A note on modeling the impact of economic announcements on interest rates

Adrienne A. Kearney (Assistant Professor of Economics)*

Department of Economics, University of Maine, 5774 Stevens Hall, Orono, ME 04469-5774, USA

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Abstract

The observed behavior of interest rates in response to real and monetary shocks is modeled over different policy regimes of the Federal Reserve. Tests at the empirical level, using the 3-month Treasury bill rate, provide support for the predictions of the model over the October 1977 to December 1997 sample period. © 2001 Elsevier Science B.V. All rights reserved.

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1. Introduction

Daily fluctuations in interest rates are often the result of unanticipated economic announcements (the 'news'). Engel and Frankel (1984) develop and test a theoretical model over the Federal Reserve’s nonborrowed reserve targeting regime which shows that nominal interest rates rise when the announced money supply is greater than expected because the real component of interest rates rises in anticipation of an offsetting contraction by the Federal Reserve. The purpose of this note is to show that by extending the money supply process, developed by Engel and Frankel, to reflect different policy regimes at the Fed and to include spending shocks, I obtain predictions for the size and direction of the response of interest rates over the various policy regimes of the Federal Reserve since the late 1970s. Tests at the empirical level, using unanticipated employment announcements to proxy spending shocks, support the extended model: unanticipated money and employment announcements have a positive effect on the Treasury bill rate, and the magnitude of the response depends on expectations for policymakers’ response to the news.

*Tel.: +1-207-581-1854; fax: +1-207-581-1851.
E-mail address: akearney@maine.edu (A.A. Kearney).
2. Theoretical model

The structural framework of the theoretical model and the underlying assumptions are displayed in Appendix A. In this model, an unanticipated money announcement occurs when a positive portfolio \((\omega > 0)\) or spending \((v > 0)\) shock shift money demand and thereby move the money supply, \(m_t\), away from the Fed’s target, \(\bar{m}_t\). The rational expectation of the Fed’s response to a portfolio shock (a shift from nonmonetary assets into money) or a spending shock (a rightward shift in aggregate demand which increases output or income and the demand for transactions balances in the short run) is incorporated in the money supply process defined by Eqs. (A4) through (A7), where \(\mu_t\) represents the adjustment of the money stock target in the following period. In Eq. (A6), the size of \(\mu_t\) depends on the setting of the policy feedback parameter, \(0 \leq g \leq 1/\lambda\), which is also the coefficient on money away from target in the monetary policy reaction function A8 (Lombra and Kaufman, 1992). The upper and lower bounds of \(g\) represent interest rate targeting \((g = 0)\) and money stock targeting \((g = 1/\lambda)\). For example, if there is a portfolio shock in \(t-1\), the money stock target, \(\bar{m}_t\), will increase by the full amount of the shock if \(g = 0\). In this case, \(E_t(\bar{m}_t - \bar{m}_{t-1}) = \omega_t\) represents the expected policy response in time \(t\) which, in turn, drives expectations for the change in the expected equilibrium price level as a result of an unanticipated announcement: \(\bar{p}_t - \bar{p}_{t-1}\), where subscript \(t\) represents expectations after the announcement and \(t'\) before the announcement. In other words, a portfolio or spending shock may permanently alter the expected path of the money supply, i.e., \((E_t m_{t+\tau} - E_t m_{t-\tau})\), and the equilibrium price level \((\bar{p}_t - \bar{p}_{t-1})\), depending on agents’ expectation of the central bank’s response to money away from target. After substitution of (A6) into (A10), the expected response of the price level to each type of shock is obtained (A11) and (A12).

Using the above results, along with the expectations theory of the term structure, the response of interest rates to each type of shock can be solved using (A14), whereby the expected change in the real rate: \(r_t - r_{t-1} = g_t(\omega_t + \phi v_t)\) represents the adjustment of the funds rate when money is away from target, (A8). After substitution, the following equations represent the response of the \(n\)-period interest rate to each shock:

\[
\text{Portfolio Shock: } i_{n,t} - i_{n,t-1} = \left[1 - \frac{\lambda^2}{1 + \lambda}\right] g_t \omega_t > 0
\]

\[
\text{Spending Shock: } i_{n,t} - i_{n,t-1} = \left[ g_t \phi \left(1 - \frac{\lambda^2}{1 + \lambda}\right) + \frac{\lambda}{1 + \lambda} \left(\phi + \frac{\lambda}{\beta}\right) \right] v_t > 0
\]

Ignoring central bank behavior, the model predicts that the impact of a positive portfolio shock is a decline in the expected equilibrium price level, (A11), and an increase in interest rates, while a positive spending shock results in an increase in the price level, (A12), and interest rates. With the central bank’s activity folded in, the largest response in interest rates is associated with money stock

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1Note that equilibrium values are denoted by a ‘bar’ over the variable. For a more complete description of the assumptions and the structural framework of the model, see Kearney (1995) and the references cited therein.

