least because the indicators are based on three-option replies and are restricted to the interval (-1,1). However, they show, in tendency, the central bank's assessment of important real economic and monetary developments.

In the next section the monetary policy of the Bundesbank will be analyzed using the method that has been outlined in this section.

\textsuperscript{13} An overview about these transformation methods can be found in Pesaran and Weale (2005)
\textsuperscript{14} OECD (2003)
3 Analysis of the Bundesbank’s Monetary Policy Using Assessment Indicators

The Bundesbank’s monetary policy continues to be considered as a benchmark for many central banks in light of the Bundesbank’s success in maintaining price stability. One distinctive feature was the Bundesbank’s strategy of monetary targeting which it officially applied since 1975. Whether monetary aggregates indeed played a role in the monetary policy strategy of the Bundesbank is subject to an ongoing debate. Analyses show mixed evidence. For example, Clarida et al. (1998) find that monetary aggregates did not play a significant role for the Bundesbank’s monetary policy from 1979 to 1993. In contrast, Gerberding et al. (2004) find, using a real-time dataset ranging from 1979 to 1998, that the Bundesbank indeed took its monetary targets seriously but also responded to deviations of expected inflation and output growth from target.

As an application of the method proposed in this paper the monetary policy strategy of the Bundesbank is re-examined using a new dataset. The dataset consists of statements the Bundesbank gave in its monthly bulletins and is utilized to construct indicators that capture the Bundesbank’s assessment of monetary and real economic developments. These assessment indicators are then used to estimate a monetary policy rule.

This analysis might also be relevant for the debate about the two pillar strategy of the European Central Bank (ECB): The ECB was established much in the spirit of the Bundesbank, also as regards the monetary policy strategy. It is subject to particular criticism for using monetary indicators in its second pillar to assess the trends in medium- to long-term inflation. If the Bundesbank actually was a monetary targeter its eminent track record concerning price stability suggests that incorporating monetary aggregates in a central bank’s policy strategy cannot be labelled as improper right away.

Due to its independency statute, its transparancy, and its vigilance towards inflation the Bundesbank had gained high credibility. Its flagship of communication with the public was the monthly bulletin. Prior to European Monetary Union (EMU) the monthly bulletins of the Bundesbank had an outstanding position in Germany in the field of regular economic publications. Since 1970 the Bundesbank regularly incorporated economic reports in its monthly bulletins. Every quarter two monthly bulletins contained abridged economic reports and one monthly bulletin gave a detailed report on the economic situation in Germany.15 These parts of the monthly bulletin touched upon the different fields the Bundesbank judged to be

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15The Bundesbank issued economic reports prior to 1970 but not on a regular monthly basis: within a year there were several issues of monthly bulletins containing only economic key data and no economic report.
of importance for its monetary policy: 'monetary development', 'public finances', 'economic situation', 'balance of payments', and 'stock and bond markets'. All monthly bulletins also contained a statistical appendix with economic key data, infrequent essays on economic questions of interest, or, if a change in monetary policy instruments took place, short reports about the reasons for the change.

3.1 The Bundesbank’s Monetary Policy

The Bundesbank Act from 1957 mandated the Bundesbank to ‘safeguard the currency’ which ultimately was interpreted as price stability.\footnote{On several occasions the Bundesbank stated that price stability is its statutory final goal, e.g. Bundesbank (1995).} To achieve this goal a monetary targeting strategy which consisted of pre-announcing targets for growth in broad money was implemented in 1975. From 1975 to 1987 this medium target was defined as the central bank monetary stock, i.e. currency in circulation and required reserves, and from 1988 to 1998 the Bundesbank targeted the monetary aggregate M3. To cross-check and verify the information content from the money stock the Bundesbank always included in its monetary policy analyses other monetary and real indicators.

