In Defense of Base Drift

By Carl E. Walsh*

By using the actual money supply as the base for its target ranges, the Federal Reserve impounds past target misses into the level of its new target ranges. This practice of allowing "base drift" has often been criticized. A simple aggregate model is used to derive the optimal degree of base drift. It is shown that some drift will be optimal if income and/or velocity are nonstationary.

Each February, target growth rates for various monetary aggregates are announced by the Federal Reserve's Open Market Committee (FOMC). These growth rates, which apply from the fourth quarter of the previous year to the fourth quarter of the current year, have been publicly announced since the passage of House Concurrent Resolution 133 in 1975.[1] It has been the practice of the FOMC to use the fourth-quarter values of each aggregate as the base from which the following year's growth path is calculated. This procedure results in what is known as base drift: if the actual value of an aggregate in the fourth quarter differs from that year's target, this deviation is made permanent by being impounded in the level of the aggregate along the following year's growth path. The FOMC could, of course, compensate for any such base drift by adjusting the target growth rate downward if drift had been positive and upward if it had been negative. The evidence, however, suggests that this has not been done.[2]

Because the FOMC establishes target ranges rather than a single-target growth rate, one estimate of the amount of base drift allowed by the FOMC would be the difference between the actual fourth-quarter value of an aggregate such as $M1$ and the fourth-quarter value implied by the midpoint of that year's target growth range for $M1$. This measure of drift is given in Table 1.[3] As the table shows, the actual fourth-quarter level was above the midpoint of the target range for seven of the ten years from 1976 to 1985, and for every year during the period 1976–83 except 1981. These above-target levels then formed the bases from which the subsequent target ranges were calculated, leading to a permanently higher level of $M1$ and, over the period as a whole, a higher growth rate as well. The opposite occurred in 1984 with $M1$ below the midpoint of the target range in the fourth quarter of that year. This low $M1$ was then used as a base for the 1985 growth path. In July of 1985, with $M1$ running well above the target ranges established in February, the FOMC

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[1] Preliminary target ranges for the following year are announced in July. In 1979, 1983, and 1985, the ranges announced in February were modified in July. For an interesting discussion of the setting of the target ranges in 1983 and 1984, see R. W. Hafer (1985).

[2] For example, the correlation between base drift in year t (see Table 1 below) and the midpoint of the growth rate range established for year $t+1$ is positive. Thus, above-average base drift has tended to be followed not by lower target ranges, but by above-average target growth ranges.

[3] The numbers in Table 1 differ from those in chart 1–4 in the *Economic Report of the President*, (1985, p. 53) because the Council's chart reflects estimated adjustments to $M1$ due to financial deregulation. These shift adjustments are discussed in Section II.

TABLE 1—ESTIMATED BASE DRIFT OF $M1$[a]
(Billions of Dollars)

	Midpoint of Target Range for Fourth Quarter (1)	Actual Fourth-Quarter Value (2)	Base Drift (2)–(1)
1976	306.8	305.6	−1.2
1977	322.4	329.5	7.1
1978	346.8	353.9	7.1
1979	367.0[b]	371.2	4.2
1980	408.2	416.8	8.6
1981	447.0	438.2	−8.8
1982	455.7	476.6	20.9
1983	507.6[b]	526.1	18.5
1984	557.7	553.5	−4.2
1985	598.6[b]	620.3	21.7

Source: Annual Report of the Board of Governors of the Federal Reserve System, various issues.

[a]Midpoints of target ranges are calculated using the fourth quarter to fourth-quarter target growth ranges except where noted. Figures refer to $M1$-A prior to 1980.

[b]Reflects change in target growth range in July.

announced new growth targets using the actual, above target, second-quarter value of $M1$ as the new base (Paul Volcker, 1985).

