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Opting Out of the Great Inflation
German Monetary Policy after the Breakdown of Bretton Woods

Andreas Beyer, Vitor Gaspar, Christina Gerberding, and Otmar Issing

6.1 Introduction

In the second half of the twentieth century, the German Bundesbank established its reputation as one of the most successful central banks in the world. Along with the Swiss National Bank, the Bundesbank was the first central bank to announce and pursue a strategy based on monetary targets after the breakdown of Bretton Woods. In this chapter, we relate the Bundesbank success in maintaining price stability and in anchoring inflation expectations to its strategy. We examine the strategy as it was presented, refined, and communicated by the Bundesbank itself. Our goal is to provide a historical account of the conduct of monetary policy, focusing especially on the first ten years of monetary targeting, from 1975

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until the middle of the 1980s, when price stability was virtually reached in Germany.

According to the Bundesbank Act of 1957, the objective of monetary policy was to safeguard the currency. This formulation left open whether the focus should be on stabilizing the external or the internal value of the currency, and indeed, the potential conflict between these two goals was not well understood by those involved until well into the 1960s. However, after the breakdown of the Bretton Woods system, the emphasis shifted decidedly toward the goal of domestic price stability.[1] Hence, it was clear from the beginning that the monetary targets were intermediate targets. They were instrumental to achieving price stability. Helmut Schlesinger (1988, 6)—as quoted in von Hagen (1995, 108)—made the point crystal clear:

> [T]he Bundesbank has never, since 1975, conducted a rigid policy geared at the money supply alone; all available information about financial markets and the development of the economy must be analyzed regularly. . . . Furthermore, the Bundesbank had to check the consistency of her original monetary targets with the ultimate policy goals.

Moreover, the Bundesbank's operational framework for monetary policy implementation implied that the first step in the transmission mechanism was the control over a money market interest rate. Thus, in this chapter, we characterize the Bundesbank's monetary policy strategy through an interest rate rule in the tradition of Taylor (1993, 1999), modified to take account of the implications of monetary targeting for the Bundesbank's interest rate decisions. The issue has already been repeatedly considered in the literature (e.g. Clarida, Galí, and Gertler 1998; Gerberding, Seitz, and Worms 2005).

The central role of monetary policy in anchoring inflation and inflation expectations was recognized as crucial by the Bundesbank early on. Such concern is transparent in the mechanics of the derivation of the monetary target. From this viewpoint, central banking practice progressed ahead of theory's emphasis on credibility and reputation (as developed later in the work of Kydland and Prescott 1977; Barro and Gordon 1983a, 1983b).

In the last fifteen years, the new neoclassical synthesis and New Keynesian models became the workhorse for the theory of monetary policymaking (see Woodford [2003] and Galí [2008] for authoritative, book-length surveys).[2] These models rely on a Real Business Cycle (RBC) core. They add on price setting by monopolistic competitive firms subject to some constraint or cost on price changes, leading to nominal stickiness. Another key feature is that economic agents form expectations in a forward-looking way, taking into

1. For a detailed discussion, see Neumann (1999, 294).

2. These models have also been actively used in policymaking institutions. Prominent examples are the ECB, the Board of Governors, and the International Monetary Fund (IMF). Relevant references are Smets and Wouters (2003, 2007); Coenen, Christoffel, and Warne (2008); Christiano, Motto, and Rostagno (2008); Erceg, Guerrieri, and Gust (2006); Edge, Kiley, and Laforte (2007); and Bayoumi et al. (2004).

account what they know about the central bank's reaction function. Hence, despite their well-known limitations, these models provide a natural environment to discuss commitment, credibility, and reputation (see, for example, Gaspar and Kashyap 2007).

Building on the modified loss function approach (pioneered by Rogoff 1985), we will show in this chapter how focusing on money growth helps to bring the conduct of monetary policy closer to optimal policy under commitment (thereby improving on the outcome under discretion). It does so by inducing a persistent, history-dependent response of policy rates to deviations of inflation and output from target. Therefore, it allows us to rationalize monetary targeting as a commitment device (here we follow the lead of Söderström 2005).

Inevitably, such stylized story does not do full justice to monetary targeting as practiced by the Bundesbank. Nevertheless, it does, in our view, help to interpret the historical evidence. Specifically, our stylized story suggests one mechanism through which monetary targeting provided a means to anchor inflation and inflation expectations. We derive an interest rate rule corresponding to this set-up and confront it with real-time data. We find that the interest rate rule implied by our model of monetary targeting captures the Bundesbank's monetary policy actions well. We compare the policy pursued in Germany with those conducted by the Fed and the Bank of England.

The chapter is organized as follows. In section 6.2 we provide an overview of the relative performance of German monetary policy as compared with other industrialized countries. In section 6.3 we briefly describe institutions and history of monetary policy in Germany in the relevant period. We elucidate the concept of "pragmatic monetarism" and clarify the crucial role of the explicit derivation of the monetary target. In section 6.4 we introduce a simple macroeconomic framework based on the standard New Keynesian model. We derive a role for monetary targeting as a commitment device. We obtain the instrument rule implied by our framework. In section 6.5 we estimate an interest rate rule, inspired by our theoretical analysis, using real time German data and compare the results with estimates for the United States and the United Kingdom. In section 6.6 we conclude.

6.2 Brief Overview of Inflation Developments in Selected Industrial Countries in the Period 1959 to 1998

In the second half of the twentieth century, the German Bundesbank acquired a strong reputation for maintaining lower inflation rates than many other countries could. In this section we will look at the relevant stylized facts and put them into historical context, in particular from a monetary policy perspective. From a global view, the second half of the twentieth century was marked by three periods: the system of Bretton Woods (which lasted until 1973), followed by the period of the Great Inflation until the end of the 1970s, and subsequently by the period of Great Moderation from the early to mid-1980s onwards.

6.2.1 Rise and Fall of the Bretton Woods Regime

The first part of the post–World War II period was marked by the Bretton Woods International Monetary Regime. The beginning of this stage is characterized by the transition to a regime of convertibility—for current account transactions—by most Western European Countries in December 1958. It involved the fixing of a par value for each currency in terms of gold. The framers of the system intended to reconcile the positive aspects of the classical gold standard (for example, exchange rate stability, intense international trade) with autonomous national macroeconomic policies. The idea was that currency convertibility would be expected only for current account transactions (capital controls were accepted) and that exchange rates would be fixed but adjustable (in the face of fundamental disequilibria). According to Garber (1993, 461): "The collapse of the Bretton Woods system of fixed exchange rates was one of the most accurately and generally predicted of major economic events." The intuition is that there are intrinsic elements of internal tension in any gold exchange standard. Bordo (1993) categorizes the problems under the heading adjustment, liquidity, and confidence. One aspect is known as the Triffin (1960) dilemma. The system relied on the convertibility of the US dollar into gold. On the other hand, it required the availability of US dollars as liquidity. The latter required US balance of payment deficits, thereby undermining (the former) convertibility of the US dollar. The most symbolic moment was, perhaps, the suspension of the convertibility of the dollar into gold, in August 1971. The system then collapsed completely into a system of generalized floating in 1973. With the collapse of the last operational link to gold, the age of a commodity standard was over.

According to a very well-known folk theorem of international monetary economics, fixed exchange rates, freedom of movement of financial capital, and autonomous monetary policy constitute an impossible trinity. As mentioned earlier, the Bretton Woods regime allowed for capital controls. Nevertheless, over time, in the context of full convertibility for current account transactions, the effectiveness of capital controls was gradually diminishing. The Bundesbank was vividly aware of the constraint that participation in the Bretton Woods systems imposed on its ability to pursue domestic price stability. During the period 1959 to 1973 the deutsche mark (DM) was revalued three times against the US dollar (1961, 1969, and 1971).[3]

6.2.2 The Stylized Facts

In the period 1960 to 1998, German inflation, measured in accordance with the Consumer Price Index (CPI), was, on average, 3.1 percent per year

3. There were also short episodes of floating.

(with a standard deviation of 1.8 percentage points). During this period German inflation was the lowest and most stable, as recorded internationally (see table 6.1, which reports the average numbers of key macroeconomic variables for the G7 countries and Switzerland over that period). Only Switzerland came close with an average inflation rate of 3.3 percent (and a standard deviation of 2.3 percentage points). These results compare with the United States, which recorded an inflation rate of 4.4 percent, on average per year, with a standard deviation of 2.9 percentage points. Across the G7 countries inflation was highest and most volatile in Italy with, respectively, 7.4 percent and 5.4 percentage points for annual inflation and for its standard deviation. After the full period the DM had retained about 30 percent of its original value, compared with less than 20 percent for the US dollar, the Canadian dollar, and the Japanese yen, about 13 percent for the French franc, about 8.5 percent for the pound sterling, and only about 6 percent for the Italian lira.

It is interesting (and instructive) to recall that during the 1960s, in the context of the Bretton Woods system, inflation was actually slightly higher in Germany than in the United States. Specifically, the ten-year average was 2.4 percent in Germany, while it was 2.3 percent in the United States (Canada was very close, with an inflation rate of 2.5 percent). Nevertheless, in the United Kingdom, France, and Italy inflation was on average above 3 percent and in Japan above 5 percent. However, using an average for the 1960s can be misleading. In the last years of the 1960s, the rise in consumer prices was accelerating in the United States with inflation at 2.8 percent in 1967, 4.2 percent in 1968, 5.4 percent in 1969, and 5.9 percent in 1970. The corresponding numbers for Germany were 1.6, 1.6, 1.9, and 3.4 percent.

The differences between the inflation rates in Germany and the other G7 countries were most marked at the start of the period of floating exchange rates. In fact, in the period 1974 to 1982 prices increased by 46 percent in Germany (with an average annual rate of 4.8 percent). In the same period of eight years, prices almost doubled in the United States (with an annual average inflation rate of 9 percent). The differences persisted in the subsequent disinflation. In the longer period 1974 to 1989 (the year of the fall of the Berlin Wall), prices increased by 72 percent in Germany (with an average annual rate of 3.5 percent) and by 181 percent in the United States (corresponding to an annual average rate of 6.7 percent). It is also worth noting that only in Germany and Switzerland did inflation peak at single-digit levels in the 1970s and the 1980s. Italy and the United Kingdom recorded two-digit ten-year averages in the 1970s. Italy did so in the 1980s as well (see figure 6.1). Table 6.1 shows that the same comparison also applies to the volatility of inflation.[4]

Germany's favorable performance applies also to the behavior of nominal interest rates. In figure 6.2 we show the averages of short-term (three months)

4. With some qualification for the case of Canada.

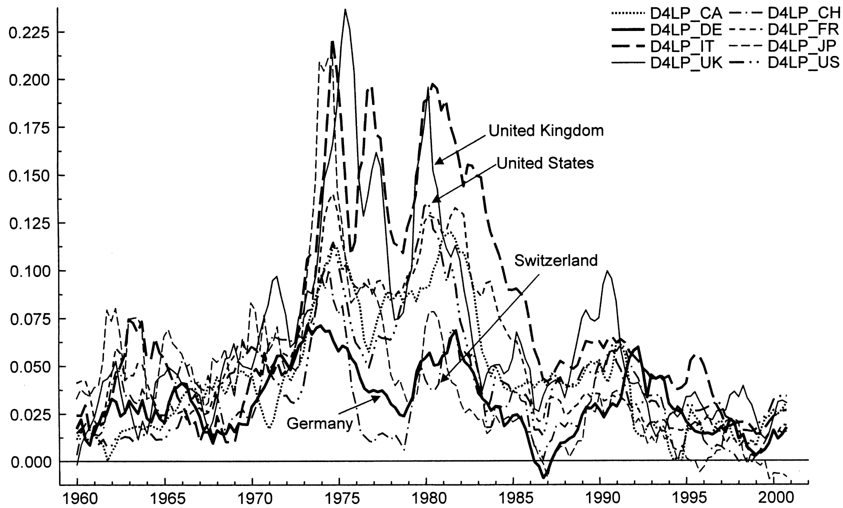

Fig. 6.1 Inflation in G7 countries and Switzerland

and long-term (ten years) interest rates during the 1970s. Evidently, German interest rates were then at the lower end of the interest-rate spectrum.

Regarding the behavior of real variables, however, it is worth noting that they did not diverge significantly among industrialized countries during the same period. Figure 6.3 shows that in the 1970s, there was no obvious trade-off between real GDP growth rates and inflation across countries.