The Bundesbank determined the money growth target for the following year via adding growth of potential output, the 'unavoidable' inflation over the medium term, and the trend rate of change in the velocity of money. The reasoning behind this approach was that if the money stock could be kept on this target path, the monetary conditions should be met for corresponding real growth to be compatible with monetary stability.\footnote{Issing (1997)} Although the Bundesbank announced the growth target on a yearly basis it frequently stressed the medium-term nature of the approach – the Bundesbank did not apply its monetary policy mechanically but accepted short-run deviations from target growth if necessary. With a few technical modifications this approach has been followed since the beginning although the Bundesbank regarded monetary targeting as an experiment in the first few years.\footnote{Schmid (1999)}

The monetary policy strategy was implemented by controlling the quantity of money indirectly by influencing the overnight money market rate in the interbank market through rediscount and lombard policies, minimum reserve policy, and open market operations.\footnote{Bundesbank (1995)}

Although the Bundesbank attained only 13 of 24 money stock targets, it impressively achieved its ultimate goal of safeguarding the currency with an annual
inflation rate of 3% on average since 1975.\textsuperscript{20}

The following section shows how the dataset that is used to analyse the monetary policy strategy of the Bundesbank is constructed.

### 3.2 Assessment Indicators for the Bundesbank

To construct the assessment indicators for the Bundesbank only the abridged reports and the editorials of the economic outlook are taken into account because the Bundesbank regularly condensed in these parts its analyses of economic and monetary aspects and gave the reasons for its policy decisions. As the structure of the monthly bulletins had undergone only minor changes since January 1970 this date is chosen as the starting point of the sample analysed. The endpoint of the sample is December 1998 because it marks the last month of an independent monetary policy of the Bundesbank.

All statements from the abridged reports and the editorials of the monthly bulletins from 1970 to 1999 that assess one or several of the categories, ‘monetary activity’, ‘real activity’, ‘fiscal activity’, ‘foreign trade activity’, and ‘price activity’\textsuperscript{21} have been collected. Table 1 summarises the influence of the most frequent variables coming up in statements of the Bundesbank. The average number of assessed statements per month amounts to 8.63 for the monetary activity indicator, 8.68 for the real activity indicator, 5.89 for the fiscal activity indicator, 4.49 for the foreign trade activity indicator, and 2.41 for the price activity indicator. The Bundesbank evaluated variables from the latter category only at irregular intervals, particularly in the monthly bulletins from the 1970s and 1980s. In the appendix I give several examples for the evaluation of statements.

Using the proposed method, assessment indicators for the five categories mentioned are set up. As a showcase for the cardinal assessment indicators figure 3 displays the assessment indicator for monetary activity, its mean value and the according number of statements in each month. The time series shows little persistence and the number of statements assessed reflects that the editorials and short reports of the monthly bulletins became more extensive over the years. While the analysed parts of the monthly bulletins covered only three to five pages in a bulletin in the 1970s, the amount of pages to be analysed in a monthly bulletin at the end of the 1990s increased up to seven pages. This development took place gradually in the course of time. Effectively it makes the assessment indicators’ information content less coarse in later issues of the monthly bulletins and provides a more differentiaced picture of the Bundesbank’s assessment about the economy.

\textsuperscript{20}Own calculation: Mean year-on-year percentage change of the consumer price index; from 1975 to 1991 only West Germany, from 1992 to 1998 re-united Germany.

\textsuperscript{21}In the following these five fields are simply referred to as categories.
Table 1: Effects of variables on the according category

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>VARIABLES WITH POSITIVE EFFECT ON THE CATEGORY</th>
<th>VARIABLES WITH NEGATIVE EFFECT ON THE CATEGORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monetary activity</td>
<td>Monetary expansion</td>
<td>Long-term deposits</td>
</tr>
<tr>
<td></td>
<td>Monetary inflows from abroad</td>
<td>Monetary outflows to abroad</td>
</tr>
<tr>
<td></td>
<td>Volume of money in circulation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Monetary aggregates</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Credits</td>
<td></td>
</tr>
<tr>
<td>Real activity</td>
<td>Industrial production</td>
<td>Unemployment</td>
</tr>
<tr>
<td></td>
<td>Investments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Business cycle</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Labour market</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Economic activity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Volume of orders</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Domestic orders</td>
<td></td>
</tr>
<tr>
<td>Fiscal activity</td>
<td>Public debt</td>
<td>Inland tax revenues</td>
</tr>
<tr>
<td></td>
<td>Public spending / investment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Public borrowing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Public deficit</td>
<td></td>
</tr>
<tr>
<td>Foreign trade activity</td>
<td>Orders from abroad</td>
<td>Inland orders for abroad</td>
</tr>
<tr>
<td></td>
<td>Exports</td>
<td>Imports</td>
</tr>
<tr>
<td></td>
<td>Active trade balance</td>
<td>Passive trade balance</td>
</tr>
<tr>
<td></td>
<td>Sales abroad</td>
<td></td>
</tr>
<tr>
<td>Price activity</td>
<td>Producer prices</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Year-on-year percentage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>change of the CPI</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Import prices</td>
<td></td>
</tr>
</tbody>
</table>