The practice of automatically allowing base drift to occur has long been attacked by monetarists.[4] They have frequently criticized base drift as a major impediment to any consistent policy of price stabilization in the longer run, and general economic stability in the shorter run. By letting "bygones be bygones,"[5] base drift, it is argued, essentially ratifies short-run deviations from target and hinders the achievement of stable money growth and prices over longer periods. The 1985 *Economic Report of the President* brought renewed attention to these criticisms.[6] The *Report* proposed that the Federal Reserve base its current year's target ranges on the midpoint of the previous year's target range for the fourth quarter. This alternative procedure, first suggested by William Poole (1976), would result in the complete elimination of base drift.

The purpose of the present paper is to examine the factors which determine optimal base drift. It will be shown that base drift is not necessarily inconsistent with a policy committed to price stability. In fact, such a policy objective is likely to require at least some degree of base drift. Only in special cases will either zero base drift, as advocated by the Council of Economic Advisers, or full base drift, as practiced by the FOMC, be consistent with price stability. The reason for this is that permanent shifts in the quantity of money demanded, due either to velocity shocks or income disturbances, require the real quantity of money to adjust to the new level of real money demand. If the nominal quantity of money is not adjusted, the price level must respond to equilibrate money demand and supply. Since U.S. data suggest that both real income and velocity are subject to permanent shocks,[7] price level stability requires that the nominal stock of money not be held to a fixed path. Deviations of money from target are noisy signals of these permanent shocks, and such deviations should be partially accommodated by adjusting the target path.

In Section I, a simple macro model is used to illustrate the factors which influence optimal drift. The final section summarizes the paper's basic points and uses the model's

[4]William Poole (1976) was one of the earliest to criticize automatic base drift. A more recent call for an end to base drift is found in the report of the Shadow Open Market Committee (1985). An extended criticism of base drift can be found in Alfred Broaddus and Marvin Goodfriend (1984). Milton Friedman (1985) has likened the Fed's practice to that of a marksman who always hits the bull's-eye by painting the target after taking his shot. See also Friedman (1982, p. 109; 1984, p. 37) and Bennett McCallum (1984, p. 123).

[5]Stephen Axilrod, Staff Director for Monetary and Financial Policy of the Board of Governors of the Federal Reserve System, has defended base drift by claiming "It is where you start that is important" (1982, p. 141).

[6]See, for example, the *New York Times*, March 4, 1985. For recent attacks on base drift in the popular press, see Poole (1985) and Friedman (1985).

[7]See Charles Nelson and Charles Plosser (1982) who show, using annual data, that real *GNP* and velocity are subject to permanent shocks. Velocity is also found to be a random walk by J. P. Gould et al. (1978). J. C. Kim (1985) finds using annual data that velocity in the U.K. is also a random walk.

results to critique the FOMC's current policy of complete base drift.

I. Optimal Base Drift

Let y_t, v_t, p_t, and m_t denote the natural logs of real output, velocity, the price level, and the nominal money stock, respectively. The evolution of income, velocity, and the price level is assumed to be given by equations (1)–(4):

$$(1)\quad y_t = \bar{y}_t + \alpha(p_t - {}_{t-1}p_t) + \beta(p_t - {}_{t-2}p_t) + \varepsilon_t,$$

$$(2)\quad (1-B)\bar{y}_t = u_t,$$

$$(3)\quad y_t = m_t - p_t + v_t,$$

$$(4)\quad (1-B)v_t = \phi_t + \psi_t - \psi_{t-1},$$

where B is the lag operator, ${}_s p_t$ is the minimum variance, linear forecast of p_t formed at time s, and ε, u, ϕ, and ψ are mean zero, identically and independently distributed disturbance terms. For simplicity, the disturbances are assumed to be independently distributed. The information set upon which expectations formed at time t are based consists of all current and lagged values of y, p, v, and m.

