Efficient Market Responses to Error-Ridden Money Supply Announcements

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Disciplines
Behavioral Economics | Econometrics | Economic History | Economic Theory | Income Distribution

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Efficient Market Responses to Error-Ridden Money Supply Announcements

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Department of Economics
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July, 1984
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*We thank members of the Iowa State Economics Seminar for helpful comments and Dorenda Maxwell for research assistance. We retain responsibility for remaining errors.
ABSTRACT

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1. Introduction

In recent years, numerous studies have estimated the response of asset prices to announced government estimates of economic aggregates. Most commonly, these studies have analyzed the response of asset prices (or yields) to the unanticipated and anticipated components of the Federal Reserve's weekly money supply announcements. Using regression methods, the estimated coefficients on the unanticipated and anticipated components of the announcement are typically interpreted to be the market's response to perceived unanticipated and anticipated money supply changes, respectively. In other words, these studies assume that private agents accept the Fed's announcements at face value, completely ignoring the fact that these announcements are contaminated by estimation errors.

This study introduces a model of the optimal market response to announced estimates of change in economic aggregates when the estimates are known to be subject to error. Under fairly general conditions, we show that rational agents will not take such estimates literally, particularly if they intend to respond only to true changes in these aggregate measures. Instead, they will attempt to extract their own perception of the true change conditional on the announcement which they will view as a noisy signal of the truth. An implication of the theory is that studies which equate an agent's perception of the money supply change with an announced money supply change can lead to incorrect conclusions regarding the behavioral response of asset prices to money supply shocks.

In the next section we formalize this argument in terms of optimal signal extraction theory. In the third section we consider some implications of the
theory for econometric practice which we apply in Section 4. Our main results and conclusions are summarized in Section 5.

2. Theoretical Model

A. Motivation

The basic model which has been used extensively to measure the response of asset yields to weekly money supply announcements can be written as

\[ R_t = b_0 + b_1 M^u_{A,t} + b_2 M^e_{A,t} + u_t \]  

(1)

where \( R_t \) is the change in an asset's yield over a short time interval that includes the Fed's money supply announcement during week \( t; \) \( M^e_{A,t} \) is the change in the money supply that the public predicts the Fed will announce during week \( t; \) and \( M^u_{A,t} \) is the surprise component of the announced money supply change (i.e., the actual announced change minus \( M^e_{A,t} \)). \( u_t \) is a zero mean, serially uncorrelated disturbance process. While individual studies differ according to the choice of an asset, the length of the interval over which the asset's price change is measured, the measurement of the anticipated component of the announcement, and the functional form used, for present purposes these differences are not particularly important and (1) captures the essential common structure that they share.

Equation (1) implicitly assumes that the public accepts the Fed's announcement at face value. This would be true if the Fed's announcement reflected all of the relevant information available to the market at the time of the announcement. However, this seems unlikely. The Fed's weekly announcements are based on data collected from a small subset of the domestic chartered banks. Thus, it seems reasonable to suppose that the market has information about the money supply which is unavailable to the Fed, just as the Fed's announcement contains information that
was unavailable to the market. In general, provided that the information sets for the Fed and the public are distinct (i.e., neither information set is a proper subset of the other) the market can do better than to accept the Fed's announcements at face value. In particular, our theory generates an estimation scheme for the market, conditional on the Fed's announcement, that results in a more efficient estimate than that of the Fed. In other words, rational agents will attempt to extract information on the true money supply from the Fed's error-ridden announcement. This signal extraction process can have serious implications for commonly used empirical tests of market efficiency and for the interpretation of estimated responses to money supply announcements.

