Economic Structure and Monetary Policy Design

Carl E. Walsh*

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Abstract

In this paper, I consider the lessons recent academic research and historical experiences with monetary targeting and inflation targeting offer for the design of monetary policy regimes. The practical experiences with both monetary and inflation targeting suggest that successful policies have incorporated a great deal of flexibility. In principle, both monetary targeting and inflation targeting can ensure the economy has a nominal anchor and be implemented in a transparent manner that promotes accountability. However, a policy that focuses on a goal, such as inflation, is less sensitive to structural change and instability in the economy than is an intermediate targeting procedure such as monetary targeting. However, inflation targeting should not be interpreted as a commitment to an instrument rule such as a Taylor rule. Such rules suffer from the same sensitivity to structural change that intermediate targeting rules do. And, to date, inflation targeting central banks have been transparent with respect to only one of their policy objectives.

1. Introduction

Over the last dozen years, central banks in countries as distinct as New Zealand, the United Kingdom, Sweden, Brazil, the Czech Republic, Korea, and Israel have adopted inflation targeting as a framework for formulating and implementing monetary policy. Mishkin and Schmidt-Hebbel (2001) identify 19 countries that now practice some form of inflation targeting. Inflation targeters differ significantly in their openness, their level of development, and their industrial composition, yet each of them has decided to implement monetary policy by targeting inflation. This is perhaps surprising; because their economies differ in so many ways, one might expect that their policy frameworks would also differ. The wide-spread adoption of inflation targeting is a departure from

* Professor of Economics, University of California, Santa Cruz (walshc@cats.ucsc.edu) and Visiting Scholar, Federal Reserve Bank of San Francisco. Any opinions expressed are those of the author and not those of the Federal Reserve Bank of San Francisco or the Federal Reserve System. I would like to thank Chinhee Hahn and other participants at the EWC/KDI conference for helpful comments and Wei Chen, Ryoto Kojima, and Ethel Wang for research assistance.

past practice, in which no one single monetary policy framework was as widely used. Perhaps this simply reflects a greater willingness on the part of central banks to attach a formal name to their monetary policy procedures. In the past, central banks were often ambiguous about their goals, and even their operating procedures. Today, central banks are increasingly willing to be explicit about the primacy of price stability among their policy goals, and this is reflected in the adoption of inflation targeting.

Korean jointed the ranks of inflation targeters in the aftermath of its 1997 financial crisis. Price stability was established as the primary goal of monetary policy by the Bank of Koran Act, which came into effect in April 1998. The Bank of Korea now officially announces a target inflation rate, defined in terms of core CPI, and it adjusts short-term interest rates to achieve this target. Inflation, which peaked above 7% in 1998, fell briefly below zero in 1999 before rising gradually during 2000 and 2001. The Bank of Korea has set a 2.5% medium-term inflation target for 2002 (see Cho 2002).

In this paper, I examine some issues related to the choice of a monetary policy framework and the implementation of inflation targeting. I begin in section 2 with a brief review of three issues relevant to an evaluation of monetary policy design. First, I discuss changes to the institutional structure of central banks. Second, I discuss a class of theoretical models that has played a prominent role in the recent analysis of monetary policy. These models have some very specific implications for how the structure of the economy -- the monetary transmission mechanism -- should affect the objectives of monetary policy. Third, I review the terminology of policy design. Then, in section 3, I turn to an overview of the historical experiences with monetary targeting, contrasting the unsuccessful case of the United States with the more successful experiences of Germany and Switzerland. This review serves to highlight the characteristics shared by successful monetary targeting and inflation targeting regimes. Section 4 reviews the adoption of inflation targeting by many central banks, while section 5 considers a number of issues that arise in implementing inflation targeting. I also review some criticisms of

inflation targeting and discuss some alternative policy regimes. The final section draws some lessons for monetary policy design.

2. Institutional structure and policy objectives

There is a long tradition of treating the institutional structure of the central bank and its policy goals as simply given. It is also common to assume central banks follow exogenous rules. The major changes in central banking institutions over the past dozen years, and the debates over the proper goals of monetary policy, have altered the way we now approach issues of monetary policy design. The more modern approach is to recognize that central banks are best viewed as making rational decisions, given their objectives and the constraints they face. These constraints include the structure of the economy, but they also include aspects of the institutional structure within which policy decisions are made. In this section, I discuss three issues that are important for understanding policy outcomes -- the recent institutional reforms of central banks, the lessons from recent theoretical models for the objectives of monetary policy, and the respective roles of goals, targets, and instruments in policy design.

Institutional structure

One of the most significant of recent structural changes is the increasing prevalence of central bank independence. Countries with widely differing economies and backgrounds have reformed their central banking institutions to grant them greater independence in the conduct of monetary policy. These changes have been driven by the acceptance that political influence over monetary policy leads to excessive inflation while failing to produce more stable real economic activity. The early empirical work by Bade and Parkin (1984) was followed by an extensive literature documenting the negative correlation between average inflation and various measures of central bank independence among developed economies (see Cukierman 1992).

This empirical work generally failed to find much relationship between inflation and central bank independence among developing economies. In part, this absence may reflect a failure of the constructed indices to fully capture the actual relationships between central banks and governments in developing economies. For that reason, Cukierman (1992) used measures of central banker turnover as a proxy for political interference in monetary policy and found that higher turnover was associated with higher average inflation.

Despite doubts over the causal link between central bank independence and low inflation (Posen 1993), independence is seen today as one of the key components of "best practices" in central banking. However, independence is multidimensional. And while there seems to be wide agreement that central banks should have instrument independence -- the independence to conduct policy to achieve stated goals -- there is less agreement over the desirability of goal independence -- the ability of the central bank itself to define its operational goals. In general, the trend in recent central bank reforms has been to establish clearly defined goals for monetary policy as part of the reform process, but to leave the central bank with flexibility in translating these into operational goals. For example, beginning with the Reserve Bank of New Zealand Act of 1989, a series of legislative reforms have made price stability either the primary or the sole objective of monetary policy, but there has been more variation in the institutional mechanism for determining how this goal is translated into an operational objective that can guide policy. In the case of New Zealand, the Policy Targets Agreement (PTA) between the government and the Reserve Bank Governor is a formal document that establishes numerical targets ranges for inflation. The Reserve Bank, however, has discretion in choosing the price index used to calculate the inflation rate. In the EU, the ECB is assigned the goal of price stability but has great freedom in translating this into an operational goal. In the U.K., the government sets the inflation target; the Bank of England is responsible for achieving it. In the U.S., the Congress defines the broad goals of monetary policy but it is left to the Fed to translate these into operational goals.

While the details of institutional reform have varied across countries, the general thrust of the reforms has been to promote three broad objectives. First, the policy framework must ensure the economy has a nominal anchor. Although monetary theory shows that multiple equilibrium price paths are feasible even with a fixed nominal money supply, and that fiscal policy may be necessary to determine the price level, I take it as widely accepted that, from a practice standpoint, it is the responsibility of the central bank to provide a nominal anchor, thereby ensuring a determinate equilibrium price level. While most developed economies were able to reduce inflation during the 1980s, and maintain low inflation through the 1990s, inflation has remained a serious problem in many developing economies. Figure 1 suggests that there remains significant scope for improved inflation performance among these economies.

Second, the policy framework should be transparent. Transparency reflects the ease and clarity with which the public is able to assess the central bank's policy objectives. Finally, the policy framework should contain mechanisms to promote accountability. These last two characteristics are related, as a policy that is not transparent is also unlikely to contain adequate measures for accountability.

The reforms in New Zealand provide a good example of a reform that aimed to promote all three characteristics of policy. The central bank was formally assigned responsibility for ensuring a nominal anchor by making price stability its sole task. Transparency was promoted through the public announcement of the inflation target contained in the PTA, and accountability was ensured by requiring the Reserve Bank Governor to explain any breech of the inflation target and ultimately by giving the Minister of Finance the power to fire the Governor if the PTA is violated.[1]

[1] See Walsh (1995b) for an analysis of New Zealand's Reserve Bank Act. Svensson (2001b) provides an assessment of the reforms in New Zealand and there effect on monetary policy as part of an independent review commissioned by the Minister of Finance.

Reforms in other countries have often not been as clear in promoting all three aspects. All, however, have emphasized the importance of a nominal anchor by making price stability the key objective of monetary policy.

Economists have long recognized the need for a nominal anchor. Transparency and accountability have emerged as important properties only in recent years. Their emergence reflects the increased focus on expectations and credibility and the lessons learned from the literature on time-inconsistency (Barro and Gordon 1983). This literature stressed the role a lack of credibility and the inability to commit played in leading to high inflation. Reforms designed to limit the role of elected government officials in the day-to-day conduct of monetary policy was seen as a means of giving greater credibility to policies to achieve and maintain low rates of inflation. Greater credibility, by influencing private sector expectations about inflation, would improve the short-run trade-off between output and inflation that the central banker faced.

The central bank reforms of the 1990s have been among the most important structural changes affecting monetary policy. In the discussion that follows, I will assume that policy is conducted by a central bank with instrument independence. The broader issue of goal independence, and the need for accountability, will play a role in evaluating both monetary and inflation targeting regimes.

