The Forward Guidance Puzzle

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Disclaimer: The views expressed are mine and do NOT necessarily reflect those of the Federal Reserve Bank of New York or the Federal Reserve System
Monetary Policy Pre-Great Recession

- **Interest-rate**: key instrument of policy
  - interest-rate rule captures systematic behavior of central bank (e.g. Taylor 1993,...)
  - Policy shocks capture unpredictable deviations from rule

- **Monetary transmission**
  - Extensively studied using both VAR models and DSGE models (Sims 1980, Christiano, Eichenbaum, Evans 1999, 2005) ...
Monetary Policy Post-Great Recession

- “New” policy tools
  - **Forward guidance**: announcements about future path of short-term policy rate
    - Used extensively since Dec. 2008 FOMC meeting
  - LSAP (quantitative easing)
    - changes in size or composition of CB balance sheet

- Goal: lower long-term bond yields $\rightarrow$ stimulate aggregate expenditures

- But ... effects not well understood; harder to use existing empirical tools (VARs) to gather evidence
Forward Guidance in the US

- FOMC statements

- December 2008:
  - economic conditions “are likely to warrant exceptionally low levels of the FFR for some time”

- March 2009 June 2011:
  - “exceptionally low levels of the FFR would likely be warranted for an extended period”

- August 2011:
  - economic conditions “are likely to warrant exceptionally low levels of the FFR at least through mid-2013”
• January 2012:
  • ... “exceptionally low levels of the FFR at least through late 2014”

• September 2012:
  • ... “highly accommodative stance of monetary policy will remain appropriate for a considerable time after the economic recovery strengthens.
  • ... exceptionally low levels for the FFR are likely to be warranted at least through mid-2015”

• December 2012 [thresholds]:
  • ... “exceptionally low range for the FFR will be appropriate at least as long as the unemployment rate remains above 6-1/2 percent, inflation between one and two years ahead is projected to be no more than a half percentage point above the Committees 2 percent longer-run goal”
Analyzing the Effects of Forward Guidance – The Challenge

- Campbell, Evans, Fisher, Justiniano 2012, Woodford 2012

- Announcement by CB that will maintain FFR at ZLB for longer can have two effects:
  - Reveals bad news about state of economy (Delphic) $\rightarrow$ lower projected activity, lower inflation
  - More monetary stimulus (Odyssean/Commitment à la Eggertsson and Woodford 2003) $\rightarrow$ stimulates economic activity, higher inflation

- Interpretation by market depends in very subtle ways on FOMC communication
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DSGEs and Forward Guidance

- Medium-scale New Keynesian DSGE models “fit data well”: reasonable forecasting performance relative to VARs, private sector forecasts, or Greenbook (Smets & Wouters 2007; Del Negro & Schorfheide 2013; ...)

- Variants with financial frictions also “fit data reasonably well” in the aftermath of the Great Recession – Del Negro, Giannoni, & Schorfheide (forthcoming)

→ these models are in principle well suited to:

1. perform counterfactual experiments, e.g., “What if we extend fwd guidance by another 2 quarters/lower the unemployment threshold to x% ...”

2. investigate the effects of past forward guidance (Milani & Treadwell 2010, Campbell, Fisher, Justiniano 2011)
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Modeling Forward Guidance: Anticipated Policy Shocks

• We modify this rule to allow for forward guidance following Laseen & Svensson 2009:

\[ \hat{R}_t = \rho_R \hat{R}_{t-1} + (1-\rho_R)(\psi_\pi \sum_{j=0}^3 \hat{\pi}_{t-j} + \psi_y \sum_{j=0}^3 (\hat{y}_{t-j} - \hat{y}_{t-j-1} + \hat{z}_{t-j})) + \epsilon^R_t + \sum_{k=1}^K \epsilon^R_{k,t-k} \]

where \( \epsilon^R_{k,t-k} \) is a policy shock that is known to agents at time \( t-k \), but affects the policy rule \( k \) periods later, that is, at time \( t \).

• Anticipated policy shocks are a simple way of capturing anticipated deviations from the standard reaction function.