2It is assumed that \(g_t\) follows a random walk process, i.e., \(E_t g_{t+\tau} = g_{t+\tau}\), which implies changes in \(g_t\) are brought about exogenously by Fed policymakers which the public has to infer and (2) the money supply is horizontal in the short run.
targeting in the case of either a portfolio shock or a spending shock. Thus, the size of the response of interest rates is positively related to $g_1$.

3. Data and empirical investigation

The foregoing hypotheses are tested below using the 3-month Treasury bill rate, over the October 1977 to December 1997 sample period (see Table 1). Eq. (3) is estimated using daily data. The change in the T-bill rate (in basis points) from market close on day $t - 1$ to market close on day $t$, $\Delta N_t$, is regressed on the proxy for portfolio shocks: unanticipated money announcements, $M_{t-1}$ (occur at $t - 1$ after market close), and the proxy for spending shocks: unanticipated employment announcements, $E_{t}$ (occur at time $t$ before the market opens). In addition, the reaction function, Eq. (4), is estimated using quarterly data, whereby the proxy for $g_1$ is reflected by: $\gamma_1$ (the adjustment of Table 1)

Impact of unanticipated money and employment on the 3-month treasury bill rate

$\Delta N_t = b_0 + b_1 M_{t-1} + b_2 E_{t} + \epsilon_t$  \hspace{1cm} (3)

and monetary policy reaction function:

$FFR_t = \gamma_0 + \gamma_1 MDEV_{t-1} + \gamma_2 EMPDEV_{t-1} + \gamma_3 FFR_{t-1} + \delta_t$ \hspace{1cm} (4)

<table>
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<tr>
<th>Sample period (Eq. (3))</th>
<th>$b_0$</th>
<th>$b_1$</th>
<th>$b_2$</th>
<th>$R^2$</th>
<th>SEE</th>
<th>DW</th>
<th>n</th>
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<tr>
<td>10/77–12/97</td>
<td>0.14</td>
<td>1.29</td>
<td>2.99</td>
<td>0.03</td>
<td>19.49</td>
<td>1.90</td>
<td>1065</td>
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<td>(0.23)</td>
<td>(4.72)</td>
<td>(3.84)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Sample period (Eq. (4))</th>
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<th>$\gamma_1$</th>
<th>$\gamma_2$</th>
<th>$\gamma_3$</th>
<th>$R^2$</th>
<th>SEE</th>
<th>D-h</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>2Q73–4Q97</td>
<td>1.17</td>
<td>0.26</td>
<td>0.20</td>
<td>0.87</td>
<td>0.84</td>
<td>1.38</td>
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<td>(6.06)</td>
<td>(2.33)</td>
<td>(21.36)</td>
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Notes: $T$-statistics are in parentheses; $R^2$, adjusted $R^2$; SEE, standard error of the estimate; DW, Durbin-Watson test statistic; $n$ = sample size. The presence of the lagged dependent variable in Eq. (4) can bias the Durbin-Watson (DW) test statistic. Therefore, Eq. (4) was tested for serial correlation using the Durbin-h (D-h) test. D-h = 0.09 was compared to the critical value, $h \approx 1.96$ ($\alpha = 2.5\%$); hence, the null (no serial correlation) was not rejected.

Unanticipated announcements are the difference between announced (unrevised) and expected, where market expectations were obtained from Money Market Services International. Money announcements (M1 from 10/77 to 10/82, M2 thereafter) and the T-bill rate are reported in Federal Reserve H.6 and H.15 releases, respectively; nonfarm payroll employment is reported by the Bureau of Labor Statistics, Employment Situation. See Kearney (1995, 2000) for elaboration. Previous research suggests portfolio shocks appear to swamp spending shocks in terms of their role in explaining the week-to-week innovations in the money stock (Kearney, 1995). Thus, unanticipated nonfarm payroll announcements are used as the proxy for spending shocks. Assuming the economy is initially in equilibrium at full employment output, a positive spending shock leads to an increase in output beyond full employment since prices are sticky in the short run.
the funds rate in response to money growth away from the Fed’s target, $MDEV$) and $\gamma_2$ (the adjustment when employment is away from potential, $EMPDEV$).\footnote{The funds rate for the first month of each quarter, $FFR_t$, was employed to eliminate the serial correlation problem that exists when the quarterly average of the funds rate is employed. Targets for $M1$ and $M2$ were obtained from the Federal Reserve, while potential employment is estimated and obtained from the Congressional Budget Office.}