Policy objectives

The traditional literature in monetary economics has followed two quite distinct approaches when it comes to defining the objectives of policy. The first traces its roots back to Ramsey (1928); the second, somewhat ad hoc approach, has less clearly defined roots but has dominated the academic monetary policy literature over the past forty years. In the Ramsey approach, the policy maker is assumed to maximize the utility of the representative agent, subject to the technological and resource constraints of the economy, and to the constraint that allocations be consistent with the optimizing behavior by private agents. The ad hoc approach specifies an objective function for

the policy maker exogenously. The policy maker then maximizes this objective subject to the constraints imposed by the economic structure and by private sector behavior. In the area of monetary policy, this second approach is typified by the enormous literature in the Barro and Gordon (1983) tradition in which the objective function is quadratic in inflation and output.

In the last few years, these two approaches have merged in the sense that the Ramsey approach has been incorporated into models with nominal rigidities, models that are much closer to the types of models employed in actual policy analysis, and, in turn, it has been demonstrated that the quadratic loss function in the Barro-Gordon tradition can be viewed, under certain conditions, as an approximation to the utility of the representative agent. These developments have given us a much clearer understanding of how economic structure is tied to policy objectives.

In particular, the recent literature has clarified how the sources of nominal rigidity that lead monetary policy to have important real effects are also critical for determining optimal policy objectives. In fact, in what is becoming a standard model for policy analysis, there is a clear-cut recommendation to central banks -- stabilize the price level (King and Wolman 1999, King and Goodfriend 2001). Because this conclusion accords with the focus on price stability in central bank reforms and with the popularity of inflation targeting, it is worth examining the assumptions on which it is based.

The desirability of price stability is an implication of new Keynesian models that combine optimizing behavior by households and firms with the assumption of price stickiness (see Rotemberg and Woodford 1997, Woodford 1999a, Clarida, Galí, and Gertler 1999, McCallum and Nelson 1999). In these models, households derive utility from the consumption of a composite consumption good consisting of differentiated goods, produced by individual firms. The individual goods are imperfect substitutes, so the goods market is characterized by monopolistic competition. Goods prices are assumed to be sticky. The most common modeling strategy is to assume there is an exogenous probability each period that an individual firm is

allowed to adjust its price. When a firm can adjust, it sets its price optimally. If 1-ω firms adjust each period, the aggregate price level will be a weighted average of the price set by the firms able to adjust and the average price level in the previous period, with weights 1-ω and ω. This form of price stickiness is due to Calvo (1983).

If we assume a steady-state inflation rate of zero, this simple model of nominal rigidity implies that the aggregate inflation rate evolves according to

$$\pi_t = \beta E_t \pi_{t+1} + \kappa mc_t, \tag{1}$$

where mc_t is the percent deviation of real marginal cost around its steady-state value. The parameter κ, giving the elasticity of inflation with respect to real marginal cost, is equal to

$$\kappa = \left[\frac{(1-\omega)(1-\omega\beta)}{\omega} \right],$$

where β is the discount rate between zero and one. The parameter ω measures the degree of nominal rigidity. If fewer firms adjust each period (i.e., ω increases and there is greater nominal rigidity), κ falls; current conditions are less important in price setting.

Because most monetary policy discussions are framed in terms of inflation and output, it is useful to related the marginal cost variable in equation (1) to an output gap variable. When nominal wages are flexible, real marginal cost is proportional to the gap between output and the output that would arise in the absence of nominal price stickiness. Denote this gap by x_t, and assume the utility function of the representative household is $C^{1-\sigma}/(1-\sigma) + N^{1+\eta}/(1+\eta),$ where C is the composite consumption good and N is labor supply. Then, if the aggregate production function is $Y_t = Z_t N_t,$ where Z_t is a productivity disturbance, it can be shown that

$$mc_t = (\sigma + \eta) x_t. \tag{2}$$

Substituting this into the inflation adjustment equation yields

$$\pi_t = \beta E_t \pi_{t+1} + \tilde{\kappa} x_t, \tag{3}$$

where $\tilde{\kappa} = \kappa(\sigma + \eta)$. Solving this forward,

$$\pi_t = \tilde{\kappa} \sum_{i=0}^{\infty} \beta^i E_t x_{t+i}.$$

As noted by Bernanke and Woodford (1997) among others, this equation implies there is no conflict between output stabilization and inflation stabilization. If the central bank ensures that $E_t x_{t+i} = 0$ for all i, then $\pi_t = 0$.

By itself, this demonstration does not imply it will be optimal to keep both x_t and π_t equal to zero. However, Woodford (1999b) has shown that within the model used to derive (1), the expected present value of the utility of the representative household can be approximated by

$$-\Omega E_t \sum_{i=0}^{\infty} \beta^i \left[\pi_{t+i}^2 + \lambda \left(x_{t+i} - x^* \right)^2 \right]. \tag{4}$$

In equation (4), x^* is the gap between steady-state output and the steady-state efficient level of output (in the absence of the monopolistic distortions). The parameters Ω and λ are functions of the underlying structural parameters of the model; Ω is simply a scale factor, but λ is a critical parameter for the design of policy since it governs the central bank's marginal rate of substitution between inflation and output stabilization. It can be shown (see Woodford 1999b) that $\lambda = \tilde{\kappa} / \theta,$, where the new parameter θ is the price elasticity of demand faced by individual firms.[2]

It has become standard in the literature to assume $x^* = 0$, thereby ensuring the central bank does not face a traditional Barro-Gordon incentive that would lead to positive average inflation. One argument is that fiscal taxes and subsidies can be used to eliminate the real distortion created by monopolistic competition, thereby ensuring $x^* = 0$.[3]

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[2] One advantage of deriving the central bank's loss function in this way is that the relative weight on the two objectives can be calibrated based on the underlying model of households and firms. For example, if on average prices are set for two quarters (ω=0.5), the discount factor is $0.96^{.25}$, σ = η = 1, and the average markup is 10%, then λ=0.01, while with an average markup of 20%, λ=0.02.

[3] Dixit and Lambertini (2002) show that the optimal policy for the fiscal authority is to set $x^* = 0$.

In this case, a central bank that wants to maximize the welfare of the representative agent should design policy to keep the output gap and inflation equal to zero simultaneously. Such a policy maximizes (4), the welfare of the representative agent, and satisfies the inflation adjustment equation (3) in a rational expectations equilibrium. Price stability is optimal.

The intuition for this result is straightforward, and is due to the inefficiencies that arise from relative price dispersion when households consume a basket of differentiated goods. Inflation causes relative price dispersion, because not all prices are adjusted each period. When average inflation is positive, prices that have remained fixed for several periods will be low relative to more recently set prices. Relative price dispersion creates inefficient variation in production among the individual firms and variation in consumption across the individual goods. This price dispersion can be eliminated if the central bank simply ensures that there is never any need to adjust prices. In other words, if the only nominal distortion is price stickiness, then a policy of price stability is optimal because it renders this stickiness irrelevant.

Interestingly, this policy conclusion does not depend on the *degree* of price stickiness. It does not matter whether prices are very sticky or only moderately sticky. What is important is that price stickiness is the source of the nominal distortion. The finding that the degree of nominal price rigidity does not affect the optimal policy is consistent with the observation that many countries have adopted price stability objectives, even though their economies display structural differences.[4]

The policy problem of maximizing (4) subject to (1) and (2) is a particularly simple one. No difficult policy trade-offs arise because there is no stochastic uncertainty in the inflation adjustment equation (1). If additional factors affect inflation, conditional on the gap variable x_t, then trade-offs will be faced. For example, suppose

[4] And in the simple world of the benchmark new Keynesian model, a central bank that is able to maintain price stability would never be able to estimate the degree of nominal price stickiness.

$$\pi_t = \beta E_t \pi_{t+1} + \tilde{\kappa} x_t + e_t. \quad (5)$$

The *e* shock is variously called an inflation shock, a cost shock, or a price shock. Solving this equation forward,

$$\pi_t = \tilde{\kappa} \sum_{i=0}^{\infty} \beta^i E_t x_{t+i} + \sum_{i=0}^{\infty} \beta^i E_t e_{t+i}.$$

Inflation depends on the discounted value of current and expected future output gaps and cost shocks. Setting $x_t = 0$ for all t is no longer sufficient to ensure zero inflation.

When trade-offs must be made between inflation stability and real output stability, the parameter λ appearing in (4) becomes critical. Woodford's analysis shows that this weight does depend on the degree of nominal price rigidity. Greater price stickiness increases the weight the central bank should place on inflation objectives. Thus, in economies with a higher degree of price stickiness, and therefore an economy in which monetary policy is likely to have greater real effects, the central bank should place less weight on output objectives relative to inflation objectives.

The parameter λ also depends on the degree of product market competition as measured by the demand elasticity parameter θ.[5] Increased product market competition (a rise in θ), reduces the weight the central bank should place on output objectives.

The value of λ is important only if the central bank faces a trade-off between its output and inflation objectives. What aspects of the economic structure can lead to cost shocks? I will mention three alternative explanations that have appeared in the literature. First, Clarida, Galí, and Gertler (2002) have suggested there is stochastic variation in the relationship between the real wage and the household's marginal rate of substitution between leisure and consumption. This variation could arise with imperfect competition in the labor market and a wage markup that fluctuates stochastically. However, fluctuations in the wage markup also alter the flexible-price

[5] The average markup in this simple new Keyensian model is equal to θ/(θ-1).

equilibrium level of output and so affect inflation through the gap variable x_t; conditional on x_t, the wage markup does not have an independent effect on marginal cost or inflation.

