Monetary News, Surprises and the Macroeconomy.

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Introduction

Question and Motivation.

News in monetary policy:

- Monetary policy forward looking setting.
- Monetary authorities attention to communication.
- Recent discussion on alternative policy instruments - Forward Guidance.
- Few quantitative measures of the role of anticipation (Gurkaynak et al., 2005; Campbell et al., 2012).
Question and Motivation.

Figure: From Gurkaynak et al. (2005). Intraday trading in Federal Fund Future contracts. Reduction of the target from 1.25 to 1. From surveys the expected reduction was 13bp deeper. The public adjusts right after the meeting.
Intraday trading in Federal Fund Future contracts. Reduction of the target from 4 to 3.75. At 11.30 a.m. the Open Market Trading Desk injects reserves in the market and the public correctly infers the target change.
QUESTION: Disentangle the effects of unanticipated (surprise) VS anticipated (news) shock to monetary policy. Assess empirically their relevance with SVARs.
Question.

Main findings:

1. News are a relevant part of the monetary policy mechanism:
   - Explain the bulk of the movements in expectations.
   - Effects on GDP account for 25-50% of the picture of monetary policy.
   - News and surprises have comparable effect on inflation.

2. Informational sufficiency of the data:
   - News cause informational misalignments and failure of classical SVAR.
   - Surprise shock: can pinned down correctly without news. Informational sufficiency in the data for this shock.
In the remainder of the presentation:

1. Simple model that includes news.
2. News generate non fundamentalness $\rightarrow$ classical SVAR failure.
3. Solutions:
   - Blaschke Matrix.
   - Add information variable to the VAR.
4. Simulation examples.
5. Empirical application.
“News” shock (anticipated/unanticipated component)

- Business Cycle:
  - Beaudry and portier (2006), Barsky and Sims (2012), Schmitt-Grhoe Uribe (2008), Blanchard et al. (2009), Gambetti et al. (2013), ...

- Fiscal Policy:

- Monetary policy:
  - DSGE: Milani and Treadwell (2012), Del Negro Giannoni and Patterson (2012), ...
  - Asset pricing: Gurkaynak et al. (2005), Campbell et al. (2012).
Main contributions:

1. Simple model to show the implications of monetary news.
2. Empirical application in VAR setting.
Model Setup.

- Standard new Keynesian framework: \( \text{NKmodel} \)

\[
\pi_t = \beta E_t\{\pi_{t+1}\} + \kappa \tilde{y}_t \tag{1}
\]

\[
\tilde{y}_t = -(i_t - E_t\{\pi_{t+1}\} - i^*) + E_t\{\tilde{y}_{t+1}\} \tag{2}
\]

\[
i_t = i^* + \phi_\pi \pi_t + \phi_y \tilde{y}_t + \nu_t \tag{3}
\]

- News setting:

\[
\nu_t = \rho(L)\varepsilon_t + \rho(L)\eta_{t-q} \tag{4}
\]
Simplifying assumptions:

- $\rho(L) = 1$. Monetary policy shock:

$$v_t = \varepsilon_t + \eta_{t-q}$$

- As in Blanchard et al. (2009), use limit case with price stickiness $\theta \to 1$. Output gap follows:

$$\tilde{y}_t = -\Omega \sum_{s=0}^{\infty} \Omega^s E_t\{v_{t+s}\}$$

with $|\Omega| < 1$

Advantages:

- Simple - tractable algebra, good explanatory tool.
- General - relevant properties are maintained.
The expected value of $v_{t+s}$ is given by:

$$E_t\{v_{t+s}\} = \begin{cases} 
\varepsilon_t + \eta_{t-q} & \text{for } s = 0 \\
\eta_{t-q+s} & \text{for } 0 < s \leq q \\
0 & \text{for } s > q.
\end{cases} \quad (7)$$

$\tilde{y}_t$ simplifies into a finite summation:

$$\tilde{y}_t = -\Omega \left( \varepsilon_t + \eta_{t-q} + \Omega \eta_{t-q+1} + \ldots + \Omega^q \eta_t \right) \omega_q(L) \eta_t. \quad (8)$$

Equations (5) and (8) form the MA representation:

$$\begin{pmatrix} v_t \\ \tilde{y}_t \end{pmatrix} = \begin{pmatrix} 1 & L^q \\ -\Omega & -\Omega \omega_q(L) \end{pmatrix} \begin{pmatrix} \varepsilon_t \\ \eta_t \end{pmatrix}. \quad (9)$$
MA Representation.

