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

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Three Motivating Observations

1. New Keynesian IS curve:

$$\begin{aligned} y_t &= E_t y_{t+1} - \alpha r_t + \varepsilon_t \\ &= -\alpha E_t \sum_{j=0}^{\infty} r_{t+j} + \varepsilon_t \end{aligned}$$

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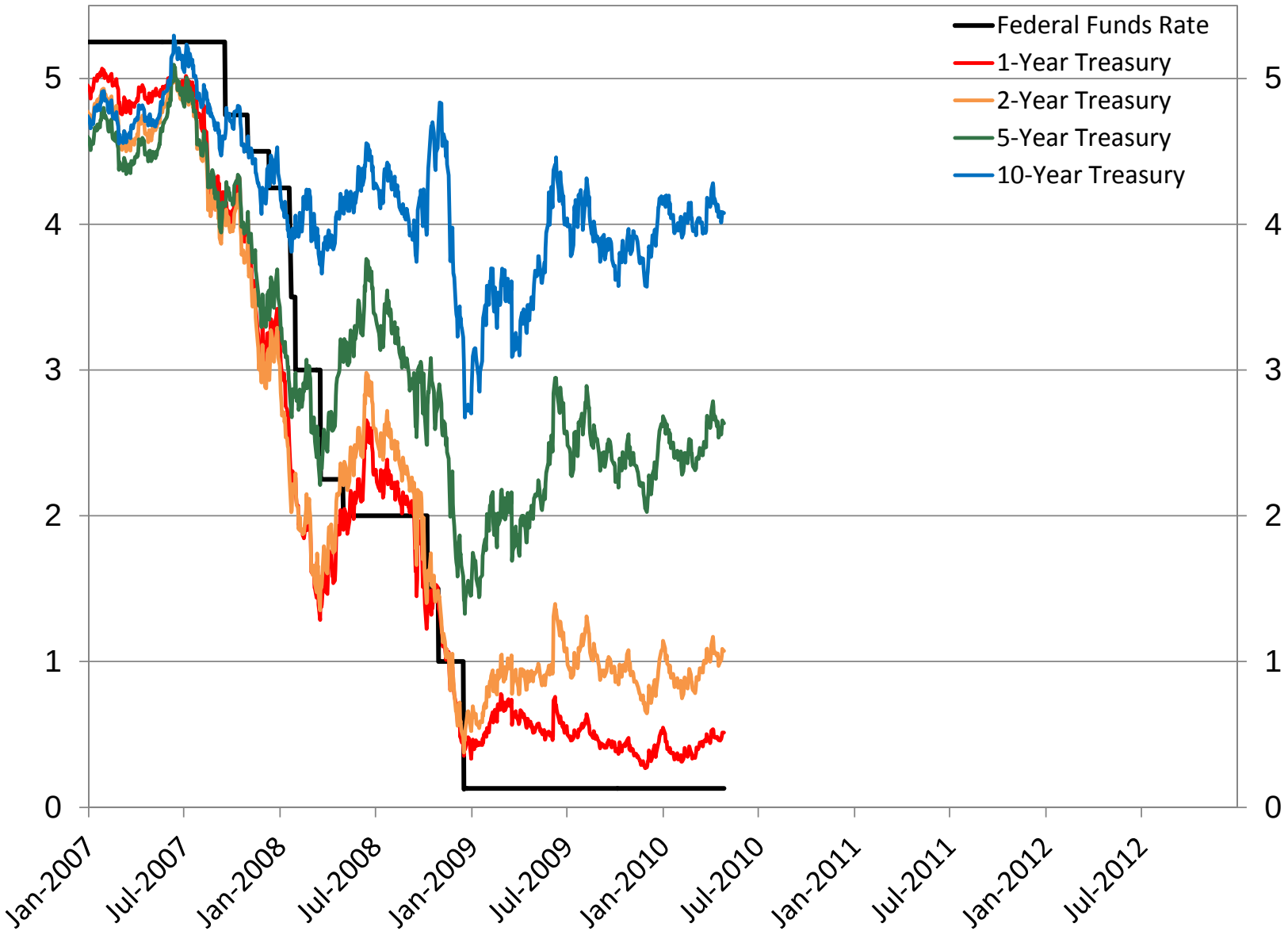
3. The zero lower bound is not a substantial constraint on monetary policy if the central bank can affect longer-term interest rates:
   - Reifschneider-Williams (2000), Eggertsson-Woodford (2003)
   - Gürkaynak, Sack, and Swanson (2005): 60–90% of the response of 2- to 10-year Treasury yields to FOMC announcements is due to *statement,* not funds rate

