Measuring the Effects of Federal Reserve Forward Guidance and Asset Purchases on Financial Markets

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University of California, Irvine

NBER Summer Institute, ME Meeting
Cambridge, MA
July 14, 2017
In December 2008, U.S. Federal Reserve/FOMC lowered federal funds rate essentially to 0

U.S. economy was still in a severe recession

FOMC began to pursue “unconventional monetary policy” to try to lower longer-term interest rates and stimulate the economy:

- **Forward guidance**: information about the future path of the federal funds rate
- **Large-scale asset purchases (LSAPs)**: purchases of hundreds of billions of $ of longer-term Treasury and mortgage-backed securities
The Committee will maintain the target range for the federal funds rate at 0 to 1/4 percent and anticipates that economic conditions are likely to warrant exceptionally low levels of the federal funds rate for an extended period. To provide greater support to mortgage lending and housing markets, the Committee decided today to increase the size of the Federal Reserve’s balance sheet further by purchasing up to an additional $750 billion of agency mortgage-backed securities, bringing its total purchases of these securities to up to $1.25 trillion this year, and to increase its purchases of agency debt this year by up to $100 billion to a total of up to $200 billion. Moreover, to help improve conditions in private credit markets, the Committee decided to purchase up to $300 billion of longer-term Treasury securities over the next six months.
**Unconventional Monetary Policy Announcements**

<table>
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<tr>
<th>Date</th>
<th>Announcement</th>
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<tbody>
<tr>
<td>Nov. 3, 2010</td>
<td>FOMC announces it will <strong>purchase an additional $600B of longer-term Treasuries</strong> (a.k.a. “QE2”)</td>
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<td>Aug. 9, 2011</td>
<td>FOMC announces it expects to keep the federal funds rate between 0 and 25 bp <strong>“at least through mid-2013”</strong></td>
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<td>Sep. 21, 2011</td>
<td>FOMC announces it will sell $400B of short-term Treasuries and use the proceeds to <strong>buy $400B of long-term Treasuries</strong> (a.k.a. “Operation Twist”)</td>
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<td>Jan. 25, 2012</td>
<td>FOMC announces it expects to keep the federal funds rate between 0 and 25 bp <strong>“at least through late 2014”</strong></td>
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<td>Sep. 13, 2012</td>
<td>FOMC announces it expects to keep the federal funds rate between 0 and 25 bp <strong>“at least through mid-2015”</strong>, and that it will <strong>purchase $40B of mortgage-backed securities per month</strong> for the indefinite future</td>
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<td>Dec. 12, 2012</td>
<td>FOMC announces it will <strong>purchase $45B of longer-term Treasuries per month</strong> for the indefinite future, and that it expects to keep the federal funds rate between 0 and 25 bp for at least as long as unemployment remains above 6.5 percent and inflation expectations remain subdued</td>
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<td>Dec. 18, 2013</td>
<td>FOMC announces it will <strong>start to taper its purchases of longer-term Treasuries and mortgage-backed securities</strong> to paces of $40B and $35B per month, respectively</td>
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<td>Dec. 17, 2014</td>
<td>FOMC announces that “<strong>it can be patient in beginning to normalize the stance of monetary policy</strong>”</td>
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<td>Mar. 18, 2015</td>
<td>FOMC announces that “<strong>an increase in the target range for the federal funds rate remains unlikely at the April FOMC meeting</strong>”</td>
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<td>Oct. 28, 2015</td>
<td>FOMC announces that <strong>it will decide whether to raise the funds rate at its next meeting.</strong></td>
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Motivation

Important Questions:

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- Many FOMC announcements contain elements of both forward guidance and LSAPs
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- Many FOMC announcements contain elements of both forward guidance and LSAPs
- One way LSAPs can affect the economy is by signaling FOMC commitment to a future path for the federal funds rate
- Only surprise component of announcement should affect asset prices, but we don’t have good data on what markets expected
Summary of This Paper

1. Extend the methods of Gürkaynak, Sack, and Swanson (2005) to **separately identify** the **forward guidance** and **LSAP** components of every FOMC announcement from January 2009 to October 2015.
Summary of This Paper


2. Use high-frequency regressions around those FOMC announcements to estimate effects of each type of unconventional monetary policy on asset prices.
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2. Use high-frequency regressions around those FOMC announcements to estimate effects of **each type** of unconventional monetary policy on asset prices.