Figure: D.g.p. $\mathcal{M}(L)$: theoretical impulse responses.
The VAR with \((\tilde{y}_t, \nu_t)\) does not contain sufficient information to identify the structural shocks.  

- **Intuition:** different information sets. 
  - **Agents:** \(l_t = (\varepsilon_{t-j}, \eta_{t-j})_{j=0}^\infty\).
    - Know \(\nu_t\) and its exact decomposition in “news” and “surprise”.
  - **Econometrician:** \(l_t^e = (\tilde{y}_{t-j}, \nu_{t-j})_{j=0}^\infty\)
    - Observes the sum \(\nu_t = \varepsilon_t + \eta_{t-q}\).
    - Ignores its decomposition and never learns it over time.
SVAR failure: information asymmetry.

How to correct the informational misalignment?

2. Add informational variables to the VAR.
Solution 1: Blaschke Factor. Example

- Consider the non invertible MA (root $r = 0$):

  \[ x_t = u_{t-1} = Lu_t. \]

  Notice: $u_t = L^{-1}x_t = x_{t+1}$ does not reside in the past of the data.

- Blaschke factor:

  \[ b(L) = \frac{L + r}{1 + rL} = L \]

- The econometrician using $x_t$ can estimate the invertible MA:

  \[ x_t = \begin{pmatrix} 1 \\ L \\ b(L)^{-1} \end{pmatrix} \begin{pmatrix} s_t \\ L \\ b(L) \end{pmatrix} u_t = s_t. \]

- The identified $s_t = Lu_t$ is not the structural shock $u_t$. 
A two steps procedure.

Two steps to pin down the structural shocks:

1. **STEP 1:** Estimate the **fundamental** VAR.
   - Obtained with classical SVAR techniques.
   
   \[ x_t = 1 \ast s_t. \]

2. **STEP 2:** Find the **structural** representation with \( b(L) \).
   - Back up \( u_t \) and the true impulse responses:

   \[
   b(L) = \frac{L + r}{1 + rL} = L \\
   u_t = b(L)^{-1}s_t \\
   L = 1 \ast b(L)
   \]

Extension to the multivariate case with Blaschke matrices \( B(L) \) (Lippi and Reichlin, 1994).
Simulations: STEP 1.

**STEP 1:** Estimate the **fundamental** VAR.

*Figure:* Theoretical (red) VS SVAR (blue) impulse responses.
Simulations: STEP 2.

**STEP 2:** Find the **structural** representation with $B(L)$.

![Graphs showing impulse responses](image)

**Figure:** Theoretical (red) VS SVAR (blue) VS Blaschke corrected (green) impulse responses.
Solution 2: Adding information to the VAR.

Informational mismatch:

- With “news” market participants act in advance of policy.
- The econometrician cannot understand which actions are attributable to “surprises” and which are due to changes in expectations.
Solution 2: Adding information to the VAR.

Adding information in the VAR:

- Knowing markets beliefs for $t + s$ would provide with sufficient information to disentangle “news” and “surprises”.
- But what is sufficient information?
- Intuitive result: econometrician needs market expectations over an horizon $s$ that is at least as wide as the CB announcements $q$.

**Intuition:** Let $v_t = \varepsilon_t + \eta_{t-2}$.

- $E_t(v_{t+1}) = E_t(\varepsilon_{t+1} + \eta_{t-1}) = \eta_{t-1} \rightarrow$ does not contain $\eta_t$
- $E_t(v_{t+2}) = E_t(\varepsilon_{t+2} + \eta_t) = \eta_t \rightarrow$ contains $\eta_t$
Simulations: case $s < q$.

Market projections $< \text{than CB announcement} \rightarrow \text{insufficient information.}$
- However, information is sufficient for $\varepsilon_t$.

Figure: Impulse responses of monetary policy and its expectations for $t + 3$. D.g.p (red) VS VAR from simulated data (blue).
Simulation: case $s \geq q$.

Market projections $> \text{than CB announcement} \rightarrow$ sufficient information.
  - Information sufficient for both $\varepsilon_t$ and $\eta_t$.

Figure: Impulse responses of monetary policy and its expectations for $t + 7$. D.g.p (red) VS VAR from simulated data (blue).
Data

1. **Macro data:** - from FRED.