6.2.3 Explanations of the Great Inflation

To avoid the accusation of omitting important facts, let us refer briefly to the most widespread explanation of the Great Inflation. According to Bruno and Sachs (1985), the key factor behind the acceleration of prices was the oil price shocks.[5] Bruno and Sachs (1985) state: "A clear and central villain of the piece is the historically unprecedented rise in commodity prices (mainly food and oil) in 1973–74 and again in 1979–80 that not coincidentally accompanied the two great bursts of stagflation" (7). The traditional explanation emphasizes supply shocks and the subsequent demand response. Supply shocks play the role of the initial exogenous impulse followed by endogenous adjustment of the private sector and policy authorities. Barsky and Kilian (2002, 2004) offer an alternative reading of the facts. According to their account, oil prices, and other commodity prices, should be seen as responding to global supply and demand factors. Specifically, the authors account for the increase in oil prices in 1973 as a delayed adjustment

5. Other related references would be Samuelson (1974), Gordon (1975), Blinder (1979), Darby (1982), and Hamilton (1983).

Table 6.1 **Selected macroeconomic indicators for G7 and Switzerland, 1960–1998**

	Canada		Switzerland		Germany		France		Italy		Japan		United Kingdom		United States	
	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.	mean	s.d.
CPI % p.a.	4.5	3.1	3.3	2.3	3.1	1.8	5.3	3.6	7.4	5.4	4.4	4.0	6.5	4.8	4.4	2.9
real GDP % p.a.	3.6	2.1	2.3	2.6	2.7	2.0	3.3	1.9	*3.4*	*2.9*	4.5	4.0	2.4	1.9	3.4	2.0
real cons. % p.a.	3.2	2.4	2.6	2.4	3.3	2.8	3.0	2.1	3.7	2.6	4.4	3.7	2.1	2.6	2.9	2.3
Empl. % p.a.	2.2	1.6	0.7	1.9	0.2	1.2	0.6	0.8	0.1	1.2	1.0	0.8	0.3	1.4	1.8	1.3
Unemp. % p.a.	7.7	2.4			5.4	3.6	6.5	3.9	8.2	2.7	2.2	0.9	6.3	3.4	6.0	1.5
RL	8.5	2.6	4.6	1.1	7.1	1.5	8.3	2.9	10.4	4.2	6.0	2.3	9.4	2.9	7.4	2.5
RS	7.2	3.5			5.3	2.3	7.7	3.4	*11.7*	*4.4*	6.0	3.0	8.3	3.2	6.0	2.7

Notes: s.d. = standard deviation; p.a. = per annum; RL = level of long-term interest rate; RS = level of short-term interest rate.

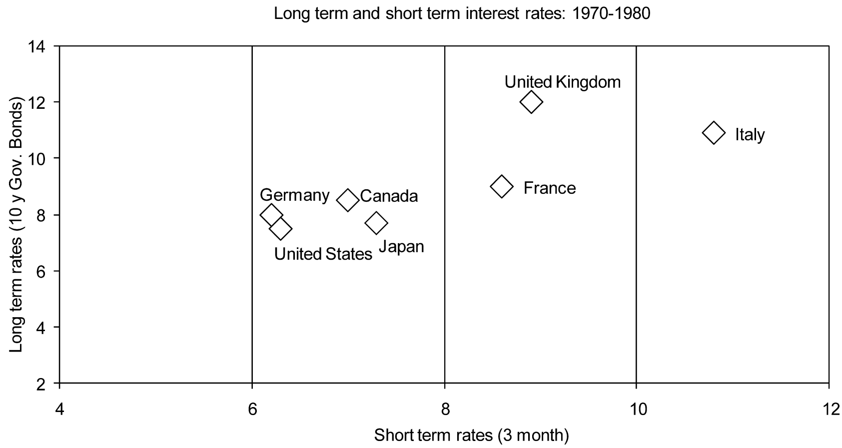

Fig. 6.2 Average nominal interest rates in the 1970s

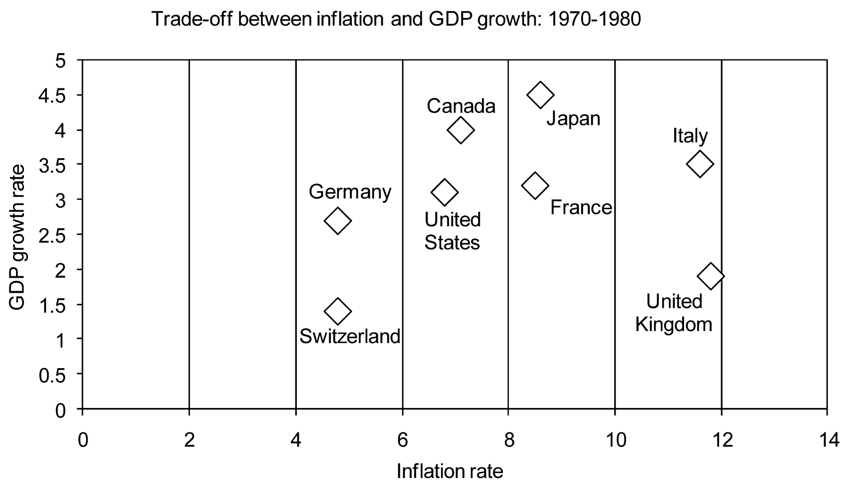

Fig. 6.3 Average inflation and real growth rates in the 1970s

to consistent demand pressure persisting since the late 1960s. The adjustment was delayed because during the 1960s oil prices were regulated through long-term contracts between oil producers and oil companies. In a situation of clear excess demand at the going price, conditions were ripe for the Organization of the Petroleum Exporting Countries (OPEC) to renege on its contractual agreements with oil companies leading to much higher oil prices. From such a viewpoint, it seems plausible that broad upward trends in commodity prices, the collapse of Bretton Woods, and the collapse of the oil market regime were all driven by excess demand growth in the late

1960s and the early 1970s. This would be compatible, following Barsky and Kilian, with a broad monetary account of the Great Inflation. Despite our obvious sympathy for such an account, investigating it is beyond the scope of this chapter.

Still, the fact that inflation in the United States and other member countries of the Bretton Woods system accelerated well before the first hike in oil prices supports the hypothesis that demand shocks (among them, increases in government spending) in conjunction with accommodative monetary policy prepared the ground for the inflationary surges of the 1970s. Furthermore, figure 6.1 suggests that it was the response to the oil price shocks of the 1970s that made most of the difference. The Bundesbank did not manage to avoid price acceleration completely (CPI inflation averaged 4.8 percent during the 1970s) but performed much better than most of all other industrialized countries.[6] The remainder of the chapter is thus devoted to the question: How did Germany manage to opt out of the Great Inflation?

6.3 Sound Money and Price Stability in Germany

6.3.1 The Legacy of the Bundesbank and Stability-Oriented Monetary Policy

On December 31, 1998, together with all national central banks joining the European Monetary Union (EMU), the Deutsche Bundesbank ended its life as a central bank responsible for conducting monetary policy for its currency. Combining this period with the term of its predecessor, the Bank deutscher Länder, the overall period coincides with the existence of the DM.[7]

The DM developed—together with the Swiss franc—into the most stable currency in the world after 1945, and the Bundesbank achieved a reputation as a model of a solid, successful central bank. This left a legacy reaching beyond its existence as a central bank responsible for a national currency. The statute of the European Central Bank (ECB), enshrined in the Maastricht Treaty, reflects this fact very well. But it is also fair to say that, in addition, the Bundesbank's track record influenced the world of central banking on a global scale.

This worldwide attention was heavily influenced by the fact that Germany (again together with Switzerland) avoided the Great Inflation of the 1970s. What explains the superior performance compared to most other countries? In this subsection, we will examine the historical, cultural, and institutional

6. The differences would be even more striking if one would consider a wider sample of industrialized countries (see, for example, Frenkel and Goldstein [1999] who consider twenty-three countries).

7. To be precise: the bank deutscher Länder was established on March 1, 1948. The DM became the currency of (then) West Germany on June 21, 1948. The Bundesbank replaced its predecessor on July 26, 1957.

background. In the next subsection, we will develop a theoretical model that formalizes the Bundesbank's strategy, and in section 6.5, we will characterize quantitatively the conduct of monetary policy by the Bundesbank.

To explain Germany's post–World War II monetary history one has to go back to 1948 and even beyond. The institutional foundation was laid in 1948 by law of the allies—West Germany did not yet exist as a state—which gave the Bank deutscher Länder (Bank of the German States) independence from any political authorities.[8] When a few months later the DM was introduced, this institution was entrusted with preserving the stability of the new currency.

The currency reform in cooperation with the simultaneous economic reforms of Ludwig Ehrhard laid the foundations of (West) Germany's economic success, the so-called "Wirtschaftswunder" (economic miracle).

As a consequence, most Germans for the first time in their lives enjoyed a stable currency. This experience had a deep impact on the mind of the German people. The mark, initially (1873) created as a currency based on gold, had ended its existence in the hyperinflation of 1923 that destroyed Germany's civil society.[9] The successor of the mark, the reichsmark, created in 1924, ended its short life with the currency reform of 1948. People had again lost most of their wealth invested in nominal assets. No wonder that a strong aversion against inflation and a desire for monetary stability became deeply entrenched in the minds of the German people![10] It became so entrenched in Germans' expectations, habits, and customs that it deserved the special expression "stability culture." It is interesting to stress the virtuous interaction between Germany's stability culture and the independence of the Bundesbank.

A particular historical episode illustrates it emphatically. The German Constitution of 1949 required the government to prepare the Deutsche Bundesbank law. It was no secret that then-chancellor Konrad Adenauer was not a friend of an independent central bank. However, his clash with the central bank in May 1956 when he criticized in public the increase of the discount rate (from 4.5 to 5.5 percent)—"the guillotine will hit ordinary citizens"—had already demonstrated to what extent the media and the public, at large, were behind the independence of the central bank from political interference. As a consequence, he lost the battle against the minister of the economy Ludwig Erhard. In the end, the Bundesbank law of 1957 in section 12 stated explicitly that: "In exercising the powers conferred on it by

8. De jure the Allied Bank Commission could interfere, but never made any use of this prerogative. See Buchheim (1999).

9. Stefan Zweig (1970), a writer, claims in his memoirs of that time that the experience of this total loss of the value of the currency more than anything else made Germans "ripe for Hitler" (359).

10. It was interesting to see that in the days before the Berlin Wall fell demonstrators in the streets of Leipzig carried posters saying: "If the D-Mark is not coming to us we will come to the D-Mark." So this desire for stability had also affected the mind of East Germans.

this Act, [the Bundesbank] is independent of instructions from the Federal Government." Together with the mandate in section 3 of "safeguarding the currency" the Bundesbank Act established the institutional fundament for a stability-oriented monetary policy.

Notwithstanding the fact that this law could have been changed at any time by a simple majority of the legislative body and insofar seemed to be based on shaky legal ground, the reputation of the Bundesbank became such that there was never any serious initiative to change the law. The status of the Bundesbank and the support for its stability-oriented monetary policy were firmly grounded on (and, in turn, reinforced) by the "stability culture" (see Issing 1993).

At the time of the ratification of the Bundesbank Act there were not only hardly any independent central banks in the world, it is even difficult to find any serious discussion in the literature on the issue of an appropriate institutional arrangement for a central bank. Interest in this topic was mainly triggered by the experience of the Great Inflation in the 1970s and the increasingly obvious failures of monetary policy in many countries. First publications discussed credibility issues (Barro and Gordon) and the time inconsistency problem (Kydland and Prescott). The outcome of monetary policy depending on the statute—here the degree of independence of the central bank—commanded broader attention only in the 1990s, with a paper by Alesina and Summers.[11]

Since then, the number of publications on central bank independence has exploded, discussing all aspects ranging from defining independence to measuring its degree to designing optimal contracts for central bankers. Is it wrong to say that the good performance of the Bundesbank, not least in the 1970s, has contributed to, if not triggered, this branch of research?

This interest in the topic and the result by more and more research papers also supported the claim to give independence to the new central bank that was yet to be founded, the European Central Bank. One should not forget that some of the countries signing the Maastricht Treaty at that time (1992) still had not given independence to their own national central banks. Since then "independence" of the central bank has become a model also on a global scale.

In a nutshell, the message stemming from experience and theory is: institutions matter! The outcome of monetary policy is heavily dependent on the institutional design of the central bank.

Another aspect of great importance pertained to the exchange rate regime (see previous section for a brief reference to the Bretton Woods system and some selected references to the relevant literature). For many years, the Bundesbank was in favor of a fixed exchange rate of the DM against the

11. See Alesina and Summers (1990). An early paper by Bade and Parkin (1980) was widely ignored and not even published.

US dollar. It even argued against the appreciation of the DM in 1961. The law of the "uneasy triangle" had been more or less forgotten (Issing 2006). However, towards the end of the 1960s, it became increasingly apparent that the fixed exchange rate was a constraint for conducting a monetary policy geared toward a domestic goal, namely price stability (Richter 1999; von Hagen 1999). In a regime of a fixed exchange rate and free capital flows, money growth becomes endogenous and any attempt to withstand the import of inflation is finally self-defeating.

The Bundesbank experienced a period of excessive money growth driven by interventions buying US dollars. In the late 1960s and early 1970s, the external component of money creation was sometimes even higher than the growth of the monetary base, implying that the internal contribution of money creation was negative. The consequences of this constellation for the institutional design of monetary policy were far-reaching: the Bundesbank, notwithstanding its independence from political interference, equipped with all the necessary instruments, was powerless with respect to pursuing a domestic goal since the exchange rate was fixed and capital flowed freely across borders. This fundamentally changed when in March 1973 Germany let its currency float against the US dollar. The Bundesbank, relieved from its obligation to intervene in the exchange market, could now consider conducting a monetary policy to safeguard the internal stability of its money (i.e., maintaining price stability).

In 1973, the Bundesbank declared the fight against inflation to be the principal goal of its monetary policy[12] and, in line with this, had already started to slow down inflation (which had peaked at almost 8 percent in mid-1973) when in October 1973, the first oil crisis broke out. The rise in oil prices thwarted the efforts of the Bundesbank while real output started to decline at the same time. Being confronted with such a situation, the Bundesbank attempted to keep monetary expansion within strict limits in order to avoid possible spillover effects into the wage and price-setting. In doing so, it did, however, not commit itself to any clear strategy and quantification.[13] Instead, the Bundesbank mainly tried to influence the behavior of market participants by means of "moral suasion." However, the social partners more or less ignored the signals given by the Bundesbank and agreed on high increases in nominal wages in 1974, trying to compensate for the loss in real disposable income. As a consequence, unemployment increased and inflation went up.

12. See Deutsche Bundesbank (1974, 1975) pages 42 and 1, respectively. At the same time, the Bundesbank never completely ignored other, secondary objectives, such as the stabilization of the business cycle and the stabilization of the external value of the currency. For more detailed accounts on the weights given to (domestic) price stability versus other goals during the period in question, see von Hagen (1999) and Baltensperger (1999).

