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

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BU-Boston Fed Macro-Finance Conference
Federal Reserve Bank of Boston
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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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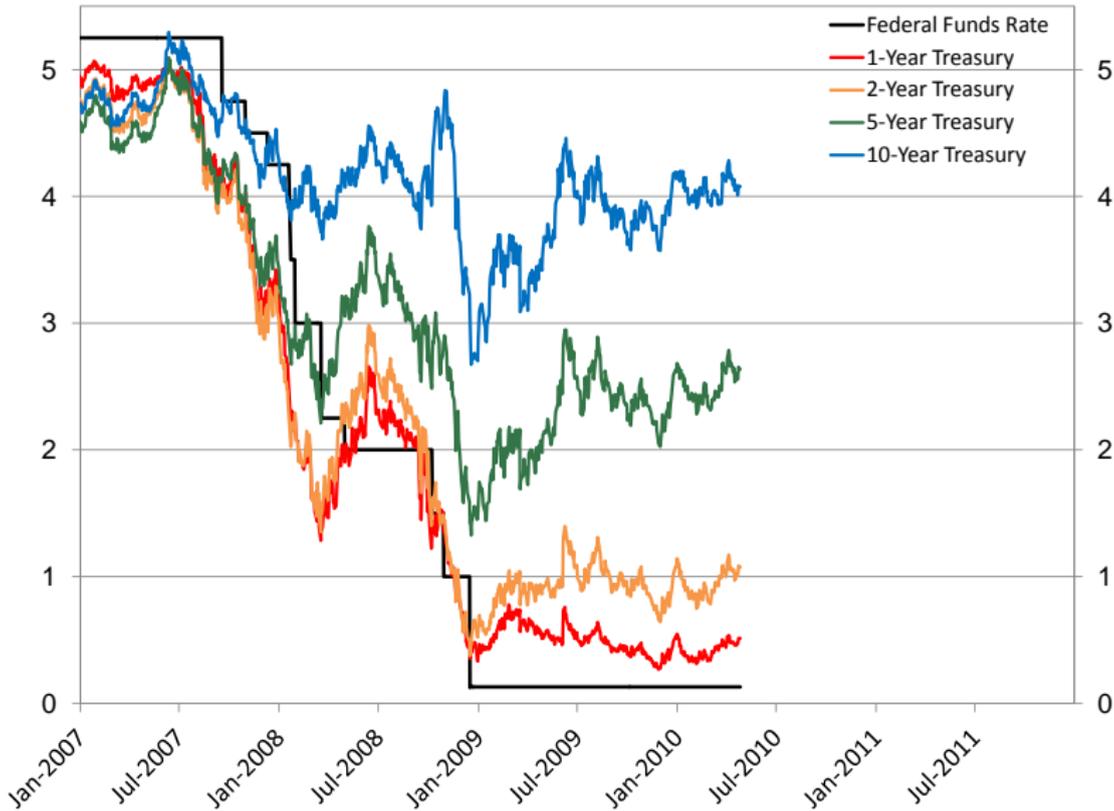
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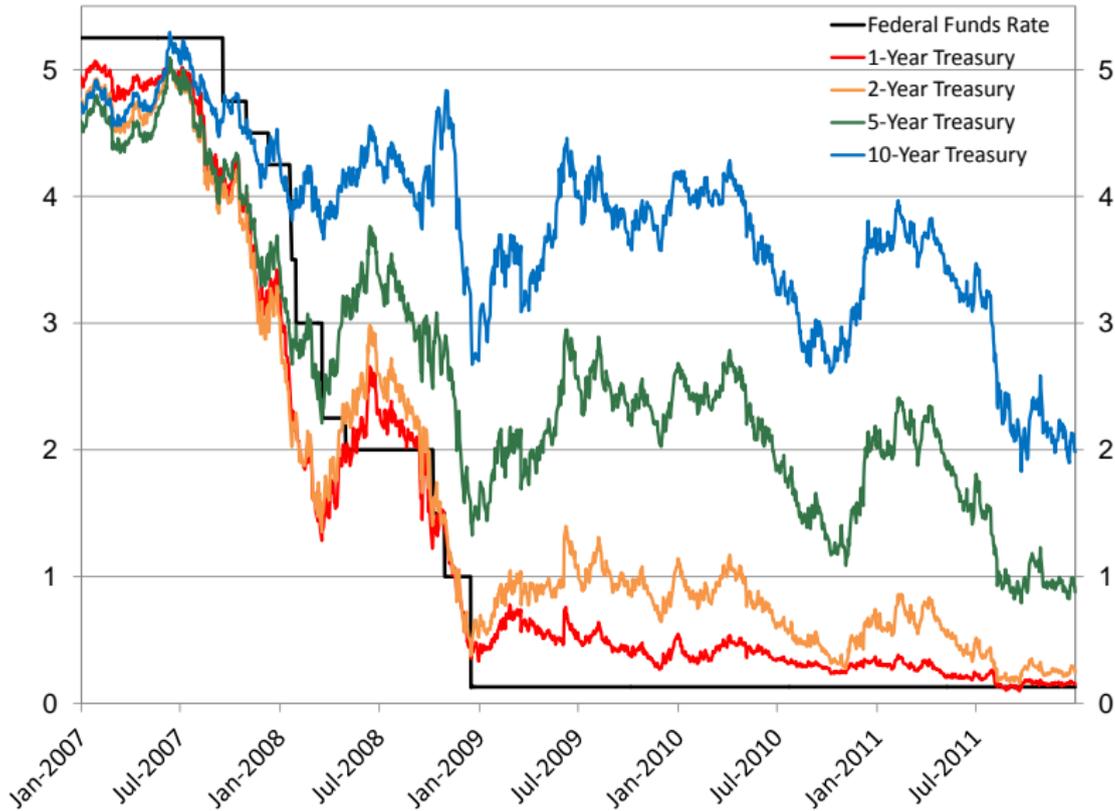
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3. The zero lower bound is not a substantial constraint on monetary policy if the central bank can affect longer-term interest rates:

   - Reifschneider-Williams (2000), Eggertsson-Woodford (2003)

   - 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

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2-Year Treasury Yield ≫ 0 for Much of 2008–10

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Questions We Address

- Was the ZLB a substantial constraint on monetary policy?
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- And how severely?

