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"FOMC Targets, Base Drift and Inflationary Expectations"

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I. INTRODUCTION

The purpose of the present paper is to study the effect on the expected inflation rate of two practices the Federal Open Market Committee (FOMC) currently engages in the setting of its monetary targets. The first is the FOMC's present procedure for basing its yearly monetary targets. Currently, these targets are computed as follows: (1) First, a range of percentage growth values for a particular monetary aggregate is chosen (e.g. 4%–8% growth in M1); (2) Second, the targets for any given year are computed as percentages about the value of the given aggregate for the fourth quarter of the previous year. This target-setting procedure results in a fan of implicit money stock targets emanating from the fourth-quarter value of the monetary aggregate.

The second FOMC practice to be examined is that of "rebasing." With rebasing, a new sequence of monetary target values is computed during the calendar year, frequently when the money supply has been behaving erratically relative to its earlier target values. This procedure for rechoosing targets is similar to the FOMC's procedure for initial target choice, since the new target values are again based on the most recent value of the money supply.

The FOMC's procedure of initiating its targets at the beginning of the calendar year has for some time come under criticism, since it results in "base drift." [Broddus and Goodfriend (1984), Clark (1985), Lombra and Strubel (1975), Poole (1976, 1985)]. The criticism is that when the FOMC links its aggregate targets to a base value of the money supply at a point in time, it runs the risk of having its entire sequence of monetary targets being abnormally high or abnormally low, depending on short-run disturbances to the base value. This results in market participants being uncertain about the FOMC's commitment to its monetary targets, with the uncertainty having effects on, among other things, inflationary expectations.

A similar criticism has been made against the practice of rebasing. [Poole (1976), Broddus and Goodfriend (1984), Hetzel (1984), Clark (1985)]. In switching to a new set of operating guides during the calendar year, the FOMC runs the risk of causing market uncertainty about its commitment to its monetary targets, with this uncertainty having effects on price expectations. Although not clear, in addition to the unpredictable behavior of the velocity of M1, the FOMC's frequent need to rebase and the resulting uncertainty could have played a role in its placing M1 on a monitoring rather than a targeting status beginning in 1984.

In the present paper, we address the question of the effects of these two FOMC practices on inflationary expectations. To do this, we build a simple model in which prices and the expected inflation rate are linked through the supply and demand for money. The model is then used to study the implications for the expected inflation rate of several stylized versions FOMC target-setting strategy. Particular attention will be paid to addressing two issues. First, we will

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address the question of whether it is optimal to build a target-basing strategy around a single period's value of the money supply, where the behavior of inflationary expectations is the criterion for evaluation. Second, we examine the effects of rebasing on the expected inflation rate.

Part II of the paper presents our model of price determination. The price level, and therefore the expected inflation rate, is determined through the supply and demand for money. Disturbances to the demand for money are assumed to be autocorrelated over time. The supply of money, on the other hand, is assumed to follow an autoregressive moving average process. The notion that the paper tries to capture is that of two types of money supply responses. The autoregressive component of the money stock models the FOMC's long-run strategy by determining the rate at which disturbances to the money supply are offset. Whether the FOMC offsets disturbances which accumulate during a single short-run period or more than one short-run period is captured by the moving average component of the money supply process. This models the FMOC's target-basing strategy.

Using this model, Part III of the paper examines the effects of the FOMC's target-basing strategy on the behavior of inflationary expectations. In particular, we examine the implications of alternative target-basing strategies on the variance of the expected inflation rate when a current money supply announcement is received.[1] Three key conclusions are reached.

First, a scheme in which the FOMC offsets disturbances in the long run about an average of more than one period's short-run disturbance is generally preferred to responding to a single period's short-run disturbance. This holds provided that the proper weights are chosen in determining the short-run averaging response. Second, not correcting for target base drift in this manner is optimal only under restricted conditions. The conditions are that the FOMC accommodate its long-run money supply strategy to long-run changes in the demand for money. Finally, there are some implications for target rebasing on the expected inflation rate. Rebasing results in inflationary expectations being entirely dominated by long-run changes in the demand for money.

These results are summarized in Section IV of the paper.