13. In fact, the Bundesbank tried to ensure that "monetary expansion was not too great but not too small either." See Deutsche Bundesbank (1974), *Annual Report* (AR), especially p. 17.

Against this experience, the idea of adopting a formal quantitative target for money growth that would provide a nominal anchor for inflation and inflation expectations rapidly gained ground. As it happened, this period coincided with the "monetarist counterrevolution." The leading monetarists Milton Friedman, Karl Brunner, and Alan Meltzer claimed that central banks should abstain from any attempt to fine-tune the economy and should instead follow a strategy of monetary targeting. (A floating exchange rate was a necessary condition for controlling the money supply.) These ideas in principle found positive reactions in Germany (Richter 1999; von Hagen 1999). The Bundesbank discussed this approach internally and with leading proponents. Helmut Schlesinger, member of the Executive Board and chief economist, had an intensive exchange of views, not least when participating in the intellectually influential Konstanz Seminar founded by Karl Brunner in 1970.[14] The rejection of fine-tuning and the medium-term orientation of monetary policy implied by monetary targeting was also strongly supported by the German Council of Economic Experts (1974).

However, in spite of the Bundesbank being the first central bank in the world to adopt a monetary target (for the year 1975), the honeymoon with leading monetarists came soon to an end. This process had already started when the Bundesbank declared its move to the new strategy "an experiment," stressed that it would not (and, in the short run, could not) control the monetary base, and over many years missed its monetary target.

The Bundesbank interpreted its approach as a kind of "pragmatic monetarism" and kept to this strategy until 1998 (see Baltensperger 1999; Issing 2005; and also Neumann 1997, 1999). Not surprisingly, this attitude was heavily criticized, especially by Karl Brunner (1983). However, in its monetary policy practice, the strategy served the Bundesbank well in defending the stability of its currency—if not in absolute terms it did at least (together with the Swiss National Bank) substantially better than most other central banks.

6.3.2 The Conduct of Policy under Monetary Targeting

Derivation of the Money Growth Target

The choice of a monetary target in 1974 undoubtedly signaled a fundamental regime shift.[15] Not only was it a clear break with the past but also a decision to discard alternative approaches to monetary policy.[16] There were

14. See Fratianni and von Hagen (2001). The authors give a comprehensive survey on subjects discussed and persons attending. The seminar still continues and was chaired for many years by the leading German monetarist Manfred Neumann.

15. Parts of this section are taken from Issing (2005).

16. It must be recognized that the start of monetary targeting was characterized by a high degree of uncertainty. After all, Germany had just come out of the Bretton Woods "adjustable peg" system in which many topics were seen as irrelevant.

two main arguments in favor of providing a quantified guidepost for the future rate of monetary expansion. First and foremost was the intention of controlling inflation through the control of monetary expansion. Second, the Bundesbank tried to provide guidance to agents' (especially wage bargainers') expectations through the announcement of a quantified objective for monetary growth.[17] Therefore, with its new strategy, the Bundesbank clearly signaled its responsibility for the control of inflation. At the same time, the Bundesbank expressed its view that while monetary policy by maintaining price stability in the longer run would exert a positive impact on economic growth, the fostering of the economy's growth potential should be considered a task of fiscal and structural policies, while employment was a responsibility of the social partners conducting wage negotiations.

Although the formulation of the new strategy was heavily influenced by the ideas of the leading monetarists, the implementation of monetary targeting in Germany deviated from the theoretical blueprint in a number of ways. One important difference was that Bundesbank did not formulate its targets in terms of the monetary base, but in terms of a broadly defined monetary aggregate, the central bank money stock (defined as currency in circulation plus the required minimum reserves on domestic deposits calculated at constant reserve ratios with base January 1974).[18] Second the Bundesbank did not attempt to control the money stock directly, but followed an indirect approach of influencing money demand by varying key money market rates and bank reserves (two-stage implementation procedure). Third, the Bundesbank made it clear from the beginning that it could not and would not promise to reach the monetary target with any degree of precision. Accordingly, in this period, the new regime of monetary targeting was in many respects an experiment.

From the outset, the Bundesbank recognized the importance of adopting a simple, transparent, and at the same time comprehensible method for the derivation of the annual monetary targets.[19] The analytical background for the derivation formula was provided by the quantity theory of money. Starting from the quantity *identity,* one gets that average money growth, $\Delta\overline{m}$, and average inflation, $\Delta\overline{p}$, will fulfill the identity:

$$\Delta\overline{m}_t + \Delta\overline{v}_t \equiv \Delta\overline{p}_t + \Delta\overline{y}_t, \tag{1}$$

where p, m, y, and v are the (logs of the) price level, the money stock, real income, and the income velocity of money, respectively, and the bars denote long-run average values. Taking the velocity trend and the long-run average

17. See Schlesinger (1983) on this issue.

18. The ratios were 16.6 percent for sight deposits, 12.4 percent for time deposits, and 8.1 percent for savings deposits. After the mid-1980s, the heavy weight on currency increasingly proved to be a disadvantage, and when setting the target for 1988, the Bundesbank switched to the money stock M3. See Deutsche Bundesbank (1995, 81).

19. See also Issing (1997) for the following considerations.

rate of real output growth to be exogenous, it follows from (1) that trend inflation can be pinned down by controlling the trend rate of money growth:

(2) $$\Delta\bar{p}_t = \Delta\bar{m}_t - \Delta\bar{y}_t + \Delta\bar{v}_t.$$

Based on this reasoning, the Bundesbank derived the target for *average* money growth in year t, Δm_t^*, from the sum of the (maximum) rise in prices it was willing to tolerate, Δp_t^*, the predicted growth in potential output, E_{t-1} Δy_t^*, and the expected trend rate of change in velocity, $E_{t-1}\Delta v_t^*$:

(3) $$\Delta m_t^* = \Delta p_t^* + E_{t-1}(\Delta y_t^*) - E_{t-1}(\Delta v_t^*),$$

where the deltas now represent year-on-year changes, and E_{t-1} denotes expectations at the end of year $t-1$. The target rate for average (year-on-year) money growth was then translated into a target rate for money growth in the course of the year (see table 6.2 and Neumann 1997, 180).

The approach reflected the insight that monetary growth consistent with this derivation would create the appropriate conditions for real growth in line with price stability. While these basic relationships were uncontested over medium to longer-term horizons, the Bundesbank was fully aware of the fact that they might not strictly apply over the shorter term. On a month-to-month or quarter-to-quarter basis and even beyond, the basic relationship between the money stock and the overall domestic price level was often obscured by a variety of other factors. Any attempt to strictly tie money growth to its desired path in the short term might have led to disturbing volatility in interest and exchange rates, thus imposing unnecessary adjustment costs on the economy. Accordingly, the Bundesbank repeatedly pointed to the medium-term nature of its strategy and explained that it was prepared to tolerate short-term deviations from the target path if that seemed advisable or acceptable in terms of the overriding goal of price stability.

From 1975 to 1978: The Learning Phase

First experiences with monetary targets were not particularly encouraging. Between 1975 and 1978, the quantitative targets were clearly (and in 1978 considerably) overshot (see table 6.2). The sharp increase in interest rates that had taken place immediately after the end of the Bretton Woods system was almost completely reversed in 1974 and 1975, and real short-term interest rates were kept rather low until the beginning of 1979 (see figure 6.6, panel A). Clarida and Gertler (1997) interpret this as evidence "that the Bundesbank's commitment to fight inflation waned somewhat during the period between the two major oil shocks." Von Hagen (1999) argues that following the first oil price shock, short-term employment-related goals gained prominence. In the Bundesbank's own reading, the loosening was mainly motivated by two considerations that, in hindsight, turned out to be partly based on misjudgments. First, policymakers apparently overestimated the extent to which the currency appreciation would dampen real activity and

Table 6.2 **Monetary targets and their implementation (in percentage)**

Year	Target: Growth of central bank money stock (1975–1987) or money stock M3 (from 1988): In the course of the year[a]	Annual average	Midyear review	Actual money growth: In the course of the year	Annual average	Target achieved	Inflation rate (CPI)[d]
1975	8			10.1 (9.5)	7.8	No	5.9
1976		8		(9.0)	9.2	No	4.2
1977	(6–7)[b]	8		(9.5)	9.0	No	3.8
1978	(5–7)[b]	8		(12.1)	11.4	No	2.7
1979	6–9		Lower limit	6.3	9.1	Yes	4.1
1980	5–8	(6)	Lower half	4.9	4.8	Yes	5.4
1981	4–7	(5–5.5)	Lower half	3.5	4.4	Yes	6.3
1982	4–7	(4.75)	Upper half	6.0	4.9	Yes	5.3
1983	4–7		Upper half	7.0	7.3	Yes	3.4
1984	4–6	(5)		4.6	4.8	Yes	2.3
1985	3–5	(4.5)		4.5	4.6	Yes	2.2
1986	3.5–5.5	(4.5)		7.7	6.4	No	–0.2
1987	3–6			8.1	8.1	No	0.3
1988	3–6			6.7	6.3	No	1.2
1989	About 5	(Just under 5)		4.7	5.7	Yes	2.8
1990	4–6	(About 5)		5.6	4.3	Yes	2.7
1991	4–6	(5.25)	3–5	5.2	4.6	Yes	3.6
1992	3.5–5.5	(5–5.25)		9.4	8.1	No	4.0
1993	4.5–6.5	(6)		7.4	7.8	No	3.6
1994	4–6	(5.5)		5.7	9.0	Yes	2.7
1995	4–6	(5.75)		2.1	0.6	No	1.8
1996	4–7	(5.5)		8.1	7.5	No	1.4
1997[c]	3.5–6.5			4.7	6.2	Yes	1.9
1998[c]	3–6			5.5	4.4	Yes	1.0
Mean				6.6	6.5		3.0

[a]Between the fourth quarter of the previous year and the fourth quarter of the current year; 1975: Dec. 1974 to Dec. 1975.

[b]According to Annual Reports for 1977 and 1978.

[c]Embedded in a two-year orientation for 1997/1998 of about 5 percent per year.

[d]From 1995, all-German figures.

inflation. The second misjudgment concerned the depth of the 1975 recession, which in hindsight, turned out to have been greatly overestimated (see Gerberding, Seitz, and Worms 2004).[20]

Nevertheless, the Bundesbank was able to slow down inflation from the high levels before to 2.7 percent in 1978. During this period the Bundesbank gained valuable insights into the new regime and introduced a number of technical modifications (see table 6.2). These experiences helped the Bundes-

20. See Bundesbank, AR 1975 and 1976.

bank to enhance the monetary targeting concept from its experimental stage into a fully-fledged strategy. As a consequence, at the end of 1978, the potential-oriented monetary targeting strategy had been established and had proven its value. Therefore, the Bundesbank was well prepared when the German economy entered especially troubled waters.

From 1979 to 1985: The Strategy Bears Fruit

The economic situation in 1978 was broadly seen as rather comfortable. German real GDP had grown by around 3 percent, accompanied by high levels of employment growth and falling unemployment. The situation was, however, less positive in terms of monetary growth and inflation. Monetary growth had overshot its target and there were signs of acceleration in the rate of inflation, which in 1978 stood, on average, at 2.7 percent. Furthermore, in 1979, the sharp increase in oil prices associated with the second oil price shock hit the German economy. The resulting massive increase in import prices, especially energy prices, augmented by a weakening of the exchange rate, brought about a turnaround in Germany's current account position, leading to a current account deficit in 1979 for the first time in many years.

At the same time, government fiscal policy was clearly expansionary. Thus, fiscal policy rendered the central bank's task even more difficult. Moreover, the European Monetary System (EMS), an exchange rate regime defining the exchange rates of participating currencies in terms of central rates against the ECU, had begun rather quietly in March 1979, but subsequently faced tensions and the need to adjust parities from as early as September 1979.

It was obvious from the beginning that the direct effect of the oil price shock on consumer prices could not be prevented by monetary policy. At the same time, the Bundesbank had carefully analyzed the lessons of the first oil price shock. Against this experience, in 1979 the Governing Council of the Bundesbank was well aware of the threat that the oil price increase could translate again into sustained increases in inflation brought about by second-round effects in wage- and price-setting.[21] In responding to these challenges, the Bundesbank took decisive action. The discount rate was increased in steps from 3 percent at the start of 1979 to reach 7.5 percent in May 1980. In parallel, the Lombard rate was increased from its initial level of 3.5 percent to 9.5 percent in May 1980, and in February 1981 (as a special Lombard) to as much as 12 percent, the normal Lombard window being closed.[22] By subsequently reducing the monetary targets from 1979 onwards, the Bundesbank sent out a clear signal for restoring price stability.

Not until the second half of 1981 did the growth rates for the monetary base begin to come down. Toward the end of 1981, there were increasingly

21. See Schlesinger (1980) on this point.

22. See Baltensperger (1999) for a more detailed description of this period, the monetary targets, and their realizations.

clear signs of an easing of price and wage pressures. The DM regained confidence in the foreign exchange markets and strengthened again, not only within the EMS but also in relation to the US dollar. The external adjustment process was promoted through a slowdown in domestic demand and the current account position improved noticeably. Furthermore, through the "monetary warning," the government became aware of the unsustainability of its deficit policy. From then on, budget consolidation was increasingly recognized as being an urgent task.