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?

What We Do

1. Empirical:
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   - And compare it to the sensitivity of those yields to news when the ZLB may have been a constraint.

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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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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.

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Measuring Time-Varying Sensitivity to News

Time-varying sensitivity version:

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where δ^i scalar, $i \in 1990, 1991, \ldots, 2012$.

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- Assumption: *relative* responses β constant over time
- Estimate δ^i, β by nonlinear least squares
- Normalize δ^i so that average δ^i from 1990–2000 is 1

Nonlinear Regression Results for β, 1990–2012

| | Treasury yield maturity | | | | | |
	3-month		2-year		10-year	
Capacity Util.	0.72	(1.52)	1.48	(2.89)	0.83	(2.48)
Consumer Conf.	0.76	(2.90)	1.37	(3.72)	0.88	(2.50)
Core CPI	0.40	(1.91)	1.91	(5.01)	1.27	(3.82)
GDP	0.93	(3.17)	1.44	(2.41)	0.98	(1.70)
Initial Claims	-0.30	(-1.81)	-1.10	(-5.35)	-0.98	(-5.08)
ISM Manufact.	1.24	(3.23)	2.74	(7.09)	2.02	(5.97)
New Home Sales	0.84	(2.63)	0.66	(1.99)	0.52	(1.96)
Nonfarm Payrolls	3.06	(7.67)	4.84	(9.55)	2.96	(6.73)
Retail Sales	0.84	(3.77)	1.87	(4.91)	1.60	(4.18)
Unemployment	-1.23	(-3.51)	-1.26	(-2.77)	-0.35	(-0.88)
# Observations	2747		2747		2747	
R^2	.08		.17		.10	
$H_0 : \beta = 0$, p-value	$< 10^{-16}$		$< 10^{-16}$		$< 10^{-16}$	

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Rolling Regressions

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To study time-varying δ in finer detail, run daily rolling regressions:

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

$$\Delta y_t = \alpha^\tau + \delta^\tau \hat{\beta} X_t + \varepsilon_t$$

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- When $\tau = $ midpoint of year i, then δ^τ agrees with δ^i

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Account for 2-stage sampling uncertainty in rolling regressions:

- Use standard errors for δ^i in $(*)$ as benchmarks
- Interpolate between them using estimates for δ^τ

Time-Varying Sensitivity δ^τ, 3-month Treasury

(a) 3-Month Treasury Yield Sensitivity to News
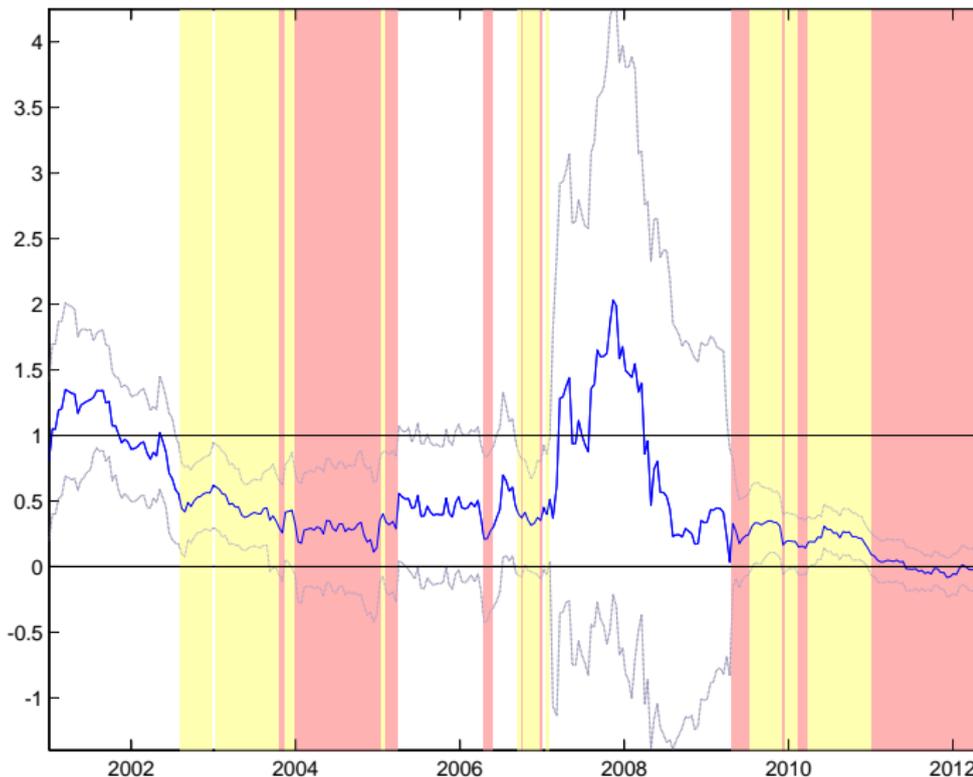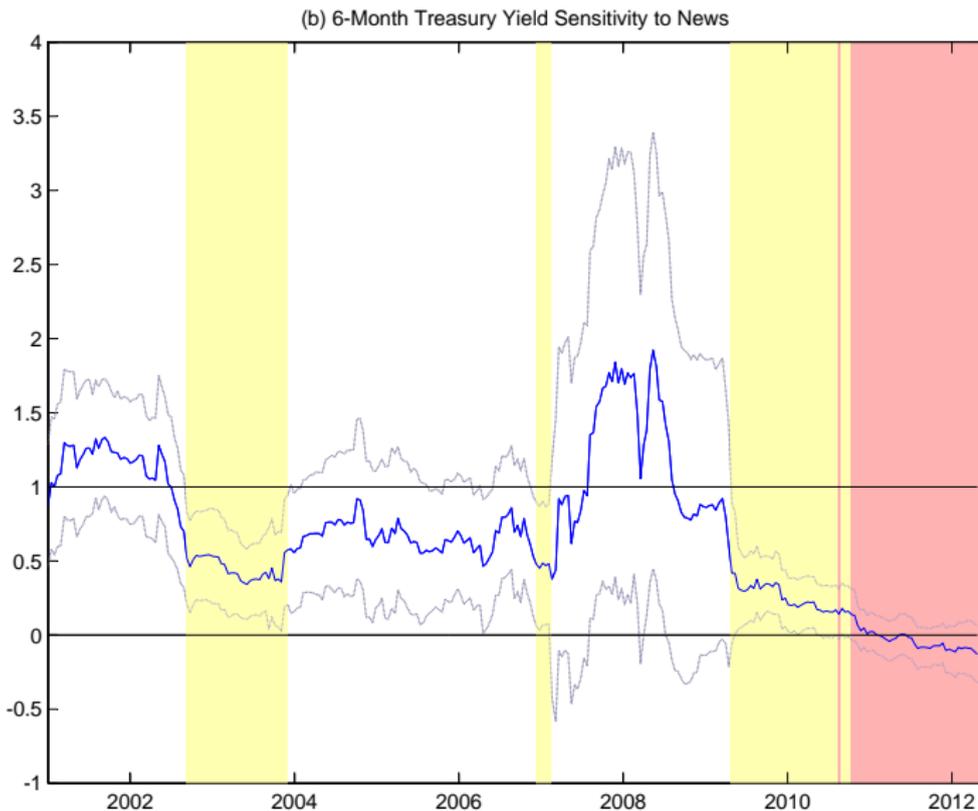
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Time-Varying Sensitivity δ^τ, 6-month Treasury