Theoretically, deviations from trend should be zero on average. However, the mean values of all indicators are positive, ranging from 0.06 (foreign trade activity indicator) to 0.17 (monetary activity indicator). This might reflect higher vigilance of the Bundesbank towards upward risks to price stability as compared to downward risks if the Bundesbank did not assess upward or downward deviations from trend symmetrically. In other words, the Bundesbank might have perceived an upward
deviation from trend in a category as sizeable because this puts upward pressure on prices while the Bundesbank might not have perceived a downward deviation of similar magnitude in the category as sizeable if it is not as sensible as regards downward risks to price stability.

Figure 3: Indicator for monetary activity, it’s mean value, and number of assessed statements

Except for the real activity indicator and the fiscal activity indicator the assessment indicators are not correlated among each other which gives evidence that each indicator has self-contained information. The correlation coefficient between the real activity indicator and the fiscal activity indicator amounts to \( -0.30 \) which might be due to countercyclical policies of the German government: Most likely it implemented deficit spending strategies when the economy was in a recession.

In the following I analyse whether the indicators can significantly explain interest rate decisions by the Bundesbank.

3.3 A Monetary Policy Rule for the Bundesbank

Investigating the properties of monetary policy rules Levin et al. (1998) show that first difference rules perform reasonably well in comparison to several alternatives and are robust to model uncertainty. The dependent variable in their first difference rule is the US federal funds rate and the independent variables are a measure
for the deviation of inflation from target and the output gap. Other authors also use first difference rules to investigate the monetary policy of the Federal Reserve System of the US or the ECB. Judd and Rudebusch (1998), for example, estimate a policy rule for the Fed with the US federal funds rate in first differences as dependent variable, and Gerlach (2007) estimates a policy rule for the ECB using first differences of the repo rate as dependent variable.

I regress the first differenced German overnight money market rate on the assessment indicators:

\[ \Delta i_t = c + \beta_1 \cdot \text{money}_t + \beta_2 \cdot \text{real}_t + \beta_3 \cdot \text{fiscal}_t + \beta_4 \cdot \text{trade}_t + \beta_5 \cdot \text{price}_t + \epsilon_t \]  

where

- \( \Delta i \) are the first differences of the German overnight money market rate (monthly averages)
- \( c \) is a constant
- 'money' denotes the deviation of monetary activity from trend
- 'real' denotes the deviation of real activity from trend
- 'fiscal' denotes the deviation of fiscal activity from trend
- 'trade' denotes the deviation of foreign trade activity from trend
- 'price' denotes the deviation of price activity from trend
- \( \epsilon \) is a white noise error term

Intuitively one would expect the coefficients of the assessment indicators in equation (2) to be positive since high values are indicative of upward risks to price stability.

To avoid spurious regressions it is important to determine the order of integration of the time series under consideration. All time series used in the following regressions are stationary at a 5% significance level when applying the Dickey-Fuller test.

### 3.4 Testing for Structural Breaks

The time span covered in the sample might contain structural breaks. Potential candidates are the breakdown of the Bretton-Woods system in March 1973, the beginning of the monetary targeting strategy of the Bundesbank in January 1975, and German re-unification in October 1990.
Bai and Perron (1998) propose a procedure that estimates the number and the position of breakpoints and tests linear models with multiple structural changes. In this application estimation is done within a pure structural change model, i.e. all parameters are subject to shifts. The following description is based on Bai and Perron (1998) and will be short as it focuses only on the application in this paper.