2-Year Treasury Yield $\gg$ 0 for Much of 2008–10



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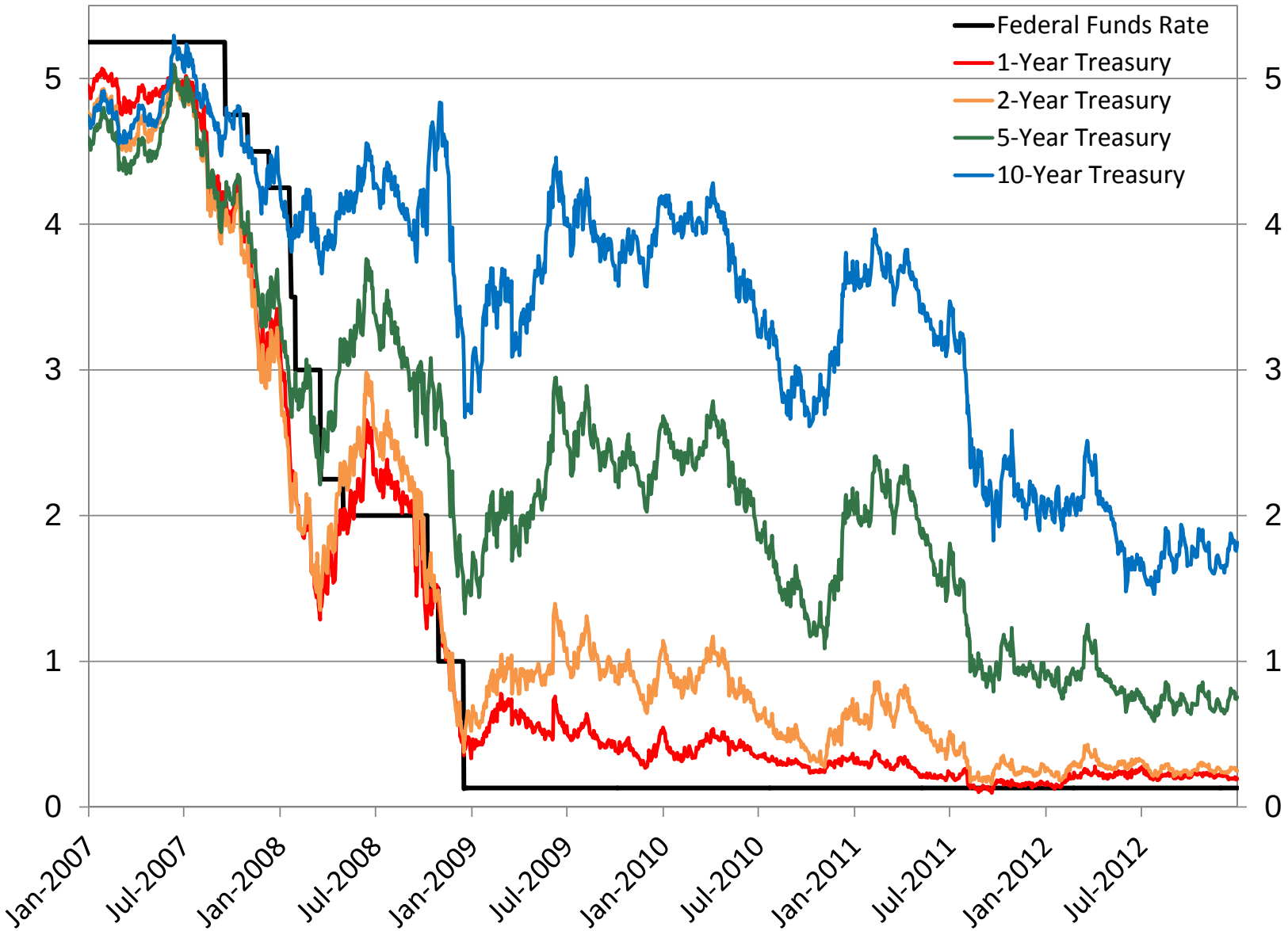

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- Was the ZLB a substantial constraint on monetary policy? —e.g., was the 2-year Treasury yield constrained?
- If so, when?
- And how severely?