(b) 6-Month Treasury Yield Sensitivity to News

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Time-Varying Sensitivity δ^τ, 1-year Treasury

(c) 1-Year Treasury Yield Sensitivity to News

Time-Varying Sensitivity δ^τ, 2-year Treasury

(d) 2-Year Treasury Yield Sensitivity to News

Time-Varying Sensitivity δ^{τ}, 5-year Treasury
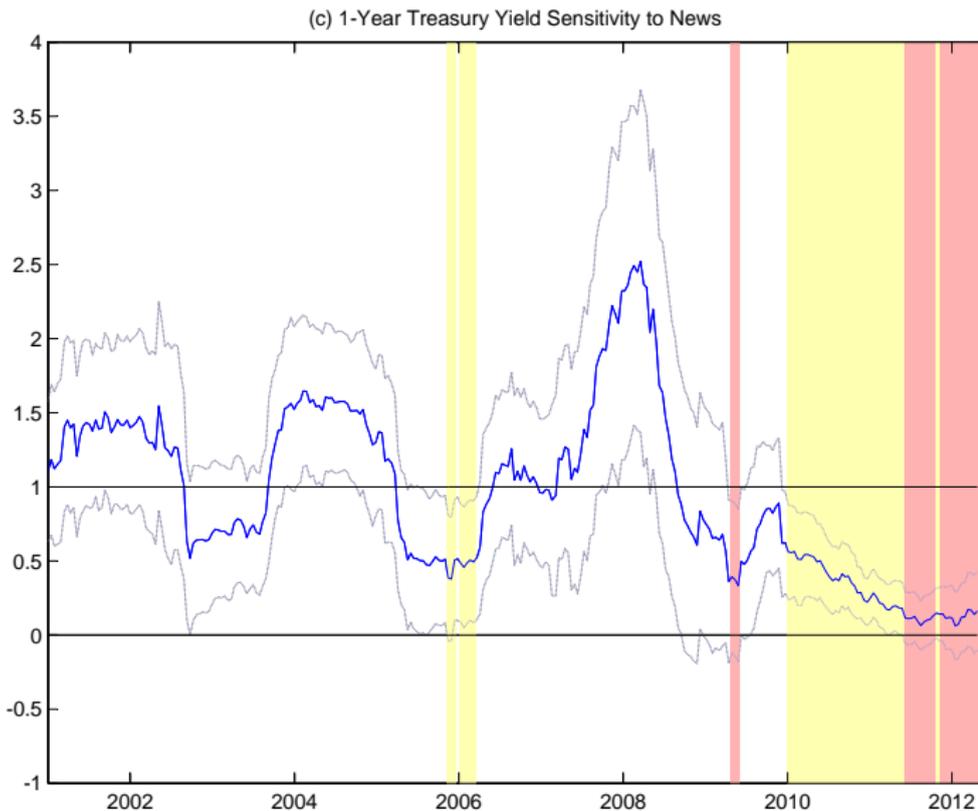
(e) 5-Year Treasury Yield Sensitivity to News
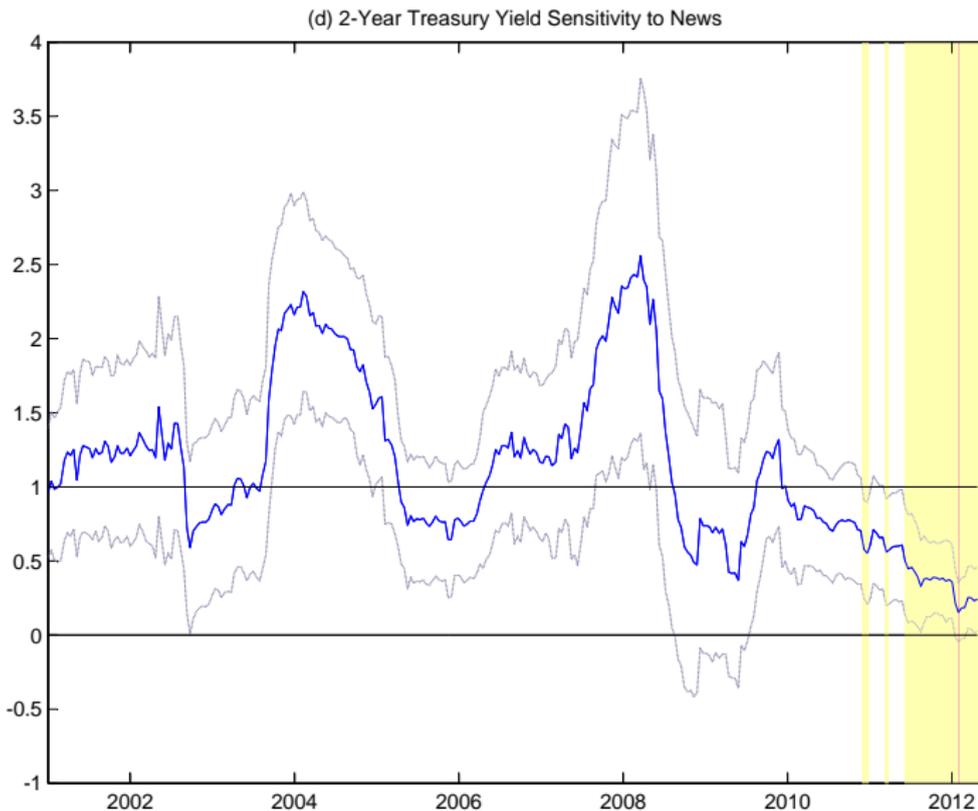
Time-Varying Sensitivity δ^τ, 10-year Treasury
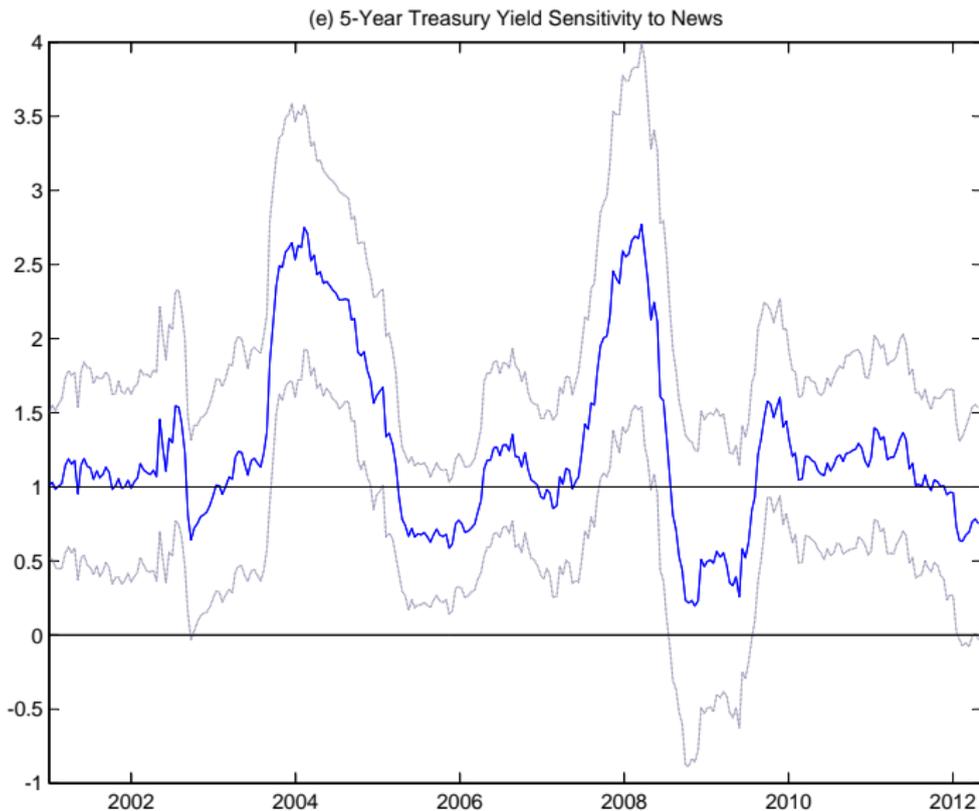
(f) 10-Year Treasury Yield Sensitivity to News
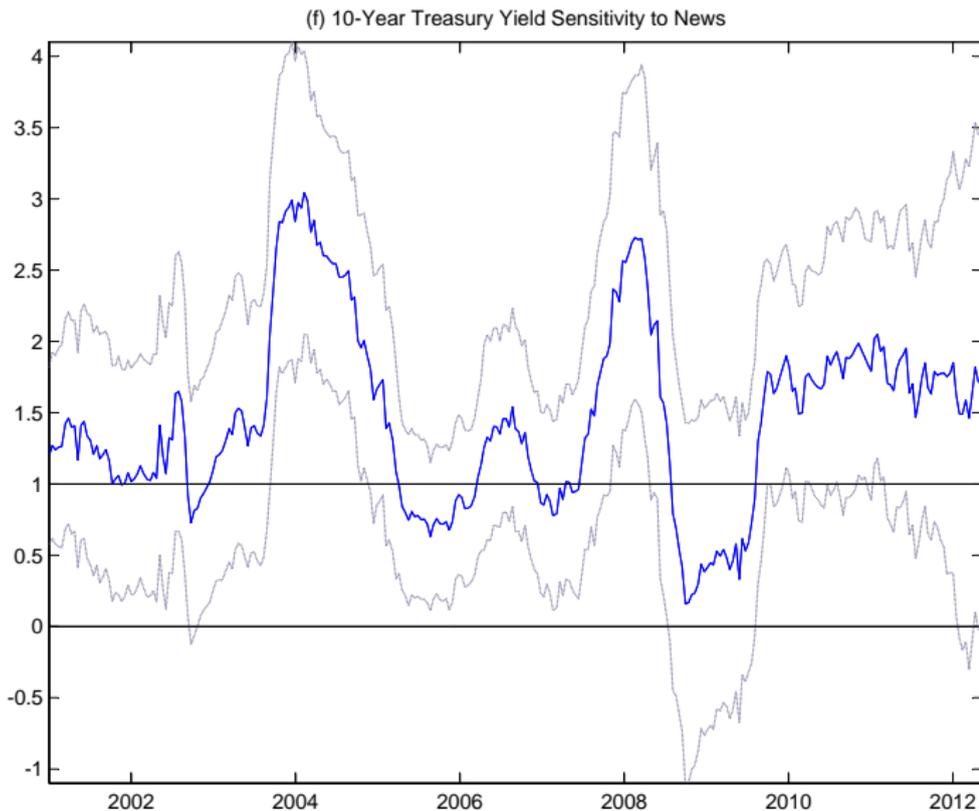
Private-Sector Expectations of Funds Rate "Liftoff"