Consider the linear regression with \( m \) breakpoints, i.e. \( m+1 \) regimes:

\[
y_t = z_t' \delta_j + u_t
\]  \hspace{1cm} (3)

where

- \( j = 1, \ldots, m + 1 \)
- \( t = T_{j-1} + 1, \ldots, T_j \), \( min(t) = h \), \( T_0 = 0 \), \( T_{m+1} = T \)
- \( h \) denotes the minimal length of a regime
- \( y_t \) is the dependent variable
- \( z_t \) are the independent variables
- \( \delta_j \) is a vector of coefficients

The following procedure estimates the unknown regression coefficients \( \hat{\delta}_j \) as well as the optimal position of the breakpoints \( \hat{T}_j \). For each possible segment \( (T_{j-1} + 1, \ldots, T_j) \), denoted \( \{T_j\} \), the corresponding least squares estimates of \( \delta_j \) are obtained by minimizing the sum of squared residuals \( \sum_{i=1}^{m+1} \sum_{t=T_{i-1}+1}^{T_i} [y_t - z_t' \delta_i]^2 \). Let \( \hat{\delta}(\{T_j\}) \) denote the resulting estimates. Using the corresponding sum of squared residuals, denoted by \( S_T(T_1, \ldots, T_m) \), for the \( \hat{\delta}(\{T_j\}) \), the estimated breakpoints \( (\hat{T}_1, \ldots, \hat{T}_m) \) are such that \( (\hat{T}_1, \ldots, \hat{T}_m) = \arg\min_{T_1, \ldots, T_m} S_T(T_1, \ldots, T_m) \).

In short, given the number of breakpoints \( m \) and the minimal length of a segment \( h \), the procedure calculates the global sum of squared residuals for all possible positions of the breakpoints. The selected breakpoints are such that the sum of squared residuals over all segments is minimized. The \( \hat{\delta}(T_j) \) chosen are the corresponding coefficient estimates at the selected breakdates \( \hat{\delta}(T_j) \).

The maximum number of breakpoints \( m \) is determined by \( h \): \( m = \theta - 1 \) where \( \theta \) is rounded to the nearest integer less or equal to \( \frac{T}{h} \). To determine the optimal number of breakpoints one applies the above procedure for \( m=0, \ldots, \theta - 1 \). The optimal number of breakpoints chosen is the one that yields the smallest value of the Bayesian Information Criterion defined as

\[
BIC(m) = \ln \hat{\sigma}^2(m) + [(m + 1)q + m] \frac{\ln T}{T}
\]  \hspace{1cm} (4)

where \( q \) is the number of independent variables.
3.5 Estimation Results

The parameter $h$ can influence the position of selected breakpoints. Bai and Perron (1998) do not give clear guidance how to choose this parameter. However, they always choose it to be in a range of 10% to 25% of all observations. When choosing $h$ too small, one ends up estimating for some segments with very few observations. The value of $h$ chosen in this application is 48 observations which is 14% of $T$ (rounded up). Note that the chosen value of $h$ does not allow the inclusion of the breakdown of the Bretton Woods system as a breakpoint.\footnote{In the range of $h$=30 to 38 the beginning of 1973 is always a chosen breakpoint.}

According to Bai and Perron (1998) the BIC performs reasonably well when no serial correlation is present in the errors. In all subsequent estimations, tests provided no evidence of serial correlation.\footnote{Durbin’s alternative test for serial correlation, Stata (2005)}

The procedure selects March 1975 as the only breakpoint. As a robustness check the procedure has been implemented with several values of $h$. In a range from $h=39$ to 63 March 1975 is always the only selected breakpoint. Table 2 displays the estimation results for the samples ranging from January 1970 to March 1975 and April 1975 to December 1998.

Regarding the first sample, only the indicator for real activity is significant.\footnote{Significance means an absolute t-value of 1.96 or larger. All t-statistics are computed with robust standard errors.} Given its coefficient the target rate’s first difference rose by ’2.84’ percentage points if, ceteris paribus, all variables from the category real activity were assessed to be above trend (i.e. the according indicator has a value of ’1’). The high coefficient can be explained with the volatility of the dependent variable during the breakdown of the Bretton-Woods system. Regarding the second sample, all assessment indicators except those for foreign trade activity and fiscal activity are significant and have the expected sign. If all assessments in one of the categories, monetary activity, real activity, or price activity, ceteris paribus, were assessed to be above trend, the overnight rate rose by 0.16, 0.22, or 0.19 percentage points, respectively.