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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?

What We Do

1. Empirical:
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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

Illustrative Macro Model

IS curve:

$$y_t = E_t y_{t+1} - \alpha(i_t - E_t \pi_{t+1} - r_t^*)$$

Phillips curve:

$$\pi_t = \beta E_t \pi_{t+1} + \gamma y_t + \mu_t$$

Taylor rule with ZLB:

$$i_t = \max\{\, 0,\ \pi_t + r_t^* + 0.5 y_t + 0.5(\pi_t - \pi^*)\,\}$$

Initial condition: $r_t^* < 0$, so that ZLB binds

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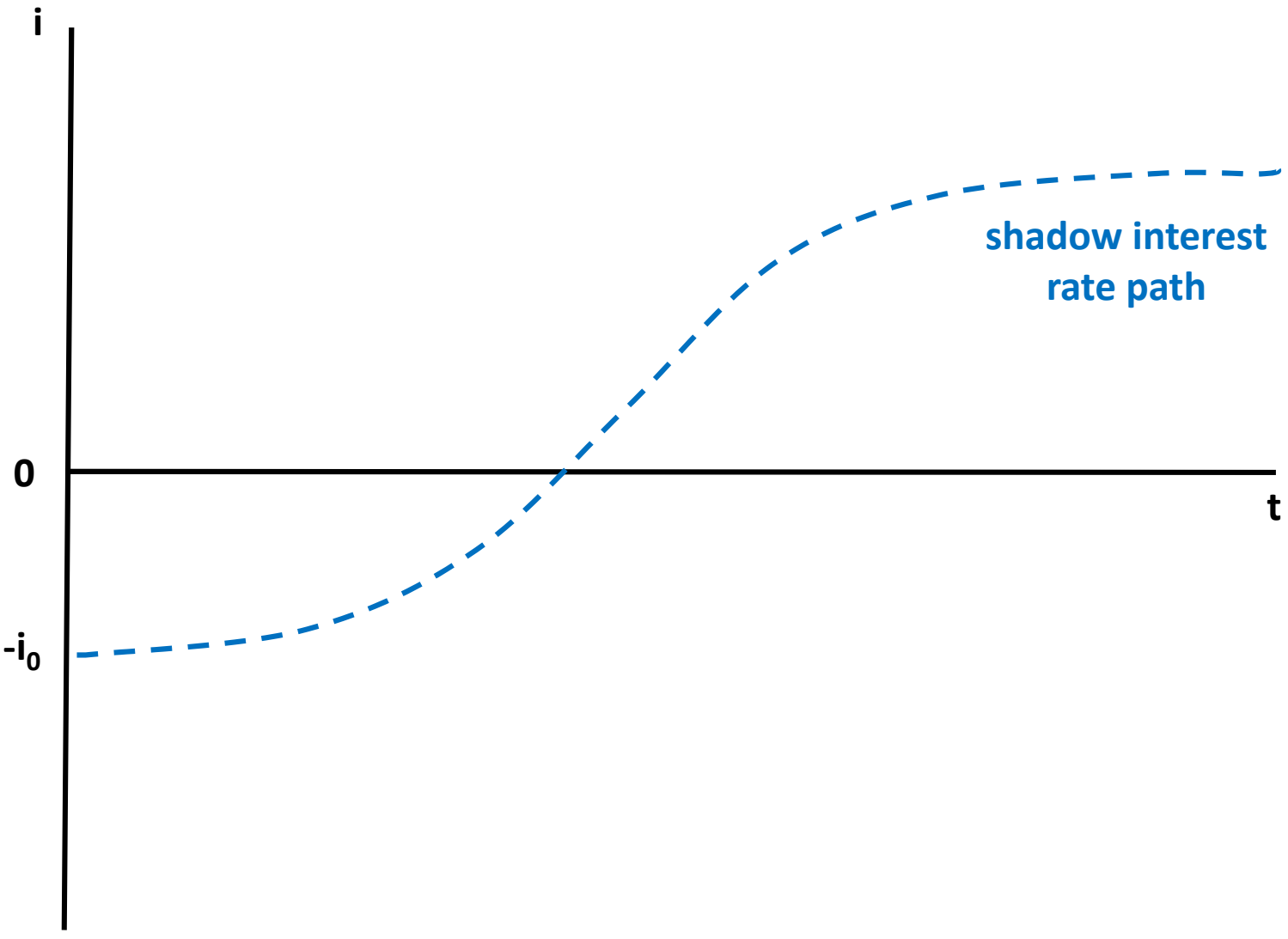