2. **Market Expectations:**
   - Federal Fund Futures (FFF) - from Quantl and Bloomberg.
   - SPF forecast - T-Bill for 1-4 quarters ahead.
   - $\Delta fff$ - Difference in FFF at tight windows around FOMC meeting
     Barakchian and Crowe (2010).
     - Similar to Kuttner (2001), Gürkaynak (2005), Campbell et al. (2012).

3. **Policy indicator:**
   - Federal Fund Rates (Christiano et al., 2005).
   - $\Delta ffr$ - Difference in the in FFR / target at tight windows around
     FOMC meeting (Barakchian and Crowe, 2010).
Empirical application.

In the remainder of the presentation we will see:

1. Toy 2-VAR: with policy measure and market expectations.  
2. Baseline 4-VAR: adding GDP and inflation.  

Robustness checks:

- Different measure of FFF expectations (1-6 horizons).
- SPF measures of market expectation.
- Different measure of policy indicator (FFR).
- Alternative timing assumptions.
- Identification with sign restrictions.
Toy VAR ($\Delta ffr$).

**Figure**: Toy VAR with $\Delta ffr$ and $\Delta fff$ from Barakchian and Crowe (2010). Sample from 89Q1 to 08Q2. Individual measures for $h$-ahead contracts are reported in green. The factor measure that summarizes all of them is black.
Baseline VAR ($\Delta ffr$).

Figure: Baseline VAR with GDP, GDPDEF, $\Delta ffr$ and $\Delta fff$. Green lines are the measure derived from $h$-ahead future contract for $h = 1, \ldots, 6$. Black line is the factor measures summarizing all the individual contracts. 95% and 68% bands computed with bootstrap methods refer to the latter.
Variance decomposition ($\Delta ffr$).

**Figure:** Variance decomposition of baseline VAR with GDP, GDPDEF, $\Delta ffr$ and $\Delta fff$. One standard deviation bands in gray.
Robustness check:

- Different timing assumption. **FFF first**
- SPF data. **SPF**
- Sign restrictions. **Sign**
- FFR with Sign restrictions. **FFR Sign**
Figures: Christiano et al. (2005) VAR with timing restriction. The variables (in order) are GDP, CONS, GDPDEF, Real Investment, Wages, Productivity, FFR, log(FF6), Profits and M2 on the sample 89Q1-14Q4. All variables are in log levels, but M2 which is in growth rates. 95% and 68% bands computed with bootstrap methods. The red line compares the results obtained from the baseline case with no news specification.
Variance decomposition.

Figure: Christiano et al. (2005) VAR with timing restriction. The variables (in order) are GDP, CONS, GDPDEF, Real Investment, Wages, Productivity, FFR, log(FF6), Profits and M2 on the sample 89Q1-14Q4. All variables are in log levels, but M2 which is in growth rates. 95% and 68% bands computed with bootstrap methods. The red line compares the results obtained from the baseline case with no news specification.
Robustness Check.

Robustness check:

- SPF data.
Theoretical summary:

- “News” provokes informational misalignments and failure of classical SVAR.
- Solution proposed:
  2. Add information in the VAR.
- Simulation exercises to assess these strategies.
Empirical results:

- **Surprise shock**: pinned down correctly without news. Informational sufficiency for this shock.
- **News shock**:
  - Feedback effects on the FFR.
  - Explains the bulk of the movements in expectations.
  - News effects on GDP account for 25-50% of the picture of monetary policy.
  - News and surprises have comparable effect on inflation.
THANKS FOR THE ATTENTION.
New Keynesian Model.

- New Keynesian Phillips curve and dynamic IS:
  \[ \pi_t = \beta E_t \{ \pi_{t+1} \} + \kappa \tilde{y}_t \]  
  \[ \tilde{y}_t = -(i_t - E_t \{ \pi_{t+1} \} - r^n_t) + E_t \{ \tilde{y}_{t+1} \} \]  

- Policy rule:
  \[ i_t = i^* + \phi_\pi \pi_t + \phi_y \tilde{y}_t + \nu_t \]
The above equation combine into:

$$
\begin{pmatrix}
\tilde{y}_t \\
\pi_t
\end{pmatrix} = A \begin{pmatrix}
E_t\{\tilde{y}_{t+1}\} \\
E_t\{\pi_{t+1}\}
\end{pmatrix} - B v_t
$$