II. A SIMPLE MODEL OF THE EXPECTED INFLATION RATE

To determine the relation between FOMC strategy and inflationary expectations we begin with a discrete-time model linking the demand for money to the expected inflation rate. The money demand function is

$$M_t = M^d + P_t + \beta E(P_{t+1} - P_t) + d_t, \tag{1}$$

where M_t is the logarithm of the nominal quantity of money demanded at time t; P_t is the logarithm of the current price level; $E(P_{t+1} - P_t)$ is the expected inflation rate from t to t + 1, conditional on the information set I (to be discussed later); d_t is a disturbance term; and $\beta < 0$ is a parameter. As the sign of β implies, the nominal demand for money decreases with the expected inflation rate from t to t + 1, because of the higher costs of holding cash balances due to expected inflation.[2] This effect on the demand for money is like that of an increase in nominal interest rates. All other factors affecting the demand for money over the holding period are subsumed in the constant term, M^d (based on permanent income), plus the log of the price level. Following this specification allows us to abstract from other variables that might affect the demand for money in the short run, such as real income. On the other hand, it allows for a complete enough interaction between the demand for money and inflationary expectations to draw some interesting policy implications for monetary policy on these expectations.

The money demand disturbance follows a first-order autoregressive scheme known by all market participants:

$$d_t = \rho d_{t-1} + u_t, \tag{2}$$

where $0 < \rho < 1$, and u_t is a white noise component with finite variance, σ_u^2.

The money supply consists of two components, a stock adjustment equation, and a target-setting response.[3]

$$(M_t - M_t^*) = \alpha(M_{t-1} - M_{t-1}^*) + v_t, \tag{3}$$

$$M_t^* = M_{t-1}^* + \lambda v_{t-1}, \tag{4}$$

where $0 < \alpha < 1$, $|\lambda| < \infty$, and v_t is a white noise component with finite variance, σ_v^2.

The parameters α and λ in equations (3) and (4) are aimed at capturing two types of FOMC behavior. The stock-adjustment α captures the speed with which the authority offsets past disturbances to the money stock, and therefore governs the rate at which future disturbances to the money supply are allowed to accumulate. This parameter governs long-run monetary policy.

The parameter λ controls the number of periods' (as well as magnitude of) monetary disturbances the FOMC allows into its current target, and therefore, into its future monetary response. As an example, when $\lambda = 0$ in equation (4), future values of the money supply are allowed to accumulate about the current disturbance v_t. This is similar to the current FOMC strategy of basing its yearly sequence of monetary targets on a single quarter's value of the money supply. When $\lambda \neq 0$, future values of the money supply will be allowed to accumulate about an average of the disturbances v_t and v_{t-1}. This would be the case if the FOMC, instead, based its yearly sequence of monetary targets on a two-quarter average of the money supply, with the relative weight on the earlier quarter's money stock value being λ.[4]

Substituting equation (4) into equation (3) and solving recursively obtains

$$M_t = (1 - \alpha)\sum_{i=0}^{\infty} \alpha^i M_{t-i-1}^* + \sum_{i=0}^{\infty} \alpha^i (v_{t-1} + \lambda v_{t-i-1}) \tag{5}$$

This reduces to the following model, consisting of a deterministic plus first-order autoregressive moving average process for the money supply.

$$M_t = M^* + s_t \tag{6}$$

$$s_t = \alpha s_{t-1} + \lambda v_{t-1} + v_t. \tag{7}$$

$$M^* = (1 - \alpha)\sum_{i=0}^{\infty} \alpha^i M_{t-i-1}^*. \tag{8}$$

To see the response of the expected inflation rate to alternative monetary strategies, we determine $E(P_{t+1} - P_t)$ both before and after the announcement of the current money stock M_t. This requires determination of the equilibrium price level P_t both before and after the announcement of M_t. At all times t, the market participant's information set I will include the current price level P_t as well as all lagged values of the price level and money stock. The monetary process defined in equations (6) through (8) will also be known to the economic agents. Finally, market participants will be assumed to form rational expectations at all times based on this information.