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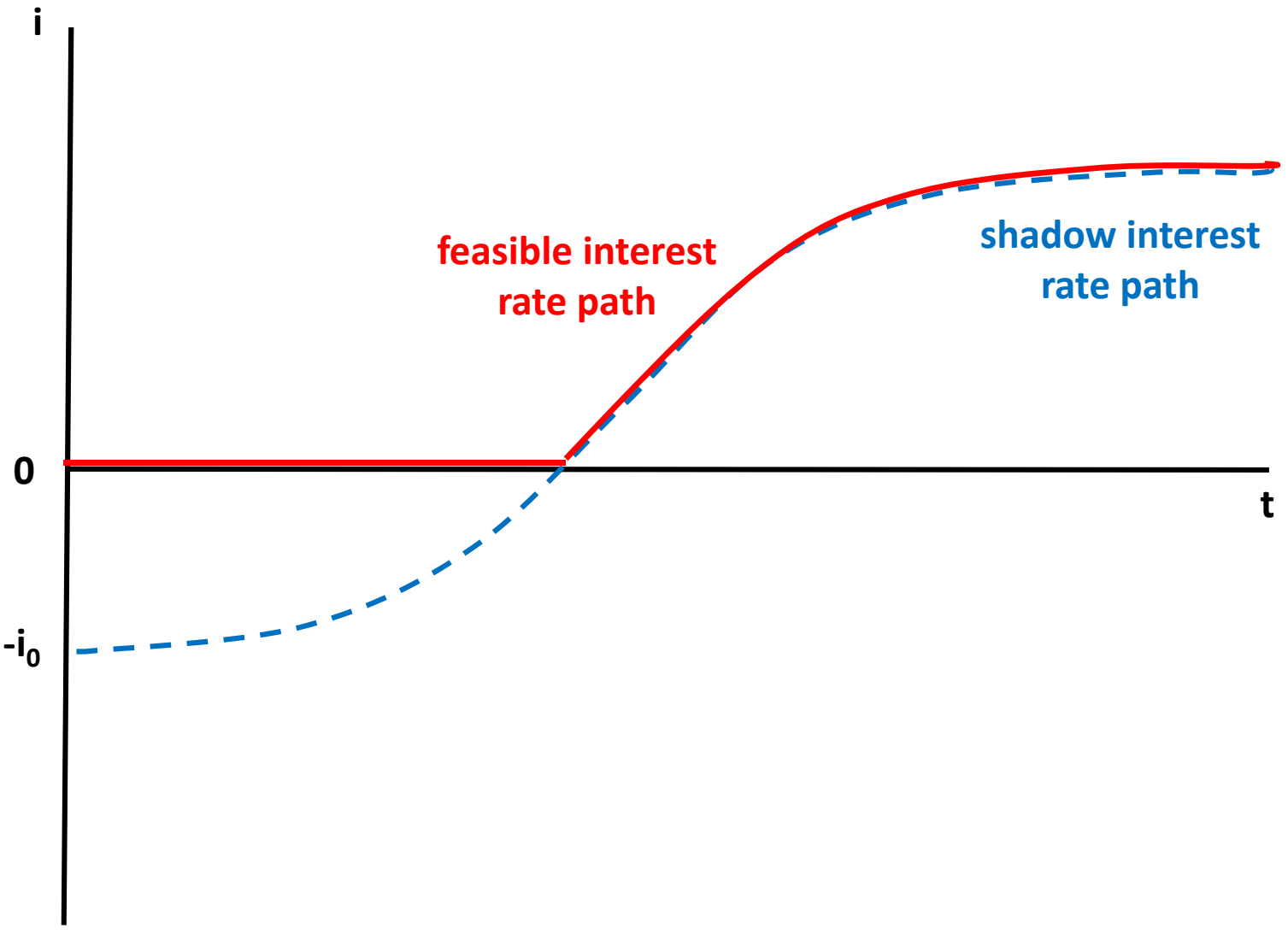