Second, nominal wage stickiness may, in addition to price stickiness, be a source of nominal rigidity. Sticky wages play an important role in models based on Lucas supply functions. In those models, wages are sticky while prices are generally assumed to be flexible. In this case, price stability is no longer optimal. Instead, the nominal distortion introduced by sticky wages can be eliminated if the central bank focuses on stabilizing nominal wages. Wage inflation generates inefficient wage dispersion when wages adjust sluggishly, so optimal policy ensures that wages do not need to adjust. Erceg, Henderson, and Levin (2000) allow for both prices and nominal wages to be sticky. In this case, the welfare of the representative household depends on price dispersion and on nominal wage dispersion. Price stability is no long a sufficient policy objective for the central bank, and neither is wage stability.

Recognizing the implications of nominal wage rigidity for policy objectives is likely to be particularly important, as the evidence suggests it is wage stickiness rather that price stickiness that accounts for the real effects of monetary shocks, at least in the U.S. For example, Christiano, Eichenbaum, and Evans (2001) estimate a model that incorporates both price and wage stickiness. They find that wage stickiness is critical for matching the dynamic responses of the economy to nominal disturbances. Similarly, Huang and Li (2002) report that wage rigidity is better able to generate the type of persistence that is observed in the data.

A third source of nominal rigidity (after price and wage rigidity) arises from incomplete exchange rate pass-through. Monacelli (2002) shows that deviations in the law of one price affect domestic inflation in a manner similar to the supply shock that appears in (5). In addition, while the open economy model of Clarida, Galí, and Gertler (2002) suggests the central bank should focus on domestic goods price inflation, incomplete pass-through means that CPI inflation also affects welfare.

Even if price stickiness is the only nominal rigidity, the exact form of the inflation adjustment equation matters for policy. Empirical estimates of the new Keynesian inflation adjustment equation generally find that the lagged inflation rate is statistically significant when included in inflation regressions. A typical specification takes the form

$$\pi_t = (1-\phi)\beta E_t \pi_{t+1} + \phi \pi_{t-1} + \tilde{\kappa} x_t + e_t. \quad (6)$$

Rudebusch (2002) argues that the best point estimate of ϕ is 0.7, a result consistent with Fuhrer (1997) who finds little role for forward-looking expectations. The presence of lagged output, and the value of the parameter φ, affects the central bank's objectives. Steinsson (2000) shows that if lagged inflation appears because of the presence of rule-of-thumb firms as in Galí, and Gertler (1999), then the central bank should care about stabilizing changes in the inflation rate, as well as the inflation rate itself and the output gap.

Recent research has highlighted how the economy's structure -- and in particular, the nature of nominal distortions -- serves to define the appropriate objectives of monetary policy. Changes in economics structure -- more price and wage flexibility, more pass-through, greater product market competition, backward-looking inflation adjustment -- alter the goals of policy. Hence, understanding the economy's structure, and particularly the sources of monetary non-neutralities, is critically important for defining the objectives of monetary policy. In some simple but influential cases, it is only necessary to know the source of the nominal distortion; no further details of the monetary transmission mechanism are relevant. But with multiple sources of nominal rigidities and multiple channels through which monetary policy can affect the real economy, policy objectives must go beyond price stability, and policy design and implementation requires detailed knowledge of the monetary transmission process.

Policy implementation

Discussions of monetary policy implementation are often framed in terms of five different types of variables: instruments, operating targets, intermediate targets, indicators, and goals (B. Friedman 1990, B. McCallum 1990, Walsh 1998). Many of the issues related to an evaluation of both monetary targeting and inflation targeting bear directly on the distinction between these five concepts, so it will be useful to review their definitions.

A *policy instrument* is the variable over which the central bank exercises direct, day-to-day control. These might include an interest rate charged on reserves borrowed from the central bank, the reserve requirement ratios that determine the level of reserves or other assets banks must hold against their deposit liabilities, and the composition of the central bank's own balance sheet (its holdings of government securities, for example). The instruments of policy are usually manipulated to achieve a prespecified value of an *operating target*, typically some measure of bank reserves (total reserves, borrowed reserves, or nonborrowed reserves---the difference between total and borrowed reserves), a very short-term rate of interest, usually an overnight interbank rate (the federal funds rate in the case of the United States), or a monetary-conditions index that combines an interest rate and the exchange rate. The traditional analysis of central bank operating procedures has focused on the choice between a monetary aggregate such as the monetary base and a short-term interest rate such as the federal funds rate as the operating target of policy (Poole 1970, Friedman 1990).

Prior to the deregulation of financial markets, markets for government debt in many countries lacked the depth needed to conduct open market operations. As a result, many central banks exercised direct control over a variety of regulated interest rates, reserve asset ratios, and credit allocation. Government debt frequently carried below market rates of interest, and reserve asset ratios imposed on financial sector institutions were used to force these institutions to hold debt issues. The financial sectors of both developed and emerging economies have evolved tremendously since the 1970s as a consequence of the growth in government debt, financial

market innovation that has created new debt instruments, deregulation, and increasing globalization of financial markets. Consequently, the primary instrument of a central bank today is the composition of its own portfolio. Because the liabilities of the central bank are a chief component of the country's monetary base, the base or a similar narrow monetary aggregate is the policy instrument of most central banks today.

In practice, however, central banks employ control of a nominal quantity such as the monetary base to achieve short-run interest rate operating targets. Because central banks are able to exercise tight control over short-term interest rates, for all practical purposes it is appropriate to treat a short-term interest rate as the direct instrument of monetary policy.

Intermediate targets are operational guideposts for implementing policy. When intermediate targets are employed in the policy process, the operating target is adjusted on a day-to-day basis to achieve a designated path for the intermediate target. Intermediate targets are neither instrument nor goal. Rather, they are guideposts for policy. The two most common examples of intermediate targets are the money supply and the nominal exchange rate. Because achieving the targeting value of an intermediate target is not of intrinsic interest itself, the usefulness of intermediate targets is dependent on the stability of the economy's structure and the predictability of the linkages between the intermediate target and the goals of policy. The advantage to framing policy in terms of an intermediate target is that such targets provide a simple framework for responding automatically to disturbances. They may, therefore, help to communicate the central bank's intentions to the private sector in a more transparent manner than would be the case under a policy that responds to a wide arrange of informational variables. The disadvantage is that the relationship between the intermediate target and the central bank's goal is likely to be unstable, requiring frequent explanations for changing the intermediate target.

An ideal intermediate target should possess three properties. First, it must be highly correlated with the goal variable(s). Second, it must be easier to control than the goal variable(s). Third, it must be easier to observe than the goal variables(s).[6]

Intermediate targets are closely related to *indicator variables*. Indicators are variables that provide information useful in setting the policy instrument. Examples might include commodity, asset prices, or interest rate spreads. Like intermediate targets, they provide information that can be used to adjust the central bank's instrument, but unlike intermediate targets, indicators are not linked to goals in ways that allow target values for them to be defined.

Finally, *goals* are the ultimate objectives of monetary policy. Any monetary policy scheme involves the choice of an instrument, indicator variables, and goals. A policy may or may not involve intermediate targets.

3. Monetary targeting

In the United States, Canada, the United Kingdom, Germany, and Switzerland, rising rates of inflation beginning in the 1960s led to the adoption of policy procedures based on money growth rate targets. Monetary targeting can be evaluated on six dimensions. The first three are general characteristics, relevant for the evaluation of any monetary policy framework; the last three are related to the role of the money supply as an intermediate target variable. These six criteria are 1) Does it provide a nominal anchor?; 2) Does it promote transparency in the conduct of policy; 3) Does it promote accountability; 4) Is there a stable relationship between money and the goals of monetary policy?; 5) Is the money supply controllable?; and 6) Is it more easily observed than the goal variables? Before assessing monetary targeting, the historical experiences in the U.S., Germany, and Switzerland are briefly reviewed.

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[6] Svensson (1997b) adds the property of being transparent to his list of characteristics of an ideal intermediate target variable.

The United States

The United States Federal Reserve began publicly announcing monetary growth targets in 1975. This move was forced on the Fed by Congress which, under Concurrent Resolution 133, directed the Federal Reserve to formulate monetary policy by establishing explicit numerical targets for money growth.

The Fed implemented this directive by setting target growth rates for several monetary aggregates, although the one that received the most attention was the target for M1. The targets were expressed in terms of ranges rather than point targets. From 1976 until 1978, the Fed set a new target growth range every quarter. For example, in February 1976, the Fed set a target range of 4.5%-7% for M1 growth to apply for the period 1975:4-1976:4, with the target calculated from a base equal to the actual level of M1 in 1976:4. Three months later, in May 1976, the Fed set a target range, again 4.5%-7%, to apply from 1976:1 to 1977:1, from a base equal to the actual level of M1 in 1976:1. After Congress passed the Full Employment and Balanced Growth Act in 1978, the Fed was required to set growth rates every February for the calendar year, with these targets re-evaluated in July. These ranges were rebased each year by using the actual level of the money supply in December as the base for the subsequent year's target range.

Throughout the period of monetary targeting, there was serious question as to whether the Fed actually viewed these targets as constraints on policy. Using real-time data, Friedman and Kuttner (1996) estimate a policy reaction function for the funds rate that includes inflation, unemployment, and the gap between money and the midpoint of the target range. They find evidence consistent with the Fed adjusting the funds rate in response to the gap, suggesting the targets did have some impact on policy. There is also some evidence at very short-run horizons that the Fed reacted to money growth. For example, the response of interest rates to the weekly release of new data on M1 was consistent with market expectations that faster than expected money growth would lead to a tightening of policy (Roley and Walsh 1985). At longer horizons,

however, most commentators believed the Fed did not view its announced targets as serious constraints on policy. In fact, policy was consistent with a regime in which the Fed used its output and inflation goals to determine a target for the federal funds rate. Given the forecast for the macroeconomy and the funds rate target, the Fed predicted money demand, and this prediction then formed the basis for the announced monetary targets.