Since P_t is in the participant's information set, the assumption $E(P_t) = P_t$ can be used in determining the equilibrium price level.[5] Use of this assumption and equations (1), (6), (7) and

(8) obtains

$$P_t = \frac{M^* - M^d}{1-\beta} + \frac{s_t - d_t}{1-\beta} - \frac{\beta E_t P_{t+1}}{1-\beta}. \tag{9}$$

Before the announcement, M_t is not observable. Agents will therefore not be able to identify s_t in equation (9). Since agents will not be able to distinguish between current disturbances to money supply and money demand, an equilibrium price level of the form[6]

$$P_t = \Pi_0 + \Pi_1 (v_t - u_t) + \Pi_2 s_{t-1} + \Pi_3 v_{t-1} + \Pi_4 d_{t-1}. \tag{10}$$

is conjectured. Letting

$$\theta_1 = \frac{\sigma_v^2}{\sigma_v^2 + \sigma_u^2} \tag{11}$$

and

$$\theta_2 = \frac{\sigma_u^2}{\sigma_v^2 + \sigma_u^2}, \tag{12}$$

equations (2), (7) and (10) through (12) can be used to obtain the expected future price level[7]

$$E(P_{t+1}) = \Pi_0 + \Pi_2 \alpha s_{t-1} + \Pi_2 \lambda v_{t-1} + \Pi_4 \rho d_{t-1} + ((\Pi_2 + \Pi_3)\theta_1 - \Pi_4\theta_2)(v_t - u_t) \tag{13}$$

Substituting (13) into (9), and equating the resulting expression to (10) results in the following Π-coefficients for the equilibrium price level:

$$\begin{aligned} \Pi_0 &= M^* - \overline{M}^d, \\ \Pi_1 &= \frac{1}{1-\beta} - \frac{\beta}{1-\beta}((\Pi_2 + \Pi_3)\theta_1 - \Pi_4\theta_2), \\ \Pi_2 &= \frac{\alpha}{1-\beta(1-\alpha)}, \\ \Pi_3 &= \frac{\lambda}{1-\beta(1-\alpha)}, \\ \Pi_4 &= \frac{-\rho}{1-\beta(1-\rho)}, \end{aligned} \tag{14}$$

Use of equations (10), (13), (14) and the assumption $E(P_t) = P_t$, in turn, results in the expected inflation rate before the announcement of M_t

$$\begin{aligned} E(P_{t+1} - P_t)_B = {} & \Pi_2(\alpha - 1)s_{t-1} + (\lambda\Pi_2 - \Pi_3)v_{t-1} \\ & + \Pi_4(\rho - 1)d_{t-1} + ((\Pi_2 + \Pi_3)\theta_1 - \Pi_4\theta_2 - \Pi_1)(v_t - u_t). \end{aligned} \tag{15}$$

After the announcement of M_t, agents will be able to observe the money supply disturbance s_t, and will therefore have sufficient information to separate the disturbance v_t and u_t. The equilibrium price level will therefore be of the form

$$P_t = \Pi_0 + \Pi_1' v_t + \Pi_1'' u_t + \Pi_2 s_{t-1} + \Pi_3 v_{t-1} + \Pi_4 d_{t-1}. \tag{16}$$

Since $E(v_t) = v_t$ and $E(u_t) = u_t$, equations (2), (6), (7), (8) and (16) can be used to obtain the expected price level.

$$E(P_{t+1}) = \Pi_0 + \Pi_2 \alpha s_{t-1} + \Pi_2 \lambda v_{t-1} + \Pi_4 \rho d_{t-1} + (\Pi_2 + \Pi_3)v_t + \Pi_4 u_t. \tag{17}$$

Substituting (17) into (9), and equating the resulting expression to (16) obtains the following Π-coefficients for the equilibrium value of P_t after the announcement

$$\begin{aligned} \Pi_1' &= \frac{1}{1-\beta} - \frac{\beta}{1-\beta}(\Pi_2 + \Pi_3), \\ \Pi_1'' &= -\frac{1}{1-\beta} - \frac{\beta}{1-\beta}\Pi_4, \end{aligned} \tag{18}$$

where Π_0, Π_2, Π_3, and Π_4 appear as in equation (14). The expected inflation rate upon announcement of M_t is then obtained using equations (16), (17), and (18), and the assumption $E(P_t) = P_t$

$$\begin{aligned} E(P_{t+1} - P_t)_A = {} & \Pi_2(\alpha - 1)s_{t-1} + (\lambda\Pi_2 - \Pi_3)v_{t-1} \\ & \Pi_4(\rho - 1)d_{t-1} + (\Pi_2 + \Pi_3 - \Pi_1')v_t + (\Pi_4 - \Pi_1'')u_t. \end{aligned} \tag{19}$$