The subsequent years 1982 to 1985 can be regarded as a phase of monetary relaxation and normalization. The Bundesbank's monetary policy was focused on bringing down inflation and restoring the stability of the currency, and it proved able to realize this aim throughout the period. The benchmark figure for the tolerated rate of inflation (which, until 1984, was termed the "unavoidable" rate of price increase) was gradually reduced from 3.5 percent in 1982 to 2 percent in 1985. At the same time, actual inflation fell steadily from an annual average rate of 5.2 percent in 1982 to 2.0 percent in 1985. When price stability was virtually reached in the middle of the 1980s, the Bundesbank changed over from the concept of an "unavoidable" rate of inflation to a medium-term price norm or price assumption of no more than 2 percent (see table 6.3).

The Last Test: German Reunification

Given the stability-oriented monetary policy strategy and the developments just described it is far from surprising that, at the end of the 1980s, the Bundesbank was one of the most respected central banks in the world. At the beginning of the 1990s, it was about to face an important historical test, in the form of German reunification.

The DM was introduced in the eastern Länder on June 1, 1990. Curiously, the introduction of the currency preceded political unification (October 3, 1990). The extension of the territorial scope of monetary policy clearly led to a significant increase in uncertainty. Specifically, the operation entailed an increase in money supply of the order of 15 percent of West German money stock. This number compared with about 10 percent, which would have been appropriate on the basis of estimates of the relative size of the former German Democratic Republic's (GDR's) GDP at market prices. Moreover, there were additional factors challenging the conduct of the Bundesbank's stability-oriented policy. In fact, German reunification led to a massive expansion of aggregate expenditure in Germany, including sizable general government deficits. As a consequence inflation rose quickly, with price increases (in West Germany) exceeding 4 percent in the second half of 1991.

How could the Bundesbank under these circumstances maintain price stability over the medium term? How could it preserve credibility?

The Bundesbank decided to stick to its tried and tested framework, including the normative rate of 2 percent for inflation. This option implied that the

Table 6.3 **Numerical inputs for the derivation of the money growth targets (average annual changes in percentage)**

Period	Medium-term price assumption[a]	Expected growth of potential output	Expected change in: Capacity utilization	Expected change in: Trend velocity (–)	Envisaged increase in money stock	Target[b]	Sources
1975	No explicit derivation by single factors					+8	MR Dec. 1974
1976	+4/+5	+2	+2.5	–1	+8		AR 1976, MR Jan. 1976
1977	+3.5[c]/+4[d]	+3	+2	–1	+8	(6–7)	AR 1976, MR Jan. 1977
1978	+3/+3.5	+3	+		+8	(5–7)	AR 1977, MR Jan. 1978
1979	+	+3	+	+		6–9	MR Jan. 1979
1980	+4	+3		–1	(+6)	5–8	AR 1979, MR Dec. 1979
1981	+3.5/+4	+2.5		–1	+5/+5.5	4–7	AR 1980, MR Dec. 1980
1982	+3.5[c]	+1.5/+2		0	(+4.75)	4–7	AR 1981, MR Dec. 1981
1983	+3.5	+1.5/+2				4–7	MR Dec. 1982
1984	+3	+2			+5	4–6	AR 1983, MR Dec. 1983
1985	+2	Over 2	+		+4.5	3–5	MR Dec. 1984
1986	+2[c]	+2.5			+4.5	3.5–5.5	MR Jan. 1986
1987	+2	+2.5				3–6	MR Jan. 1987
1988	+2	+2		+.5		3–6	MR Feb. 1988
1989	+2	+2/+2.5		+.5	5	about 5	MR Dec. 1988
1990	+2	+2.5		+.5	about 5	4–6	MR Dec. 1989
1991[e]	+2	+2.5		+.5		4–6	AR 90, MR July 1991
		(+2.25)[e]				(3–5)[e]	
1992	+2	+2.75		+.5		3.5–5.5	MR Dec. 1991
1993	+2	+3		+1	+6	4.5–6.5	MR Dec. 1992
1994	+2	+2.5		+1	+5.5	4–6	MR Jan. 1994
1995	+2	+2.75		+1	+5.75	4–6	MR Jan. 1995
1996	+2	+2.5		+1	+5.5	4–7	MR Jan. 1996
1997	+1.5/+2	+2.25		+1	+5	3.5–6.5	MR Jan. 1997
1998	+1.5/+2	+2		+1	+5	3–6	MR Jan. 1998

[a]Before 1985: unavoidable increase in prices.

[b]Targets referred to central bank money stock (defined as currency in circulation plus required minimum reserves on domestic deposits calculated at constant reserve ratios with base January 1974) until 1987 and the broad money stock M3 thereafter.

[c]Explicit reference to GDP deflator.

[d]Explicit reference to Consumer Price Index.

[e]Downward correction of target range in midyear review.

Bundesbank was, for a short time, prepared to accept monetary expansion above the announced target. Again, the money growth targets proved to be highly beneficial in terms of anchoring inflation expectations, even though it was not easy to derive an adequate money growth target for reunited Germany (see Issing et al. 2005, 3). The Bundesbank abided by its well-proven strategy right up to the beginning of EMU in January 1999. While some technical features of the strategy (e.g., the exact definition of the target variable) were changed over time, its major elements—the explicit derivation of the annual money growth targets from medium-term macroeconomic benchmark figures, the flexible implementation that included temporary departures from the medium-term rule, and the two-stage implementation procedure—stayed intact. In this respect, the Bundesbank's approach certainly stands out by reason of its consistency and remarkable continuity.

Lessons

What are the lessons that can be drawn? Why was Germany better able to counter the inflationary shocks of the 1970s than most other countries? Several key aspects emerge from this brief review of German monetary policy after the end of the Bretton Woods system. To begin with, the Bundesbank was the first central bank to announce a monetary target and thus to undertake a strategy of commitment, transparently communicated to the public.[23] Moreover, when announcing the money growth targets, the Bundesbank disclosed the most important guiding principles behind its decisions, such as the maximum rise in prices that would be tolerated by the central bank and its estimate of potential output growth. By doing so, the Bundesbank fostered transparency and provided an anchor for medium-term inflation expectations. In retrospect, against the background of the more recent debate about the merits of an intensive communication policy, these elements of the Bundesbank's strategy appear very modern indeed.

After the initial years of experimentation, the strategy had proven its value in the baptism of fire of 1979 and the early 1980s. In doing so, it had managed to establish credibility which, in turn, had started to set in motion a virtuous circle. Still, one may well ask—and indeed, it has often been asked—how the Bundesbank was able to get away with its practice of deviating time and again from the announced targets while at the same time preserving its reputation as a bulwark of monetary stability.[24] After all, even if one excludes the years 1975 to 1978, the targets were missed seven out of twenty times (see figure 6.4).

As explained by Issing (1997, 71), the target misses were rarely of a completely involuntary nature, but mostly constituted deliberate monetary policy decisions. Yet it was exactly in those situations that the monetary targets had an especially valuable disciplining effect because once a target was missed the decision makers were put under pressure to justify the outcome in terms of the ultimate aim of safeguarding the currency. Similarly, Schlesinger (2002) argues that the targets imposed discipline on the decision makers by forcing them to explain their decisions and to persuade the public that failure to meet the intermediate target did not jeopardize the final goal of policy. Finally, according to Neumann (2006, 14), "the Bundesbank was the first central bank that provided the public (or at least, an elite audi-

23. See Issing (1992, 291).
24. See Neumann (2006, 14).

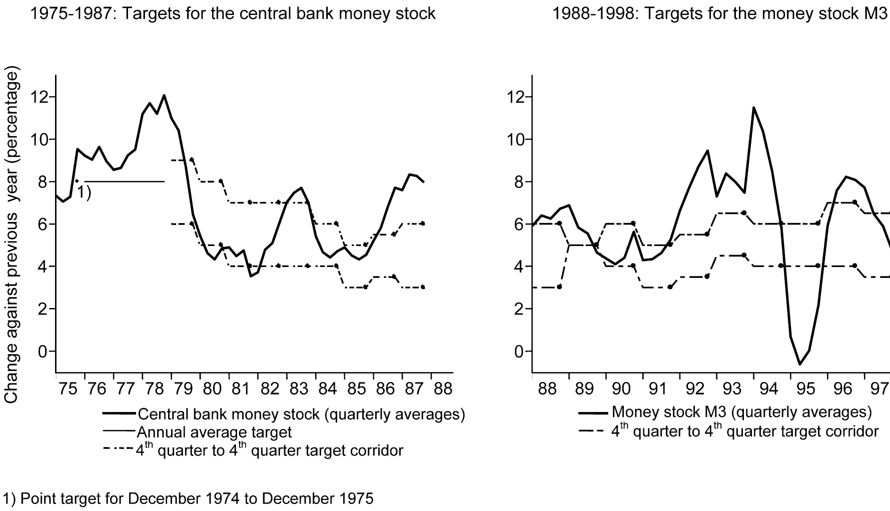

Fig. 6.4 Money growth targets 1975–1998

ence), with an intelligible numerical framework that facilitated the evaluation of its policy course from the outside." Viewed from this perspective, the money growth targets represented a movement away from purely discretionary policy toward a more rule-based behavior. The Bundesbank itself has sometimes designated its strategy as constrained or disciplined discretion; Neumann (1997) talks of "rule-based discretion."

6.4 Monetary Targeting as a Commitment Device

As explained in the previous section, the Bundesbank did not attempt to control the money stock directly, but followed an indirect management procedure that worked via influencing conditions in the money market. Hence, on a basic level, the Bundesbank's approach may be described as setting the short-term interest rate so as to achieve the rate of money growth that was viewed as consistent with the attainment of the final goal, price stability. In this section, we present a model that formalizes this approach and enables us to compare the implied interest rate rule with other interest rate rules proposed in the academic literature (such as the Taylor rule and its many variants).

Taylor (1999) and more recently, Orphanides (2003) and Kilponen and Leitemo (2008) have discussed the implications of targeting money growth for a central bank that sets the short-term interest rate. Although we know from the previous section that the Bundesbank's practice of monetary targeting differed from the monetarist blueprint in a number of ways, it is still instructive to consider the simple case of a "pure" or "strict" money growth rule first. Under strict money growth targeting, the central bank is required to find the short-term interest rate, i_t, which sets the growth rate of money equal to the prespecified target:

$$\Delta m_t = \Delta m_t^* \tag{4}$$

subject to a money demand relation that relates real money holdings to output and the interest rate:[25]

$$(m_t - p_t) = \eta_y \bullet y_t - \eta_i \bullet i_t + \varepsilon_t^{md} \tag{5}$$

where ε_t^{md} captures short-run dynamics and shocks to money demand. Taking first differences, the growth rate of money is related to the inflation rate, the change in the nominal interest rate, and the growth rate of output through

$$\Delta m_t = \pi_t + \eta_y \Delta y_t - \eta_i \Delta i_t + \Delta\varepsilon_t^{md}. \tag{5a}$$

Given the money demand relation (5), equilibrium velocity can be written as

$$v_t^* = -((m_t - p_t)^* - y_t^*), \text{ where} \tag{6}$$

$$(m_t - p_t)^* - y_t^* = (\eta_y - 1)y_t^* + \eta_i \bullet i_t^* + \varepsilon_t^{v*}$$

$$\Rightarrow v_t^* = (1 - \eta_y)y_t^* - \eta_i \bullet i_t^* - \varepsilon_t^{v*}$$

and equilibrium changes in velocity

$$\Delta v_t^* = (1 - \eta_y)\Delta y_t^* - \eta_i \bullet \Delta i_t^* - \Delta\varepsilon_t^{v*} \tag{6a}$$

are represented by a function of potential output growth and of changes in the steady-state level of the nominal interest rate (if there are any). We define the velocity shock ε_t^{v*} as a shock to *equilibrium* money demand. We interpret ε_t^{v*} as a portfolio shock that can be observed by the central bank due to its institutional knowledge.

As discussed in the previous section, a central bank with the objective of controlling long-run average inflation will set the money growth target equal to the "acceptable" rate of inflation, π_t^*, adjusted for the predicted growth rate of potential output and the expected trend rate of change in velocity (which is exactly what the Bundesbank did):

$$\Delta m_t^* = \pi_t^* + E_t\Delta y_t^* - E_t\Delta v_t^*. \tag{7}$$

Note that in contrast to equation (3), we now assume that the money growth targets are based on current-period expectations of Δy_t^* and Δv_t^*, which presupposes that the money growth targets are regularly updated to

25. Such a money demand equation can be derived from the optimization problem of a household who values money holdings in its utility function that is separable in real balances and consumption goods (see Woodford 2003).

take account of revisions in the estimates of potential output growth and the trend change in velocity.[26] From (6a) the formula for the money growth target can be reformulated as:

(7a) $$\Delta m_t^* = \pi_t^* + \eta_y E_t \Delta y_t^* + \Delta\varepsilon_t^{v*},$$

where we abstract from changes in the nominal equilibrium interest rate (as the Bundesbank did).[27]

Combining (5a) and (7a), the deviation of money growth from target can now be expressed as:

(8) $$\Delta m_t - \Delta m_t^* = \pi_t - \pi_t^* + \eta_y(\Delta y_t - E_t \Delta y_t^*) - \eta_i \Delta i_t + \{\Delta\varepsilon_t^{md} - \Delta\varepsilon_t^{v*}\}.$$

Using the equality of actual money growth with target (equation [4]) entails:

(9) $$\pi_t - \pi_t^* + \eta_y(\Delta y_t - E_t \Delta y_t^*) - \eta_i \Delta i_t + \{\Delta\varepsilon_t^{md} - \Delta\varepsilon_t^{v*}\} = 0.$$

Solving for the nominal interest rate, (9) can be transformed into an instrument rule of the form:

(10) $$i_t = i_{t-1} + \frac{1}{\eta_i}(\pi_t - \pi_t^*) + \frac{\eta_Y}{\eta_i}(\Delta y_t - E_t \Delta y_t^*) + \frac{1}{\eta_i}\{\Delta\varepsilon_t^{md} - \Delta\varepsilon_t^{v*}\}.$$

According to (10), money growth targeting implies an interest rate reaction to the lagged interest rate, to the deviation of inflation from target, to the deviation of actual output growth from (the central bank's estimate of) potential output growth (which is equivalent to the change in the output gap), and to the difference between the "true" money demand shock $\Delta\varepsilon_t^{md}$, and the portfolio shock observed by the central bank, $\Delta\varepsilon_t^{v*}$. As pointed out by Orphanides (2003), the interest rate rule implied by (strict) money growth targeting thus belongs to the class of "natural-growth targeting rules," which do not rely on estimates of the natural rate of interest and output and thus "stay clear of the pitfalls known to plague the natural-rate-gap-based policy approach" (990). Notice, however, that in order to be a meaningful specification, which would be suitable for characterizing the practical implementation of monetary policy, the money demand shocks in (10) should have reasonable properties. We will discuss this issue in more detail in section 6.5, where we present our empirical results.