The pretext of monetary targeting was abandoned gradually during the 1980s. In the mid-1980s, M1 grew at double digit rates, with the year-over-year growth rate of M1 exceeding 10% between September 1985 and August 1987 (see figure 2). Despite this rapid growth in the money supply, inflation remained low. This apparent breakdown in the relationship between money and inflation led the Fed to abandon M1 growth targets in 1987. Targets were still set for M2 and M3, but by 1993, even these were reduced to "ranges" rather than targets. These ranges were reported to Congress to fulfill the letter of Resolution 133, but they are no longer viewed as targets.[7]

While the Friedman and Kuttner results indicate the Fed did react to deviations of money from target, the Fed's policy of rebasing its target paths suggests it was willing to let bygones-be-bygones as far as target misses were concerned. Under the Fed's procedures, the new growth path for each targeting period began at a level equal to the actual money supply at the end of the previous targeting period. Thus, target overshoots were permanently impounded in the level of the new target. The Fed was widely criticized for rebasing its target growth paths each year. Broaddus and Goodfriend (1984) argued that "base drift" contributed to making the price level nonstationary. Walsh (1986) showed that some base drift is optimal if velocity is subject to permanent shifts, as the evidence at the time seemed to suggest. However, Ireland (1993) has questioned this evidence and concludes that velocity was stationary.

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[7] Reflecting the disappearance of money in the formulation of monetary policy in the United States, money does not appear in the Board of Governor's econometric policy model (Brayton, et. al. 1997)

Figure 3 shows actual M1, the target path, and a hypothetical path with the effects of base drift removed. Whether some base drift was optimal or not, the figure shows that base drift contributed significantly to the growth of M1. Because of the short-run real effects of changes in monetary policy, a central bank might choose to offset target misses gradually, spreading out the adjustment over several quarters. This was done by both Germany and Switzerland. A gradual return to target could be accomplished by following target overshoots with rebasing and a lower target growth rate. This was not done in the U.S., where target misses were positively correlated with subsequent target growth rates (Walsh 1987).

The Fed was also severely criticized for using monetary targets to confuse rather than to communicate. Instead of announcing a single target, the Fed announced targets for several difference monetary aggregates. While one aggregate might be growing faster than its target, another aggregate might be growing more slowly than its target. This situation allowed the Fed to focus on whichever aggregate was most consistent with the policy the Fed was pursuing. Monetary targeting contributed to making policy less transparent and accountable rather than more so.

Monetary targeting as implemented in the United States failed to provide a nominal anchor for monetary policy, and it failed to make policy more transparent or the Fed more accountable. This judgement, though, must be directed at the version of monetary targeting the Fed actually followed. Mishkin (2000) argues that achieving the announced growth targets was never a high priority of the Fed. If achieving announced monetary targets was never accepted by the Fed as an appropriate short-run objective of monetary policy, it is not surprising that monetary targeting in the U.S. was not judged to be a success.

German and Switzerland

"A central bank must thus be constantly on the alert and implement its monetary target with the required flexibility." Markus Lusser, President of the Board of Governors, Swiss National Bank 1990, p. 183, quoted in Dueker and Fischer (1996).

In contrast to the case of the United States, both Germany and Switzerland are usually cited as examples of successful monetary targeting. Beginning in the mid-1970s, the Bundesbank and the Swiss National Bank (SNB) promoted monetary targeting as their operational framework for implementing monetary policy. Each established explicit growth rates for a monetary aggregate. From 1975 to 1987, the Bundesbank announced targets for the growth rate of a narrow monetary aggregate; after 1988, the announced targets were for M3. Switzerland, in contrast, moved in the opposite direction, first establishing targets for M1 and then, later, switching to a narrower measure (the monetary base).

The case of monetary targeting in Germany provides an interesting illustration of the flexibility with which a targeting regime can be implemented. When the Bundesbank began announcing monetary targets, it also announced targets for inflation at the same time. This served to make clear that it was inflation that was the ultimate goal variable of the central bank, not money for its own sake. The Bundesbank, like the Fed, used the actual level of the money supply as the base for its target ranges. For example, after 1979, the target growth rates referred to the growth of money from the actual money supply in the fourth quarter to the fourth quarter of the following year. The Bundesbank frequently missed its target growth rates, as it responded to short-run developments in the economy. When the Bundesbank overshot its target in 1987, it switched from targeting a narrow monetary aggregate to a broader one (M3). The SNB had fewer target misses, but this was due in part to its decision after 1990 to formulate medium-term growth paths with five-year horizons. While the Fed was criticized for allowing base drift and for missing its target, similar behavior by the Bundesbank and the SNB does not seem to have brought forth the same level of criticism.

A further characteristic of monetary targeting in Germany was the Bundesbank's use of “unavoidable inflation” and potential output in calculating its money growth target. The Bundesbank's money growth target was calculated using a quantity theory framework, but rather

than employing a forecast of actual income growth for the target horizon, the Bundesbank used an estimate of potential GDP growth. One consequence of this was to allow the Bundesbank to shift public focus away from its forecast of short-run economic developments. The use of unavoidable inflation rather than an explicit inflation forecast also allowed the Bundesbank to bring inflation back to its long-run target gradually while still maintaining a focus on its inflation goals. In a similar vein, the SNB used its estimate of the growth rate of potential output rather than a forecast of actual output growth to calculate its target money growth rates.

Laubach and Posen (1997) have argued that neither the Bundesbank nor the SNB followed a rigid policy of monetary targeting. Instead, they argue that monetary targeting as implemented by both these central banks provided for "disciplined discretion." The Bundesbank and the SNB were able to respond flexibly to changing economic conditions, reflecting their concern with real economic outcomes as well as inflation. In that sense, neither central bank was a strict monetary targeter but instead used its money targets as a means of communicating monetary policy to the public in a manner consistent with its long-run inflation goals.

Lessons

Monetary targeting was successful in both Germany and Switzerland because, in both countries, the central banks viewed their monetary targets as part of an overall strategy for controlling inflation. As such, they did not rigidly attempt to achieve announced monetary targets. Instead, when changing economic conditions altered the rate of money growth consistent with long-run inflation targets, the monetary target was missed. Monetary targeting was successful when it was combined with a clear statement of inflation goals. In contrast, in the United States there was no clear commitment to an inflation target. Thus, monetary targeting assisted in providing a nominal anchor in Germany and Switzerland. In the U.S., it did not.

In Germany and Switzerland, the target money growth rates were only loosely tied to short-run developments in the real economy, and they were not adjusted to reflect short-run real

output objectives. In both countries the targets were based on an estimate of the growth rate of potential output rather than on a forecast of actual output growth. This procedure was also employed by the SNB. Similarly, the Bundesbank allowed for a gradual adjustment to its longer-run inflation target by explicitly incorporating unavoidable inflation. This allowed it to maintain its long-run inflation target while allowing short-run deviations of inflation that would have caused too much real economic instability to eliminate. The use of potential output growth helped to divorce discussions of the growth targets and monetary policy from the banks' output forecast and short-run stabilization objectives.

A key difference between the use of money targets in the U.S. and their use in Germany and Switzerland was in the way the latter two central banks employed monetary targeting as a means of communicating their long-term inflation strategy. Laubach and Posen (1997) argue that, rather then imposing a constraint on policy, the publicly announced targets aided the Bundesbank and the SNB in explaining their polices and allowing them to follow what Laubach and Posen describe as “disciplined discretion.” Monetary targeting contributed to policy transparency in these countries.

In contrast, monetary targets in the U.S. were never used as an aid to communications. In fact, the Fed's response to a Congressional mandate to announce monetary targets was to announce several targets. Even the switch to a nonborrowed reserves operating procedure in 1979, a move that might have suggested the Fed was more serious about hitting its money growth targets, appeared designed instead to obscure the Fed's responsibility for interest rate increases. The Fed's attitude towards communications is perhaps summed up by the following statement by Alan Greenspan:

> “Since I have become a central banker, I have learned to mumble with great coherence.” Alan Greenspan (quoted in *Newsweek*, July 25, 1988, p. 54.

Control over the growth rate of money serves as a nominal anchor. In Germany and Switzerland monetary targeting contributed to policy transparency and, perhaps, accountability.

But monetary targeting, even in the successful cases of German and Switzerland, suffered from one glaring defect -- the behavior of the nominal money stock is not among the ultimate goals of policy. Because the money stock is not a direct policy instrument, its usefulness in the operation of monetary policy arises only insofar as it has a role to play as an intermediate target or as an indicator variable. To perform either role requires that there exist a predictable link between the money supply and the true goals of policy. The potential tension structural change poses for any intermediate targeting procedure is illustrated by the case of Germany in the early 1990s with the re-unification process. The portfolio shifts arising from unification and their affects on money demand made it particularly difficult to interpret fluctuations in money growth. In 1990, for example, the Bundesbank calculated separate monetary aggregates for eastern and western Germany. Financial deregulation and innovation, and the disinflationary policies of the early 1980s in the U.S. leads to very rapid M1 growth in the mid-1980s. This led the Fed to downplay the M1 targets. The breakdown in the M1 relationship in the U.S. is clear from Figure 2. Friedman and Kuttner (1996) provide an extensive statistical analysis of the increased unpredictability associated with the movements of the monetary aggregates, inflation, and real economic activity in the U.S. The failure to find stable statistical relationships between monetary aggregates and policy goals is reflected in the disappearance of money from many of the simple policy models found in the academic literature and even from some central bank models.[8]

4. The rise of inflation targeting

> "People think it's just about low inflation; it isn't. Low inflation is really a means to the end of stable growth." Sir Eddie George, Governor of the Bank of England, *Financial Times*, May 7, 2002.