III. MONETARY TARGETING AND THE VARIANCE IN INFLATIONARY EXPECTATIONS

The change in the expected inflation rate upon the announcement of M_t is obtained from equation (14), (15), (18) and (19), and the property $\theta_1 + \theta_2 \equiv 1$.

$$\begin{aligned} & E(P_t - P_{t+1})_B - E(P_t - P_{t+1})_A \\ & = \frac{-1}{1-\beta}(\Pi_2 + \Pi_3 + \Pi_4)(\theta_2 v_t + \theta_1 u_t) \\ & = \frac{-1}{1-\beta}\left(\frac{\alpha + \lambda}{1-\beta(1-\alpha)} - \frac{\rho}{1-\beta(1-\rho)}\right)(\theta_2 v_t + \theta_1 u_t). \end{aligned} \tag{20}$$

Its variation is

$$\begin{aligned} & E(E(P_t - P_{t+1})_B - E(P_t - P_{t+1})_A)^2 \\ & = \left(\frac{1}{1-\beta}\right)^2 \left(\frac{\alpha + \lambda}{1-\beta(1-\alpha)} - \frac{\rho}{1-\beta(1-\rho)}\right)^2 \frac{(\sigma_v^2 \sigma_u^2)}{\sigma_v^2 + \sigma_u^2}. \end{aligned} \tag{21}$$

Equation (21) is to be used in our model as a welfare loss due to inflationary uncertainty. Some explanation of this measure is warranted.

Our choice of welfare loss due to uncertainty is made on grounds of consistency with Barro's (1976, 1980) and King's (1982) definition of welfare loss as a variation in aggregate supply under incomplete information relative to full information aggregate output. Our definition of uncertainty rests on its consistency with Barro's and King's framework, and alternative modeling assumptions would lead to alternative definitions of uncertainty and different policy conclusions than those to be derived.

The central idea for these authors is that supply decisions made by firms with complete information will be optimizing, and that deviations in aggregate supply away from full information will therefore result in welfare loss. Since output supplied in Barro's and King's framework is proportional to the difference between the current actual and expected future aggregate price levels, output variation in their class of models is proportional to variation in the expected inflation rate about its full-information value. This definition of uncertainty is consistent with the variation in price expectations defined in equation (21). As our derivation of equations (14) and (18) suggests, with the announcement of the current money stock, M_t, agents have sufficient information to determine the complete-information expected inflation rate $E(P_{t+1} - P_t)_A$. In contrast, before the announcement, the expected inflation rate $E(P_{t+1} - P_t)_B$ is determined without knowledge of the current money stock and therefore based on less than complete information.

In attempting to minimize the variance defined in equation (21), policy is set so that the expected inflation rate before the announcement will not be too different from the full-information response that will occur after the announcement. Because of the cost involved in providing earlier money stock information to market participants, an alternative to providing this information might be the intelligent choice of monetary targets and money supply control strategy. Under these conditions, minimization of equation (21) is a reasonable policy objective.

Assuming decreased inflationary uncertainty in the above sense is the policy objective, equation (21) can be minimized with respect to λ to obtain

$$\lambda^* = \frac{(\rho - \alpha)(1 - \beta)}{1 - \beta(1 - \rho)}. \tag{22}$$

Some interesting implications about the relationship between the FOMC's targeting procedures and inflationary expectations are revealed by equation (22).

First, as the equation suggests, the FOMC's targeting procedures will generate less inflationary uncertainty (measured by the variance in the expected inflation rate about its full information value) if an optimal or near-optimal averaging scheme for selecting the target bases is used than with no base averaging. In our model, this scheme is determined by choosing the weights λ^* and 1 for the disturbances v_{t-1} and v_t in the moving average component of the money supply process.