Why were 1- and 2-year Treasury yields so responsive to news from 2008–2010?

Private-Sector Expectations of Funds Rate "Liftoff"

Why were 1- and 2-year Treasury yields so responsive to news from 2008–2010?

Look at private sector expectations of funds rate "liftoff":

- Blue Chip survey
- interest rate options
- Eurodollar futures

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Private-Sector Expectations of Funds Rate "Liftoff"

Blue Chip Consensus expectation, time until first funds rate increase:
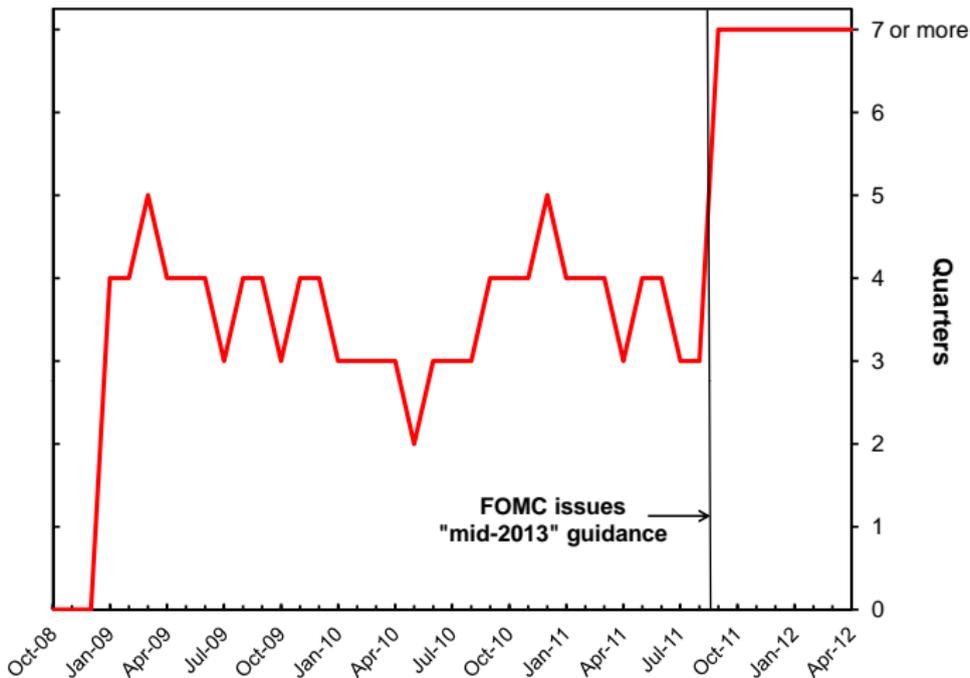
Private-Sector Expectations of Funds Rate "Liftoff"