Equation (1) is an aggregate supply function in which output is a positive function of price expectational errors. Stanley Fischer (1977) shows how such an aggregate supply equation would arise in the presence of multiperiod (in this case two periods) overlapping contracts. This formulation insures that the monetary authority's choice of a target for the nominal money supply will have real effects even when announced at the start of each period, as long as the target depends in part on information unavailable one period earlier. Equation (1) also assumes that income can be written as the sum of a permanent component, $\bar{y}_t$, and a transitory component, $\alpha(p_t - {}_{t-1}p_t) + \beta(p_t - {}_{t-2}p_t) + \varepsilon_t$. The evolution of the permanent component is governed by equation (2) which specifies that $\bar{y}$ is a random walk. Together, equations (1) and (2) reflect the evidence presented by Charles Nelson and Charles Plosser (1982) that real output is a difference stationary process. The disturbance term u_t equals the innovation in the permanent component of output. From (1), it is clear that individuals (and the monetary authority) can observe the sum $\bar{y}_t + \varepsilon_t$, but not ε_t and u_t separately.[8]

The aggregate demand side of the model is represented in (3) by a simple quantity theory equation. Since J. P. Gould et al. (1978), Nelson and Plosser, and J. C. Kim (1985) all present evidence that suggests velocity is, like real income, a difference stationary process, equation (4) assumes that v_t is the sum of a permanent component ($\bar{v}_t$) with innovation ϕ_t and a transitory component with innovation ψ_t. As with the income disturbances, neither ϕ_t nor ψ_t is individually observable, although $\bar{v}_t + \psi_t = v_t$ is.

The monetary authority is assumed to set a target for the nominal money supply at the start of each period. The target will be denoted γ_t. Since γ_t is announced at the beginning of the period, it is contained in all information sets dated $t-1$ or later. Between the dates at which the targets are announced, the policy rule used to determine the nominal supply of money is taken to be of the form

$$(5)\quad m_t = \gamma_t + \gamma[y_t - {}_{t-1}y_t] + \xi_t,$$

where ξ_t is a white-noise control error. At the start of the period, equation (5) implies that the expected value of the money supply is γ_t. If income diverges from the monetary authority's forecast, m_t is adjusted according to the parameter γ.[9] In this framework then, deviations from target are due to a

[8] The business cycle implications of an inability to distinguish between permanent and transitory shocks are explored in Karl Brunner et al. (1980).

[9] If aggregate demand were assumed to depend on the real rate of interest, and money demand on the nominal rate, the nominal rate could be introduced into equation (5) to yield what might be a more familiar looking money supply, or policy reaction, function. Unanticipated velocity movements could be made an argument in the policy reaction function without affecting any of the paper's basic results. For simplicity, equation (5) is used.

pure control error and the current realizations of the random shocks which affect income. The policy rule reflects the assumption that agents are able to contemporaneously observe income. A policy rule similar to (5) could also arise as a result of automatic adjustments to bank borrowing from the discount window, even if the monetary authority could not observe the contemporaneous value of income.

At the start of period t, the targeted value for the nominal money supply is γ_t. The actual realized value is m_t. A policy of zero base drift would use γ_t as the base for the target path in period $t+1$, while a policy of complete base drift would use m_t as the base from which the targeted value for $t+1$ is calculated. Thus, if the target growth rate is assumed, for simplicity, to be zero, we can write $\gamma_{t+1} = \delta m_t + (1-\delta)\gamma_t + x_t$, or $\gamma_{t+1} - \gamma_t = \delta(m_t - \gamma_t) + x_t$, where δ is an index of the degree of base drift, and x_t represents any additional adjustment to the target that is independent of the past deviation $m_t - \gamma_t$. An absence of drift corresponds to $\delta = 0$, and complete drift corresponds to $\delta = 1$.