B. The Signal-Extraction Model

Consider an agent's response to an unanticipated announced change in the money supply, \( M_{A,t}^U \). In general, this unanticipated portion of the announcement will be contaminated by measurement error. Thus, \( M_{A,t}^U \) can be decomposed as follows

\[
M_{A,t}^U = M_t^T + e_t
\]

where \( M_t^T \) is the true money supply innovation and \( e_t \) is the Fed's initial reporting error (i.e., its initial announcement minus its subsequent revised estimate). If agents had perfect information regarding the values of \( M_t^T \) and \( e_t \) we assume that they would respond only to the true money supply innovation. In the absence of such information the agents will respond to their best guess of the true component of the money supply announcement. That is, (1) can be written as

\[
R_t = a_0 + a_1 M_{t}^T + a_2 \hat{e}_t + a_3 M_{A,t}^E + \nu_t
\]

where \( \hat{M}_t^T \) and \( \hat{e}_t \) are, respectively, the agents' best estimates of the true and error components of the unexpected portion of the Fed's money supply announcement at \( t \).
Our previous argument would imply that $a_2$ be equal to zero. Therefore, we will proceed under the assumption that $a_2$ is equal to zero. It remains to determine the agents optimal calculation of $\hat{M}_t^T$.

We propose the following model. Let $E[M_t^T|M_{A,t}^U, M_{A,t}^E]$ denote the agents' estimate of $M_t^T$ conditioned upon the unanticipated and anticipated components of the Fed's money supply announcement at $t$. Then

$$\hat{M}_t^T = E[M_t^T|M_{A,t}^U, M_{A,t}^E]$$

(4)

which (since we have assumed that $a_2 = 0$) can be combined with (3) to obtain

$$R_t = a_0 + a_1 E[M_t^T|M_{A,t}^U, M_{A,t}^E] + a_3 M_{A,t} + \epsilon_t$$

(5)

For simplicity we will henceforth define the conditional expectation in (4) as the best linear predictor of $M_t^T$ on $M_{A,t}^U$ and $M_{A,t}^E$. We then generate a solution to (5) that can easily be compared to (1).

To find the projection of $M_t^T$ on $M_{A,t}^U$ and $M_{A,t}^E$ we formulate the following problem. Find constant values for $a_0$, $a_1$, and $a_2$ to minimize $E(M_t^T - \hat{M}_t^T)^2$ subject to

$$\hat{M}_t^T = a_0 + a_1 M_{A,t}^U + a_2 M_{A,t}^E.$$ 

(6)

Assume that the unconditional means of $M_t^T$ and $\epsilon_t$ in (2) are equal to zero and that $M_{A,t}^U$ is orthogonal to $M_{A,t}^E$. Then the solution to the projection problem is

$$a_0 = a_2 = 0 \text{ and } a_1 = (\sigma_T^2 + \sigma_e^2)/(\sigma_T^2 + 2\sigma_e^2 + 2\sigma_e^T) \text{ where } \sigma_T^2 = \text{Var}(M_t^T), \sigma_e^2 = \text{Var}(\epsilon_t), \text{ and } \sigma_e^T = \text{Cov}(M_t^T, \epsilon_t).$$

(6)

For convenience we will simply denote $a_1$ as $\alpha$ from now on. Thus the solution to (5) is

$$R_t = a_0 + a_1 \alpha M_{A,t} + a_3 M_{A,t} + \epsilon_t$$

(7)

so that (7) is our estimable version of (3). Notice that (7) and (1) differ only
in that $b_1$ in (1) is equal to $a_1 \alpha$ in (7). We will discuss the importance of this distinction in the next section. To understand the intuition behind the distinction, note that $\alpha$ represents the weight that a rational agent will place on the Fed's announcement. The optimal weight derived from the signal extraction theory is the proportion of the total variance of unanticipated money announcements due to true changes in the money supply. The parameter $b_1$ will equal $a_1$ only if $\alpha = 1$ which corresponds to the case where $\sigma_e = \sigma_{eT} = 0$, i.e., there are no random errors in the Fed's money announcements. So long as there is a stochastic component to the Fed's announcement errors, $\alpha$ will not equal one. In fact, $\alpha$ can be positive or negative and can be greater than or less than one in absolute value.

3. Implications

In this section we discuss the implications of the theory for empirically analyzing the response of asset prices to announced estimates of the money supply. We first consider how error-ridden announcements complicate the derivation of inferences of behavioral responses to true unanticipated money supply shocks. Then we extend the analysis to consider testing for structural changes in these behavioral responses over time. Finally we analyze the theory's implications for standard tests of efficient markets.