A central result is the significance of the assessment indicator for monetary activity in the sample that starts in April 1975. It gives evidence that the Bundesbank indeed took into account the development of monetary aggregates for its monetary policy. Whether the Bundesbank directly influenced its target rate via monetary policy decisions or indirectly via influencing market expectations through its communication policy within the framework of its monetary policy strategy\footnote{For an analysis of the money growth targeting of the Bundesbank in light of a communication strategy ?} – monetary aggregates played a significant role. Similar to Gerberding et al. (2004) the results also show that the Bundesbank was not a pure monetary targeter but
Table 2: Regression Results, sample Jan 1970 - Mar 1975

<table>
<thead>
<tr>
<th>Dependent Variable:</th>
<th>∆ overnight money market rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample:</td>
<td>Jan 1970 - Mar 1975</td>
</tr>
<tr>
<td>No. of obs.</td>
<td>63</td>
</tr>
<tr>
<td>Apr 1975 - Dec 1998</td>
<td>285</td>
</tr>
<tr>
<td>R²</td>
<td>0.15</td>
</tr>
<tr>
<td>Apr 1975 - Dec 1998</td>
<td>0.12</td>
</tr>
<tr>
<td>Coefficient</td>
<td>t</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.61</td>
</tr>
<tr>
<td>Monetary activity</td>
<td>-1.75</td>
</tr>
<tr>
<td>Real activity</td>
<td>2.84</td>
</tr>
<tr>
<td>Fiscal activity</td>
<td>1.65</td>
</tr>
<tr>
<td>Foreign trade activity</td>
<td>-0.46</td>
</tr>
<tr>
<td>Price activity</td>
<td>-0.25</td>
</tr>
</tbody>
</table>

Estimated equation:
\[ \Delta i_t = c + \beta_1 \cdot \text{money}_t + \beta_2 \cdot \text{real}_t + \beta_3 \cdot \text{fiscal}_t + \beta_4 \cdot \text{trade}_t + \beta_5 \cdot \text{price}_t + \epsilon_t \]

took into consideration real activity and inflation developments as well.
Besides the Bundesbank several other central banks incorporated monetary targeting elements in their policy strategies – with different degrees of success. Switzerland successfully followed a strategy of monetary targeting from 1975 to 2000. The Federal Reserve System of the United States adhered to a policy strategy with monetary targeting elements at the beginning of the 1980’s, and the Bank of England pursued a strategy that focused on monetary targeting at the end of the 1970’s and in the 1980’s. However, the latter two central banks more or less abandoned monetary targeting elements in their strategies after several years. In the United States a large literature has criticised the notion of monetary targeting because of the macroeconomic turbulence of that period and of the severity of the recession that followed.\(^{26}\) The authors claim that accurate control of the money stock is not feasible or that control induces extreme volatility to money market rates. The approach practiced by the Bundesbank might be a reason why criticisms against monetary targeting do not convincingly apply in the case of the German experience. Clearly, the Bundesbank never claimed to be able to completely control money growth and often missed its target growth rate. In large part this should be due to the medium-term orientation of the Bundesbank’s strategy but also to a certain degree of pragmatism which comes out by also taking real

\(^{26}\) McCallum (1985)
economic and inflation developments into consideration. This is underlined by the following statement from Otmar Issing:27