However, as discussed in the previous section, the Bundesbank did not adhere to a strict version of the Friedman rule, but instead pursued a strategy of "pragmatic monetarism." Most importantly, the assumption that the central bank hits the money growth target each period that underlies equation (4) is at odds with the Bundesbank's acclaimed medium-

26. As regards the Bundesbank, the fact that the targets were usually formulated as a corridor of 2 or 3 percentage points (see table 6.3) provided flexibility for adjustments to changes in the underlying estimates. In addition, there was a regular midyear review of the targets.

27. See Gerberding, Seitz, and Worms (2007, 5).

term orientation and the fact that it tolerated short-term deviations from target.

In order to capture these features of the Bundesbank's monetary policy strategy, we choose a framework that allows us to interpret a monetary target as a commitment device. Specifically, we assume that policymakers at the Bundesbank were aware of the pitfalls of discretionary policy and used monetary targeting as a device to get closer to the optimal (but time-inconsistent) commitment solution. More formally, we assume that the Bundesbank council optimized the setting of the policy instrument(s) with respect to a standard objective function, modified to include an additional money growth target:[28]

$$E_0 \sum_{t=0}^{\infty} \beta^t [(\pi_t - \pi_t^*)^2 + \hat{\lambda}_x x_t^2 + \hat{\lambda}_i (i_t - i_t^*)^2 + \hat{\lambda}_m (\Delta m_t - \Delta m_t^*)^2], \tag{11}$$

where β is the discount factor, x_t is the output gap defined as the gap between actual output, y_t, and potential output, y_t^*, and $\hat{\lambda}_x$, $\hat{\lambda}_i$, and $\hat{\lambda}_m$ are the relative weights attached to the output, interest rate, and money growth terms.

The use of a modified loss function to attenuate the pitfalls associated with discretionary monetary policy was pioneered by Rogoff (1985). More recently, several authors have analyzed the properties of monetary policy strategies based on modified loss functions in the context of forward-looking New Keynesian-type models. There are many variants of modified loss functions, including price-level targeting (Svensson 1999; Vestin 2006; Røisland 2006; and Gaspar, Smets, and Vestin 2007); average inflation targeting (Nessén and Vestin 2005); interest-rate smoothing (Woodford 1999); nominal income growth targeting (Jensen 2002); and speed limit targeting (Walsh 2003).

For our purposes, the most closely related contribution in the literature is Söderström (2005), who analyzes the implications of delegating a loss function to the central bank, which deviates from society's true loss function by an additional money growth target. As shown by Söderström, this modification can be beneficial for a central bank acting under discretion since the money growth target introduces interest rate inertia and history dependence into interest rate decisions, both of which are features of the optimal commitment policy. In Söderström's baseline simulations, a money growth target closes about 80 percent of the gap between discretionary policy and the optimal policy under precommitment. This result is more remarkable given the fact that it is obtained in the context of a standard New Keynesian model where money growth is neither useful as an indicator of future inflation nor of output growth, and where

28. In the loss function (11), we have abstracted from the complications arising from a gap between the efficient and the natural level of output, but one should keep in mind that with a positive value of x*, the optimal discretionary policy suffers from an average inflation bias as well as a stabilization bias (see Woodford 2003, 469).

money plays no direct role in the transmission mechanism of monetary policy.

Nevertheless, our objective differs from Söderström's. Specifically, we want to derive the interest rate rule characterizing optimal discretionary policy under the modified loss function (11). In our reading, this loss function captures some relevant dimensions of the Bundesbank's approach of pragmatic monetarism. Most importantly, it accounts for misses of the monetary target in the context of a strategy where monetary growth is *always* important for monetary policymaking. Hence, we expect the interest rate rule implied by this loss function to provide a useful starting point for the empirical analysis undertaken in section 6.5.

In order to derive the interest rate rule implied by the modified loss function (11), we need a model of the underlying structural relationships between the target variables. To keep the analysis as simple as possible, we assume that these relationships are adequately captured by the standard New Keynesian model, which, despite its well-known limitations, is the workhorse in the theory of monetary policymaking.

Specifically, we use the baseline version of the model, which consists of an aggregate supply and an aggregate demand equation, augmented by the simple money demand relation (5):[29]

$$\pi_t - \pi_t^* = \beta(E_t\pi_{t+1} - \pi_{t+1}^*) + \kappa x_t + u_t^\pi \tag{12}$$

$$x_t = E_t x_{t+1} - \varphi(i_t - E_t\pi_{t+1} - r_t^n) \tag{13}$$

$$(m_t - p_t) = \eta_y \bullet y_t - \eta_i \bullet i_t + \varepsilon_t^{md}, \tag{5}$$

where u_t^π is a cost-push shock and r_t^π is a natural-rate shock. For simplicity's sake, we assume that both are independent and identically distributed (i.i.d.). Combining equation (5) with the definition of the money growth target from equation (7a) yields:

$$\begin{aligned}\Delta m_t - \Delta m_t^* &= \pi_t - \pi_t^* + \eta_y(\Delta y_t - \Delta y_t^*) - \eta_i\Delta i_t + \{\Delta\varepsilon_t^{md} - \Delta\varepsilon_t^{v*}\}\\ &= \pi_t - \pi_t^* + \eta_y\Delta x_t - \eta_i\Delta i_t + \Delta\varepsilon_t,\end{aligned} \tag{14}$$

where $\varepsilon_t = \varepsilon_t^{md} - \varepsilon_t^{v*}$ and we have again assumed that the money growth target is regularly updated to take account of observed portfolio shifts and of revisions in the central bank's estimates of potential output growth. Alternatively, the shock variable in (14) would have to be modified to include shocks to potential output growth.[30]

Clearly, the model misses some important elements for understanding

29. For details on the model, see Woodford (2007, 6).

30. Loss function (11) assumes that output is targeted at the natural rate, which is a time-varying variable. If output-gap targeting is feasible, the value of the natural rate must be known (or, in real-life terms, a good estimate is available). Therefore, y_t^n can, in principle, also serve as an input for the (time-varying) money growth target (see Jensen 2002, 948).

monetary policymaking, such as the role of financial factors in the transmission mechanism. Nevertheless, it does provide a simple and workable framework to discuss the key issues of commitment, credibility, and reputation (see, e.g., Gaspar and Kashyap 2007).

We are now in a position to derive the interest rate rule implied by the modified period loss function (11) subject to the underlying model composed of equations (12), (13), and (14). Formally, the solution can be found by minimizing the Lagrangian expression:

$$(15)\quad L_t = E_t\begin{bmatrix} (\pi_t - \pi_t^*)^2 + \hat{\lambda}_x x_t^2 + \hat{\lambda}_i (i_t - i_t^*)^2 + \hat{\lambda}_m(\Delta m_t - \Delta m_t^*)^2 \\ +\beta(\pi_{t+1} - \pi_{t+1}^*)^2 + \beta\hat{\lambda}_x x_{t+1}{}^2 + \beta\hat{\lambda}_i(i_{t+1} - i_{t+1}^*)^2 + \beta\hat{\lambda}_m(\Delta m_{t+1} - \Delta m_{t+1}^*)^2 + \beta^2 \ldots \\ +\phi_{1,t}(\beta(E_t\pi_{t+1} - \pi_{t+1}^*) + \kappa x_t + u_t^\pi - (\pi_t - \pi_t^*)) \\ +\phi_{2,t}(E_t x_{t+1} - \varphi(i_t - E_t\pi_{t+1} - r_t^n) - x_t) \\ +\phi_{3,t}(\pi_t - \pi_t^* + \eta_y \Delta x_t - \eta_i \Delta i_t + \Delta\varepsilon_t - (\Delta m_t - \Delta m_t^*)) \\ +\beta\phi_{1,t+1}(\beta(E_{t+1}\pi_{t+2} - \pi_{t+2}^*) + \kappa x_{t+1} + u_{t+1}^\pi - (\pi_{t+1} - \pi_{t+1}^*)) \\ +\beta\phi_{2,t+1}(E_{t+1}x_{t+2} - \varphi(i_{t+1} - E_{t+1}\pi_{t+2} - r_{t+1}^n) - x_{t+1}) \\ +\beta\phi_{3,t+1}(\pi_{t+1} - \pi_{t+1}^* + \eta_y\Delta x_{t+1} - \eta_i\Delta i_{t+1} + \Delta\varepsilon_{t+1} - (\Delta m_{t+1} - \Delta m_{t+1}^*)) + \ldots \end{bmatrix}$$

with respect to the paths of each of the four endogenous variables, π_t, x_t, Δm_t, and i_t. The derivation is complicated by the fact that the money growth target introduces lagged values of the endogenous variables into the state vector. In any stationary equilibrium therefore, the expected values of the endogenous variables will depend on their own lagged values.[31] In general, analytical solutions to this kind of problem are not available, but Söderlind (1999) and Dennis (2007) have developed algorithms that provide numerical solutions. While we do not want to take that route here, it is possible to gain important insights into the nature of the policy problem by considering the analytical solution to the much simpler static version of the problem.[32] Hence, in what follows we assume that when taking interest rate decisions, the Bundesbank Council was concerned only with minimizing the current period loss function, taking private sector expectations as given. In this case, (15) reduces to:

$$(15a)\quad L_t = E_t\begin{bmatrix} (\pi_t - \pi_t^*)^2 + \hat{\lambda}_x x_t^2 + \hat{\lambda}_i(i_t - i_t^*)^2 + \hat{\lambda}_m(\Delta m_t - \Delta m_t^*)^2 \\ +\phi_{1,t}(\beta(E_t\pi_{t+1} - \pi_{t+1}^*) + \kappa x_t + u_t^\pi - (\pi_t - \pi_t^*)) \\ +\phi_{2,t}(E_t x_{t+1} - \varphi(i_t - E_t\pi_{t+1} - r_t^n) - x_t) \\ +\phi_{3,t}(\pi_t - \pi_t^* + \eta_y\Delta x_t - \eta_i\Delta i_t + \Delta\varepsilon_t - (\Delta m_t - \Delta m_t^*)) \end{bmatrix}$$

31. See Clarida, Galí, and Gertler (1999, 1692, fn 74), or Walsh (2003).
32. For a similar approach, see Guender and Oh (2006).

and the first-order conditions are:

(16a) $$\frac{\partial L}{\partial(\pi_t - \pi_t^*)} = 2(\pi_t - \pi_t^*) - \phi_{1,t} + \phi_{3,t} = 0 \qquad \text{for all } t$$

(16b) $$\frac{\partial L}{\partial x_t} = 2\hat{\lambda}_x x_t + \phi_{1,t}\kappa - \phi_{2,t} + \phi_{3,t}\eta_y = 0 \qquad \text{for all } t$$

(16c) $$\frac{\partial L}{\partial i_t} = 2\hat{\lambda}_i(i_t - i_t^*) - \phi_{2,t}\varphi - \phi_{3,t}\eta_i = 0 \qquad \text{for all } t$$

(16d) $$\frac{\partial L}{\partial(\Delta m_t - \Delta m_t^*)} = 2\hat{\lambda}_m(\Delta m_t - \Delta m_t^*) - \phi_{3,t} = 0 \qquad \text{for all } t.$$

Solving for the Lagrangian multipliers and inserting the solutions into (16c) yields:

(17) $$\hat{\lambda}_i(i_t - i_t^*) - \varphi\hat{\lambda}_x x_t - \varphi\kappa(\pi_t - \pi_t^*) - (\varphi\kappa + \varphi\eta_y + \eta_i)\hat{\lambda}_m(\Delta m_t - \Delta m_t^*) = 0,$$

which can be transformed into an (implicit) instrument rule of the form:

(18) $$i_t = i_t^* + \frac{\lambda_x\varphi}{\lambda_i}x_t + \frac{\kappa\varphi}{\lambda_i}(\pi_t - \pi_t^*) + \frac{\lambda_m\varphi}{\lambda_i}\left(\kappa + \frac{\eta_i}{\varphi} + \eta_y\right)(\Delta m_t - \Delta m_t^*).$$

Equation (18) reproduces the well-known result that the implicit interest rule under discretion takes the form of a standard Taylor rule. However, the inclusion of a money growth term in the loss function implies an additional interest rate response to deviations of money growth from target. Interestingly, the Euler equations ("targeting rules") derived by Dennis (2007) for the case of fully optimal discretionary policy take essentially the same form as equation (18). This suggests that the functional form of the policy rule (18) is not specific to the simple one-period optimization problem considered here, but carries over to the much more complex intertemporal optimization problem.[33] Note, however, that in order to apply the Dennis algorithm to the problem described by equation (15), the model has to be extended to include the first difference of the interest rate in the vector of endogenous variables.[34] As a consequence, under fully optimal discretionary policy, the current interest rate will be a function of the first difference of the interest rate as well as of all the variables included in equation (18).