3. Also look at the **persistence** of these effects, the effects of these policies on **uncertainty**, etc.
Consider FOMC announcements from July 1991 to October 2015 (there are $T = 213$ of them)
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Look at 30-minute response of $N = 8$ different points along yield curve to those announcements
Intraday Futures Response to FOMC Announcement

(a) June 25, 2003 (July 2003 Contract)

The federal funds futures contract rate falls to 3.85 percent after the announcement rather than the new funds rate target of 3.75 percent because nine
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Idea: Matrix of asset price responses $X$ is well described by a factor model with a small number of factors:

$$X_{T \times N} = F_{T \times k} \Lambda_{k \times N} + \varepsilon_{T \times N}$$
Test for the Number of Factors

Apply Cragg-Donald (1997) test for the number of factors \( k \) needed to explain the data \( X \):

\[
H_0: \text{number of factors equals degrees of freedom Wald statistic p-value} \\
0 \hspace{1cm} 28 \hspace{1cm} 88.4 \hspace{1cm} 3.5 \times 10^{-8}
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Given a 3-dimensional factor model

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- Then \( F\Lambda = \tilde{F}\tilde{\Lambda} \), so

\[
X = \tilde{F}\tilde{\Lambda} + \varepsilon
\]

fits the data exactly as well as the original factor model
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**Full-sample Identification:**

- estimate 3 factors that moved asset prices the most over 1991–2015 sample using principal components
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Forward Guidance and LSAP Factors, 2009–2015

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"QE1"
Forward Guidance and LSAP Factors, 2009–2015

FOMC signals caution in raising rates

FOMC hints at Dec. rate hike

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Forward Guidance and LSAP Factors, 2009–2015

- Estimated forward guidance factor
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"QE1"

FOMC decides not to taper

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Forward Guidance and LSAP Factors, 2009–2015

- "QE1"
- "Operation Twist"
- "taper tantrum"
- "mid-2013"
- FOMC decides not to taper
- FOMC extends LSAP end date from 2009Q4 to 2010Q1
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Estimated forward guidance factor
Estimated LSAP factor
Run high-frequency regressions on FOMC announcement days:

\[ \Delta y_t = \alpha + \beta \tilde{F}_t + \varepsilon_t \]
## Effects of Fwd Guidance, LSAPs on Treasury Yields

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<td>[20.56]</td>
<td>[20.33]</td>
<td>[10.77]</td>
</tr>
</tbody>
</table>

### Jan. 2009–Oct. 2015:
- Change in fwd guidance: 1.19***
  - [t-stat.]: 3.69
- Change in LSAPs: 0.19**
  - [t-stat.]: 2.07

<table>
<thead>
<tr>
<th></th>
<th>6-month</th>
<th>2-year</th>
<th>5-year</th>
<th>10-year</th>
<th>30-year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in fwd guidance</td>
<td>1.19***</td>
<td>5.14***</td>
<td>6.22***</td>
<td>3.06***</td>
<td>0.14</td>
</tr>
<tr>
<td>[t-stat.]</td>
<td>[3.69]</td>
<td>[15.91]</td>
<td>[17.13]</td>
<td>[10.24]</td>
<td>[0.16]</td>
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<tr>
<td>Change in LSAPs</td>
<td>0.19**</td>
<td>0.20</td>
<td>-2.92***</td>
<td>-6.49***</td>
<td>-5.77***</td>
</tr>
<tr>
<td>[t-stat.]</td>
<td>[2.07]</td>
<td>[1.66]</td>
<td>[-5.69]</td>
<td>[-18.91]</td>
<td>[-10.42]</td>
</tr>
</tbody>
</table>
Effects of Fwd Guidance, LSAPs on Treasury Yields

Run high-frequency regressions on FOMC announcement days:

\[ \Delta y_t = \alpha + \beta \tilde{F}_t + \varepsilon_t \]

<table>
<thead>
<tr>
<th></th>
<th>6-month</th>
<th>2-year</th>
<th>5-year</th>
<th>10-year</th>
<th>30-year</th>
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<tbody>
<tr>
<td>July 1991–Dec. 2008:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>change in fed funds rate</td>
<td>4.11***</td>
<td>3.70***</td>
<td>2.02***</td>
<td>0.82***</td>
<td>0.05</td>
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<tr>
<td>[t-stat.]</td>
<td>[10.36]</td>
<td>[24.22]</td>
<td>[9.47]</td>
<td>[3.70]</td>
<td>[0.30]</td>
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<tr>
<td>change in fwd guidance</td>
<td>2.87***</td>
<td>4.81***</td>
<td>4.59***</td>
<td>3.44***</td>
<td>2.22***</td>
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<tr>
<td>[t-stat.]</td>
<td>[6.93]</td>
<td>[25.17]</td>
<td>[20.56]</td>
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</table>
Effects on Stocks and Exchange Rates

Results from regressions

\[ \Delta \log x_t = \alpha + \beta \tilde{F}_t + \varepsilon_t \]
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Results from regressions

\[ \Delta \log x_t = \alpha + \beta \tilde{F}_t + \varepsilon_t \]