The parameter γ of the policy rule (5) and the time path of γ_t are assumed to be chosen to minimize the loss function

$$(6) \qquad L(\gamma_t, \gamma) = \left[\sigma_y^2 + \rho\sigma_p^2\right],$$

where $\sigma_y^2 = E[y_t - \bar{y}_t]^2$, and $\sigma_p^2 = E[p_t - p^*]^2$. Thus, the monetary authority attempts to minimize transitory income fluctuations around the unobserved permanent component of income, and to minimize price level fluctuations around a target price level p^*.[10] The parameter ρ captures the weight placed by the monetary authority on price stability relative to output stability.

[10] Since any constant, anticipated rate of inflation has no real effects in this model, the target path for the price level could incorporate a constant rate of change. While most of the criticisms of base drift have emphasized price stability as a policy goal, the basic conclusions of this section would continue to hold if the policymaker's objective function included inflation stability. For an argument that the monetary authority should keep the price level, not the rate of inflation, on target, see Robert Hall (1984).

In order to evaluate the monetary authority's loss function, the model is first solved for the rational expectations equilibrium price function for arbitrary values of the parameters in the policy rule. The optimal values of the policy parameters γ_t and γ are then derived by minimizing the loss function.

Using (1) and (5) to eliminate y_t and m_t from (3), and noting that (1) implies ${}_{t-1}y_t = {}_{t-1}\bar{y}_t + \beta({}_{t-1}p_t - {}_{t-2}p_t)$, yields an expression for the equilibrium price level:

$$(7) \quad p_t = [1+(\alpha+\beta)(1-\gamma)]^{-1} \times [\gamma_t - (1-\gamma)(\bar{y}_t + \varepsilon_t) - \gamma_{t-1}\bar{y}_t + (\bar{v}_t + \psi_t) + (\alpha(1-\gamma) - \beta\gamma)\,{}_{t-1}p_t + \beta\,{}_{t-2}p_t + \xi_t].$$

Equation (7) can be solved, using the method of undetermined coefficients, to yield the rational expectations equilibrium price function:

$$(8) \quad p_t = k[\bar{v}_t - {}_{t-1}\bar{v}_t + \psi_t + \xi_t] - (1-\gamma)k[\bar{y}_t - {}_{t-1}\bar{y}_t + \varepsilon_t] + [1/(1+\beta)][{}_{t-1}\bar{v}_t - {}_{t-1}\bar{y}_t + \gamma_t] + [\beta/(1+\beta)][{}_{t-2}\bar{v}_t - {}_{t-2}\bar{y}_t + {}_{t-2}\gamma_t],$$

where $k = [1+(\alpha+\beta)(1-\gamma)]^{-1}$. It will be assumed that $k > 0$. From (1) and (8), the equilibrium level of output is given by

$$(9) \quad y_t = \bar{y}_t + (\alpha+\beta)k[\bar{v}_t - {}_{t-1}\bar{v}_t + \psi_t + \xi_t] - (\alpha+\beta)(1-\gamma)[\bar{y}_t - {}_{t-1}\bar{y}_t + \varepsilon_t] + \varepsilon_t + [\beta/(1+\beta)]\left[({}_{t-1}\bar{v}_t - {}_{t-2}\bar{v}_t) - ({}_{t-1}\bar{y}_t - {}_{t-2}\bar{y}_t) + (\gamma_t - {}_{t-2}\gamma_t)\right].$$

From the monetary authority's loss function, (6), and an inspection of the terms in (8) and (9) involving γ_t or expectations of γ_t, it is clear that the optimal choice for the target value of the nominal money stock is

$$(10) \qquad \gamma_t = {}_{t-1}\bar{y}_t - {}_{t-1}\bar{v}_t + p^*.$$

The target level of m_t should be adjusted to reflect current estimates of permanent real output and permanent velocity.