One-year-ahead implied probability distribution for federal funds rate, derived from options, on November 2, 2011:
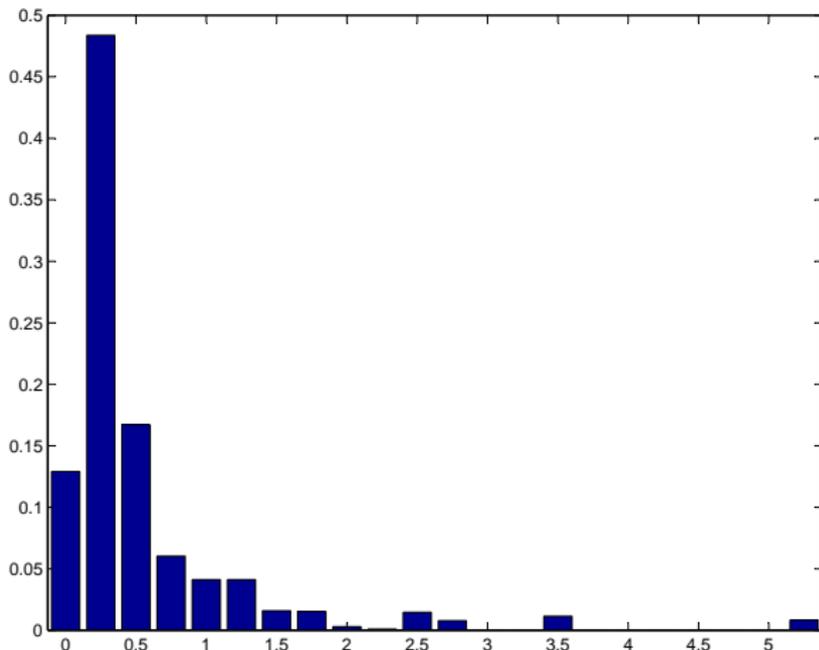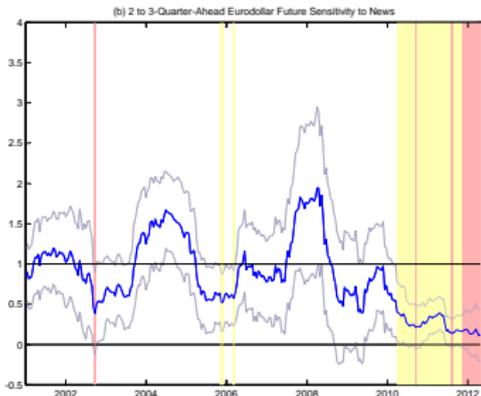
Private-Sector Expectations of Funds Rate "Liftoff"

Probability of funds rate < 50bp in 5 quarters, from options:
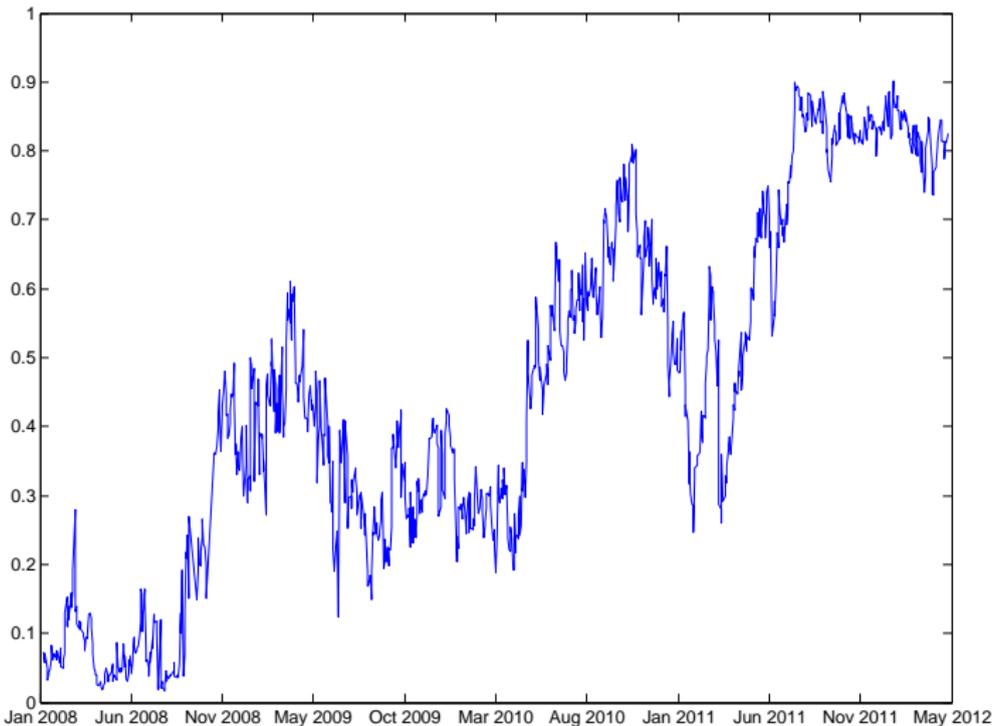
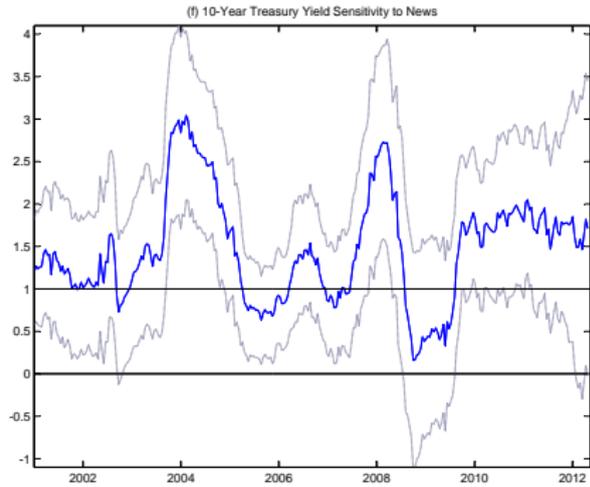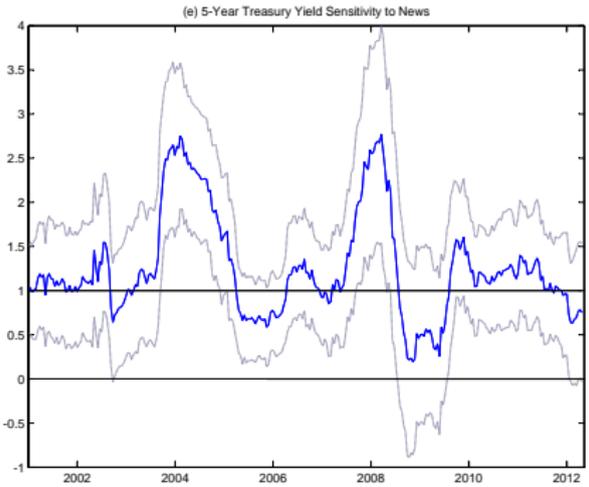# Monetary Policy Expectations from Eurodollar Futures
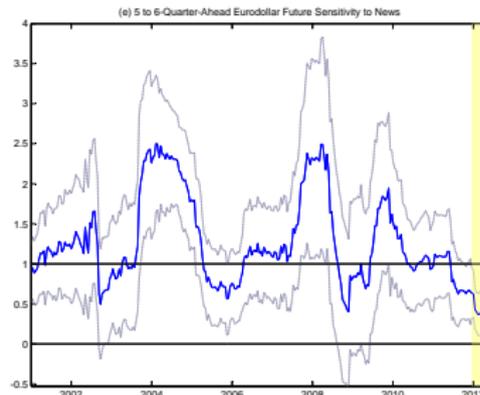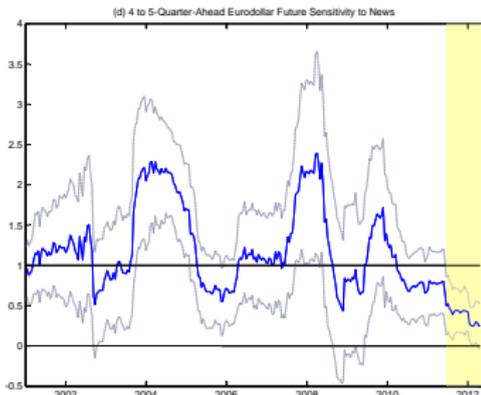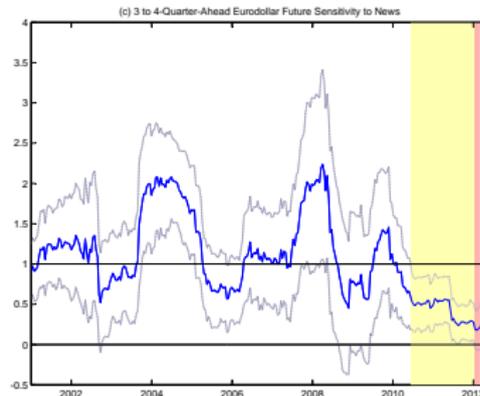
Federal Reserve Long-Term Bond Purchases