This result is intuitive, given agent's response to information in our model. Before the announcement of the money supply M_t, agents cannot distinguish between the current money supply disturbance v_t and current disturbance to money demand u_t. With the announcement of M_t and information about the disturbance, agents will adjust their expectations $E(P_{t+1} - P_t)$ of inflation in a manner consistent with their newly-acquired information about future monetary policy. That is, long-run monetary policy will be expected to offset future disturbances accumulated about the value v_t, as well as about the past money supply disturbance s_{t-1}.

When target averaging is used, long-run monetary policy is expected to offset future disturbance about the value $v_t + \lambda v_{t-1}$, as well as about s_{t-1}. In this case a larger proportion of expected future monetary policy is determined before the announcement. Market participants incorporate this information into their expectations before the announcement (see equation (13)) and respond less to v_t when M_t is announced. In essence, their response to M_t is smaller when there is target-base averaging because they have prior information that the FOMC is taking a more gradualistic approach to monetary policy.[8]

Whether or not the use of a base averaging scheme for choosing monetary targets will generate less inflationary uncertainty than allowing future money stock values to accumulate about the value v_t will, of course, depend on the weighing scheme chosen for the disturbances v_t and v_{t-1}. Equation (21) does suggest, though, the factors the FOMC should consider in choosing such a weighing scheme. The relative weight λ^* for the disturbance v_{t-1} depends in equation (22) on the difference $(\rho - \alpha)$. In other words, when it chooses its targets, the Federal Reserve should consider how fast it plans on offsetting disturbances to the money stock in the long run relative to the rate at which disturbances to money demand dissipate. Being more gradualistic in its setting of the targets through the choice of λ allows the FOMC more latitude in its long-run monetary policy, since this information can be provided to market participants through the target itself.

Equation (22) also reveals that if the FOMC does not prefer to use a gradualistic approach in basing its targets, and inflationary uncertainty is a concern, it may be forced to be more accommodative in its long-run monetary policy. The analog of base drift occurs in our model when $\lambda = 0$, so that future money stock disturbances are allowed to accumulate about the single-period's disturbance v_t. As equation (22) suggests, the assumption that $\lambda^* = 0$ equivalently implies that $\alpha = \rho$. In other words, the same variation in inflationary expectations in equation (21) can only be obtained when base drift is not offset by target-base averaging in the short run, if money supply disturbances are offset in the long run at the rate at which money demand disturbances dissipate. What this suggests is that when more information is contained in the announcement of M_t (and revealed values of v_t and u_t) rather than in the target, markets adjust their expectations more rapidly. The FOMC is, then, forced to offset this uncertainty by accommodating its long-run money supply strategy to changes in money demand.[9]

Finally, equation (22) suggests some implications for the FOMC practice of money supply target rebasing. Rebasing differs from choosing a single period's value for the money stock target in that not only does the FOMC choose a single period target base, but the long-run targeting period changes. This is because rebasing is done during the calendar year to determine new targets for the remainder of the calendar year. In our model, a version of rebasing is to assume $\lambda = \alpha = 0$. In other words, the long-run policy horizon is shortened from a one period lag to a zero period lag, as the FOMC recalculates its targets. As equation (22) suggests, when $\alpha = \lambda = 0$, $\lambda^* = 0$ only if $\rho = 0$. Rebasing is therefore optimal only under the assumption that money demand disturbances accrue entirely in the short run.

This result is intuitive. When the FOMC rebases its targets it, at least temporarily, relinquishes both short and long-run control of the money stock. This, in itself, imparts a particular type of uncertainty to market participants. With any information about future money supply strategy, market participants will only obtain information about money demand from the current announcement of M_t. As equation (21) suggests, in this case the change in inflationary expectation upon the announcement of M_t will be entirely dominated by long-run changes in the demand for money. Unless changes in the demand for money are confined entirely to the current market period, rebasing will, then, in general, not be optimal in terms of behavior of the expected inflation rate.

IV. CONCLUSIONS

The strength of these results, clearly, depends on two factors: 1) first, our use of a relatively simple model in which inflationary expectations were determined entirely through the supply and demand for money; 2) second, our use of a simplistic model of the money supply target-setting and long-run monetary control process. This latter assumption has been particularly helpful in that it has allowed our presentation of a potentially complex process as a simple first-order autoregressive moving average scheme.

