Measuring the Effect of the Zero Lower Bound on Medium- and Longer-Term Interest Rates

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Federal Reserve Bank of San Francisco

AEA Meetings, San Diego
January 5, 2013
Three Motivating Observations

1. New Keynesian IS curve:

\[
y_t = E_t y_{t+1} - \alpha r_t + \varepsilon_t = -\alpha E_t \sum_{j=0}^{\infty} r_{t+j} + \varepsilon_t
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3. The zero lower bound is not a substantial constraint on monetary policy if the central bank can affect longer-term interest rates:
   - Gürkaynak, Sack, and Swanson (2005):
     60–90% of the response of 2- to 10-year Treasury yields to FOMC announcements is due to statement, not funds rate
2-Year Treasury Yield $\gg 0$ for Much of 2008–10
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Questions We Address

- Was the ZLB a substantial constraint on monetary policy? —e.g., was the 2-year Treasury yield constrained?
- If so, when?
- And how severely?
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Implications for fiscal as well as monetary policy:

- Several papers show fiscal multiplier larger when ZLB binds (Christiano-Eichenbaum-Rebelo 2011, Erceg-Lindé 2010, Eggertsson-Krugman 2011)
- But did ZLB constrain yields that matter for private-sector spending?
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- Shows ZLB able to explain all of our results.
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The level of yields alone is not a good measure of ZLB constraint:
- No way to measure severity or statistical significance —e.g., is a 50 bp 2-year Treasury yield constrained or not?
- Crowding out, fiscal multiplier determined by response of yields to fiscal policy, not level of yields
- Effective lower bound may be $\gg 0$, e.g. 50bp in the UK
Measuring Treasury Yield Sensitivity to News

Measure Treasury yield sensitivity to news in normal times using a high-frequency regression:

\[ \Delta y_t = \alpha + \beta X_t + \varepsilon_t \]
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- regression is at daily frequency
- \( \Delta y_t \) denotes one-day change in Treasury yield on date \( t \)
- \( X_t \) is a vector of surprises in macroeconomic data releases (GDP, CPI, nonfarm payrolls, etc.) on date \( t \)
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Surprise component of data release: $x_t - E_{t-1}x_t$.

Market expectation of macroeconomic data releases measured by Money Market Services, Bloomberg surveys.
Measuring Time-Varying Sensitivity to News

Time-varying sensitivity version:

\[ \Delta y_t = \alpha^i + \delta^i \beta X_t + \varepsilon_t \]

where \( \delta^i \) scalar, \( i \in 1990, 1991, \ldots, 2012 \).
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where $\delta^i$ scalar, $i \in 1990, 1991, \ldots, 2012$.

- Assumption: relative responses $\beta$ constant over time
- Estimate $\delta^i, \beta$ by nonlinear least squares
- Normalize $\delta^i$ so that average $\delta^i$ from 1990–2000 is 1
## Nonlinear Regression Results for $\beta$, 1990–2012

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# Observations | 2747 | 2747 | 2747

$R^2$ | 0.08 | 0.17 | 0.10

$H_0: \beta = 0$, $p$-value | $< 10^{-16}$ | $< 10^{-16}$ | $< 10^{-16}$
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$H_0 : \beta$ constant, $p$-value | 1.00 | 1.00 | 1.00

$H_0 : \delta$ constant, $p$-value | $< 10^{-16}$ | $< 10^{-10}$ | 0.016
To study time-varying $\delta$ in finer detail, run daily rolling regressions:

Use $\hat{\beta}$ from (*) to define "generic surprise" regressor $\hat{\beta}X_t$

Estimate:

$$\Delta y_t = \alpha^i + \delta^i \beta X_t + \varepsilon_t$$

(*)
Rolling Regressions

\[ \Delta y_t = \alpha^i + \delta^i \beta X_t + \varepsilon_t \]  

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To study time-varying \( \delta \) in finer detail, run daily rolling regressions:

- Use \( \hat{\beta} \) from (\( (*) \)) to define “generic surprise” regressor \( \hat{\beta} X_t \)
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where sample is 1-year rolling window centered around date \( \tau \)
- When \( \tau = \) midpoint of year \( i \), then \( \delta^\tau \) agrees with \( \delta^i \)
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Account for 2-stage sampling uncertainty in rolling regressions:
- Use standard errors for \( \delta^i \) in \( (*) \) as benchmarks
- Interpolate between them using estimates for \( \delta^\tau \)
Time-Varying Sensitivity $\delta^\tau$, 3-month Treasury

(a) 3-Month Treasury Yield Sensitivity to News
Time-Varying Sensitivity $\delta^\tau$, 6-month Treasury
Time-Varying Sensitivity $\delta^\tau$, 1-year Treasury

(c) 1-Year Treasury Yield Sensitivity to News
Time-Varying Sensitivity $\delta^\tau$, 2-year Treasury
Time-Varying Sensitivity $\delta^\tau$, 5-year Treasury

(e) 5-Year Treasury Yield Sensitivity to News
Time-Varying Sensitivity $\delta^{\tau}$, 10-year Treasury

(f) 10-Year Treasury Yield Sensitivity to News
Private-Sector Expectations of Funds Rate “Liftoff”

Blue Chip Consensus expectation, time until first funds rate increase:

FOMC issues "mid-2013" guidance
Private-Sector Expectations of Funds Rate “Liftoff”

Probability of funds rate < 50bp in 5 quarters, from options:
Implications for the Fiscal Multiplier

- **(A)** Liftoff expected sooner
- **(B)** Liftoff expected later

This paper: 2008–10 look like scenario A
Implications for the Fiscal Multiplier

A) liftoff in 4 qtrs. $\implies$ multiplier same as normal (CER 2011)
B) liftoff in 8 qtrs. or more $\implies$ large multiplier (CER 2011)
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Conclusions

What we do:

- Test whether the ZLB is a significant constraint on interest rates.
- Measure the degree to which interest rates are constrained.

What we find:

- 1- and 2-year Treasury yields were surprisingly responsive to news throughout much of 2008–11.

What we conclude:

- Effectiveness of monetary and fiscal policy likely close to normal throughout much of 2008–11.
- Zero lower bound a more severe constraint since mid-2011.