"Some occasions when targets were missed may well be interpreted as showing that at these points in time the Bundesbank allowed itself additional room for discretion in the light of the then prevailing situation. Only rarely have money stock overshoots been of a completely involuntary nature; mostly rather they constituted deliberate monetary policy decisions. (...) Crucially though, monetary policy was always analyzed with a view to achieve the ultimate aim of safeguarding the currency. Such an approach may be termed 'pragmatic monetarism', but the expression should not be viewed as pejorative. In my view this constitutes a successful synthesis of a theoretical basis and practical implementation."28 In part this also explains why the Bundesbank’s monetary policy strategy did not induce extreme volatility to money market rates: The Bundesbank did not mechanically try to achieve its medium target but claimed a certain discretionary margin when judged necessary. As a result the Bundesbank did not bring extreme hikes or slumps about its target rate. Figure 4 displays the first differenced overnight money market rate during the period of analysis. One can detect several large changes only during and shortly after the period of Bretton-Woods. Critics of monetary targeting also stress that practical difficulties that come up through technological changes and deregulations in the payment industry render monetary targeting practices unfeasible. These arguments do not apply in the German case as well. It is possible that money demand functions become unstable and that targeted monetary aggregates lose explanatory power and utility for forecasting. However, this was not the case for Germany as the liberalization of financial markets and cross-border money and capital movements was largely completed in Germany at the beginning of the 1970s. In addition, new financial products generally turned out to be of little relevance in Germany.29 The results of the analysis in this paper indicate that the Bundesbank actually applied monetary targeting elements in its policy strategy which were in large part operational due to a combination of the Bundesbank’s pragmatic approach and to a relatively stable financial environment in Germany after the period of Bretton-Woods.

\[27\]From 1990 to 1998 Otmar Issing was a member of the Board of the Deutsche Bundesbank with a seat in the Central Bank Council.

\[28\]Issing (1997)

\[29\]Issing (1997)
4 Conclusion

The method proposed in this paper can well be used to analyze a central bank’s monetary policy strategy. Using assessment indicators offers the possibility to incorporate information about the policymaker’s assessment of macroeconomic keyfigures that is neglected otherwise. Applied to an analysis of the Bundesbank’s monetary policy strategy the method gives evidence that the Bundesbank actually was a flexible monetary targeter: When estimating a monetary policy rule over the sample April 1975 to December 1998 the indicators for monetary activity, real activity, and price activity are significant and have the expected sign. Particularly for the monetary indicator this is an interesting result as studies claimed that the Bundesbank did not target monetary aggregates. Regarding the overall strategy it is difficult to determine the degree to which the outstanding success of the Bundesbank is due to its monetary targeting elements as regards achieving price stability but in the judgement of the former chief economist of the Bundesbank,
Otmar Issing, it was by no means small.  
These results point in the direction that the inclusion of monetary aggregates in a central bank’s monetary policy strategy, as done by the ECB, might not be refuted as unreasonable right away. The example of the Bundesbank gives evidence that successfully incorporating monetary targeting elements in a policy strategy is possible.

\[30\] Issing (1997)
References


Appendix

Examples for the evaluation of statements

First of all consider three examples for the category ‘monetary activity’.
"Das längerfristige Mittelaufkommen bei den Banken war [...] weit höher als gewöhnlich [...]."\(^{31}\)
The statement suffices to assign an out-of-trend mark as it describes the variable ‘long-term deposits’ to be much higher than usual. The influence of long-term deposits on monetary aggregates is negative. Accordingly the statement is evaluated with ‘−1’ (Case D in figure 2).
"Deutlicher noch als in den vorangegangenen Monaten beruht das starke Wachstum der Geldmenge im Juni des Jahres auf der kräftigen Expansion der Kreditgewährung der Banken an inländische Kunden."\(^{32}\)
This statement assesses two variables: ‘monetary quantity’ and ‘credits’. Both variables change sizeably into a positive direction. As the variables are positively correlated with the category both are evaluated with ‘1’ (Case E in figure 2).
"Insgesamt waren die Kredite [...] an inländischen Nichtbanken Ende Juli 1970 um 12.8 Prozent höher als vor einem Jahr."\(^{33}\)
Nothing suggests that the variable ‘loans’ which positively influences the category ‘monetary activity’ is out-of-trend. Hence the statement is evaluated with ‘0’ (Case A in figure 2).

Next consider three examples for the category ‘real activity’.
"Die Investitionstätigkeit der Unternehmen hielt sich in den vergangenen Monaten auf hohem Niveau."\(^{34}\)
The variable ‘firm investments’ is described to be on a high level which is sufficient to assign an out-of-trend mark. As the influence of firm investments on the category ‘real activity’ is positive the statement is evaluated with ‘1’ (Case E in figure 2).
"Das verarbeitende Gewerbe hat seine Produktion in den ersten beiden Monaten

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The positive change of the variable ‘production in the manufacturing industries’ is sizeable which turns the balance towards an out-of-trend mark. As the influence of the variable on the category is positive the statement is evaluated with ’1’ (Case E in figure 2).