A. Interpreting Responses to Announcements

In a number of studies of the relationship between asset price changes and money supply announcements, economists have suggested that the parameter $b_1$ in (1) can be interpreted as the behavioral response of asset prices to the market's perceptions of the money supply innovation. We have already argued that $b_1$ will,
in general, be a biased estimate of \( a_1 \) which according to (3) measures the actual behavioral response. The implications of this bias go beyond the obvious problem of underestimating or overestimating the magnitude of \( a_1 \) by using \( b_1 \) as a proxy. For example, Cornell [1] has suggested that the sign of \( b_1 \) can be used to evaluate various hypotheses regarding how perceived money supply changes influence asset prices since these hypotheses differ as to the direction of change in various asset prices in response to a perceived money supply innovation. He argues, for example, that a perceived positive money supply innovation would tend to generate an increase in the dollar price of foreign currency according to the "Expected Inflation Hypothesis" but would generate a decrease in that price according to the "Keynesian Hypothesis." However, as we have shown above, knowing the direction of the change in an asset's price in response to a surprise money supply announcement (i.e., knowing the sign of \( b_1 \)) does not allow one to directly infer the direction of the change to a true (or what is believed to be a true) money supply innovation (i.e., the sign of \( a_1 \)). If, for example, \( \alpha \) is equal to zero then \( b_1 \) will also equal zero regardless of the sign and magnitude of \( a_1 \). If \( \alpha \) is negative then \( b_1 \) and \( a_1 \) will be of opposite signs. Even if \( \alpha \) is positive, \( b_1 \) will yield the correct information on the magnitude of the market's response to true money supply shocks only if there are no measurement errors in the Fed's announcements or if the market accepts the Fed estimates at face value.  

B. Testing for Structural Change

A second problem arises when equation (1) is used to test for structural changes in market responses to money supply innovations. Typically, studies will divide the sample into pre and post October 1979 components to assess whether the market is responding differently to perceived money supply innovations after the
Fed's announced policy changes. The problem is that accepting or rejecting the equality of $b_1$ across the sample periods says nothing about the equality of $a_1$ across the sample periods unless $\alpha$ is unchanged. However, $\alpha$ will change any time there are changes in the way that the Fed estimates weekly money supply changes. Such changes will alter the distribution of the Fed's measurement errors, $e^*_t$, and since $\alpha$ depends upon the moments of this distribution, will change the public's interpretation of an announcement surprise of a given magnitude in a systematic manner. This, in turn, will result in a change in the value of $b_1$ in (1) even if the market response $a_1$ remains unchanged. A proper test of the stability of $a_1$ would require the use of a regression model such as (5), controlling for the error structure of the Fed's announcements.

C. Testing the Efficient Markets Hypothesis

The final issue we consider regards the possibility of uncovering lagged responses to error-ridden announcements. The conventional interpretation of the Efficient Markets Hypothesis is that asset markets should respond quickly to new information. Therefore, if the market takes the Fed announcement as true, then the response to the Fed's weekly money supply announcement should be completed soon after the announcement. Our theory suggests that even if these markets are efficient (in the sense that asset prices respond to only new information about the actual behavior of the money supply), there could still be lagged responses by the market to the Fed's announcement. The reason is that at the time of the announcement, agents respond to their estimate of the actual money supply innovation. Over time, these estimates will be revised. As agents revise their estimates of the true component of the unanticipated announcement, asset prices will continue to respond. In fact, Urich [5] has presented evidence of significant lagged responses
to unanticipated monetary announcements on the day after the announcement. In the post October 1979 period we find weak evidence of a lagged response on the second day after the announcement.\(^{13}\) Further indirect evidence that the market continues to learn about and respond to the true component of the announcement is the fact that the Fed's revisions to earlier announcements seem to have no effect on asset prices.\(^{14}\) Presumably, if the market were taking the Fed announcement at face value, Fed revisions should be informative, particularly since these revisions can be substantial. Since the revisions appear to have no informational content, one can infer that the market has managed to completely decompose the money supply announcement into its true and error components within the one week period.