Illustrative Macro Model

Use model to illustrate three main points:

1. When short-term rates are constrained by ZLB, all yields respond less to news;
   attenuation is greatest for shortest maturities
2. Dampening effect of ZLB on yields is essentially *symmetric* for positive and negative shocks
3. Attenuation is roughly the same for different types of shocks (as long as shock persistences are similar)

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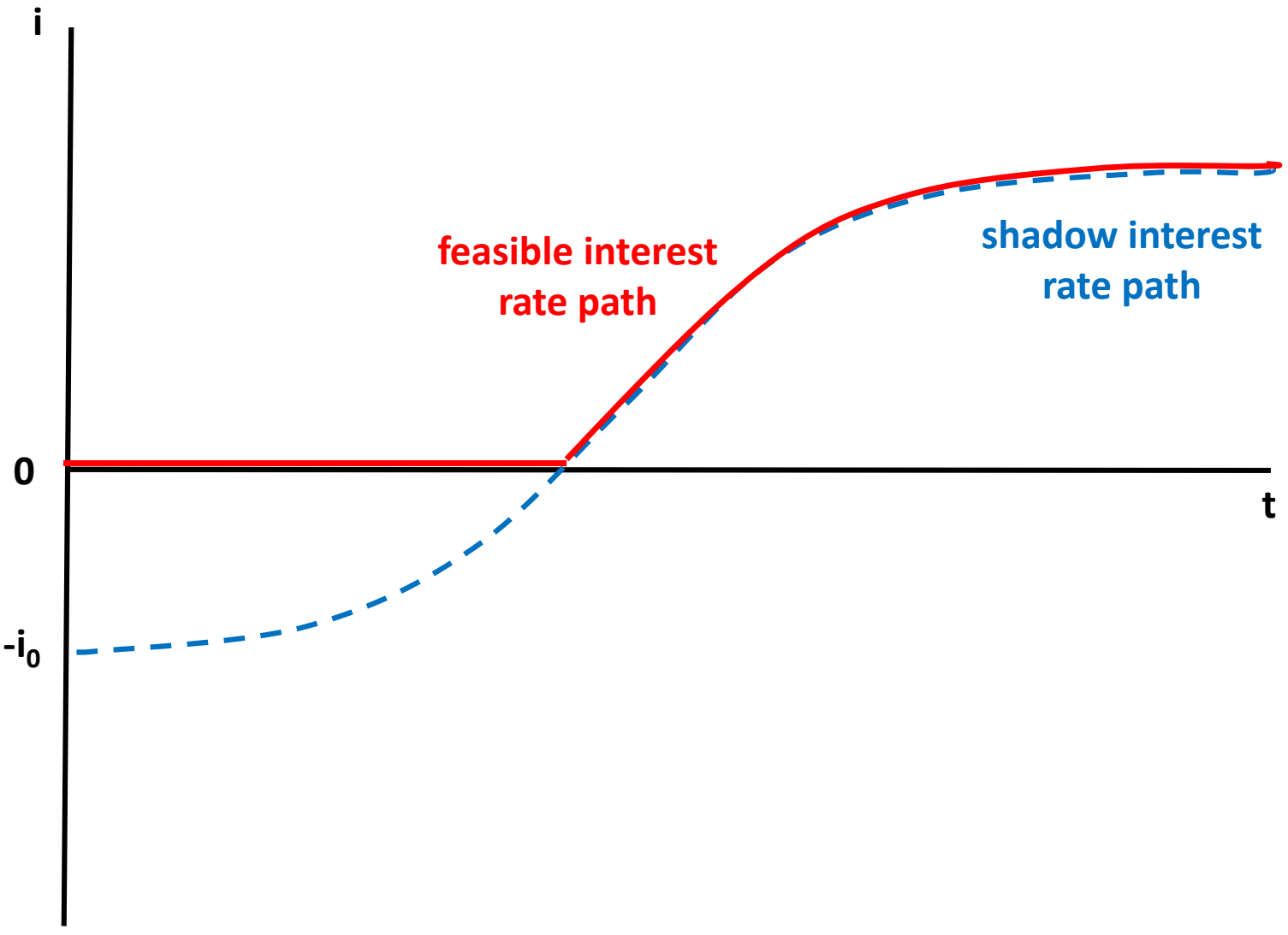
Symmetric Response to Positive, Negative Shocks