To see if changes in the policy feedback parameter are positively related to changes in $b_1$, $b_2$, I estimated the evolution of $b_1$, $b_2$ and $\gamma_1$, $\gamma_2$ across the full-sample period. After extracting $b_{1t}$ and $b_{2t}$ parameters for the first week in each quarter (to match the periodicity of $\gamma_{1t}$ and $\gamma_{2t}$), Eqs. (5) and (6) were estimated (see Table 2).\footnote{The RATS TVARYING procedure with the Kalman filter algorithm is employed in estimating the evolution of $b_{1t}$, $b_{2t}$ and the proxy for $\gamma_t$ over the full sample, whereby the parameters, e.g., $b_{1t}$, are assumed to follow a random walk process. More detail is included in Kearney (1995).}

Overall, the results support the maintained hypothesis: holding the magnitude of unanticipated money or employment constant, the response of the T-bill rate to the ‘news’ is determined by $b_1$ and $b_2$ which, in turn, is positively related to $\gamma_{1t}$ and $\gamma_{2t}$, respectively. This implies that over the 1977–1984 sample period, policy moves toward tighter short-run control over the growth in the monetary aggregates (i.e., large, positive changes in $\gamma_{1t}$) resulted in larger and more positive changes in $b_{1t}$, which in the face of a positive unanticipated money announcement resulted in a sizeable increase in short-term interest rates. Furthermore, the results imply that, over the full-sample period which spans the latter part of the Fed funds regime (1970–September 1979), the nonborrowed reserves operating procedure (October 1979–September 1982) and the gradual return to an interest rate-based operating procedure (October 1982–present), announced policy moves to bring down...

### Table 2

| Relationship between T-bill response coefficients and policy feedback parameters$^a$ |
|---------------------|-----|-------|-----|-----|-----|
| $\Delta b_{1t} = \alpha_0 + \alpha_1 \Delta \gamma_{1t} + \epsilon_t$ |
| $\Delta b_{2t} = \xi_0 + \xi_1 \Delta \gamma_{2t} + \epsilon_t$ |
| Sample period (Eq. (5)) | $\alpha_0$ | $\alpha_1$ | $\hat{R}^2$ | SEE | DW | $n$ |
| 4Q77–4Q84 | 0.04 | 0.47 | 0.11 | 0.07 | 1.52 | 28 |
| (3.01) | (2.11) |
| Sample period (Eq. (6)) | $\xi_0$ | $\xi_1$ | $\hat{R}^2$ | SEE | DW | $n$ |
| 4Q77–4Q97 | 0.00 | 0.82 | 0.17 | 0.10 | 2.40 | 80 |
| (0.23) | (4.11) |

$^a$ Notes: The policy feedback parameters are represented by: $\gamma_1$ (adjustment of the funds rate in response to money growth away from the Fed’s target) and $\gamma_2$ (adjustment when employment is away from potential); the response of the T-bill rate to the ‘news’ is represented by: $b_1$ (response to unanticipated money) and $b_2$ (response to unanticipated employment). Also, in estimating Eq. (5), the sample period was truncated at 4Q84 to correct positive, first-order serial correlation: $DW=1.03$, in the full sample regression. It was inferred that this serial correlation results from the very small changes in $\gamma_{1t}$ after 1988 when the average quarterly change in $\gamma_{1t}$ is approximately zero.

Pagan (1984) shows that if generated residuals are employed as regressors, OLS provides the correct value of the parameter $\alpha_1$ in Eq. (5) and $\xi_1$ in Eq. (6) and the standard errors of $\alpha_1$ and $\xi_1$ are consistent estimators of the population standard error.
inflation (i.e., large, positive changes in $\gamma_2$) resulted in larger and more positive changes in $b_2$, which in the face of a positive employment surprise, resulted in a relatively large increase in the T-bill rate. Hence, financial market participants’ expectations for the monetary policy response to the news varied appropriately within and across monetary policy regimes and significantly influenced the size and direction of the response of short-term interest rates to the news.