(13)

where:

$$A \equiv \Omega \begin{pmatrix}
1 & 1 - \beta \phi \pi \\
\kappa & \kappa + \beta (1 + \phi y)
\end{pmatrix}$$

$$B \equiv \Omega \begin{pmatrix}
1 \\
\kappa
\end{pmatrix}$$

$$\Omega = \frac{1}{1 + \phi y + \kappa \phi \pi}$$

$$\kappa = \frac{(1 + \varphi)(1 - \theta)(1 - \beta \theta)}{\theta}$$
Forwards recursion of (13) allow us to write:

\[
\begin{pmatrix}
\tilde{y}_t \\
\pi_t
\end{pmatrix} = -\sum_{s=0}^{\infty} A^s B E_t\{v_{t+s}\}
\]  

(14)

Given the structure of expectation:

\[
E_t\{v_{t+s}\} = \begin{cases} 
\rho(L)L^{q-s}\eta_t + \rho^s\rho(L)\varepsilon_t & \text{for } s \leq q \\
\rho^{s-q}\rho(L)\eta_t + \rho^s\rho(L)\varepsilon_t & \text{for } s > q
\end{cases}
\]  

(15)

Some lengthy algebra delivers:

\[
\begin{pmatrix}
v_t \\
\tilde{y}_t
\end{pmatrix} = \begin{pmatrix}
\rho(L) & \rho(L)L^q \\
\delta(L) & \gamma(L)
\end{pmatrix} \begin{pmatrix}
\varepsilon_t \\
\eta_t
\end{pmatrix}
\]

(16)
SVAR failure: non fundamentalness.

$M(L)$ is **fundamental** if the $Det(M(z))$ vanishes for values of $z$ outside the unit circle.

- The MA has all roots of modulus $\Omega < 1$.
  - Example with $q = 2$.
    $$
    \begin{pmatrix}
    \nu_t \\
    \tilde{y}_t
    \end{pmatrix}
    =
    \begin{pmatrix}
    1 & L^2 \\
    -\Omega & -\Omega(L^2 + \Omega L + \Omega^2)
    \end{pmatrix}
    \begin{pmatrix}
    \varepsilon_t \\
    \eta_t
    \end{pmatrix}.
    $$
    The determinant vanishes for $L = -\Omega$.

- Consequence:
  - The assumption that structural shocks are a linear combination of the reduced form residuals fails.
  - Standard SVAR are not valid.
Solution 1: Blaschke Matrices.

- Let $r_1, r_2, \ldots, r_q$ be a sequence of complex numbers smaller than one in modulus.

- **Blaschke product**:

  \[ b_q(L) = \prod_{j=1}^{q} \frac{L - r_j}{1 - \bar{r}_j L}. \]  
  \[ (17) \]

  $b_q(L)$ has zeros exactly at $r_1, r_2, \ldots, r_q$.

- **A Blaschke matrix** (BM) can be obtained as:

  \[ B(L) = \begin{pmatrix} I & 0 \\ 0 & b_n(L) \end{pmatrix} \]  
  \[ (18) \]

- Interesting facts about $B(L)$:
  - Preserves orthonormality.
  - $B(L)B^*(L^{-1}) = I$ where $B^*$ denotes complex conjugate.
An Example.

- For q=2:

\[
\begin{pmatrix}
    v_t \\
    \tilde{y}_t
\end{pmatrix} = \begin{pmatrix}
    1 & L^2 \\
    -\Omega & -\Omega(L^2 - \Omega L - \Omega^2)
\end{pmatrix} \begin{pmatrix}
    \varepsilon_t \\
    \eta_t
\end{pmatrix}. \tag{19}
\]

whose the determinant vanishes at and \(-\Omega\).

- The associated Blaschke factor:

\[
b_1(L) = \frac{(L + \Omega)}{1 + \Omega L} = \frac{\omega_1(L)}{c(L)}. \tag{20}
\]

where \(c(L) = 1 + \Omega L\).
Using BM we can rewrite the system (19) as:

- **Fundamental:**

\[
\begin{pmatrix}
  v_t \\
  \tilde{y}_t
\end{pmatrix} = \begin{pmatrix}
  1 & \frac{L^2}{b_1(L)} \\
  -\Omega & -\Omega \frac{\omega_2(L)}{b_1(L)}
\end{pmatrix} \begin{pmatrix}
  \varepsilon_t \\
  \chi_t
\end{pmatrix}
\]  

(21)

- An identification restriction is given by $F_{12}(0) = 0$.
- The $\text{det}(F(z))$ vanishes for $z = -1/\Omega$, then the system is fundamental.
- This is what the naive econometrician would estimate with standard VARs.