In order to test whether the Bundesbank attached any weight to its money growth targets (relative to other potential targets), we could stop the analysis here and estimate equation (18) directly. This is the route taken by most empirical studies, such as Clarida, Galí, and Gertler (1998). However, in

33. See Dennis (2007, equation [25]).

34. The model is closed by including the definition of the additional variable, $\Delta i_t = i_t - i_{t-1}$, among the model equations. See Dennis (2007, Technical Appendix).

order to make the policy rule implied by the modified loss function (11) more directly comparable with other types of simple interest rate rules, we do not follow this approach here, but instead repeat the earlier exercise and eliminate the money growth term from equation (18). The process of elimination of money growth deviations from the policy rule mimics the steps we have taken earlier for the case of pure money growth targeting. To simplify the procedure, we first rewrite equation (18) as:

$$i_t = i_t^* + \frac{\Gamma_2}{\Gamma_1} x_t + \frac{\Gamma_3}{\Gamma_1}(\pi_t - \pi_t^*) + \frac{\Gamma_4}{\Gamma_1}(\Delta m_t - \Delta m_t^*) \tag{19}$$

with $\Gamma_1 = \hat{\lambda}_i$, $\Gamma_2 = \hat{\lambda}_x \varphi$, $\Gamma_3 = \varphi\kappa$, $\Gamma_4 = \hat{\lambda}_m(\varphi\kappa + \eta_i + \varphi\eta_y)$, and then use equation (14) to substitute out the money growth term:

$$i_t = i_t^* + \frac{\Gamma_2}{\Gamma_1} x_t + \frac{\Gamma_3}{\Gamma_1}(\pi_t - \pi_t^*) + \frac{\Gamma_4}{\Gamma_1}(\pi_t - \pi_t^* + \eta_y \Delta x_t - \eta_i \Delta i_t + \Delta\varepsilon_t). \tag{20}$$

Finally, solving for i_t, we get:

$$\begin{aligned} i_t = {} & \frac{\Gamma_1}{(\Gamma_1 + \Gamma_4\eta_i)} i_t^* + \frac{\Gamma_2}{(\Gamma_1 + \Gamma_4\eta_i)} x_t \\ & + \frac{(\Gamma_3 + \Gamma_4)}{(\Gamma_1 + \Gamma_4\eta_i)}(\pi_t - \pi_t^*) + \frac{\Gamma_4\eta_y}{(\Gamma_1 + \Gamma_4\eta_i)} \Delta x_t \\ & + \frac{\Gamma_4}{(\Gamma_1 + \Gamma_4\eta_i)} \Delta\varepsilon_t + \frac{\Gamma_4\eta_i}{(\Gamma_1 + \Gamma_4\eta_i)} i_{t-1}. \end{aligned} \tag{21}$$

According to (21), the interest rate rule of a central bank that targets money growth differs from a standard Taylor rule in that it implies a response to the deviation of actual output *growth* from potential output *growth* (which is equivalent to targeting the *change* in the output gap) as well as a response to the lagged interest rate and to the difference between the "true" money demand shock and the portfolio shock observed by the central bank. As shown by Giannoni and Woodford (2003), responding to the lagged interest rate (interest rate inertia) and to the change rather than the level of the output gap (history dependence) are both features of the optimal commitment policy. Equation (21) therefore nicely illustrates the argument put forth by Söderström (2005) that money growth targeting may play a useful role in overcoming the stabilization bias of discretionary policy. The response to money demand shocks implied by equation (21) is usually viewed as a major drawback of monetary targeting. However, it cannot be established a priori how serious this problem is when the central bank takes into account portfolio shifts when implementing monetary targeting (as routinely practiced by the Bundesbank). In section 6.5 we attempt to look at the relevant empirical evidence.

Equation (21) is the basis for the interest rate rule that we will estimate in the next section.[35] As before, the intuition presented is predicated on some restrictions on the behavior of the error term in the money demand equation. We will further discuss the issue in section 6.5.

6.5 The Conduct of Monetary Policy and Monetary Policy Rules

In this section, our goal is to provide a systematic comparison of policy rules followed in Germany, the United States, and the United Kingdom. To allow for a fair comparison, our aim was to use model specifications for each of the three countries that are as similar as possible regarding the dynamic structure and the corresponding variables. In order to provide a more precise characterization of systematic differences in the conduct of monetary policy, we estimate and compare interest rate reaction functions. The specification of the estimated reaction functions is based on the interest rate rule derived in the previous section, which includes the elements of a standard Taylor rule as well as the features implied by including a money growth target in the loss function.

6.5.1 Brief Reference to the Literature

There is a voluminous literature about monetary policy reaction functions, especially as regards the United States. According to the established view, there was a regime shift around October 1979 (the start of the Volcker disinflation).[36] The broad strand of the empirical literature sees the main difference between the pre-Volcker period and the Volcker-Greenspan period as pertaining to the interest response to an increase in inflation (or expected inflation). Specifically, the claim is that the coefficient measuring the interest rate response to inflation was significantly below unity during the pre-Volcker period and significantly above unity in the later period. An inflation coefficient below unity corresponds to accommodative monetary policy as real interest rates decline in response to an inflation increase (see, e.g., Clarida, Galí, and Gertler 1998, 2000 or Lubik and Schorfheide 2004). In other words, before 1979 US monetary policy does not comply with the Taylor principle. Characterization of monetary policy in the interim period, between 1979 and 1982, is difficult as it seems dominated by transition dynamics induced by the Fed's monetary experiment. Moreover, the Fed's policy response to economic slack also seems difficult to pin down. Orphanides (2003, 2004) goes as far as to argue that the key distinction does not involve the response to expected inflation, but rather the response

35. In the above mentioned simple model we do not consider lags in monetary transmission. In the empirical results we will see that forecast inflation performs better than current inflation. Transmission lags can rationalize such a result (see comments in section 6.5).

36. See Beyer and Farmer (2007) for an econometric investigation and Gaspar, Smets, and Vestin (2006) for an analytical narrative drawing on the documentary evidence provided in Lindsey, Orphanides, and Rasche (2005).

to policymakers' real-time perceptions of real activity (excess demand). Using real-time data to reestimate the Fed's policy rule, he finds that, prior to Volcker's appointment, policy was too responsive to perceived output gaps. Specifically, loose monetary policy was a consequence of responding strongly to overestimations of economic slack. More recent papers (Boivin 2006; Kim and Nelson 2006; Partouche 2007) using a time-varying coefficients framework find important, but gradual, changes in the Fed's response to both inflation and real activity, not properly accounted for by the typical split-sample approach.

6.5.2 A Comparison of Empirically Estimated Policy Rules

As a starting point for a comparative analysis of German and US monetary policy reaction functions during the Great Inflation, it is useful to take another look at the relative inflation performance of the two countries from the mid-1960s to the early 1980s. According to figure 6.5, the upsurge of inflation in Germany in the early 1970s was stopped by quick disinflation, which preceded the Volcker disinflation by about six years. Still, the dating of the regime shift is not as straightforward for Germany as it is for the United States, where the appointment of Paul Volcker as chairman provides an obvious date for a structural break. Two potential candidates are the breakdown of the Bretton Woods system in March 1973 and/or the official start of the monetary targeting regime in 1975:Q1.[37] However, most studies on the Bundesbank's reaction function, including Clarida, Galí, and Gertler (1998) and Gerberding, Seitz, and Worms (2005, 2007), choose an even later date, namely 1979:Q1, as the starting point of their analysis. The reason for doing so can best be understood by comparing the behavior of real interest rates and inflation during the period in question.

As shown in figure 6.6, pre-1979 the US real rate steadily declines as inflation rises, becoming persistently negative during most of the 1970s. In late 1979, the real rate rose sharply, leading to a subsequent decline in inflation. This observation provides the rationale for the analysis in Beyer and Farmer (2007). They argue that the source of the inflation build-up in the 1970s was a downward drift in the real interest rate that was translated into a simultaneous increase in unemployment and inflation by passive Fed policy. For Germany, the picture is different. Real interest rates rose sharply after the breakdown of the Bretton Woods system in March 1973. Moreover, real interest rates were (almost) always significantly positive throughout the period. Nevertheless, the early increase in real interest rates was almost completely reversed in 1974 and 1975 and the real rate was kept rather low until the beginning of 1979 (data: inflation measured by

37. The Bundesbank had already established an internal monetary target for its own orientation for the year 1974 (see Dudler 1980, 299), so 1974:Q1 may be considered another potential breakpoint.

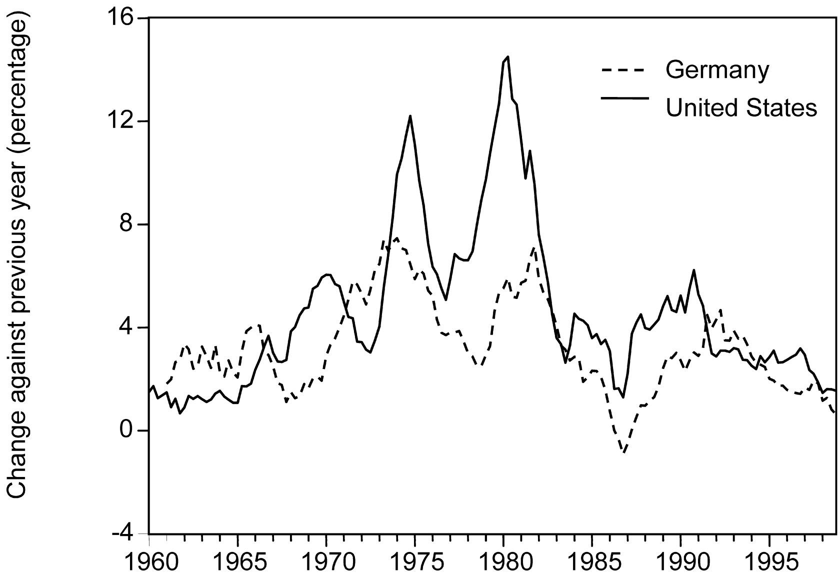

Fig. 6.5 Inflation in Germany and the United States (consumer prices, quarterly data)

CPI inflation against previous quarter, real rates calculated by subtracting period $t + 1$ inflation from three-month money market rates, three-quarter centered moving averages). Overall, however, the visual comparison between the conduct of monetary policy in Germany and the United States in the 1970s suggests loose monetary policy in the latter country, but not in Germany.

In the remainder of this section, our aim is to characterize differences in monetary policy in terms of differences in the estimated monetary policy reaction functions. In order to be better able to capture empirical regularities, we extend the interest rate rule derived in the previous section (equation [21]) in two directions. First, the theoretical model of section 6.4 was silent on the frequency of the data, but it is usually taken to describe regularities observed in quarterly data and in quarterly rates of change. However, when applying the model to the Bundesbank's monetary policy, we have to take account of the fact that the Bundesbank's money growth targets were annual targets that referred to money growth over the previous four quarters. Hence, in the empirical application of equation (21), we extend the time horizon of the inflation and output growth variables to annual (four-quarter) rates of change. Second, we allow for forward-looking behavior on part of the policymakers; that is, we allow them to focus on expected rather than current inflation. This modification of equation (21) can be rationalized by lags in the transmission of monetary policy impulses that are not accounted for

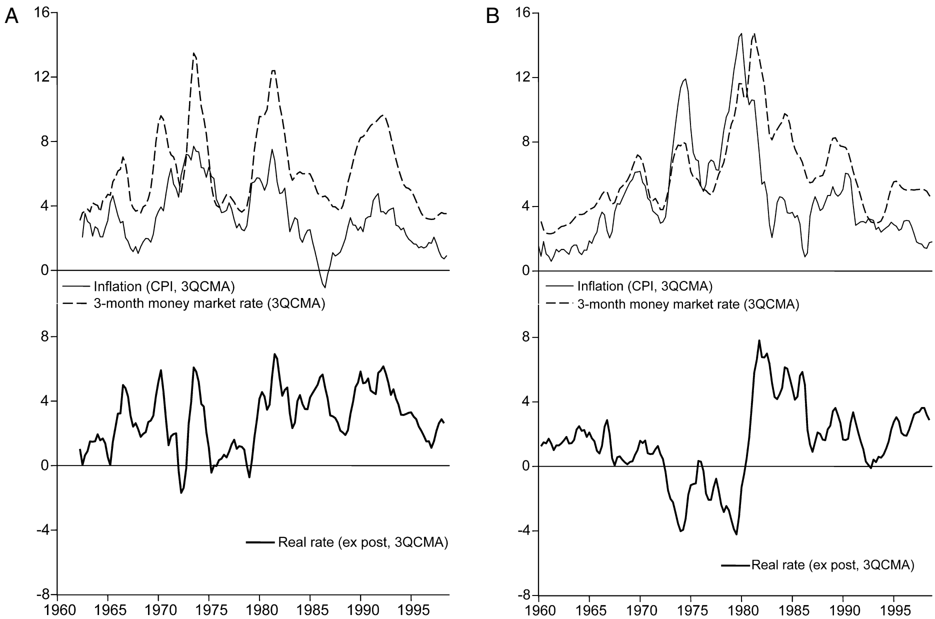

Fig. 6.6 Interest rates and inflation: *A*, in Germany; *B*, in the United States

in the baseline New Keynesian model.[38] Third, in order to capture interest rate dynamics not accounted for by the first lag of the interest rate, we also included the second lag of the interest rate among the endogenous variables. Hence, we start from a specification of the following form:

$$(22)\quad i_t = (1-\rho_1-\rho_2)\begin{pmatrix} \alpha + \beta E((\pi^a_{t+n} - \pi^*)|\Omega_t) + \gamma_1 E((y_t - y^*_t)|\Omega_t) \\ + \gamma_2 E(\Delta_4(y_t - y^*_t)|\Omega_t) + \dfrac{\gamma_2}{\eta_y}(\Delta_4\varepsilon^{md}_t - \Delta_4\varepsilon^{v*}_t) \end{pmatrix} + \rho_1 i_{t-1} + \rho_2 i_{t-2} + u_t$$

where $E(\pi^a_{t+n}|\Omega_t)$ is policymakers' inflation forecast for period $t + n$ formed in t on the basis of the information available at time t, π^a denotes annual inflation, $E((y_t - y^*_t)|\Omega_t)$ is policymakers' estimate of the current output gap, again formed on the basis of information available at the time, u_t is an error term, and Δ_4 denotes changes over the previous four quarters. An important issue is the method used to generate the forecasts of inflation, the output gap, and the output growth gap. Unfortunately, as regards the Bundesbank, real-time forecasts of these variables over the relevant time horizons and at