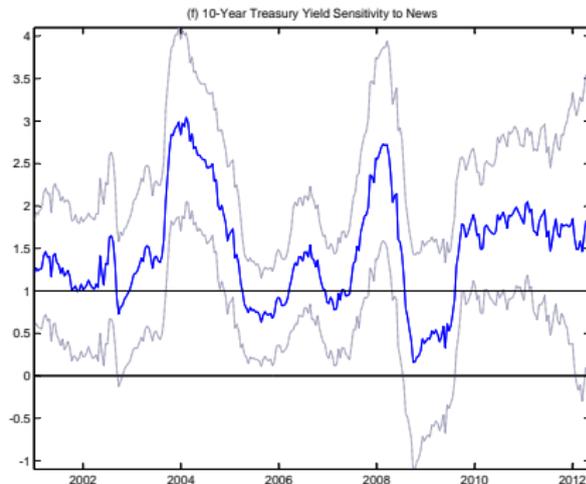Why are 5-, 10-year Treasuries so sensitive to news in 2010–12?

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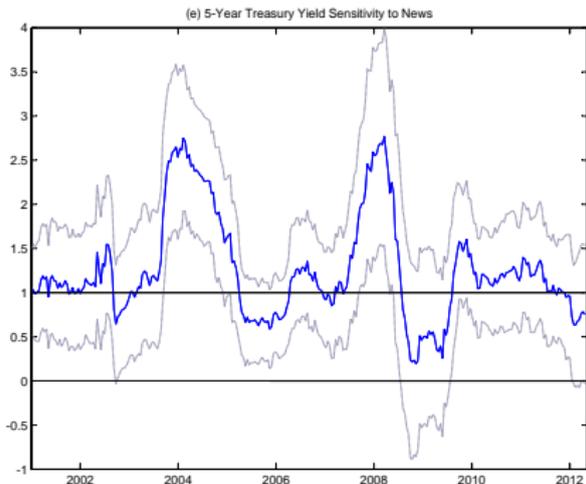000000

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Federal Reserve Long-Term Bond Purchases

Why are 5-, 10-year Treasuries so sensitive to news in 2010–12?

Federal Reserve Long-Term Bond Purchases

Why are 5-, 10-year Treasuries so sensitive to news in 2010–12?

In the illustrative model, all yields are attenuated by the ZLB
(although longer-term yields are attenuated less)

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Federal Reserve Long-Term Bond Purchases

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Forward Guidance:

- Eggertsson-Woodford (2003), Reifschneider-Williams (2000)