It will be useful to postpone temporarily the consideration of the optimal choice of γ and just assume, as seems to be the actual case in the United States, that the monetary authority allows the money supply to vary procyclically; that is, $\gamma > 0$. To derive the optimal degree of base drift for arbitrary γ, note first that from (10),

$$(11) \qquad \gamma_{t+1} - \gamma_t = [{}_t\bar{y}_{t+1} - {}_{t-1}\bar{y}_t] - [{}_t\bar{v}_{t+1} - {}_{t-1}\bar{v}_t].$$

J. F. Muth (1960) shows that for the assumed stochastic processes generating y and v,

$$(12a) \qquad {}_{t-1}\bar{y}_t = \lambda_y \sum_{i=0}^{\infty} (1-\lambda_y)^i \times [\bar{y}_{t-1-i} + \varepsilon_{t-1-i}]$$

$$(12b) \qquad {}_{t-1}\bar{v}_t = \lambda_v \sum_{i=0}^{\infty} (1-\lambda_v)^i v_{t-1-i}$$

where

$$\lambda_y = [1 + \sigma_u^2/4\sigma_\varepsilon^2]^{1/2}(\sigma_u/\sigma_\varepsilon) - (\sigma_u^2/2\sigma_\varepsilon^2),$$

$$\lambda_v = [1 + \sigma_\phi^2/4\sigma_\psi^2]^{1/2}(\sigma_\phi/\sigma_\psi) - (\sigma_\phi^2/2\sigma_\psi^2),$$

and σ_x^2 denotes the variance of x. Both λ_y and λ_v are positive and increasing in the ratio of the variance of the permanent innovation to the variance of the transitory innovation to $\bar{y} + \varepsilon$ and v, respectively. Equations (12a) and (12b) imply that ${}_t\bar{y}_{t+1} - {}_{t-1}\bar{y}_t = \lambda_y(\bar{y}_t + \varepsilon_t - {}_{t-1}\bar{y}_t)$ and ${}_t\bar{v}_{t+1} - {}_{t-1}\bar{v}_t = \lambda_v(v_t - {}_{t-1}\bar{v}_t)$. Using these results, (11) becomes

$$(11') \qquad \gamma_{t+1} - \gamma_t = \lambda_y(\bar{y}_t + \varepsilon_t - {}_{t-1}\bar{y}_t) - \lambda_v(v_t - {}_{t-1}\bar{v}_t).$$

Equation (11′) is the fundamental relationship governing the appropriate adjustment in the target base. In order to determine the optimal degree of base drift, it is necessary to relate this adjustment in the target to the deviation of the money supply from target in period t. Equation (5) and (11′) can be used to write

$$(13) \qquad \gamma_{t+1} - \gamma_t = (\lambda_y/\gamma k)(m_t - \gamma_t) - (\lambda_v + \lambda_y(\alpha+\beta))(\bar{v}_t + \psi_t - {}_{t-1}\bar{v}_t) - (\lambda_y/\gamma)(1+\alpha+\beta)\xi_t.$$

Equation (13) gives the optimal base adjustment as a function of the deviation from target during the period just ending, $m_t - \gamma_t$, the velocity surprise in period t, and the monetary control error. To interpret this equation, it is helpful to start with a special case. Suppose velocity is constant and there are no control errors. In this case, (13) becomes

$$(14) \qquad \gamma_{t+1} - \gamma_t = (\lambda_y/\gamma k)(m_t - \gamma_t),$$

so that the optimal degree of base drift is $\delta = \lambda_y/\gamma k > 0$. The index δ depends on both the structural parameters of the model (α and β appear in k), the monetary authority's behavior between target announcements (via γ), and, through λ_y, the relative variances of the permanent and transitory shocks to real output.