• Note: Even in the model, not commitment to a path: conditionality is still there!
Estimating Forward Guidance

- Add Expected FFR to the measurement equations:

\[
\text{FFR}_{t,t+k}^e = 400 \left( E_t \hat{R}_{t+k} + \ln R_* \right) = 400 \left( \Psi_{R,2}(\theta) \Phi_1(\theta)^k s_t + \Psi_{R,1}(\theta) \right), \quad k = 1, \ldots, K
\]

where \( \text{FFR}_{t,t+k}^e \) is measured using OIS rates (1 through 12 quarters ahead), and

\[
s_t = \Phi_1(\theta) s_{t-1} + \Phi_\epsilon(\theta) \epsilon_t
\]

is the transition equation, and

\[
y_t = \Psi_1(\theta) + \Psi_2(\theta) s_t
\]

is the measurement equation

- Note: From the ex-post behavior of output and inflation the model should be able to tell whether the change in expected FFR is due to a policy shock or bad news
The shock decomposition is presented for the conditional forecast. The solid lines (black for realized data, red for mean forecast) show each variable in deviation from its steady state. The bars represent the shock contributions; specifically, the bars for each shock represent the counterfactual values for the observables (in deviations from the mean) obtained by setting all other shocks to zero.
The Forward Guidance Puzzle

- Perform a “counterfactual” experiment in 2012Q2: Fed announces that FFR is 25 bp through 2015Q2
The Forward Guidance Puzzle

- Perform a “counterfactual” experiment in 2012Q2: Fed announces that FFR is 25 bp through 2015Q2

Excessive response of activity/inflation to fixing the policy rate is also discussed in Laseen & Svensson 2009 and Carlstrom, Fuerst, & Paustian 2012
Forward Guidance in NK DSGE 101

• Take a 3-equations NK model

• Modify the policy rule so to introduce anticipated policy shocks:

\[ \hat{R}_t = \psi_\pi \hat{\pi}_t + \epsilon^R_t + \sum_{k=1}^{K} \epsilon^R_{k,t-k} \]

• Are these policy news shocks more or less powerful than contemporaneous (usual) policy shocks?
**Forward Guidance in NK DSGE 101**

**Step 1:** Consumption depends on the (real) long rate:

From the Euler eq. \( \hat{c}_t = -E_t[\hat{R}_t - \hat{\pi}_{t+1} + \hat{c}_{t+1}] \rightarrow \)

\[
\hat{c}_t = - \sum_{j=0}^{\infty} E_t[\hat{R}_{t+j} - \hat{\pi}_{t+1+j}]
\]

\[\underbrace{\hat{LR}_t}_{\text{LR}_t}\]

**Step 2:** Anticipated shocks move consumption tomorrow and today → stronger effect on inflation:

- (Assume for now the price level is fixed → the CB pegs the real rate)
- **Contemporaneous** shock: \( \hat{R}_t = -\Delta, \hat{R}_{t+1} = 0, \hat{R}_{t+2} = 0 \ldots \rightarrow \hat{LR}_t = -\Delta, \hat{LR}_{t+1} = 0, \ldots \rightarrow \hat{c}_t = \Delta, \hat{c}_{t+1} = 0, \ldots \)
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\]

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\]
\[
LR_t
\]

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  \( \rightarrow \)
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Step 3: Now let $\pi$ move. In the NK model inflation is the PDV of future expected output gaps

$$\hat{\pi}_t = \kappa \sum_{j=0}^{\infty} \beta^j E_t[\hat{c}_{t+j}]$$

- **Anticipated** shock: more prolonged output increase $\hat{c}_t = \hat{c}_{t+1} = \Delta$ $\rightarrow \hat{\pi}_t$ rises more $\rightarrow$ real rate drops today.

- However, as $\hat{\pi}_t$ increases, $\hat{R}_t$ also increases and this mitigates the effect of the shock
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Impulse Responses to Anticipated Shocks in an Estimated (FRBNY) DSGE Model

Quarters Ahead:

0

4

8

Interest Rate

10-year Rate

Output Level

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Impulse Responses to Anticipated Shocks in an Estimated (FRBNY) DSGE Model

Quarters Ahead:

0  4  8

Interest Rate

Output Level

Core PCE Inflation
Evidence from Campbell et al. (BPEA 11)

Table 8. Regressions Estimating Asset Price Responses to Forward Guidance Shocks Identified from an Interest Rate Rule, 1996Q1–2007Q2