<table>
<thead>
<tr>
<th></th>
<th>S&amp;P 500</th>
<th>$/euro</th>
<th>$/yen</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>July 1991–Dec. 2008:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>change in federal funds rate</td>
<td>$-0.32^{***}$</td>
<td>$-0.11^{**}$</td>
<td>$-0.13^{***}$</td>
</tr>
<tr>
<td>[ t-stat.]</td>
<td>$[-2.98]$</td>
<td>$[-2.41]$</td>
<td>$[-4.02]$</td>
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<tr>
<td>change in forward guidance</td>
<td>$-0.16^{**}$</td>
<td>$-0.16^{***}$</td>
<td>$-0.14^{***}$</td>
</tr>
<tr>
<td>[ t-stat.]</td>
<td>$[-2.37]$</td>
<td>$[-4.64]$</td>
<td>$[-4.53]$</td>
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<tr>
<td><strong>Jan. 2009–Oct. 2015:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>change in forward guidance</td>
<td>$-0.26^{***}$</td>
<td>$-0.37^{***}$</td>
<td>$-0.24^{***}$</td>
</tr>
<tr>
<td>[t-stat.]</td>
<td>$[-2.61]$</td>
<td>$[-6.46]$</td>
<td>$[-4.86]$</td>
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<td>change in LSAPs</td>
<td>$0.12^{**}$</td>
<td>$0.21^{***}$</td>
<td>$0.29^{***}$</td>
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<td>[t-stat.]</td>
<td>$[1.99]$</td>
<td>$[4.00]$</td>
<td>$[6.08]$</td>
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</tbody>
</table>
Effects on Corporate Bond Yields and Spreads

Results from regressions

\[ \Delta y_t = \alpha + \beta \tilde{F}_t + \varepsilon_t \]
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Results from regressions

\[ \Delta y_t = \alpha + \beta \tilde{F}_t + \varepsilon_t \]

<table>
<thead>
<tr>
<th></th>
<th>Corporate Yields</th>
<th>Spreads</th>
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<tbody>
<tr>
<td><strong>July 1991–Dec. 2008:</strong></td>
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</tr>
<tr>
<td>change in fed funds rate</td>
<td>0.32</td>
<td>0.41</td>
</tr>
<tr>
<td>[ t-stat.]</td>
<td>[0.83]</td>
<td>[0.98]</td>
</tr>
<tr>
<td>change in fwd guidance</td>
<td>2.08***</td>
<td>1.96***</td>
</tr>
<tr>
<td>[ t-stat.]</td>
<td>[5.24]</td>
<td>[4.87]</td>
</tr>
<tr>
<td><strong>Jan. 2009–Oct. 2015:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>change in fwd guidance</td>
<td>0.48</td>
<td>−0.51</td>
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<tr>
<td>[t-stat.]</td>
<td>[0.63]</td>
<td>[−0.56]</td>
</tr>
<tr>
<td>change in LSAPs</td>
<td>−4.51***</td>
<td>−5.25***</td>
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<td>[t-stat.]</td>
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Are the Effects of Fwd Guidance, LSAPs Persistent?

Interesting question whether one-day effects of forward guidance and LSAPs are persistent
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“Slow-moving capital” view (Duffie 2010; Fleckenstein, Longstaff, Lustig 2014):

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Run daily regressions forecasting $h$-day change in yields:

$$y_{t+h} = \alpha_h + \beta_h y_t + \gamma_h \tilde{F}_t + \varepsilon_t^{(h)}$$

$$y_{t+h} - y_t = \gamma_h \tilde{F}_t + \varepsilon_t^{(h)}$$
Persistence of LSAP Effects (on 10y Treasury)

Effect of LSAPs on 10-Year Treasury Yield

\[ \gamma_h = ae^{-b(h - 1)} \]
Persistence of LSAP Effects (on 10y Treasury)

\[ \gamma_h = ae^{-b(h-1)} \]
March 18, 2009, FOMC “QE1” Announcement

The graph shows the yield percent of various Treasury bonds from March 2 to May 25, 2009. The FOMC announcement on March 18, 2009, is marked on the graph. The yields for the 10-year Treasury, 5-year Treasury, 2-year Treasury, and 1-year Treasury are represented by red, green, orange, and blue lines, respectively.
Persistence of LSAP Effects on 10Y Tr., excl. 3/18/09

Effect of LSAPs on 10-Year Treasury Yield (excl. 3/18/09)
Effect of Fed Funds Rate on 2-Year Treasury Yield, 1991-2008
Persistence of Forward Guidance Effects (post-2008)

Effect of Forward Guidance on 2-Year Treasury Yield
Persistence of Forward Guidance Effects (pre-2009)


horizon $h$ (days)

0 20 40 60 80 100 120

coefficient $\gamma_h$ (bp/sd)

-10
-5
0
5
10
15
20
25

horizon $h$ (days)
Conclusions

1. Unconventional monetary policy was effective (on financial markets) on impact; LSAP effects persistent
   - suggests Fed does not need to raise its inflation target

2. Both forward guidance and LSAPs were effective on impact:
   - FG and LSAPs about equally effective for medium-term Treasury yields, stocks, and exchange rates
   - Forward guidance had larger effects on short-term Treasury yields
   - LSAPs had larger effects on long-term Treasury yields, corporate bond yields, and interest rate uncertainty

3. Results for persistence are mixed:
   - Effects of federal funds rate completely persistent
   - Effects of LSAPs completely persistent (excluding 3/18/09)
   - Effects of forward guidance surprisingly not persistent
Full-Sample vs. Split-Sample Identification

![Graph showing standard deviations over time from 1991 to 2015. The x-axis represents years from 1991 to 2015, and the y-axis represents standard deviations ranging from -4 to 5. The graph displays a series of data points for each year, with some years showing more pronounced deviations compared to others.](image-url)
Full-Sample vs. Split-Sample Identification