4. **Empirical Results**

In this section we use several methods suggested by our previous discussion to estimate the response of Treasury bill yields to perceived money supply innovations. We show how the parameter characterizing that response can be recovered from an estimate of the response of asset price changes to the unanticipated component of weekly money supply announcements over periods in which the joint distribution of the money supply process and the money supply estimation process are stable. We also suggest and execute a test of the signal extraction theory proposed above. The results of this test lend support to that theory and consequently to our critique of conventional approaches to the problem.

A. **Indirect Estimation of \(a_1\)**

Equation (7) indicates that the behavioral response to perceived money supply shocks, \(a_1\), can easily be estimated if \(\alpha\) is known. Since \(\alpha\) can be estimated from the sample moments of the joint distribution of \(e_t\) and \(M_t^T\), we can estimate \(a_1\) as
the coefficient on $\alpha_{A,t}$. Since $\alpha$ (and therefore $\alpha_t$) can be estimated for each subsample (i.e., before and after October 1979), we can test for structural change in the response to perceived money supply shocks, independently of changes in the error structure of the Fed's announcement.

Following Cornell [1], we measured changes in the announced money supply as the weekly percentage change in the narrowly defined money stock as reported in the Federal Reserve's H.6 release. We decompose this announcement into its anticipated ($M^E_A$) and unanticipated components ($M^U_A$). Our measure of anticipated money announcements is taken as the median of the Money Market Services, Inc., Thursday survey.\(^{15}\) Following a suggestion by Roley [2], we revise the survey data to account for new information in the period when only the Tuesday survey data are available. We also decompose the unanticipated money supply announcement into its true and error components. The unanticipated error, $e_t$, is defined as the initially announced money supply growth minus the subsequent revision. The true unanticipated money growth is the difference between the unanticipated announcement and the error. The measure of the initial asset yield change ($R_t$) we chose to use is the change in the yield of outstanding three-month U.S. Treasury bills from the close of the market at 3:30 p.m. on the day of the Fed's 4:00 p.m. weekly announcement to the close after the announcement.\(^{16}\)

We divide the sample into two periods: before and after the October 1979 change in the Fed's monetary policy. The first sample begins on January 5, 1978 and ends on October 4, 1979. The second sample covers the October 11, 1979 through January 13, 1984 period. We first obtain the sample moments of the joint distribution of $M^T_t$ and $e_t$. In the first period $\sigma_e = 0.0018$, $\sigma_T = 0.005$, and $\sigma_{eT} = -0.44 \times 10^{-5}$. Therefore $\alpha = 1.06$ for this period. In the second period, $\sigma_e = 0.0027$, $\sigma_T = 0.005$, and $\sigma_{eT} = -0.59 \times 10^{-5}$, and so $\alpha = 0.94$. In other words, the sample moments indicate
that the error variance in the Fed announcements rose while the variance of the true component remained the same. Consequently, rational agents should have put 15 percent less weight on Fed announcements in the second sample than they did in the first.

Having estimates of $\alpha$ for each period we can estimate (7) to deduce $a_1$. These results are reported in Table 1. The regressions show that the anticipated component of the announcement has no significant effect on Treasury bill yields in either period. The estimate of $a_1$ in the first period is 6.69 and in the second period it increases to 34.4.\(^{17}\) The hypothesis that the behavioral response to perceived money supply shocks is equal across the two periods is easily rejected at the .01 level.\(^{18}\)