[8] In optimizing models of the sort used in section 2, real money balances will appear in the labor market equilibrium condition if preferences are nonseparable in consumption and money balances. Ireland (2001) estimates a model with nonseparable preferences, but he finds he cannot reject the hypothesis of separability.

The Reserve Bank of New Zealand is generally recognized as the first central bank to adopt inflation targeting.[9] It did so as part of a formal legislative reform embodied in the Reserve Bank Act of 1989. The experience of an early group of inflation targeters -- New Zealand, Canada, the United Kingdom, Sweden, Israel, Australia, and Spain -- is surveyed in Bernanke, Laubach, Mishkin, and Posen (1998). Leiderman and Svensson (1995) also contains chapters discussing inflation targeting in many of these same countries.[10] Amato and Gerlach (2002) discuss inflation targeting among emerging market economies. Mishkin and Schmidt-Hebbel (2001) list 19 central banks as inflation targeters.[11]

While inflation targeting has become widespread, its popularity is due in part to the flexibility central banks have shown in interpreting it. Mishkin and Schmidt-Hebbel identify five pillars that characterize inflation targeting: "absence of other nominal anchors, an institutional commitment to price stability, absence of fiscal dominance, policy instrument independence, and policy transparency and accountability" (Mishkin and Schmidt-Hebbel 2001, p. 3). Not all inflation targets meet all five of Mishkin and Schmidt-Hebbel's pillars, and the details of policy implementation differ substantially among inflation targeters. Because of these differences, it is perhaps useful to formulate a somewhat more parsimonious definition rather than rely on Mishkin and Schmidt-Hebbel five characteristics.

Amato and Gerlach (2002) distill the essential ingredients of inflation targeting as an announced numerical target for inflation and a clear desire to achieve this target, as exemplified by evidence that the central bank actively adjusts its operational targets (instruments) in a way consistent with achieving the inflation target. Instrument independent is a necessary condition for this last aspect of an inflation targeting regime. Hence, the core ingredients of an inflation

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[9] Amato and Gerlach (2002) note that Chile adopted numerical inflation targets in 1990, Israel in 1991.

[10] See also Ammer and Freeman (1995) and McCallum (1998).

targeting regime seem to be 1) a commitment to a low and stable inflation rate, 2) this commitment is publicly expressed in terms of an announced numerical inflation target (including the definition of the price index), and 3) to achieve its target, the central bank has instrument independence. Regardless of the specific definition of inflation targeting, one thing is clear; inflation targeting is not defined in terms of a specific instrument rule that describes how a monetary policy instrument should be adjusted in response to inflation.

Table 1 provides a list of Mishkin and Schmidt-Hebbel's 19 inflation targeters, together with some of the key characteristics of the targeting regime in each country. The countries are about evenly divided with regard to the price index used for the inflation target. A majority use the basic consumer price index (headline CPI), but almost as many focus on a core measure of inflation.[12]

This core CPI generally excludes direct interest rate effects on the CPI or volatile components such as food and energy prices. Interestingly, Clarida, Galí, and Gertler (2002) develop an open economy model with sticky prices and show that the central bank's loss function should depend on domestic goods price inflation and output, yet none of these central banks target a measure of domestic price inflation.

In ten of the 19 cases, the central bank sets the inflation target. Only in the case of the United Kingdom is the power to set the target vested solely in the government. In the other eight countries, the government and the central bank both play a role in determining the target, although in most of these cases, the role of the central bank is a consultative one.

The flexibility allowed under an inflation targeting regime is reflected in the time horizon associated with the target. It is clear that none of these countries have implemented a strict

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[11] Carare and Stone (2002) list 20 full fledged inflation targeters. In contrast to Mishkin and Schmidt-Hebbel, Carare and Stone do not include Peru or Switzerland but they add Hungary, Iceland, and Norway.
[12] This was also the case in New Zealand before 1999 when interest charges were removed from the definition of the consumer price index.

inflation targeting regime; each regime provides for a horizon of at least a year over which the target is to be achieved.

Who targets inflation?

Relatively little research has tried to examine systematically the characteristics of inflation targeters. One exception is Gerlach (1999). He examines 22 countries, all OECD members. Of these, Australia, Canada, Finland, New Zealand, Spain, Sweden, and the United Kingdom are classified as inflation targeters (as of 1997). Countries that are less likely to suffer from a Barro-Gordon-type inflation bias (i.e., more open economies, countries with independent central banks) are predicted to be less likely to adopt inflation targeting. Countries subject to large economic disturbances are less likely to adhere to fixed exchange rates and so are therefore predicted to be more likely to target inflation. Gerlach's empirical results tend to support these basic hypotheses. In particular, countries with characteristics associated with historical experience of higher average inflation (i.e., low central bank independence, low degree of openness) are more likely to adopt explicit inflation targeting.

These conclusions are broadly consistent with Mishkin and Schmidt-Hebbel (2001), who find inflation targeting is negatively (positively) associated with central bank independence when independence is measured in terms of goal (instrument) independence. They interpret this to mean that central banks with goal independence are more likely to choose either monetary targeting or exchange rate targeting, as inflation targeting tends to be associated with giving up goal independent to governments.

Perhaps not surprisingly, formal inflation targeting is more likely to be adopted in countries where inflation has been a problem in the past. For these countries, inflation targeting is viewed as a solution to the inflationary bias problems highlighted in the time inconsistency literature (Barro and Gordon 1983). The connection in the academic literature between the Barro-Gordon story and current inflation targeting regimes runs through Rogoff (1985), Walsh (1995a),

and Svensson (1997a). Rogoff's conservative central banker result stressed the potential gains from delegating monetary policy to a central bank that places greater weight on controlling inflation than society at large does. Walsh demonstrated that one could improve over the Rogoff conservative central banker by linking the central banker's incentives to realized inflation, and Svensson showed that this was equivalent to assigning the central bank an inflation target.

Inflation targeting ranks highly with regard to the basic desirable characteristics of a monetary policy regime. First, it provides a nominal anchor. Second, it is a transparent framework. With the target publicly announced, the central bank makes it clear what its objectives are. In practice, many inflation targeters have taken special effort to provide timely and informative reports, including making their forecasts public. Third, the presence of an announced target provides the basis of accountability, although how this accountability is enforced in practice is less clear.

Implementing inflation targeting

The advantages of a policy framework expressed in terms of ultimate goals is that it is less affected by the sorts of structural change that create problems for an intermediate targeting framework. However, the task of implementing inflation targeting does require knowledge of the monetary transmission process. Three approaches to implementing inflation targeting have been advanced in the academic literature. One view interprets inflation targeting in terms of an instrument rule for setting the central bank's policy interest rate. The most famous of these rules is the Taylor rule in which the short-term interest rate is adjusted on the basis of inflation and the output gap. The second view, associated with Svensson (1997b), is that inflation targeting should be implemented through an intermediate targeting strategy in which the intermediate target is the central bank's inflation forecast. In a final interpretation (not necessarily incompatible with the second), inflation targeting is viewed as a “targeting rule” (Svensson 2001b).

Instrument rules for inflation targeting

One interpretation of an inflation targeting regime is that it involves the commitment by the central bank to set its policy instrument as a function of a few key variables such as inflation and the output gap. The most well know instrument rule is the Taylor rule (Taylor 1993). Taylor argued that the behavior of the U.S. federal funds rate could be explained in terms of the Fed's reaction to inflation and a measure of the output gap. A representative specification of a Taylor rule takes the form

$$i_t = (1-\gamma)\left[r + \pi_t + \delta_\pi(\pi_t - \pi^T) + \delta_x x_t \right] + \gamma i_{t-1}, \tag{7}$$

where r is the central bank's estimate of the real rate of interest and π^T is its target inflation rate. Clarida, Galí, and Gertler (2000) have estimated modified Taylor rules for the Fed that included expected inflation and the output gap, and they include a lagged interest rate in their instrument equations.[13]

Clarida, Galí, and Gertler (forthcoming) have estimated Taylor rules for the Bundesbank, the Bank of England, and the Bank of Japan, and they argue that the behavior of these central banks can also be captured by a simple rule. The papers collected in Taylor (1999) and the June 1999 issue of the Journal of Monetary Economics analyze the implications of Taylor rules. McCallum (2000) uses simple rules to investigate the policy actions of the Fed, the Bank of England, and the Bank of Japan.

As a representation of inflation targeting, Svensson (2001a) has noted several difficulties with (7). These objections include 1) no inflation targeting central bank has formally committed to following such a rule; 2) estimated Taylor rules can account for only about two-thirds of the

[13] For the Volker-Greenspan period (up to 1996:4), their baseline estimated instrument rule is

behavior of i_t and therefore miss a sizable fraction of policy behavior; 3) inflation targeting central banks seem to employ a much larger information set than is captured in a simple rule; and 4) a simple rule is inherently suboptimal.[14]

Instrument rules may offer the most transparent means of implementing policy, but the cost of this transparency is the very limited information set on which policy must be based.