In standard aggregate models, it is common to assume that output follows a stationary process. In the present model, this would amount to assuming $\sigma_u^2 = 0$. This, in turn, implies that $\lambda_y = 0$. Thus, if income is not subject to any permanent shocks, optimal base drift is zero.[11] As mentioned previously, however, recent work by Nelson and Plosser suggests that output is difference stationary. In fact, they estimate the ratio of the

[11]If $\gamma = (1+\alpha+\beta)/(\alpha+\beta)$, then $\delta = 0$ even if $\lambda_y > 0$. Since $\alpha+\beta$ is usually estimated to be fairly small, this would require a large value for γ. Economically, this special case seems of little interest.

variance of permanent shocks to income to the variance of transitory shocks to be quite large. In order to keep the average price level constant, the monetary authority must let the nominal stock of money vary with movements in the real demand for money arising from permanent shocks to real income. If the actual money stock differs from its targeted level, the deviation is likely to be partially due to such a permanent shock, calling for an adjustment in the target for the nominal money supply. If base drift is never allowed, the price level must adjust to insure that the real quantity of money equals the real demand for money.

As (14) shows, δ is increasing in λ_y and decreasing in γ. With a larger λ_y, more of any income surprise is treated as due to a permanent shock, calling for more drift. A larger γ implies that m responds more within the period to output shocks; consequently, a smaller adjustment in the base is required.

Equation (14) holds only in the absence of control errors and with a constant velocity. When these conditions do not hold, equation (13) can be written

$$(15)\quad \gamma_{t+1}-\gamma_t=\delta(m'_t-\gamma_t)-\lambda_v(\bar{v}_t+\psi_t-{}_{t-1}\bar{v}_t),$$

where the optimal degree of base drift, δ, is exactly the same as in (14), but drift is now defined relative to a measure of "shift-adjusted" money:

$$(16)\quad m'_t=m_t-\xi_t-\gamma k(\alpha+\beta)\times(\bar{v}_t+\psi_t-{}_{t-1}\bar{v}_t+\xi_t).$$

According to equation (16), two types of adjustments need to be made to the realized money stock before determining optimal drift. The first is a one-for-one adjustment for any control errors. This shows clearly that in calculating base drift, bygones are not bygones: control errors should be fully offset. The second adjustment, given by the last term in (16), arises because of the induced response of the money supply to unanticipated income movements through the policy rule (5). Velocity shocks and control errors affect the excess supply of money and thereby affect income. This, through the policy reaction function, has an automatic impact on m_t. As (16) shows, m_t should be adjusted to offset changes arising from this source before drift is determined. Because of the induced impact via income, the total adjustment for control errors is more than one-for-one.

In addition to shift adjusting the realized money supply, equation (15) indicates that velocity shocks require a base change even if shift-adjusted m_t equals the target γ_t. The last term in (15) is equal to the fraction of any velocity shock that is expected to be permanent. The target for the money supply should be fully adjusted to reflect estimated permanent shifts in velocity. If all velocity shocks are transitory ($\lambda_v=0$), this term is zero. Transitory velocity shocks still have an effect on target levels, though, through the shift adjustment in equation (16). At the other extreme, if velocity is a random walk ($\lambda_v=1$), the monetary authority should fully offset changes in velocity, plus shift-adjust the realized money supply for velocity shocks.

So far, the results have all been predicated on an arbitrary value for γ. However, the monetary authority's choice of γ affects the short-run tradeoff between output stabilization and price stabilization and, hence, the value of the monetary authority's loss function given in (6). An optimal setting for γ can be found by minimizing $[\sigma_y^2+\rho\sigma_p^2]$ with respect to γ. As long as the target money supply is chosen according to (11), equations (8) and (9) imply $p_t-p^*=z_t$ and $y_t-\bar{y}_t=(\alpha+\beta)z_t+\varepsilon_t$, where $z_t=k[\bar{v}_t-{}_{t-1}\bar{v}_t+\psi_t+\xi_t]-(1-\gamma)k[\bar{y}_t-{}_{t-1}\bar{y}_t+\varepsilon_t]$. Hence, the loss function is independent of the base parameter γ_t. Setting the partial derivative of the loss function with respect to γ equal to zero and solving for the optimal policy response γ^*, one finds that