In spite of its simplicity, the model has been useful in pointing out some important points about the relationship between the FOMC's target-setting behavior and the behavior of inflationary expectations. It is worthwhile mentioning these results.

First, some type of averaging scheme for determining the FOMC's money stock target bases will, in general, generate less inflationary uncertainty than no averaging. The notion we try to convey is that an averaging scheme for determining the target bases results in a more gradualistic approach to setting the targets, which can provide information to market participants about future monetary policy.

Second, the effects on inflationary uncertainty of the present alternative to such an averaging scheme, which has been to let the FOMC's target base drift upward or downward at the end of each calendar year, can be offset. But doing so requires the FOMC to accommodate its long-run money supply strategy to changes in the demand for money.

Third, rebasing the money supply targets during the calendar year carries with it an implicit assumption about the FOMC's behavior relative to market participants. That is, when the FOMC rebases its targets, it must at least temporarily be willing to allow market participants' inflationary expectations to be dominated by long-run changes in the demand for money.

NOTES

1. This response, if conceptually separate from the response of interest rates to the announcements of the current money supply, has been extensively treated in the literature [See Cornell (1982, 1983a, 1983b), Culbertson and Koray (1986), Engel and Frankel (1984), Gavin and Karamouzis (1986), Hein (1985), Roley (1982, 1983), Roley and Troll (1983), Roley and Walsh (1984), Urich and Wachtel (1981), to mention a few]. The related issue of whether interest rate responses to monetary announcements are, in part, due to inflationary expectations has been studied by Cornell (1983b), Culbertson and Koray (1986), and Gavin and Karamouzis (1986). The conclusion of these latter studies is that the source of interest rate response to monetary announcements depends on the sample period under consideration.
2. An alternative way in which the inflation rate can affect the demand for money is through the variance in inflation rate, e.g. $E(P_t - P_{t+1})^2$. Inclusion of such a term in equation (1) would be along the lines of Kline (1977), and would capture the effect of inflation on the quality of cash balances. We neglect this type of money demand specification, since Marwah (1976) and Carlson and Frew (1980) have demonstrated that there are problems in empirically measuring the demand for money using Kline's specification.
3. Since similar target-setting procedures have, until the recent abandonment of M1 targets, been used by the Federal Reserve for M1, M2, and M3, M_t in equation (3) will refer to any of these three monetary aggregates.
4. Another interpretation of the moving average component of equation (7) is that the money supply process is subject to statistical observation error. In this case v_t represents the current period's observation error to the money stock, while v_{t-1} is the data revision, i.e., the update of the previous period's error.
5. Under the assumption of the observability of P_t, the only signal extraction problem in the model becomes that of obtaining the expected future price level $E(P_{t+1})$, and therefore inflation rate, before and after the observation of the announced money stock M_t.
6. The model is solved using the method of undetermined coefficients introduced by Lucas [1972, 1973, 1975]. The reader familiar with this method is referred to p. 11 for the principal conclusions of the paper. A more detailed derivation of the paper's results is also available to the interested reader upon request.
7. A point of clarification to the reader not familiar with the signal extraction problem might at this point be helpful. The expectation $E(P_{t+1})$ in equation (13) which depends on θ_1 and θ_2 defined in equations (11) and (12) is obtained as follows. Equation (10) is led one period ahead and its expectation is obtained using equations (2) and (7). This results in an expression in the expected values $E(u_t)$ and $E(v_t)$. Regressing u_t and v_t against all current information in the price level, ie. the innovation $v_t - u_t$, obtains these expectations, which depend on the proportions in price variation θ_1 and θ_2 stemming from the current money supply and money demand disturbances.
8. A related problem is if monetary policy is not based on v_{t-1}, there is no opportunity for data revision, so the v_t will contain the observation error. Basing a targeting strategy on data subject to such observation error conveys uncertainty to market participants [see Poole (1976)].
9. Although not explicitly allowed for in our model, such accomodation of the money supply to the demand for money might be undesirable in being inconsistent with other FOMC objectives, for instance, the state of the balance of trade.

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