B. Testing the Theory

To test the signal extraction theory we have outlined above, we must obtain an estimate of $a_1$ more directly than the estimate we obtained in the previous section. Then we can test whether the direct estimate of $a_1$ differs significantly from the value we obtained indirectly from the restrictions implied by the signal extraction model. To directly estimate $a_1$, consider the case of rational agents who happen to always know the true component of the unanticipated announcement exactly. These agents should respond only to that component of the announcement so that in the regression model

$$R_t = c_0 + c_1m_t + c_2e_t + w_t,$$

where $w_t$ is a disturbance term, $c_2$ would equal zero and $c_1$ would be equal to $a_1$. In the case of the Treasury bill market the only way to make this scenario operational is to allow for a time interval long enough for the market's participants to
know $M_t^T$ and $e_t^T$ exactly. While it is possible that the market determines the true values of $M_t^T$ and $e_t^T$ before the revision is announced, it is certain the market will know these values once the revisions are announced. This implies that we should measure the change in the asset's yield from immediately before the first announcement to the close following the revision one week later. Then, estimates of $c_1$ and $c_2$ in (8) should be unbiased estimates of $a_1$ and $a_2$ in (3). Thus, a test of the signal extraction theory we have proposed is to jointly test the hypotheses that $c_1$ in (8) equals $a_1$ in (3) and that $c_2$ is equal to zero in (8). This can be extended to simultaneously test for efficient markets by adding the restriction that $a_3$ equals zero in (3).

The estimates of equation (8) are reported in Table 2. In both samples only the true component of the unanticipated announcement has a significant effect on Treasury bill yields. More importantly, we cannot reject the joint hypotheses implied by our theory of efficient market responses in the presence of noisy information for either period.\footnote{Further, when we suppress the anticipated announcement variable we cannot reject the restriction that $c_1$ equals $a_1$ in either sample.\footnote{We take this to be strong support for the notion that rational agents will take the government forecast errors into account when responding to announcements of economic aggregates.}} 5. Conclusion

This paper illustrates that the response of Treasury bill yields to announced money supply changes is consistent with a model in which rational agents take the Fed's estimation errors into account in formulating their notion of actual money supply changes. Such agents can "do better" than to accept the Fed's announcement
at face value in the sense that the variance of their estimation errors will be smaller than the Fed's. One could, of course, argue that we are wrong to suppose that market participants decompose money supply announcement surprises into their estimates of the true and error components in the manner we suggested. However, so long as these agents use any device to execute such a decomposition, our critique of conventional approaches to interpreting the response to money supply announcements remains valid.

The Fed has recently proposed that noise be deliberately added to the weekly announcement by, for example, using weighted averages or seasonally adjusted data. The reason is that, in the Fed's view, too much emphasis is placed on what may be unreliable data. By making the data even less reliable the Fed believes that the public's response to its announcements will be diminished. Our theory of how rational agents respond to error-ridden money supply announcements predicts that as these announcements become noisier (i.e., $\sigma_e^2$ increases) the market's initial response to the announcements will be dampened (since $\alpha$ will decrease). However, the behavioral response to the perceived money supply change, $a_1$, will remain unchanged.

The model has numerous applications to analogous cases of markets with error-ridden announcements. In recent years, errors in generating the Consumer Price Index, Gross National Product, agricultural acreage measures, and crop yield statistics have been alleged to have caused commodity and asset markets to respond perversely. It would be interesting to observe if these relationships could also be fitted to models such as the one developed here.
Table 1

Empirical Results of the Model: \( R_t = a_0 + a_1 \omega^U_{A,t} + a_2 \omega^E_{A,t} + \nu_t \)

<table>
<thead>
<tr>
<th>Sample Period</th>
<th>Estimate Coefficients</th>
<th>( a_0 )</th>
<th>( a_1 )</th>
<th>( a_2 )</th>
<th>( R^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/5/78 - 11/4/79</td>
<td></td>
<td>.047</td>
<td>6.69</td>
<td>-4.64</td>
<td>.10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.63)</td>
<td>(2.93)</td>
<td>(1.53)</td>
<td></td>
</tr>
<tr>
<td>11/11/79 - 1/13/84</td>
<td></td>
<td>.05</td>
<td>34.35</td>
<td>-6.63</td>
<td>.21</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2.32)</td>
<td>(7.46)</td>
<td>(1.27)</td>
<td></td>
</tr>
</tbody>
</table>