Equation (7) can be rewritten as

$$i_t - i_{t-1} = (1-\gamma)(i_t^* - i_{t-1}),$$

where $i_t^* = r + \pi_t + \delta_\pi(\pi_t - \pi^T) + \delta_x x_t$. Written in this form highlights the similarity between a Taylor rule and intermediate targeting in which the operating target i_t is adjusted in response to the gap between i_t^* and i_{t-i}. The intermediate target, i_t^*, is a function of the equilibrium real return r, inflation, and the output gap. Viewing Taylor rules in this manner suggests they are subject to the same problems as monetary targeting, or any other intermediate targeting rule. Structural changes in the economy will alter the link between the intermediate target i^* and the true goal variables of the central bank. Of particular concern must be the dependence of the rule on the equilibrium real rate of interest. This variable must be estimated by the central bank and can shift in response to changes in fiscal policy, private sector behavior, or, in the case of an open economy, changes in world interest rates. In addition, the optimal values of the response coefficients δ_π and δ_x will depend on the monetary transmission mechanism. For example, Rudebusch (2002) uses an estimated model for the U.S. economy with an inflation adjustment equation of the form given by (6) and reports that the optimal coefficient on inflation in the Taylor rule falls from 2.06 when φ=1 (inflation completely backward-looking) to 0.88 when φ=0.6 (inflation primarily forward-looking).

$$i_t = (1-0.79)\left[r + \pi_t + 2.15(E_t\pi_{t+1} - 3.58) + 0.93E_t x_{t+1}\right] + 0.79 i_{t-1}.$$

[14] Lansing and Trehan (2001) investigate conditions under which the Taylor rule is optimal.

Despite the potential for performance to be sensitive to the structure of the economy, Taylor (2000) argues that these rules actually perform quite well in a wide range of models reflecting alternative views about the transmission process of monetary policy. This conclusion is also consistent with Rudebusch's finding that Taylor rules perform well as the weight on lagged inflation in (6) is varied. However, these results pertain to instrument rules that maintain the form of the Taylor rule. The actual coefficients, as noted previously, are different for different models. Unfortunately, except in very simple models, the dependence of these optimal coefficients on the structure of the economy is complex.

Taylor rules provide a simple description of policy that seems to capture much of the systematic component of monetary policy. However, it is important to recognize that the evaluation of instrument rules, generally based on simulation exercises in small scale models, assume the central bank is able to commit to the rule. Thus, expectations about policy are formed using the rule. If a central bank can in fact commitment, then it is not clear why it should commit to a suboptimal rule like a Taylor rule. If the central bank cannot commit but instead acts under discretion, then it may still appear as if it were following a Taylor rule. For example, the optimal discretionary policy in a simple new Keynesian model leads to an instrument rule in equilibrium that looks much like a Taylor rule (Walsh 1998, Chapter 10 provides an example). Hence, the empirical evidence that inflation targeting central banks seem to follow Taylor rules should not be interpreted to mean they have committed to instrument rules.

Inflation forecasts as intermediate targets

Svensson (1997b) has argued that the central bank's own inflation forecast provides the optimal intermediate target for implementing inflation targeting (see also Svensson and Woodford 1999). The intuition for this conclusion is straightforward. Monetary policy acts on both inflation and real economic activity with long lags. Because policy affects future output and

inflation, the central bank's actions must be based on its forecasts. Under an inflation forecast targeting regime, the central bank compares its forecast of future inflation with its inflation target. If the forecast is above the target, the short-term interest rate should be raised. If the forecast is below target, the interest rate should be cut.

The inflation forecast, unlike the money growth rate, has many desirable properties as an intermediate target. If the central bank is doing a good job of forecasting, then the forecast should be very highly correlated with the goal variable, actual inflation. One advantage of using the forecast as an intermediate target is that it does not limit the information the central bank uses, as, for instance, a Taylor rule does or as monetary targeting does. However, there are still implementation issues associated with the choice of price index, the targeting horizon, and the weight to give to output stability.

Many inflation targeting central banks have chosen to focus on a measure of core inflation rather than target the overall CPI inflation rate (headline CPI). This choice can be understood in terms of the controllability of an intermediate target. Core inflation generally removes the most volatile components of the overall CPI, components such as food and energy. Core inflation is therefore likely to be subject to smaller fluctuations, making it easier to forecast and to control.

To be controllable, though, the forecast horizon must be set to be consistent with the estimated lags in the effect of monetary policy on actual inflation. The central bank is unlikely to be able to influence inflation over the next month, but it can affect the inflation rate two years out. Where in between these two horizons the optimal horizon lies depends on the lags in the monetary transmission mechanism. In an open economy, for instance, the exchange rate channel on consumer price inflation means the lags are generally shorter than in a closed economy and so the appropriate inflation forecast horizon would be shorter.

Finally, the forecast is observable (to the central bank) since it is the central bank's own internal forecast that it is targeting. Thus, on the grounds of correlation with the goal,

controllability, and observability, the central bank's inflation forecast provides an ideal intermediate target.

However, just having a numerical target for inflation does not provide a complete blueprint for policy implementation. Under inflation forecast targeting, the central bank actively adjusts its policy instrument to keep the forecast on target. But suppose monetary policy affects inflation with a two year lag. And suppose the current two-year ahead inflation forecast is above the central bank's target rate. This discrepancy signals that monetary policy must tighten, but by how much? Should the policy interest rate be raised until the two-year ahead forecast is equal to the target? Svensson (1997b) shows that a central bank that cares only about inflation will always ensure its forecast of future inflation is equal to its target for inflation. Svensson also shows that a central bank with output and inflation objectives will bring the forecast back to target gradually. But how quickly should the forecast be brought back to target? Attempts to bring the forecast back to target quickly are likely to result in more output instability than policies that react more gradually.

This issue is raised by John Vickers (1998) of the Bank of England Monetary Policy Committee (MPC). He asks, “So how fast should the MPC try to return inflation to target following, say, an adverse supply shock? That depends on the cost of output volatility (around the natural rate of output) relative to the cost of inflation volatility (around the inflation target). The MPC's remit is silent on this parameter of the loss function, but optimal policy is arguably not too sensitive to its value within a reasonable range.”

However, what is a reasonable range? And what does “not too sensitive” mean? Figure 4 illustrates the consequences of an adverse supply shock under optimal discretion with different weights on output stability in the central bank's objective function. Simulations are shown for two values of λ in equation (4). The model is a basic new Keynesian model with an inflation

adjustment equation of the form given by (6). Policy is optimal in the sense that it is chosen (under discretion) to minimize (4).[15]

Responses are shown for values of λ equal to 0.007 and 0.25. The effects of λ on the response of inflation to a supply (cost) shock is increasing in λ; if the central bank places more weight on output stability in its objective function, it allows inflation to absorb more of the impact of the cost shock. Inflation then returns gradually to its baseline value. The effect of λ on the response of output is much more dramatic. Output falls below its flexible-price equilibrium by 12% when λ=0.007 but by less than 2% when λ=0.25.

While the impulse responses in Figure 4 show how important λ is for determining the path of inflation and output after a cost shock, the asymptotic standard deviations of the output gap and inflation also reflect the large increase in output volatility that occurs as λ declines. For instance, the standard deviation of the output gap increases by a factor of five when λ is reduced from 0.25 to 0.007, while the standard deviation of inflation falls by 65%. Thus, the weight the central bank places on output stabilization, rather than being inconsequential, is likely to be very important for determining the desirability of an inflation targeting regime.

Inflation targeting rules

Earlier, I described policy as consisting of an objective and constraints, with the central bank acting optimally. The first order condition that arises from the central bank's decision problem then becomes one of the equilibrium conditions that determine output and inflation. If the central bank adjusts its policy instrument to satisfy its first order condition, then, according to Svensson (1997b), it is following a targeting rule as opposed to an instrument rule. "A general targeting rule specifies the objectives for monetary policy in an operational way, that is, specifies

[15] Other parameter values used for the simulation were β=0.99 and κ=0.05. See Jensen (2001) and Walsh (2002b).

an operational loss function. A commitment to a general targeting rule is hence a commitment to minimize such a loss function." (Svensson 2001b, p. 6)

Thinking of policy implementation as a targeting rule has two distinct advantages relative to instrument rules. First, because monetary policy acts with a lag on both inflation and the real economy, the first order condition will involve the central bank's forecasts for the variables it affects. The presence of these forecasts rather than specific informational variables emphasizes the need for central banks to look at all relevant information in formulating policy. Instrument rules and monetary targeting or exchange rate targeting rules, rules that emphasize responding to a small subset of the information available, may cause important information to be ignored.

Second, a targeting rule, as opposed to an intermediate targeting procedure (including inflation forecast targeting), is consistent with the central bank's objectives in a way that an intermediate targeting rule may not be. For example, some inflation targeters have used the exchange rate as an intermediate target (e.g., Israel) or as part of an indicator of monetary policy stance (e.g., the use of a monetary conditions index in New Zealand). The problem is that the correlation between goal variables and an endogenous intermediate target variable depends on the nature of the disturbance to the economy. A portfolio shift that causes a depreciation requires a more contractionary monetary policy to offset the impact of the shift on domestic inflation and output; a negative terms of trade shock that causes a depreciation requires a more expansionary policy response. An instrument rule that responds to exchange rate movements cannot get it right all the time. In contrast, a targeting rule will always produce the policy response that is consistent with achieving the central bank's goals.