- **Structural:**

\[
\begin{pmatrix}
  \varepsilon_t \\
  \chi_t
\end{pmatrix} = \begin{pmatrix}
  1 & 0 \\
  0 & b_1(L)
\end{pmatrix} \begin{pmatrix}
  \varepsilon_t \\
  \eta_t
\end{pmatrix}.
\]

(22)

- Notice that being $B(L)$ a BM it preserves orthonormality of $(\chi_t \ \varepsilon_t)'$.
- $(\chi_t \ \varepsilon_t)'$ is a dynamic linear combination of structural shocks.
Forward guidance.

- Let forward guidance be a combination of all the available “news”:

\[ g_t = \eta_{t-1} + \Omega \eta_t = \omega_1(L)\eta_t. \]  

(23)

- \( g_t \) induces the reversed discounting.

- \( x_t \) estimated with standard VARs is a combination of guidance shocks:

\[ x_t = b_1(L)\eta_t = \frac{g_t}{c(L)} = \sum_{j=0}^{\infty} (-\Omega)^j g_{t-j}. \]  

(24)
Adding information in the VAR.

Agents’ expectations at $t$:

$$E_t\{v_{t+s}\} = \begin{cases} 
\rho^s \rho(L) \varepsilon_t + \rho(L) L^{q-s} \eta_t & \text{for } s < q \\
\rho^s \rho(L) \varepsilon_t + \rho^{s-q} \rho(L) \eta_t & \text{for } s \geq q
\end{cases} \quad (25)$$

Intuition - expectations are based on:
- Projections of $\varepsilon_t$ according to its persistence.
- For the first $q$ periods: “news” available.
- From $q$ onwards: only linear projection.

Need to consider $s < q$ and $s \geq q$ separately.
For $s < q$.

\[
\begin{pmatrix}
\nu_t \\
E_t\{\nu_{t+s}\}
\end{pmatrix}
= \begin{pmatrix}
\rho(L) & \rho(L)L^q \\
\rho^s\rho(L) & \rho(L)L^{q-s}
\end{pmatrix}
\begin{pmatrix}
\varepsilon_t \\
\eta_t
\end{pmatrix}
\]

\(\mathcal{R}(1)(L)\)  

\(\text{Det}(\mathcal{R}(1)(z)) = \rho(z)^2z^{q-s} - \rho^s\rho(z)^2z^q\)  

Root at $z = 0$.

For $s \geq q$.

\[
\begin{pmatrix}
\nu_t \\
E_t\{\nu_{t+s}\}
\end{pmatrix}
= \begin{pmatrix}
\rho(L) & \rho(L)L^q \\
\rho^s\rho(L) & \rho^{s-q}\rho(L)
\end{pmatrix}
\begin{pmatrix}
\varepsilon_t \\
\eta_t
\end{pmatrix}
\]

\(\mathcal{R}(2)(L)\)  

\(\text{Det}(\mathcal{R}(2)(z)) = \rho^{s-q}\rho(z)^2 - \rho^s\rho(z)^2z^q\)  

Root of modulus $z = \rho^{-1}$. 
Generalization of the model.

- Allow for a general calibration for the model.
- Allow for persistence in the policy shocks.

\[ \nu_t = \rho(L) \eta_{t-q} + \rho(L) \varepsilon_t. \]

The MA representation:

\[
\begin{pmatrix}
\nu_t \\
\tilde{y}_t
\end{pmatrix}
= \begin{pmatrix}
\rho(L) & \rho(L)L^q \\
\delta(L) & \gamma(L)
\end{pmatrix}
\begin{pmatrix}
\varepsilon_t \\
\eta_t
\end{pmatrix}.
\]

with \( \rho(L)L^q = 0 \) for \( L = 0 \).
Appendix. Generalization of the model.