Notes: The dependent variable is the change in yield on 90 day Treasury bills from immediately before a money supply announcement to the close on the following market day. t-statistics are in parentheses. \( \omega \) is assumed to equal 1.06 in the earlier period and .94 in the later period.
Table 2

Empirical Results of the Model: \( R_t = c_0 + c_1 M_t^e + c_2 e_t + w_t \)

<table>
<thead>
<tr>
<th>Sample Period</th>
<th>Estimate Coefficients</th>
<th>( R^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/5/78 - 11/4/79</td>
<td>( .094 )</td>
<td>( 13.44 )</td>
</tr>
<tr>
<td></td>
<td>( (3.22) )</td>
<td>( (2.15) )</td>
</tr>
<tr>
<td>11/11/79 - 1/13/84</td>
<td>( .029 )</td>
<td>( 33.05 )</td>
</tr>
<tr>
<td></td>
<td>( (.610) )</td>
<td>( (3.33) )</td>
</tr>
</tbody>
</table>

Notes: The dependent variable is the change in yield on 90 day Treasury bills from immediately before a money supply announcement to the close after the announced revision. t-statistics are in parentheses.
Footnotes

1/ The list of these studies is quite lengthy. The most recent of these are papers by Cornell [1], Roley [2], and, Roley and Walsh [3].

2/ It is debatable as to whether the Fed has access to all of the information incorporated in the private sectors' money supply estimates. Our theoretical model and empirical results are consistent with the view that the market has information which is unavailable to the Fed. These results are also consistent with the Fed having access to all market information but, for whatever reason, not utilizing this information in its estimation process. In this event, our theory provides a simple way for the Fed to improve upon its initial estimates of the money supply.

3/ At the time of each announcement the Fed also announces an initial revision to the previous week's announcement and a second revision to the money supply change originally announced two weeks earlier. In addition, the Fed occasionally will revise data pertaining to much earlier announcements. Here we are assuming that the initial revision reveals the truth. Our theoretical analysis is unaffected by this simplifying assumption and much of the empirical work we present was done using both initial and second revisions with no substantive differences being apparent.

Others, such as Roley [2], and, Roley and Walsh [3], also used (initial) revision data in models of asset price responses to money supply announcements. However, these studies consider responses to revisions once the revisions are announced to the public. Our point is that account should be taken of the public's incentive to deduce the revision before that time.

4/ We are assuming that the only source of new information at the time of the announcement comes from the announcement itself. It will turn out that only the
unanticipated component of the announcement provides "relevant" new information but we leave that result to be derived.

5/ Our main conclusions are not sensitive to this assumption. See Sargent [4] for a discussion of projection theory and its application to signal extraction problems.

6/ These assumptions seem reasonable, a priori, if we assume that the Fed and the public use their respective information sets efficiently. In fact, our sample statistics support these assumptions. The sample mean of $M_{t}^{T}$ is $-0.00007$ with a standard error of $0.0052$ and the sample mean of $e_{t}$ is $-0.0002$ with a standard error of $0.0025$. The correlation between $M_{A,t}^{U}$ and $M_{A,t}^{E}$ was insignificantly different from zero for both parts of our sample.

7/ The first order conditions to this problem, found by differentiating

$$E(M_{t}^{U} - \alpha_{0} - \alpha_{1} M_{A,t}^{U} - \alpha_{2} M_{A,t}^{E})^2$$

with respect to $\alpha_{0}$, $\alpha_{1}$, $\alpha_{2}$, respectively, are

$$E(M_{t}^{T} - \alpha_{0} - \alpha_{1} M_{A,t}^{U} - \alpha_{2} M_{A,t}^{E}) = 0$$

(i)

$$E[(M_{t}^{T} - \alpha_{0} - \alpha_{1} M_{A,t}^{U} - \alpha_{2} M_{A,t}^{E}) M_{A,t}^{U}] = 0$$

(ii)

$$E[(M_{t}^{T} - \alpha_{0} - \alpha_{1} M_{A,t}^{U} - \alpha_{2} M_{A,t}^{E}) M_{A,t}^{E}] = 0$$

(iii)