<table>
<thead>
<tr>
<th>Asset</th>
<th>Constant</th>
<th>$v_0$</th>
<th>$v_1$</th>
<th>$v_2$</th>
<th>$v_3$</th>
<th>$v_4$</th>
<th>Adjusted $R^2$</th>
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<tbody>
<tr>
<td><strong>Treasuries</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2 years to maturity</td>
<td>5.90</td>
<td>1.08***</td>
<td>1.98***</td>
<td>1.56***</td>
<td>0.70*</td>
<td>0.89*</td>
<td>0.77</td>
</tr>
<tr>
<td></td>
<td>(4.47)</td>
<td>(0.37)</td>
<td>(0.22)</td>
<td>(0.33)</td>
<td>(0.42)</td>
<td>(0.50)</td>
<td></td>
</tr>
<tr>
<td>5 years to maturity</td>
<td>3.46</td>
<td>0.61*</td>
<td>1.83***</td>
<td>1.91***</td>
<td>1.43***</td>
<td>1.25**</td>
<td>0.78</td>
</tr>
<tr>
<td></td>
<td>(4.31)</td>
<td>(0.36)</td>
<td>(0.21)</td>
<td>(0.32)</td>
<td>(0.40)</td>
<td>(0.49)</td>
<td></td>
</tr>
<tr>
<td>10 years to maturity</td>
<td>1.57</td>
<td>0.38</td>
<td>1.48***</td>
<td>1.60***</td>
<td>1.41***</td>
<td>1.29***</td>
<td>0.70</td>
</tr>
<tr>
<td></td>
<td>(4.44)</td>
<td>(0.37)</td>
<td>(0.22)</td>
<td>(0.33)</td>
<td>(0.42)</td>
<td>(0.50)</td>
<td></td>
</tr>
<tr>
<td><strong>Corporate bonds</strong> b</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aaa/AAA-rated</td>
<td>0.60</td>
<td>0.19</td>
<td>0.65***</td>
<td>0.75**</td>
<td>0.86**</td>
<td>0.17</td>
<td>0.33</td>
</tr>
<tr>
<td></td>
<td>(4.63)</td>
<td>(0.38)</td>
<td>(0.23)</td>
<td>(0.34)</td>
<td>(0.43)</td>
<td>(0.52)</td>
<td></td>
</tr>
<tr>
<td>Baa/BBB-rated</td>
<td>0.57</td>
<td>0.13</td>
<td>0.69***</td>
<td>0.71**</td>
<td>1.00***</td>
<td>0.37</td>
<td>0.42</td>
</tr>
<tr>
<td></td>
<td>(4.01)</td>
<td>(0.33)</td>
<td>(0.20)</td>
<td>(0.30)</td>
<td>(0.38)</td>
<td>(0.45)</td>
<td></td>
</tr>
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</table>

* Source: Campbell et al. (BPEA 11)

<table>
<thead>
<tr>
<th>Change in forecast[^2]</th>
<th>Constant</th>
<th>Shock</th>
<th>Adjusted R²</th>
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<tr>
<td></td>
<td></td>
<td>v₉,0</td>
<td>v₉,1</td>
</tr>
<tr>
<td>Unemployment rate</td>
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<td></td>
</tr>
<tr>
<td>u₋¹ – u₀</td>
<td>-6.82***</td>
<td>-0.37*</td>
<td>-0.20</td>
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<tr>
<td></td>
<td>(2.47)</td>
<td>(0.20)</td>
<td>(0.12)</td>
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<tr>
<td>u₀ – u¹</td>
<td>-4.02</td>
<td>-0.34</td>
<td>-0.30**</td>
</tr>
<tr>
<td></td>
<td>(2.92)</td>
<td>(0.24)</td>
<td>(0.14)</td>
</tr>
<tr>
<td>u¹ – u²</td>
<td>-3.39</td>
<td>-0.46*</td>
<td>-0.47***</td>
</tr>
<tr>
<td></td>
<td>(2.93)</td>
<td>(0.24)</td>
<td>(0.14)</td>
</tr>
<tr>
<td>u² – u³</td>
<td>-2.86</td>
<td>-0.31</td>
<td>-0.47***</td>
</tr>
<tr>
<td></td>
<td>(2.65)</td>
<td>(0.22)</td>
<td>(0.13)</td>
</tr>
<tr>
<td>Inflation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>π₋¹ – π₀</td>
<td>1.83</td>
<td>-0.35</td>
<td>0.23</td>
</tr>
<tr>
<td></td>
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<td>(0.46)</td>
<td>(0.27)</td>
</tr>
<tr>
<td>π₀ – π¹</td>
<td>-5.20*</td>
<td>-0.18</td>
<td>0.17</td>
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<td>(2.91)</td>
<td>(0.24)</td>
<td>(0.14)</td>
</tr>
<tr>
<td>π¹ – π²</td>
<td>-7.55***</td>
<td>-0.05</td>
<td>0.15</td>
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<td></td>
<td>(2.69)</td>
<td>(0.22)</td>
<td>(0.13)</td>
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</tr>
<tr>
<td></td>
<td>(2.11)</td>
<td>(0.18)</td>
<td>(0.10)</td>
</tr>
</tbody>
</table>