A targeting rule is also better than an instrument rule that reacts to deviations between the inflation forecast and the target inflation rate. An instrument rule will not always correctly balance the trade-offs between goals that central bank must face.

While a targeting rule is, by definition, optimal given the central bank's loss function, a targeting rule may be less transparent then an instrument rule or an intermediate targeting rule. It

may simply be more difficult to explain a loss function than a Taylor rule to the public. An instrument rule may allow the central bank's actions to be more closely monitored and held accountable, as deviations from the rule would be easy to determine. To address these problems, Svensson (2001b) has proposed that central banks announce their loss function, complete with the weights attached to each objective.

Criticisms of inflation targeting

The major criticism levied against inflation targeting is that it elevates one desirable objective of economic policy -- low and stable inflation -- at the inevitable cost of diminishing other, perhaps equally or more important goals of macroeconomic policy, such as real income and employment stability. In principle, this conflict is not inherent in an inflation targeting regime. Flexible inflation targeting regimes allow for both output and inflation objectives. The weight placed on output objectives governs the horizon over which the inflation target is achieved. Greater concern for output fluctuations calls for a more gradual return to target after any inflation fluctuation.

While output concerns can be incorporated under inflation targeting, any system that stresses accountability and casts policy discussions in terms of a single variable risks creating policy biases. This is a standard problem in incentive design; by defining a performance measure (inflation), the agent (the central bank) may neglect other outcomes (stable employment) that the principle (the public) also cares about.[16]

As Ben Friedman (2002, p. 7) has noted, “Notwithstanding the compatibility in principle of inflation targeting as a conceptual framework for implementing a monetary policy in which real outcomes matter as well as inflation, an observer who has paid attention to the last quarter century of debate about monetary policy is entitled to suspect that a powerful motivation for

adopting this framework, as least in some quarters, is the hope that if the explicit discussion of the central bank's policy is carried out entirely in terms of an optimal inflation trajectory, concerns for real outcomes may somehow atrophy or even disappear from consideration altogether."

Interestingly, Laubach and Posen (1997) actually argued that the German experience with monetary targeting was successful, in part, because the targets allowed the Bundesbank to shift debate away from the effects of monetary policy on real economic activity. As Friedman notes, central bankers often support inflation targeting by arguing that monetary policy cannot control real variables but can control inflation. But this confuses short-run and long-run effects of monetary policy. In fact, all current models of inflation are based on the assumption that a (the) primary channel through which central banks control inflation is through the short-run impact of monetary policy on real economic activity.

These concerns are serious ones. One could argue that central banks are attracted to inflation targeting because it makes them responsible for a single task they know they can achieve. Holding central banks responsible for implementing socially optimal monetary policies presents central banks with a much more difficult task. However, presumably the point is not to make life easy for central bankers but to establish institutional structures that will promote good policy making.

Alternatives to inflation targeting

One attraction of inflation targeting is that it appears consistent with recent theoretical models in which minimizing inflation and output fluctuations is the socially optimal policy. These models also imply that the short-run inflation-output trade-off can be improved if the central bank is able to influence private sector expectations of future inflation. Part of the support for inflation targeting arises from the belief that it can serve as a commitment mechanism, that it can help

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[16] This can be a particular problem if it is difficult to monitor the central bank's

central banks affect expectations of future inflation, thereby presenting central banks with better short-run policy options.

However, the earlier literature on monetary policy had also suggested that, in discretionary policy environments, it might be desirable to assign the central bank a loss function that differs from the welfare of the representative agent. That is, even though low inflation and stable output are the ultimate goals of policy, it may not be efficient to assign these specific goals to the central bank if policy is conducted under discretion. Because discretionary policies are inefficient in the presence of forward-looking expectations, distorting the central bank's objectives may lead to improved policy outcomes.

Several recent papers have considered alternative policy objectives that might be assigned to the central bank. In some cases, social welfare, usually represented by a loss function of the form given by (4), may be higher if the central bank is assigned an objective that differs systematically from (4). Among the alternatives considered are price level targeting, nominal income growth targeting, and speed limit policies. All three of these alternatives may improve over inflation targeting by introducing greater inertia into policy. As Woodford (1999a) has shown, it can be optimal for a central bank to impart inertia to output after a purely transitory cost shock. In the face of an adverse cost shock, inflation increases and output falls (see figure 4). If future output is also expected to be low, expected future inflation falls. This acts to reduce the inflationary impact of the cost shock and improves the short-run trade-off between inflation and output. Under inflation targeting, the central bank does not impart enough inertia to output, but it may do so if its objectives are altered. For example, under price level targeting policy, the central bank must follow a positive inflation shock with a deflation to return the price level to its target. This requires that the output gap remain negative for several periods. The expectation of a future deflation reduces the inflationary effect of the initial shock (see equation (1).

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information. See Walsh (2002a).

The importance of forward-looking expectations in affecting policy choice is well illustrated by the work on price level targeting (Svensson 1999, Dittmar, Gavin, and Kydland 1999, and Vestin 2000). The traditional view argued that stabilizing the price level, as opposed to the inflation rate, would generate undesirable output variability. For example, a positive cost shock that pushes up the price level would require a deflation to bring the price level back on target, and this deflation would be costly. However, it can be shown that the optimal commitment policy that minimizes the social loss function also induces a deflation after a positive cost shock. The expectation of a deflation in period $t+1$ reduces $E_t\pi_{t+1}$, and actually improves the trade-off between inflation variability and output variability. The deflation generated under a discretionary policy concerned with output and price level stability might actually come closer to the commitment policy outcomes than discretionary inflation targeting would. Using a basic new Keynesian model, Vestin (2000) shows that this intuition is correct. In fact, when inflation is given by (1) and the cost shock is serially uncorrelated, price level targeting can replicate the timeless precommitment solution exactly if the central bank is assigned the loss function $\pi_t^2+\lambda_{\mathrm{PL}}\mathrm{x}_{\mathrm{t}}^2$, where λ_{PL} differs from the weight λ in the social loss function. Price level targeting actually accords more closely with the official goals of price stability, although, to date, central banks have chosen to interpret price stability as a low and stable rate of inflation. Measurement error in common inflation indices, as well as concern that the zero bound on nominal interests may restrict policy at low rates of inflation may, in part, account for the lack of support for price level targeting.

Jensen (2001) shows that a nominal income growth targeting regime can also dominate inflation targeting. A central bank that focus on nominal income growth introduces an inertia into policy that improves over pure discretion. Svensson and Woodford (1999) have considered interest rate smoothing objectives as a means of introducing the inertia into discretionary policy that is optimal under commitment.

The key aspect of the economic structure for these comparisons turns out to be the weight on lagged inflation in the inflation adjustment equation (i.e., the parameter ϕ in equation (6)). In Walsh (2002b), I show that the advantages of price level targeting over inflation targeting decline as the weight on lagged inflation increases. I also analyze discretionary outcomes when the central bank targets inflation and the change in the output gap (a "speed limit" policy).[17]

Introducing the change in the gap induces inertial behavior similar to that obtained under precommitment. For empirically relevant values of the weight on lagged inflation (i.e., ϕ in the range 0.3 to 0.7), speed limit policies dominate price level targeting, inflation targeting, and nominal income growth targeting. For ϕ below 0.3, price level targeting does best.[18]

Conclusions

Earlier experiences with monetary targeting, recent academic work on monetary policy, and an evaluation of alternative interpretations of inflation targeting lead to several conclusions.

First, recent academic research has clarified the connections between the monetary transmission mechanism and the objectives of monetary policy. This research has shown how the objectives of optimal monetary policy depend on the sources of nominal rigidity in the economy. While the goal of price stability has been the dominant focus of recent institutional reforms, price stability is optimal only if price stickiness is the sole nominal rigidity that characterized the economy. When other nominal rigidities are present -- sticky wages or incomplete pass-through, for example -- price stability no longer delivers the optimal policy.

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[17] The central bank is assigned a loss function of the form
$E_t \sum_{i=0}^{\infty} \beta^i \left[\pi_{t+i}^2 + \lambda_{SL} \left(x_{t+i} - x_{t+i-1} \right)^2 \right]$.

[18] These findings are consistent with those of Rudebusch (2002) who analyzes instrument rules. He finds that the weight on lagged inflation has a large impact on the performance of nominal income rules.

Second, the academic literature has stressed the importance of a nominal anchor. While a goal of price stability may not by itself be sufficient to deliver good monetary policy, it is a necessary component. Third, inflation targeting is not an instrument rule. Instrument rules, like intermediate targeting policies such as monetary targeting, are suboptimal and likely to be sensitive to structural changes in the economy. Fourth, a numerical target for inflation is not a complete description of monetary policy. Policy also involves a decision on how quickly to return inflation to target after any target deviation.

The practical experiences with both monetary targeting and inflation targeting suggest that successful policies have incorporated a great deal of flexibility. In principle, both monetary targeting and inflation targeting can ensure the economy has a nominal anchor and be implemented in a transparent manner that promotes accountability. However, a policy that focuses on a goal, such as inflation, is less sensitive to structural change and instability in the economy than is an intermediate targeting procedure such as monetary targeting. However, inflation targeting should not be interpreted as a commitment to an instrument rule such as a Taylor rule. Such rules suffer from the same sensitivity to structural change that intermediate targeting rules do.