$$(17)\quad \gamma^*=1-(\alpha+\beta)\times\left[\Omega\left(\sigma_v^2+\sigma_\psi^2+\sigma_\xi^2\right)+\sigma_\varepsilon^2\right]/\left[\Omega\sigma_y^2+\rho\sigma_\varepsilon^2\right],$$

where $\Omega=(\alpha+\beta)^2+\rho,$

and $\sigma_{\bar{v}}^2 = E[\bar{v}_t - {}_{t-1}\bar{v}_t]^2$

$$= [\sigma_\phi^2 + \lambda_v^2 \sigma_\psi^2] / [\lambda_v (2 - \lambda_v)],$$

$$\sigma_{\bar{y}}^2 = E[\bar{y}_t - {}_{t-1}\bar{y}_t]^2$$

$$= [\sigma_u^2 + \lambda_y \sigma_\varepsilon^2] / \lambda_y^2 (2 - \lambda_y)]$$

are the variances of the prediction errors of permanent velocity and income. It is useful to recall that the covariances among all the underlying shocks have been assumed to equal zero.

If the aggregate demand disturbances (velocity shocks and monetary control errors) are large relative to supply shocks, income and prices will tend to move together, and the optimal γ is likely to be negative as the monetary authority works to offset demand shocks. In this case, the formula for δ shows that drift should be negative. If a supply shock causes a rise in income, m_t will undershoot its target, and the appropriate response by the monetary authority is to increase its target for the money supply. On the other hand, γ^* increases with the variance of permanent supply innovations as positive shocks to output require an increase in aggregate demand to prevent the price level from changing. The impact of σ_ε^2, the variance of transitory supply shocks, on γ^* is ambiguous and depends on the weight the monetary authority places on price stabilization. If ρ is large, γ^* will increase with σ_ε^2.

Using equation (17), it is possible to derive the appropriate degree of base drift when γ is optimally chosen. Calling this δ^*, some simple algebra yields

$$\text{(18)} \quad \delta^* = \lambda_y \Omega \big[\sigma_{\bar{y}}^2 + \sigma_\varepsilon^2 + (\alpha + \beta)(\sigma_{\bar{v}}^2 + \sigma_\psi^2 + \sigma_\xi^2) \big] \Big/ \big[\Omega \sigma_{\bar{y}}^2 + (\rho - \alpha - \beta) \sigma_\varepsilon^2 - (\alpha + \beta) \Omega (\sigma_{\bar{v}}^2 + \sigma_\psi^2 + \sigma_\xi^2) \big].$$

In general, δ^* depends on the error variances, the structural parameters, and the monetary authority's preferences for price versus output stability as measured by ρ. A sufficient condition for $\delta^* = 0$ continues to be $\lambda_y = 0$ (i.e., no permanent shocks to supply). A sufficient condition for $\delta^* = 1$ is $\lambda_y = 1$ (no transitory supply shocks) *and* no velocity disturbances or control errors. Also, even though $\delta = 0$ when $\lambda_y = 0$, this only implies that the target for $t+1$ should not depend on deviations of m_t from target; it does not imply the target base should remain constant. This latter condition, as (11′) shows, requires that both λ_y and λ_v equal zero. While the expression for δ is a complicated function of all the parameters of the model, it is important to recall that the fundamental equation determining the optimal base change is (11′) which depends only on λ_y and λ_v. Because income movements affect the contemporaneous deviation of money from target, while the policy rule affects income movements, much more information is needed, as (18) shows, if the base change is to be related to the target deviation.

II. Interpretation

The results of Section I were derived within the context of a simplified aggregate model, but the basic conclusions suggested by the model will hold more generally. To the extent that deviations of the nominal money stock from its target path reflect permanent shocks to the economy, a policy of price stability requires some degree of base drift. While zero drift will not be optimal, neither will complete base drift generally be consistent with a policy of price stability. It is interesting, though, to consider how the actual practice of the FOMC compares to the implications derived for optimal drift.