[^1]: Source: Authors’ regression reports
[^2]: A subscript indicates lag, 0 to 4, where a superscript indicates the horizon, t – n to t + n.
What is the “Excessive” Response Due To?

1. The **NKPC** (Kiley et al. NBER Macroannual 2014, Carlstrom et al.)
2. The Euler equation: long-term rate $\rightarrow$ activity
3. Excess propagation: too strong a response of long-term rate to news shocks?
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What Did Actually Happen Following the Announcements? – Treasury Yield Curve

<table>
<thead>
<tr>
<th>Date</th>
<th>30-Year</th>
<th>10-Year</th>
<th>5-Year</th>
<th>3-Year</th>
<th>1-Year</th>
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<tr>
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<td>-18</td>
<td>-12</td>
<td>-3</td>
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<td>9/21/2011</td>
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<td>-23</td>
<td>-6</td>
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<td>1</td>
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<tr>
<td>1/25/2012</td>
<td>-5</td>
<td>-12</td>
<td>-15</td>
<td>-8</td>
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</tr>
<tr>
<td>6/20/2012</td>
<td>-5</td>
<td>-1</td>
<td>2</td>
<td>2</td>
<td>1</td>
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<td>9/13/2012</td>
<td>17</td>
<td>11</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
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Forward Rates

08/09/11
“at least through mid-13”

01/25/12
“mid-14”

09/13/12
“mid-15” “after the economy strengthens”
The Policy Reaction Function and the FFR Path

- How can we explain what happened to nominal rates on 9/13/12?
- A different policy experiment (with the opposite sign) to show that nominal rates can ↑ in equilibrium following an announcement about the reaction function
• A different experiment that makes the same point ...

Nominal Rates

Federal Funds Rate

Real Rates

Ex-ante Real Interest Rate

Baseline Forecast

Output Inflation

Output Growth

Inflation (GDP Deflator, Q/Q Annualized)

Inertial Taylor 99

Baseline Forecast

Inertial Taylor 99

Baseline Forecast

Inertial Taylor 99

Baseline Forecast

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<table>
<thead>
<tr>
<th>Date</th>
<th>30-Year</th>
<th>20-Year</th>
<th>10-Year</th>
<th>7-Year</th>
<th>5-Year</th>
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<tr>
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<td>6</td>
<td>10</td>
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<td>-9</td>
<td>-8</td>
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<td>-19</td>
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Breakeven and Inflation Swaps

Breakeven

<table>
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<th>Date</th>
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<th>5-Year</th>
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<tbody>
<tr>
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Inflation Swaps

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<th>Date</th>
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<td>26</td>
<td>27</td>
</tr>
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- In all three periods, financial markets reaction is consistent with Odyssean forward guidance.
... Not Driven by Illiquidity

TIPS-Teasury Spread (Fleckenstein, Longstaff, Lustig JF)

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What If We Constrain the Long Rates Response?

- Choose anticipated shocks so to i) minimize the weighted deviations from baseline path, ii) subject to causing a given drop in a long-term rate (say 10 bps of 10-year yield)
• We obtain “reasonable” effects on output and inflation

• The problem seems to be in the mapping *forward guidance* $\rightarrow$ *long rate* and not so much in *long rate* $\rightarrow$ *activity*
Conclusions

• What is the forward guidance puzzle?

• A model that is almost “designed” to capture well the responses to a contemporaneous policy shocks fails to adequately describe the impact of anticipated shocks:
  It arguably delivers implausibly large responses to forward guidance.

• ... and this is the case in part because the model over-predicts the impact of forward guidance on long term rates – a model that one may a priori expect to have too little persistence, has in fact too much

• Lots to do:
  • Better understand the sources of the excessive response of long-term rates
  • Estimating the model with the “right” observables may deliver more reasonable responses to forward guidance
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## Risk-neutral Forward Rates

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