Policy should be transparent; transparency can aid a central bank in building credibility for low inflation policies, helping to anchor private sectors expectations about future inflation. Transparency also promotes accountability. But if central banks are transparent about only one of their objectives, inflation, they may tend to neglect their responsibilities for promoting short-run real economic stability. Monetary policy has important real effects in the short-run. This is particularly so in small open economies where real exchange rate fluctuations can be costly and have significant effects on the sectorial distribution of activity and employment. Flexibility in the pursuit of an inflation target is necessary if undesirable real fluctuations are to be avoided. Central banks, therefore, face a tension between preserving flexibility while maintaining credibility.

Inflation targeting policies have been very transparent, with announced numerical targets a key component of all inflation targeting regimes. This transparency has not been extended to the goals of output stabilization and, as such, a commitment to inflation targeting imposes little constraint on the actual conduct of monetary policy. Perhaps this explains the popularity of inflation targeting among such a wide and varying group of countries.

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Table 1: Inflation Targeters

Country	Adoption	Price Index	Current Target	Horizon	Set by*
Australia	9/1994	Core CPI	2-3%	1 cycle	Both
Brazil	6/1999	Headline CPI	4%(±2%)	1-year	Both
Canada	2/1991	Core CPI	1-3%	multi-year	Both
Chile	1/1991	Headline CPI	2-4%	indefinite	Both
Colombia	9/1999	Headline CPI	6%	1-year	Both
Czech Republic	1/1998	Core CPI	2-4%	1-year	CB
Finland	2/93-6/98	Core CPI	2%	indefinite	CB
Israel	1/1992	Headline CPI	2%	indefinite	CB
Korea	1/1998	Core CPI	2.5%	indefinite	CB
Mexico	1/1999	Headline CPI	3%	indefinite	CB
New Zealand	3/1990	Headline CPI	0-3%	indefinite	Both

Peru	1/1994	Headline CPI	1.5-2.5%	1-year	Both
Poland	10/1998	Headline CPI	<4%	indefinite	CB
South Africa	2/2000	Core CPI	3-6%	Multi-year	CB
Spain	11/94 - 6/98	Headline CPI	2%	1 year	CB
Sweden	1/1993	Headline CPI	2%(±1%)	indefinite	CB
Switzerland	1/2000	Headline CPI	<2%	3 years	CB
Thailand	4/2000	Core CPI	0-3.5%	indefinite	Both
U. K.	10/1992	RPIX	2.5%	indefinite	Gov.

Source: Mishkin and Schmidt-Hebbel (2001).

* "Both" indicates that the central bank and the government are involved in setting the target. Except in the cases of Chile and Peru, the target is set by the government in consultation with the central bank.

Figure 1: Consumer Price Inflation in Developed and Developing Economies

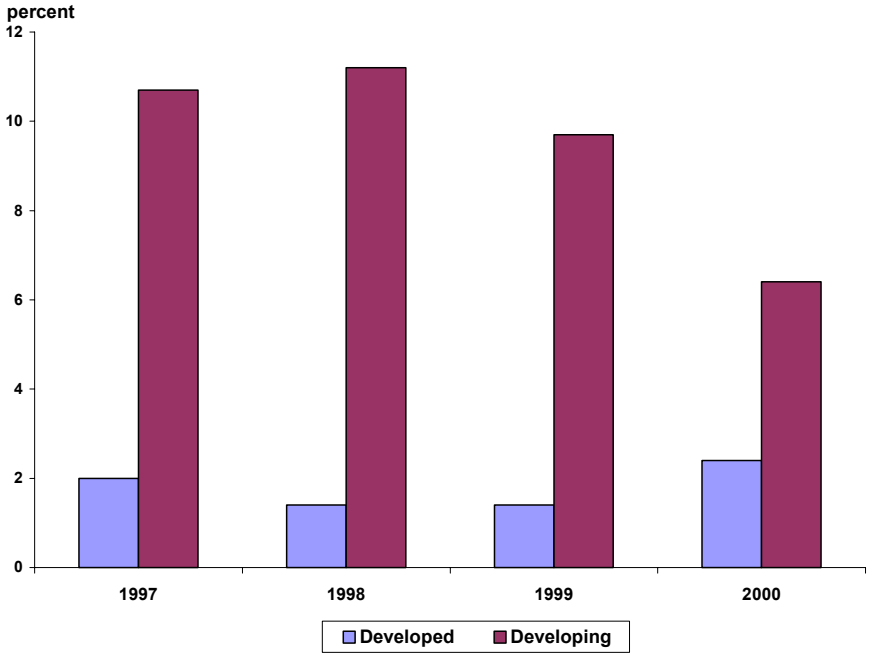

Figure 2: U.S. Inflation, the Federal Funds Rate, and M1 Growth

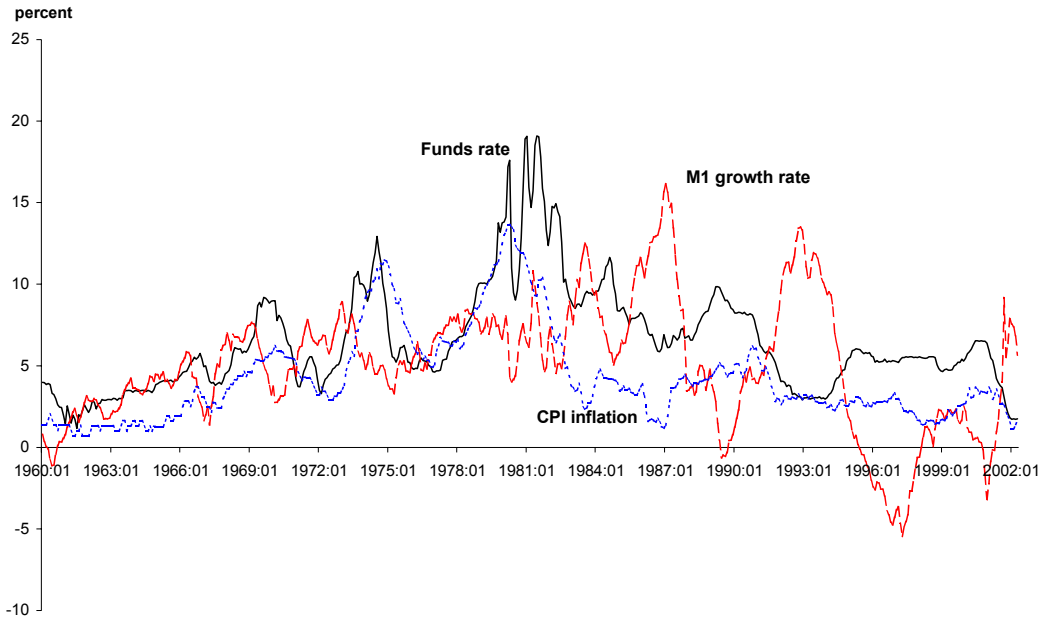

Figure 3: The Effects of Base Drift in the United States

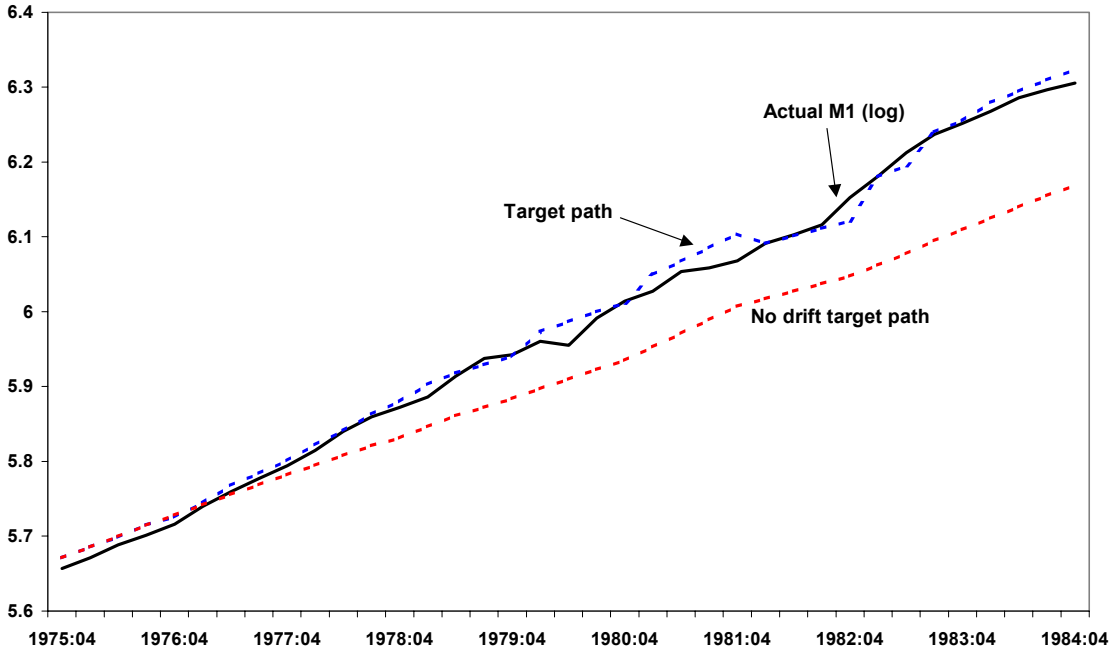

Figure 4: The Effects of a Cost Shock with DIfferent Weights on Output Objectives