38. Strictly speaking, this argument is valid only for the part of the interest rate response to inflation that derives directly from the inflation stabilization objective in the loss function (11). Therefore, we also estimated specifications of the interest rate reaction function that allow for a response to current as well as expected future inflation. However, not surprisingly, in these exercises one of the two terms usually drops out.

the appropriate frequency do not exist. Therefore, we follow the method first proposed by McCallum (1976) and proxy the unobserved forecasts by the corresponding realizations (see Clarida, Galí, and Gertler 1998). Hence, the error term u_t is a linear combination of the forecast errors and the exogenous disturbance term. In order to keep the forecast errors as small as possible, we use the initial (unrevised) figures on inflation and output as well as the first available estimates of the output gap.[39] To avoid endogeneity problems, these variables are instrumented by a vector of variables I_t, which were part of policymakers' real-time information sets and that are orthogonal to the error term u_t (for details on the instrument sets, see tables 6.4 through 6.6).

Finally, for empirical tractability, the model requires a sufficiently stable empirical money demand function. Reviewing the empirical literature on money demand, we are confident that this condition is fulfilled as there is broad evidence for the existence of sufficiently stable cointegrated money demand models. In conventional cointegrated money demand models, money is usually explained by output (e.g., GDP, serving as a scale variable), and one or more suitable interest rate variables that represent own rates and opportunity costs for holding money. Derivations of actual money from the long-run money demand relationship ($m - m^*$) are then interpreted as stationary (i.e., transitory) money demand shocks, corresponding to the *level* of ε_t in equation (21). For example, Beyer (1998) finds a stable cointegrated long-run money demand function for German M3 over the sample period 1975 to 1994 with stationary money demand shocks. The standard deviation of their first differences is 4.6 percent, compared with a standard deviation of 3.5 percent for the year-on-year growth rate of money. Similarly, Baba, Hendry, and Starr (1992) find a stable long-run money demand function for US M1 for the sample period 1960 to 1988 and likewise see Hendry and Ericsson (1991b) for UK M1 over the sample 1963 to 1989.[40] Hence we believe that the empirical model (22) is a valid approximation for empirically estimating our modified theoretical Taylor rule (21).

We first report our findings for Germany, which are summarized in table 6.4. The estimates are based on the real-time data set described in Gerberding, Seitz, and Worms (2004). In order to compare the conduct of monetary policy in Germany before and after the collapse of Bretton Woods, the data set was extended backwards to 1965 so that it now covers the sample period 1965 to 1998.[41] As formal tests for structural break do not yield unambiguous

39. See Gerberding, Seitz, and Worms (2005, 279).

40. Using annual data Hendry and Ericsson (1991a) find a stable long-run money demand function for US M1 over the sample period 1878 to 1970.

41. The first vintage of Bundesbank estimates of potential output that we were able to reconstruct dates from April 1972 (Bundesbank, AR 1971). In order to go back beyond this date, we proxied the unavailable "true" real-time data by the estimates dating from April 1972. We think this justifiable since there are no indications of major revisions during the time span 1965 to 1972. For instance, the estimates of the German output gap in the 1960s published by the Organization for Economic Cooperation and Development (OECD) in April 1970 (see OECD 1970) are very similar to the estimates that we reconstructed from the April 1972 vintages of Bundesbank data on actual and potential output.

Table 6.4 Estimates of the extended reaction function, inflation forward-looking (from *t* to *t* + 4), change in output gap from *t* – 4 to *t*, real-time data

Estimation equation

$$i_t = (1 - \rho_1 - \rho_2)\left(\begin{array}{c}\alpha + \beta E(\pi^a_{t+4}|\Omega_t) + \gamma_1 E((y_t - y^*_t)|\Omega_t) \\ + \gamma_2 E(\Delta_4(y_t - y^*_t)|\Omega_t\end{array}\right) + \rho_1 i_{t-1} + \rho_2 i_{t-2} + u_t$$

	β	γ1	γ2	ρ1	ρ2	$\bar{R}^2$	SEE	*J*-stat (*p*-values)
				Germany's "great" inflation				
1965:Q1–1973:Q1	0.52***	0.44***	—	0.72***	–0.12*	0.71	1.09	0.64
	(0.09)	(0.08)		(0.07)	(0.06)			
1965:Q1–1974:Q4	0.69***	0.51***	—	0.72***	–0.17*	0.76	1.41	0.55
	(0.15)	(0.13)		(0.12)	(0.09)			
1965:Q1–1978:Q4	1.05***	0.52***	—	0.62***	–0.04	0.81	1.21	0.79
	(0.24)	(0.07)		(0.14)	(0.11)			
				Post-Bretton Woods/monetary targeting				
1973:Q2–1998:Q4	0.82***	0.58**	1.39**	1.02***	–0.09	0.92	0.81	0.63
	(0.30)	(0.25)	(0.66)	(0.05)	(0.06)			
1975:Q1–1998:Q4	1.70***	0.06	0.75***	1.05***	–0.21***	0.92	0.69	0.59
	(0.22)	(0.13)	(0.23)	(0.06)	(0.05)			
1979:Q1–1998:Q4	1.89***	0.05	0.74***	0.98***	–0.17***	0.94	0.64	0.89
	(0.19)	(0.10)	(0.24)	(0.07)	(0.05)			

Notes: Estimation method: generalized method of moments (GMM); heteroskedasticity and autocorrelation-consistent (HAC)-robust standard errors in parentheses. R^2: adjusted coefficient of determination. SEE: standard error of the regression. *J*-stat: *p*-value of the *J*-statistic on the validity of overidentifying restrictions. Left-hand side variable: three-month money market rate (end of quarter). Right-hand side variables: inflation gap according to CPI; output gap with Bundesbank's own estimates of production potential. For further details on the data see Gerberding, Seitz, and Worms (2004). The instrument set includes contemporary values of the inflation variable (CPI over previous year in percent) and a commodity price variable (change of Hamburg Archive of World Economics [HWWA] index of commodity prices in DM over previous quarter in percent), as well as up to three lags of each explanatory variable, the commodity price variable, and a money growth variable (change in the Bundesbank's respective monetary target variable over previous year in percent). Pretesting suggests that this instrument structure is sufficient.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

results, we present estimates for three different break points, with the Bretton Woods/premonetary targeting samples ending in 1973:Q1, 1974:Q4, and 1978:Q4, respectively. In table 6.4, we only report results for a forward-looking specification of the reaction function where the horizon of the inflation forecast variable has been set to four quarters. However, in order to check the robustness of the results to changes in the horizon of the inflation variable, we conducted the exercise for different horizons of the inflation forecast, reaching from $n = 0$ to $n = 4$, and found that the results were qualitatively the same.[42] Our estimations also established that the term $(\Delta_4\varepsilon^{md}_t - \Delta_4\varepsilon^{v}_t{}^*)$ does

42. Results available from authors on request.

not play a major econometric role. In theory, this term is unobservable. Point estimates and standard errors of regressors in model (22) remain virtually unaffected whether an empirical proxy of that term is included or not. However, as part of a money demand shock this error variable has interesting policy implications, which we will discuss further below (see table 6.6).

The analysis yields a number of interesting results. First, we find that the coefficient β, which captures the interest rate response to inflation, is significantly below one before the introduction of monetary targeting (i.e., for the sample periods 1965:Q1 to 1973:Q1 and 1965:Q1 to 1974:Q4, respectively), but significantly above one afterwards (i.e., for the samples starting in 1975:Q1 and later). Note, however, that the standard error of the inflation coefficient and of the equation is lowest for the (arguably more stable) 1979 to 1998 period. From this, we conclude that the Bundesbank respected the Taylor principle (responded to a rise in expected inflation in a stabilizing way) right from the beginning of the monetary targeting regime. This contrasts with empirical estimates of standard Taylor rules for the United States over the 1970s. Second, the response to the perceived output gap, γ_1, is significantly positive, with point estimates about 0.5 in the Bretton Woods/premonetary targeting subsamples. By contrast, it is close to zero and insignificant under monetary targeting. If one follows Orphanides (2003), the lack of response to real-time estimates of the output gap, which at the time were heavily biased downwards in most countries, may also have been an important reason for Germany's superior inflation performance after the regime shift. Third, the coefficient on the output growth gap, which is insignificant before the introduction of monetary targeting, becomes highly significant afterwards. According to our theoretical model, this is an important feature that distinguishes the Bundesbank's policy under monetary targeting from a purely discretionary approach. Hence, we interpret this result as evidence that the money growth targets did bring the Bundesbank policy closer to the (otherwise not feasible) optimal commitment solution. Fourth, we find a significant degree of interest rate inertia, captured by ρ, in all subsample periods, with point estimates of about 0.6 before and about 0.8 after the regime change. The high degree of inertia after the regime shift is in accordance with the predictions of the theoretical model as well as with the Bundesbank's often professed preference for conducting policy with a steady hand ("Politik der ruhigen Hand").[43]

Table 6.5 present the results for a very similar formulation for the United States. We use the three months' Treasury Bill (T-Bill) rate as a short-term interest rate. Regarding the explanatory variables, inflation is again measured by year-on-year changes in CPI. For the output gap, $(y_t - y_t^*)$, we use the real-time perceptions of the US output gap reconstructed by Orphanides (2003). We report results for annual changes in the output gap as well as for

43. In Gerberding, Seitz, and Worms (2007), we show that for the sample period 1979:Q1 to 1998:Q4, this result is robust to the inclusion of an AR(1) model for the error term.

Table 6.5 **The United States: Estimates of the extended reaction function, inflation forward-looking *y-o-y* (from $t-3$ to $t+1$). *A*, using real-time inflation forecast; *B*, using realized data.**

	β	γ1	γ2	ρ1	Const.	$\bar{R}^2$	SEE	*J*-stat (11dof) (*p*-values)
				A. Estimation equation				
	$i_t = (1-\rho_1)(\alpha + \beta E_t(\pi^a_{t+1}\mid\Omega_t) + \gamma_1 E_t((y_t - y^*_t)\mid\Omega_t) + \gamma_2 E_t(\Delta_j(y_t - y^*_t)\mid\Omega_t)) + \rho_1 i_{t-1} + u_t$							
1970:Q1–1979:Q2	1.100***	0.367***	*0.064*	0.592***	0.009**	0.86	0.006	0.11*34
$j=1$	(0.114)	(0.072)	*(0.053)*	(0.098)	(0.003)			(>10%)
1970:Q1–1979:Q2	1.023***	0.390***	*–0.013*	0.545***	0.012***	0.87	0.006	0.15*34
$j=4$	(0.128)	(0.098)	*(0.026)*	(0.109)	(0.004)			(>10%)
1983:Q1–1998:Q4	3.499***	0.926***	*0.512****	0.912***	–0.004**	0.93	0.004	0.15*60
$j=1$	(1.150)	(0.418)	*(0.183)*	(0.028)	(0.002)			(>10%)
1983:Q1–1998:Q4	2.721***	0.458***	*0.122****	0.89***	–0.003	0.96	0.003	0.17*60
$j=4$	(0.609)	(0.161)	*(0.035)*	(0.029)	(0.002)			(>10%)
				B. Estimation equation				
	$i_t = (1-\rho_1)(\alpha + \beta E_t(\pi^a_{t+1}\mid\Omega_t) + \gamma_1 E_t((y_t - y^*_t)\mid\Omega_t) + \gamma_2 E_t(\Delta_j(y_t - y^*_t)\mid\Omega_t)) + \rho_1 i_{t-1} + u_t$							
1970:Q1–1979:Q2	0.619***	0.195***	*0.095*	0.458***	0.018***	0.87	0.006	0.22*34
$j=1$	(0.030)	(0.040)	*(0.059)*	(0.064)	(0.001)			(>10%)
1970:Q1–1979:Q2	0.591***	0.206**	*0.014*	0.493***	0.018***	0.86	0.006	0.22*34
$j=4$	(0.033)	(0.084)	*(0.028)*	(0.108)	(0.002)			(>10%)
1983:Q1–1998:Q4	2.73*	1.406	*0.419****	0.960***	–0.002*	0.94	0.004	0.15*60
$j=1$	(1.506)	(1.035)	*(0.076)*	(0.025)	(0.001)			(>10%)
1983:Q1–1998:Q4	2.040***	0.475**	*0.149****	0.89***	–0.002	0.96	0.003	0.17*60
$j=4$	(0.540)	(0.221)	*(0.027)*	(0.029)	(0.002)			(>10%)

Notes: Estimation method: GMM; HAC-robust standard errors in parentheses. R^2: adjusted coefficient of determination. SEE: standard error of the regression. *J*-stat: *p*-value of the *J*-statistic on the validity of overidentifying restrictions. Left-hand side variable: 3-month T-Bill rate. Right-hand side variables: Green Book inflation forecasts (*y-o-y* CPI); output gap; and *y-o-y* changes in the output gap. For further details on the output gap data see Orphanides (2003, 996). The instrument set includes up to 3 lags of i, π, $(x - x^*)$. Extending the set of instruments by including changes of commodity prices as well as three lags of nominal money growth M2 (*y-o-y*) does not change the results qualitatively.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

its quarterly changes. Notice that for the United States we normalize the inflation target π^* at zero. For the forward-looking element, we use inflation expectations one period ahead that are formed at period t. In panel A of table 6.5, we use real-time inflation forecasts based on Green Book data (as in Orphanides 2003, 2004), whereas in panel B we use the lead of revised inflation data. For interest-rate smoothing we restricted ourselves to reporting the case of one lag only.[44]

For analyzing the United States we follow the strategy that is common in the empirical literature and estimate over samples that correspond to the chairmanships of Burns–Miller and Volcker–Greenspan. Using quarterly data, we consider the period 1970:Q1 to 1979:Q2 "the Burns-Miller period" and the period 1983:Q1 to 1998:Q4 "the Volcker-Greenspan period". The omitted interim period is characterized by transitional dynamics and does not yield useful estimates.