Equations (15) and (16) show that the appropriate adjustment in the target for the nominal money supply at the start of each period depends very much on the reason there may have been a divergence between actual money and targeted money. In the present model, supply shocks, velocity shifts, and control errors can all cause m_t to differ from γ_t, and each type of disturbance calls for a different adjustment in the target base. For example, if the deviation is due to a velocity shock, two adjustments should be made. First, there should be an offsetting movement in the base equal to the fraction of the velocity shock estimated to be permanent. This, in fact, is done indirectly by the FOMC. The Fed has in several years focused on $M1$ adjusted for velocity shifts due to financial deregulation. Such shifts occurred, for example, with the introduction of automatic transfer from savings (ATS) accounts in 1979 and the national authorization of negotiable order of withdrawal (NOW) accounts in 1981.[12] Since the FOMC has practiced complete base drift with respect to deviations of this adjusted $M1$ from target, it has essentially made what equation (16) shows to be the appropriate base change (i.e., full adjustment for estimated permanent shifts in velocity) if it has correctly estimated the permanent velocity shifts. For example, for 1981, Table 1 shows that base drift was $-\$8.8$ billion. Financial deregulation (the national authorization of NOW accounts) produced what the Fed estimated to be a permanent upward shift in velocity. Some negative drift was therefore appropriate in setting the target path for 1982. These adjustments for permanent shifts in velocity should be made even if the nominal money supply were to equal its target value for the fourth quarter.

Second, any velocity shock, whether permanent or transitory, produces an effect on the nominal money supply through the monetary authority's reaction function. This effect on the money supply must be offset if the price level in future periods is to be kept constant.

If output for period t is underestimated due to either a permanent (u_t) or a transitory (ε_t) supply shock, m_t will exceed its target γ_t. Because some fraction of this miss should be attributed to a positive realization of the permanent shock, an upward revision in the base is required for price and output stabilization.[13] Some drift is optimal in this case. However, only if all income shocks are permanent and there are no velocity shocks or control errors would complete base drift, as practiced by the Fed, be optimal.

If the money supply target is missed because of a control error, the realized money supply should be adjusted, in calculating the appropriate change in the base, in order to offset the impact of the control error. Under current Fed practice, a positive control error leaves the nominal money supply permanently higher.[14] For the model studied here, the optimal response calls for a shift adjustment that more than offsets the control error.

In its critique of base drift, the Council of Economic Advisers attributed deviations of $M1$ from target, and hence the subsequent base drift, to the Fed's attempts to smooth interest rates. As the analysis of optimal base drift shows, deviations from target due to any response of money to current shocks should not lead to a change in the base unless a permanent innovation to income or velocity is estimated to have occurred. The recent deemphasis of $M1$ by the FOMC may mean that future deviations of $M1$ will be more responsive to transitory disturbances and subject to larger control errors. This would suggest the optimal degree of base drift will decline.

While the analysis suggests that a policy of zero base drift will not be optimal, it also suggests that the current Federal Reserve practice of complete base drift is also not generally optimal. This is particularly true with respect to monetary control errors which produce deviations of the money supply from its target path. However, during periods of technological change in both the real and financial sectors, there is no a priori reason to argue that base drift is inconsistent with a policy objective of price stability. In fact,

[12] These adjustments are discussed in Barbara Bennett (1982) and Broaddus and Goodfriend.

[13] This discussion assumes $\gamma > 0$. If $\gamma < 0$, then a positive income disturbance will cause m_t to fall below γ_t. With $\delta = \lambda_v/\gamma k < 0$, this implies that γ_{t+1} should be increased. As (11′) shows, the appropriate change in the target is independent of the sign of γ, even though the sign of δ is not.

[14] Poole calls base drift "the insidious practice of sweeping monetary control errors under the rug..." (1985, p. 4).

empirical evidence suggesting the presence of permanent real and financial shocks indicates that the complete elimination of base drift is likely to be incompatible with the achievement of price stability.

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