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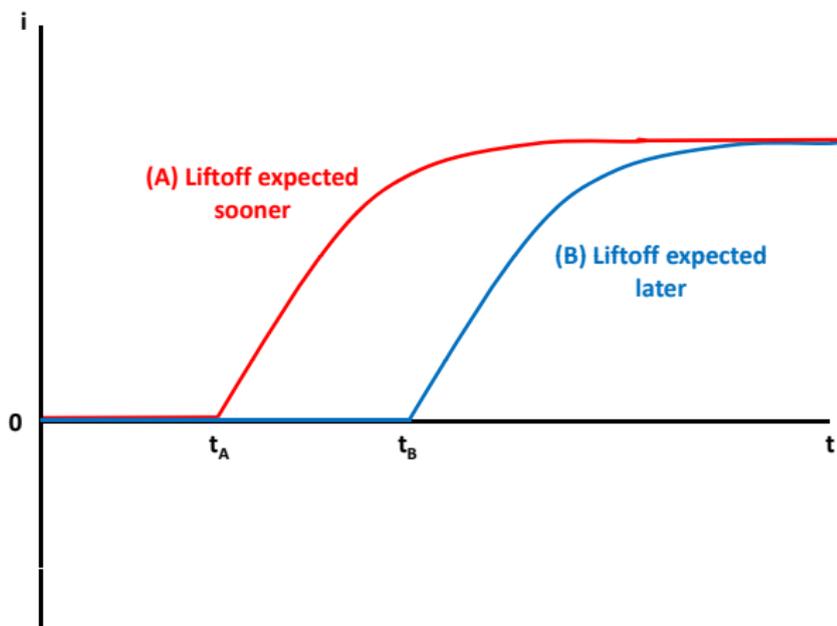- Eggertsson-Woodford (2003), Reifschneider-Williams (2000)

Federal Reserve's long-term bond purchases:
- 11/25/08: \$500B MBS, \$100B GSE
- 3/18/09: \$750B MBS, \$100B GSE, \$300B Treasuries
- 11/3/10: \$600B Treasuries
- 9/21/11: \$400B "Operation Twist"

Federal Reserve Long-Term Bond Purchases

Why are 5-, 10-year Treasuries so sensitive to news in 2010–12?

Forward Guidance:

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Federal Reserve's long-term bond purchases:

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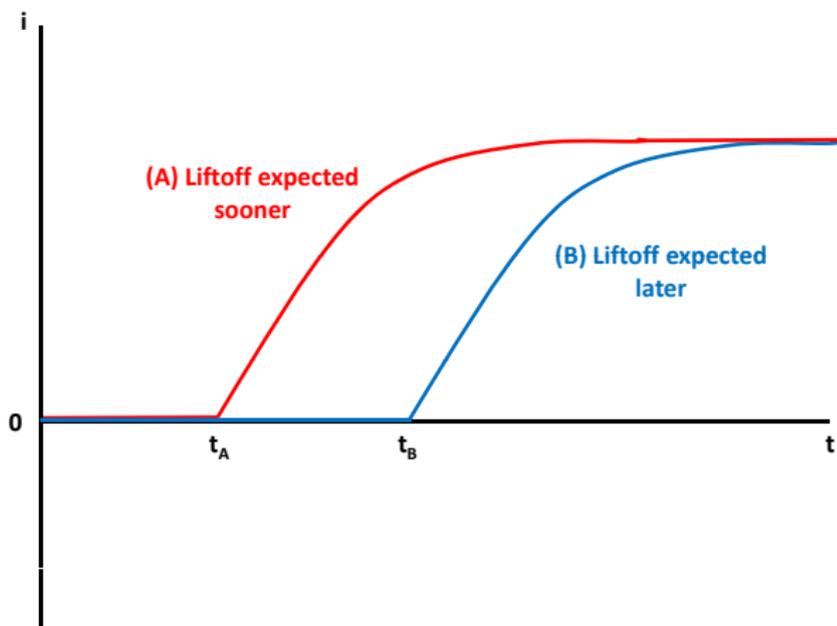- 9/21/11: $400B "Operation Twist"

Theoretical and empirical studies:

- Vayanos-Vila (2009), Krishnamurthy-Vissing-Jorgensen (2011, 2012), Greenwood-Vayanos (2008), Gagnon et al. (2011), Hamilton-Wu (2012), Swanson (2011)

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Implications for the Fiscal Multiplier

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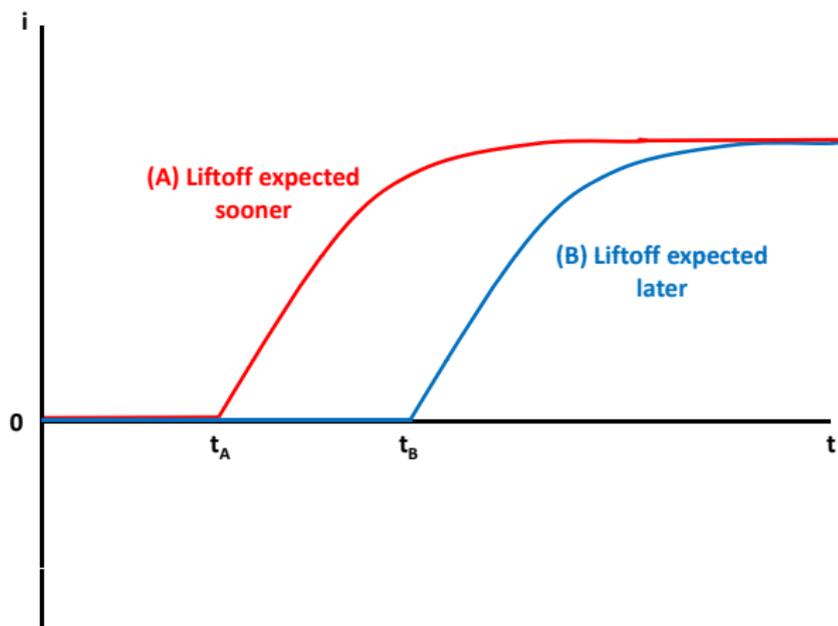000000

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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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This paper: 2008–10 look like scenario A

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What we do:

- Test whether interest rates are responding normally to news.
- Measure the degree to which interest rates are attenuated.

What we find:

- 1- and 2-year Treasury yields were surprisingly responsive to news throughout 2008–10.

What we conclude:

- Effectiveness of monetary and fiscal policy likely close to normal throughout 2008–10.
- Zero lower bound a more severe constraint since mid-2011.