Since $E(M_{t}^{T}) = E(M_{A,t}^{U}) = 0$ and $E(M_{t}^{T} M_{A,t}^{E}) = E(M_{A,t}^{U} M_{A,t}^{E}) = 0$, conditions (i) and (iii) reduce to $\alpha_{0} = -\alpha_{2} E(M_{A,t}^{E})$ and $\alpha_{0} E(M_{A,t}^{E}) = -\alpha_{2} E[(M_{A,t}^{E})^2]$, respectively. If $M_{A,t}^{E}$ is constant then there are an infinite number of solutions for $\alpha_{0}$ and $\alpha_{2}$ all of which, however, imply that $\alpha_{0} + \alpha_{2} M_{A,t}^{E} = 0$. If $M_{A,t}^{E}$ is a nontrivial random variable then $E(M_{A,t}^{E})^2 \neq E[(M_{A,t}^{E})^2]$ and the only solution is $\alpha_{0} = \alpha_{2} = 0$. Thus, in any case, $\alpha_{0} + \alpha_{2} M_{A,t}^{E} = 0$. So condition (ii) reduces to $E[(M_{t}^{T} - \alpha_{1} M_{A,t}^{U}) M_{A,t}^{U}] = 0$.

Replacing $M_{A,t}^{U}$ with the sum of $M_{t}^{T}$ and $e_{t}$, then taking expectations and solving for $\alpha_{1}$, provides the solution given in the text.
If $\alpha \neq 1$, the signal extraction process yields estimates of the true money supply change that are better than the Fed's estimates. In other words, the error variance using the signal extraction process should be lower than the Fed's estimation error. This prediction is borne out in the empirical work reported below.

This can be easily established. Let $\sigma_T^2 > 0$, $\sigma_e^2 > 0$ and $\sigma_{eT} \neq 0$. The denominator of $\alpha$ can be shown to always be positive using the Cauchy-Schwartz inequality. If $\sigma_{eT} < 0$ and $|\sigma_{eT}| > \sigma_T^2$, the numerator will be negative, as will $\alpha$. If $\sigma_e^2 + \sigma_{eT} < 0$ then $\alpha > 1$ and if $0 > 2\sigma_T^2 + \sigma_e^2 + 3\sigma_{eT}$ then $\alpha < -1$.

We will eventually argue that the data do not support the view that the Fed's estimates are taken literally. In particular we will point to the presence of a lagged response to the announcement and the absence of a response to the announced revision as evidence in this regard. Footnote 8 is also relevant.

See, for example, Cornell [1] and Roley [2].

We can reject the hypothesis that an unanticipated Friday announcement has no effect on changes in 90 day Treasury bill yields from the market's Monday close to its Tuesday close at the .1 significance level.

Roley [2] finds no effect of revisions on yield changes. Our replication of Roley's regressions using different sample periods corroborates his findings.

See Roley [2] for a description of these data. We thank Kim Rupert of Money Market Services, Inc. for providing these data to us.

Other work we have done suggests that the basic results are not very sensitive to a finer time interval.

The corresponding values for $b_1$ are 7.1 and 32.2, respectively. Thus, $b_1$ overestimates the response to perceived money supply shocks by 6 percent in the
first period and underestimates it by 7 percent in the second period. Thus, the bias is toward accepting the hypothesis of no change in the behavioral response across these two samples.

18/ The F-statistic is 14.9. Without correcting for the signal extraction problem the F-statistic would have been 11.7. Although the conclusion is not sensitive to the correction in this particular case, it is clear that the potential for perverse conclusions exists in analogous tests for structural change in the responses of agents to error-ridden announcements.

19/ In the first sample, the F-statistic was .616 which is below the critical value of 2.66 at the .05 significance level. In the second sample, the F-statistic was 1.72 which is below the critical value of 2.62 at the .05 significance level.

20/ In the first sample the F-statistic was .895 which is below the critical value of 3.90 at the .05 significance level. In the second sample, the F-statistic was .268 which is below the critical value of 3.86 at the .05 significance level.
References