- **Fundamental:**
  \[
  \begin{pmatrix}
  v_t \\
  \tilde{y}_t
  \end{pmatrix} =
  \begin{pmatrix}
  \rho(L) & \frac{\rho(L)L^q}{b(L)} \\
  \delta(L) & \frac{\gamma(L)}{b(L)}
  \end{pmatrix}
  \begin{pmatrix}
  \varepsilon_t \\
  x_t
  \end{pmatrix}
  \]
  \[G(L)\] \hspace{1cm} (27)

- **Structural:**
  \[
  \begin{pmatrix}
  \varepsilon_t \\
  x_t
  \end{pmatrix} =
  \begin{pmatrix}
  1 & 0 \\
  0 & b(L)
  \end{pmatrix}
  \begin{pmatrix}
  \varepsilon_t \\
  \eta_t
  \end{pmatrix}.
  \] \hspace{1cm} (28)
Identification.

Identification strategy:

- Run a VAR and impose the restriction that the \( x_t \) does not affect \( \nu_t \) contemporaneously.
- Obtain an estimate of \( \hat{b}^*(F) \) using:

\[
\hat{b}^*(F) = \hat{b}(L)^{-1} = (\hat{G}_{11}(L)L^q)^{-1}\hat{G}_{12}(L) \tag{29}
\]

- Find the roots \( \hat{r}_j \) of \( \hat{b}^*(F) \). These roots can be used to compute \( \hat{b}(L) \).

- The structural representation of the system in terms of the “new” and “surprise” shock is given by:

\[
\begin{pmatrix}
\nu_t \\
\tilde{y}_t
\end{pmatrix}
= \hat{G}(L)\hat{B}(L)
\begin{pmatrix}
\varepsilon_t \\
\eta_t
\end{pmatrix}
\]
Model parameters.

\[ \delta(L) \equiv \psi_1(L) \]

and

\[ \gamma(L) \equiv \phi_1^{q-1}(L) + \psi_1(L)L^q \]

where:

\[ \psi_1(L) \equiv -e_1(I - A\rho)^{-1}B \sum_{s=0}^{\infty} \rho^s L^s, \]

\[ \phi_1^{q-1}(L) \equiv -e_1 \sum_{s=0}^{q-1} (A^{q+1}\rho^{s+1}(I - A\rho)^{-1} + \sum_{m=0}^{s} A^{q-m}\rho^{s-m})BL^s \]

and \(e_1 \equiv [1 \ 0]\) selects the first element of the vectors above.
Robustness: $\Delta \text{ffr}$ first.

Figure: Baseline VAR with $\Delta \text{ffr}$, $\Delta \text{fff}$, GDP, GDPDEF. Green lines are the measure derived from $h$-ahead future contract for $h = 1, \ldots, 6$. Black line is the factor measures summarizing all the individual contracts. 95% and 68% bands computed with bootstrap methods refer to the latter. The red line is the factor response obtained with Cholesky identification.
Variance decomposition $\Delta ffr$ first.

Figure: Variance decomposition of baseline VAR with $\Delta ffr$, $\Delta fff$, GDP, GDPDEF. One standard deviation bands in gray.
Robustness: $\Delta ffr$ with SPF.

**Figure:** Baseline VAR with GDP, GDPDEF, $\Delta ffr$ and FF6 or 1 and 2 quarters ahead SPF forecast of T-bill. The policy shock has been cumulated to obtain an I(1) series. Green lines are specifications obtained replacing the FF6 with the SPF data. 95% and 68% bands computed with bootstrap methods refer to the latter.
Robustness: Sign restrictions ($\Delta ffr$).

Figure: Baseline VAR with FFR log(FF6) GDP, GDPDEF, identified with zero and Sign restrictions. Results are compared to Cholesky scheme. Restrictions set are on the news shock effects: (-) for GDP at h=15; (-) for inflation at h=15; (+) for $\Delta ffr$ at h=5.
Robustness: sign restrictions with FFR.

**Figure:** Baseline VAR with FFR log(FF6) GDP, GDPDEF, identified with zero and Sign restrictions. Restrictions set are on the news shock effects: (-) for GDP at h=5; (-) for inflation at h=5; (+) for FFR at h=12; (+) for FF6 at h=5.
Robustness: Christiano et al. (2005) with SPF.

Figure: Christiano et al. (2005) VAR with timing restriction. 95% and 68% bands computed with bootstrap methods. The red line compares the results obtained from the baseline case with no news specification. The Baseline case considered is the 4 month ahead forecast. Specification with forecasts at shorter horizons are reported in green.