"Die Produktion des produzierenden Gewerbes ist im September tendenziell leicht gesunken."36

A ‘slight decrease’ is not sufficient to assign an out-of-trend mark for the variable ‘industrial production’. The statement is evaluated with ’0’ (Case A in figure 2).

The following three examples are about the evaluation of the category ‘foreign trade activity’.

"In den hohen Auslandsbestellungen spiegelt sich die fortschreitende Konjunkturbelebung in wichtigen Industrieländern wieder."37

‘Foreign export orders’ are described to be high which is sufficient to assign an out-of-trend mark. As the influence of the variable on the category ‘foreign trade activity’ is positive the statement is evaluated with ’1’ (Case E in figure 2).

"Saisonbereinigt waren die Exporte (...) im Mai nach dem recht umsatzstarken Vormonat ausgesprochen schwach."38

‘Exports’ are described to be markedly weak which points in the direction of being below trend. As exports and foreign trade indicator are positively correlated the statement is evaluated with ’−1’ (Case C in figure 2).

"Schaltet man die Saisonschwankungen aus, so waren Aus- und Einfuhren gleichermaßen dem Wert nach um 1% höher als im Februar 1983."39

The change of the variables ‘exports’ and ‘imports’ is not sizeable. Hence they are assumed to be in line with their trend. Both variables assessed are evaluated with ’0’ (Case A in figure 2).

Next I will give three examples for the interpretation of assessments from the category ‘fiscal activity’.

"Demzufolge muss für 1980 auch mit einem weit höheren Gesamtdefizit der öffentlichen Haushalte gerechnet werden, als noch im Frühjahr erwartet worden war [...]"40

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40. "As a result one should expect a much higher overall public deficit than the deficit that was
'Public debt’ is expected to be considerably above previous expectations which hints that the variable will be higher than normal in the future. Its influence on the category is positive and consequently the statement is evaluated with '1' (Case E in figure 2).

"Der vorangegangene Monat November war für den Bund [steuerlich] ein außerordentlich einnahmeschwacher Monat gewesen [...]". 41

'Inland revenues’ are assessed to be ‘extraordinarily weak’ which hints that they are below trend. The influence of inland revenues on the category is negative. Consequently the statement is evaluated with '1' (Case B in figure 2).

"Auch im kommenden Jahr werden die staatlichen Defizite weiter steigen, aber sie werden voraussichtlich nicht die im Sommer des Jahres erwartete Größenordnung erreichen." 42

Nothing suggests that the variable 'public deficit' which positively influences the category ‘fiscal activity' is out-of-trend. Hence the statement is evaluated with '0' (Case A in figure 2).

Finally I give three examples for statements from the category ‘price activity’.

"Die Zunahme der Außenhandels und Leistungsbilanzüberschüsse ist allein ein-
fahrbedingt, und zwar geht sie ausschließlich auf die drastischen Rückgänge der
Einfuhrpreise zurück." 43

'Import prices’ positively influence the category ‘prices’. They have declined drastically which hints that the category is below trend. The statement is evaluated with ‘−1’ (Case C in figure 2).

"[...] das Problem der Inflationsbekämpfung [stellt sich] mehr denn je." 44

One can infer from this statement that inflation is considerably too high. This justifies an out-of-trend mark. As the variable is positively correlated with the category the statement is evaluated with ‘1’ (Case E in figure 2).

"Die Einfuhrpreise sind im Mai saisonbereinigt wieder leicht gesunken." 45

One cannot infer that the variable 'import prices’ is out-of-trend. The statement is evaluated with ‘0’ (Case A in figure 2).


41”Inland revenues in the previous month, November, were extraordinarily weak.” Bundesbank. Monthly Bulletin of the Bundesbank (January 1975), p. 9.

42”Public deficits will also rise in the forthcoming year but presumably they will not reach the magnitude that was expected in the summer of this year.” Bundesbank. Monthly Bulletin of the Bundesbank (December 1978), p. 6.

43”The growth of the surpluses in the foreign trade balance and the current account balance is only due to imports, it can be attributed to a drastic decline in import prices.” Bundesbank. Monthly Bulletin of the Bundesbank (September 1986), p. 8.