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Appendix A. Assumptions

Sticky prices:

$$p_t = p_{t-1}$$

Horizontal money supply function in the very short run:

$$i_t = i_{t-1}$$

Changes in policy feedback parameter are exogenous:

$$E_t g_{1,t+1} = g_{1,t}$$

Shocks are permanent:

$$E_t \omega_{t+1} = \omega_t; E_t v_{t+1} = v_t$$

The model

Goods market:

$$\ddot{y} = - \beta (i_t - (E_t \ddot{p}_{t+1} - \ddot{p}_t)) + v_t$$

(A1)

Money market:

$$\dot{m}_t - \dot{p}_t = - \lambda i_t + \phi \ddot{y} + \omega_t$$

(A2)

Long-run aggregate supply:

$$\ddot{y} = k$$

(A3)
Money supply process:

\[ m_t = \bar{m}_t + \epsilon_t \]  \hspace{1cm} (A4)

where,

\[ \epsilon_t = \omega_t + \phi v_t \]  \hspace{1cm} (A5)

\[ \bar{m}_t = m_{t-1} + \mu_t \]  \hspace{1cm} (A6)

\[ \mu_t = \mu + (\omega_{t-1} + \phi v_{t-1}) - g_1(\omega_{t-1} + \phi v_{t-1}) \lambda \]  \hspace{1cm} (A7)

Monetary policy reaction function:

\[ r_t = g_0 + g_1(m_t - \bar{m}_t) \]  \hspace{1cm} (A8)

where,

\[ m_t - \bar{m}_t = \omega_t + \phi v_t \]  \hspace{1cm} (A9)

Change in the expected equilibrium price level:

\[ \tilde{p}_t - \tilde{p}_{t'} = \frac{1}{1 + \lambda} \sum_{\tau=0}^{\infty} \left( \frac{\lambda}{1 + \lambda} \right)^\tau \left[ (E_t m_{t+\tau} - E_t m_{t+\tau'}) - (E_t m_{t+\tau} - E_t m_{t+\tau'}) \right] \]

\[ - (E_t y_{t+\tau} - E_t y_{t+\tau'}) \left( \phi + \frac{\lambda}{\beta} \right) + \frac{\lambda}{\beta} (E_t v_{t+\tau} - E_t v_{t+\tau'}) \]  \hspace{1cm} (A10)

Portfolio Shock:

\[ \tilde{p}_t - \tilde{p}_{t'} = - \frac{g_1^2 \lambda^2}{1 + \lambda} \omega_t < 0 \]  \hspace{1cm} (A11)

Spending Shock:

\[ \tilde{p}_t - \tilde{p}_{t'} = \frac{\lambda}{1 + \lambda} \left[ \phi - g_1 \phi \lambda + \frac{\lambda}{\beta} \right] v_t > 0 \]  \hspace{1cm} (A12)

Response of the \( N \)-period interest rate:

\[ i_{n,t} = \frac{1}{n} \sum_{i=0}^{n-1} E_t(r_{t+i} + \pi_{t+i}) \]  \hspace{1cm} (A13)

\[ i_{n,t} - i_{n,t'} = \left( \frac{1}{n} \sum_{i=0}^{n-1} [E_t r_{t+i} - E_t r_{t+i'}] + (E_t \tilde{p}_{t+i} - E_t \tilde{p}_{t+i'}) \right) = g_1(\omega_t + \phi v_t) + (\tilde{p}_t - \tilde{p}_{t'}) \]  \hspace{1cm} (A14)

Where: \( \beta, \lambda, \phi > 0; t, t' \) subscripts denote values after a money announcement versus immediately before the announcement, respectively; \( p_t, \tilde{p}_t \) log of short-run price level and equilibrium price level, respectively; \( i_t \) short-term interest rate; \( r_t \) the current Federal funds target; \( y_t, \tilde{y}_t \) log of short-run and long-run equilibrium output, respectively; \( k \) full employment output; \( m_t, \bar{m}_t \) log of nominal money stock and money stock target, respectively; \( g_0, g_1 \) the funds target when the money market is in equilibrium and the policy feedback parameter, respectively; \( v_t, \omega_t \) spending shock and portfolio shock.
shock, respectively; $\mu$, $\mu_t$ targeted growth of the money stock and the adjustment of the targeted money stock after a shock, respectively.

References