We are able to reproduce a number of well-known findings. First, for real-time inflation forecast data (see panel A) we can replicate Orphanides's (2003) findings with a Taylor coefficient greater than unity also in the Burns-Miller period, whereas for revised inflation data (panel B) the Taylor coefficient on inflation is significantly below unity in the Burns-Miller period and significantly above one in the Volcker-Greenspan period. Second, the coefficient on the lagged interest rate is much larger in the latter period (becoming close to one). Third, and focusing on formulation with the annual measure of the change in the output gap, the coefficient on the output gap is always significant, at the 5 percent level, except for the Volcker–Greenspan period in case of quarterly changes of the output gap (see panel B, third row). Regarding the history dependence of monetary policy, we find significant differences between the United States and Germany. For the United States the coefficients for both quarterly or annual changes in the output gap are insignificant during the 1970s. Conversely, it is highly significant during the 1980s and 1990s whereas for Germany it is significant throughout the entire post-Bretton Woods sample period. The comparison of the models for Germany and the United States between table 6.4 and table 6.5 therefore suggests that the conduct of monetary policy in the United States and Germany differed during the 1970s, but after 1983, US monetary policy approached the practice that the Bundesbank followed since 1975.

Turning to the case of the United Kingdom, already from eyeballing figures 6.1 through 6.3 one would expect, with respect to Germany but to a lesser extent also to the United States, very different empirical results for any estimated Taylor rule. Compared to the United States and Germany, inflation in the United Kingdom peaked highest and interest rates during the 1970s were at a much higher level, whereas growth performance was

44. We also estimated the models with two lags and got very similar quantitative and the same qualitative results compared to the one lag-only specification.

comparatively much weaker than in the United States or Germany. In order to explain the United Kingdom three-month T-bill rate, we use the real-time perceptions of the UK output gap reconstructed by Nelson and Nikolov (2003). For future inflation we use revised data, analogue to table 6.5, panel B, for the United States. The results in table 6.6 confirm our priors. Interest rates in the 1970s appear to follow a near-unit root process. Neither output nor inflation gap are remotely significant. This changes only later in the 1980s and 1990s, when the output gap remains insignificant but the Taylor coefficient on inflation is estimated rather tightly at 1.5.

6.5.3 The Role of Money Demand Shocks

As pointed out in the previous subsection, dealing with the term $(\Delta_4\varepsilon_t^{md} - \Delta_4\varepsilon_t^{v}*)$ has interesting policy implications. The term represents those (exogenous) changes in money demand that are not identified and accounted for by the central bank. Ignoring this term in the empirical model implies an assumption that the central bank—in our case the Bundesbank—did not make systematic mistakes in identifying shocks to money demand. Under this assumption, the variable $(\Delta_4\varepsilon_t^{md} - \Delta_4\varepsilon_t^{v}*)$ will be a white noise (or at least stationary) process that can be subsumed as, say, $\tilde{u}_t$, into the error term of equation (22). However, we are aware that our framework also has testable implications for the Bundesbank's response to unidentified disturbances to money demand.[45] Specifically, we would expect to find that policy was tightened in response to an increase in this variable and vice versa. Unfortunately, since we do not have reliable information on the magnitude of the portfolio shocks observed by the Bundesbank, in real time, $\varepsilon_t^{v}*$, we cannot test this hypothesis directly. However, as a robustness check, we conducted an alternative test that is based on the assumption that the Bundesbank was able to identify a fraction δ of the "true" money demand shock so that $\varepsilon_t^{v}* = \delta\varepsilon_t^{md}$ holds. Under this assumption, we can rewrite equation (22) as:

$$(22a)\quad i_t = (1-\rho_1-\rho_2)\begin{pmatrix}\alpha + \beta E((\pi^a_{t+n} - \pi^*)|\Omega_t) + \gamma_1 E((y_t - y_t^*)|\Omega_t) \\ + \gamma_2 E(\Delta_4(y_t - y_t^*)|\Omega_t) + \dfrac{\gamma_2}{\eta_y}(1-\delta)\Delta_4\varepsilon_t^{md}\end{pmatrix} + \rho_1 i_{t-1} + \rho_2 i_{t-2} + u_t,$$

where δ denotes the fraction of the true money demand shock that the Bundesbank was able to identify. In the special case when $\delta = 1$, the Bundesbank could identify all shocks as portfolio shocks, whereas if $\delta = 0$ the shock to money demand remained unreduced. Using the residuals from the money demand model of Beyer (1998) to estimate equation (22a), we find that the coefficient δ is highly significant, with a point estimate of

45. We thank our discussant, Benjamin Friedman, for bringing this important point to our attention.

Table 6.6 The United Kingdom: Estimates of the extended reaction function, inflation forward-looking *y-o-y* (from $t-3$ to $t+1$)

Estimation equation

$$i_t = (1-\rho_1)(\alpha + \beta E_t(\pi^a_{t+1}|\Omega_t) + \gamma_1 E_t((y_t - y^*_t)|\Omega_t) + \gamma_2 E_t(\Delta_j(y_t - y^*_t)|\Omega_t)) + \rho_1 i_{t-1} + u_t$$

	β	γ1	γ2	ρ1	Const.	$\bar{R}^2$	SEE	*J*-stat (11dof) (*p*-values)
1970:Q1–1979:Q2	–0.10	0.007	*0.02*	0.869***	0.015***	0.73	0.015	0.24*35
$j=1$	(0.463)	(0.34)	*(0.05)*	(0.10)	(0.005)			(>10%)
1970:Q1–1979:Q2	0.058	–0.02	*0.07*	0.827***	0.016**	0.74	0.014	0.23*35
$j=4$	(0.33)	(0.37)	*(0.083)*	(0.081)	(0.006)			(>10%)
1983:Q1–1996:Q1	1.531***	–0.32	*–0.09*	0.70***	0.002	0.92	0.0078	0.16*53
$j=1$	(0.14)	(0.28)	*(0.095)*	(0.071)	(0.002)			(>10%)
1983:Q1–1996:Q1	1.526***	–0.20	*–0.02*	0.72***	0.004	0.92	0.0079	0.16*53
$j=4$	(0.156)	(0.299)	*(0.081)*	(0.069)	(0.003)			(>10%)

Notes: Estimation method: GMM; HAC-robust standard errors in parentheses. R^2: adjusted coefficient of determination. SEE: standard error of the regression. *J*-stat: *p*-value of the *J*-statistic on the validity of overidentifying restrictions. Left-hand side variable: 3-month T-Bill rate. Right-hand side variables: inflation (*y-o-y* CPI); output gap; and *y-o-y* changes in the output gap. For further details on the output gap data see Nelson and Nikolov (2003). The instrument set includes up to 3 lags of i, π, $(x - x^*)$, and changes of commodity prices as well as three lags of nominal money growth "money + quasi-money" (*y-o-y*).

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

0.77.[46] On the other hand, the fact that our estimate of δ is also significantly different from one suggests that the Bundesbank did react to shocks to money demand, which it was unable to identify in real time. Specifically, when money growth increased as a consequence of a nonidentified disturbance to money demand, the Bundesbank would tighten policy, in contrast with what would be the case under perfect information. This empirical finding is in line with the testable implication from the theoretical model presented in the previous section. Nevertheless, the relatively high value of δ suggests that the Bundesbank was able to identify most money demand disturbances in real time. Hence, it responded to such shocks in a much more muted way, thereby limiting the volatility of policy rates.

6.5.4 Summary

To sum up, the empirical results for Germany, the United States, and the United Kingdom suggest that monetary policy in the three countries was conducted very differently in the 1970s. For Germany and the United States, estimating a Taylor rule for that period produces reasonable results but reveals different policy strategies. Money as a commitment device has worked well for Germany and is reflected by a significant coefficient in changes of the output gap variable. For the United States we do not find any similar history dependence in the data for the 1970s, but we do find it for the Volcker–Greenspan period in the 1980s and 1990s. By sharp contrast, monetary policy in the United Kingdom has been very different both with respect to the United States and Germany. Our empirical findings do not allow for any Taylor-type characterization of UK monetary policy in the 1970s and only very vaguely for the 1980s and 1990s.

6.6 Conclusion

In this chapter we examine an important episode in European monetary history. We investigate the conduct of monetary policy in Germany in the 1970s and the 1980s. It was during this period that the Bundesbank acquired its credibility and reputation as a bulwark against inflation. Our goal was to illustrate how the monetary growth targeting strategy, followed by the Bundesbank since 1975, contributed to this success. We wanted, as much as possible, to examine the strategy as conceived, communicated, and refined by the Bundesbank itself. Naturally we are not able to do full justice to the Bundesbank's approach. We can only present a simplified (stylized) view of the conduct of monetary policy in that period.

Nevertheless, we think that by focusing on anchoring inflation and inflation expectations, we capture a fundamental aspect of the interaction between monetary policy and the behavior of economic agents. Using a

46. Results available from Andreas Beyer on request.

standard New Keynesian model and a modified loss function (incorporating money growth deviations) we are able to explain the role of money growth targeting as a commitment device. Under some mild conditions regarding the existence of a stable money demand function that are fulfilled (at least for Germany) for the time period under consideration, we are able to derive a role for money as a commitment device that succeeds even in the context of the New Keynesian model (in which money plays no active role).

The operation of monetary growth targeting as a commitment device is compatible with target misses, even repeatedly. In the modified loss function framework monetary growth targeting is permanently relevant and imposes structure on the monetary policy reaction function. Nevertheless, given that monetary deviations from target have to be traded off against other arguments in the loss function, frequent deviations from target cannot be excluded. In practice, the Bundesbank had to account for the determinants of observed deviations and explain how, in the end, it would deliver on the final goal of price level stability.

A standard objection to monetary targeting is that it induces unwarranted volatility in policy rates in response to unidentified disturbances to money demand. In the context of our theoretical model, it is the case that the central bank will tighten in response to nonobserved positive shocks to money demand. Empirically, we find this holds true for the Bundesbank. Nevertheless, empirical evidence shows that money demand was stable in Germany during the period. Moreover, the Bundesbank appears to have been able to take into account most special factors in real time. Hence, the response of policy to money demand disturbances was much attenuated, limiting the relevance of this concern for the historical performance of the Bundesbank.

Issing in his Stone Lecture (Issing et al. 2005, 50ff.) affirms:

> The Bundesbank missed its target roughly half of the time. . . . This does not mean, however, that the Bundesbank did not take monetary targets seriously. On the contrary, money growth targets were regarded as constituting the basis for a rules-oriented approach to monetary policy. Announcing a monetary target implied a commitment by the Bundesbank towards the public. Deviations of money growth from the target had always to be justified. Even if it is true that the reputation of the Bundesbank ultimately was achieved by its success in fulfilling its mandate to safeguard the stability of its currency, its final goal, current policy continuously had to be justified in the context of its pre-announced strategy. In this sense, the strategy contributed to the transparency, the accountability and the credibility of Bundesbank's policy.

From our theoretical framework we derive an interest rate rule. Using real-time data, we find that it closely approximates the monetary policy, as it was conducted by the Bundesbank, in the period of 1975 to 1998. The main finding is that the Bundesbank response to the output growth gap was highly significant. Such a response is a characteristic of the conduct of monetary policy under commitment. It is also robust policy against problems in the measurement of the level of potential output in real time. A similar response to the growth gap was not present in the reaction function of the Federal Reserve System during the Burns-Miller period. It does become significant, for the United States, in the later Volcker-Greenspan period. We were able to characterize systematic monetary policy for Germany and the United States. Our empirical findings suggest a much less stable approach in the United Kingdom.

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Comment Benjamin M. Friedman

In 2003, Milton Friedman famously concluded, "The use of quantity of money as a target has not been a success."[1] The object of this chapter by Beyer, Gaspar, Gerberding, and Issing is to present a counterexample to Friedman's proposition. The specific example the authors suggest is German monetary policy during the 1970s and 1980s. As the title suggests, the chapter reminds us that Germany, more so than most other countries (and certainly more so than the United States), avoided what became the high and chronic price inflation of those years. The chapter's central argument, which the authors advance through a combination of historical narrative, formal analysis, and empirical evidence, is that the key to Germany's suc-

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1. *Financial Times,* June 7, 2003, 12.