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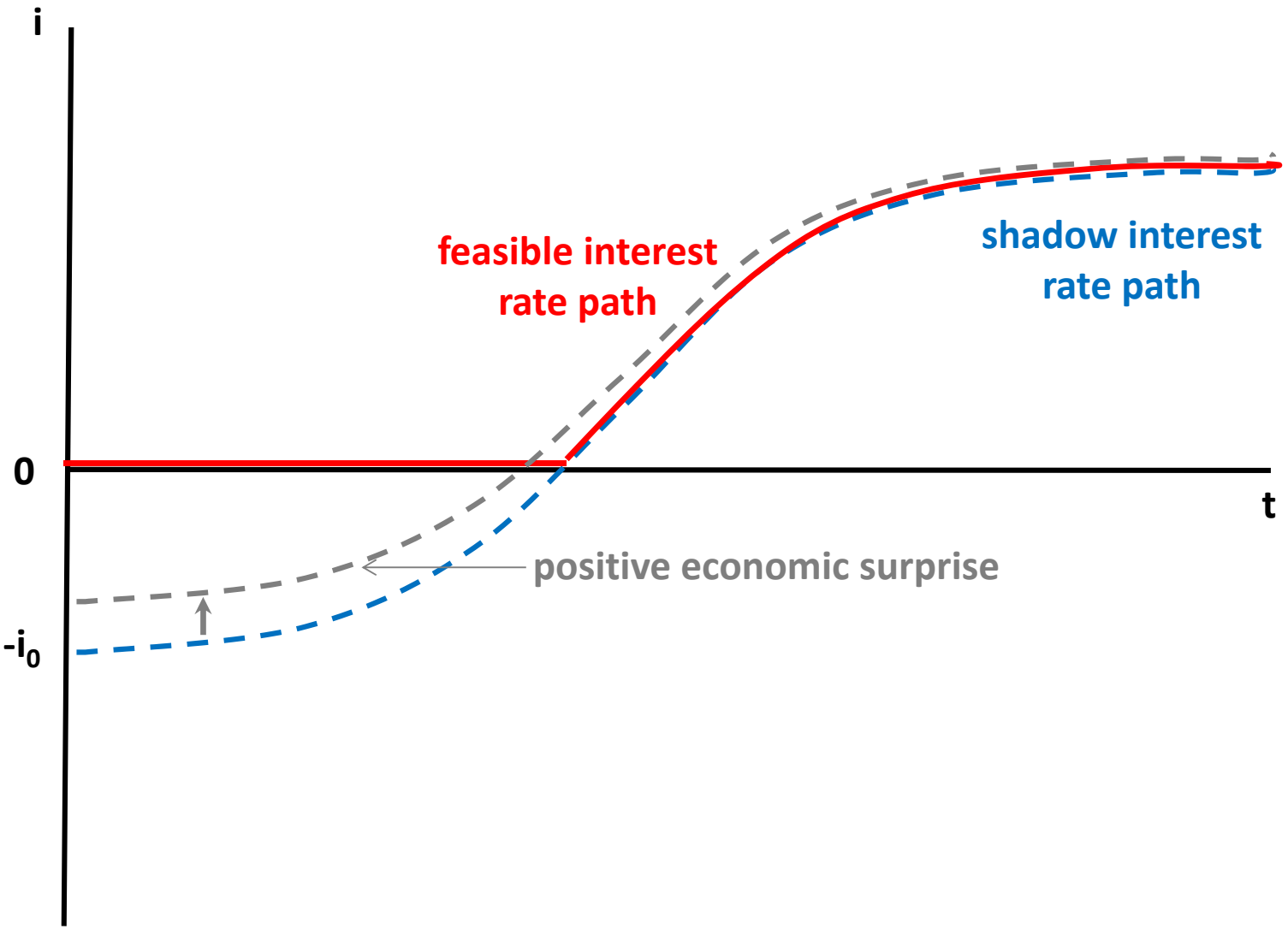

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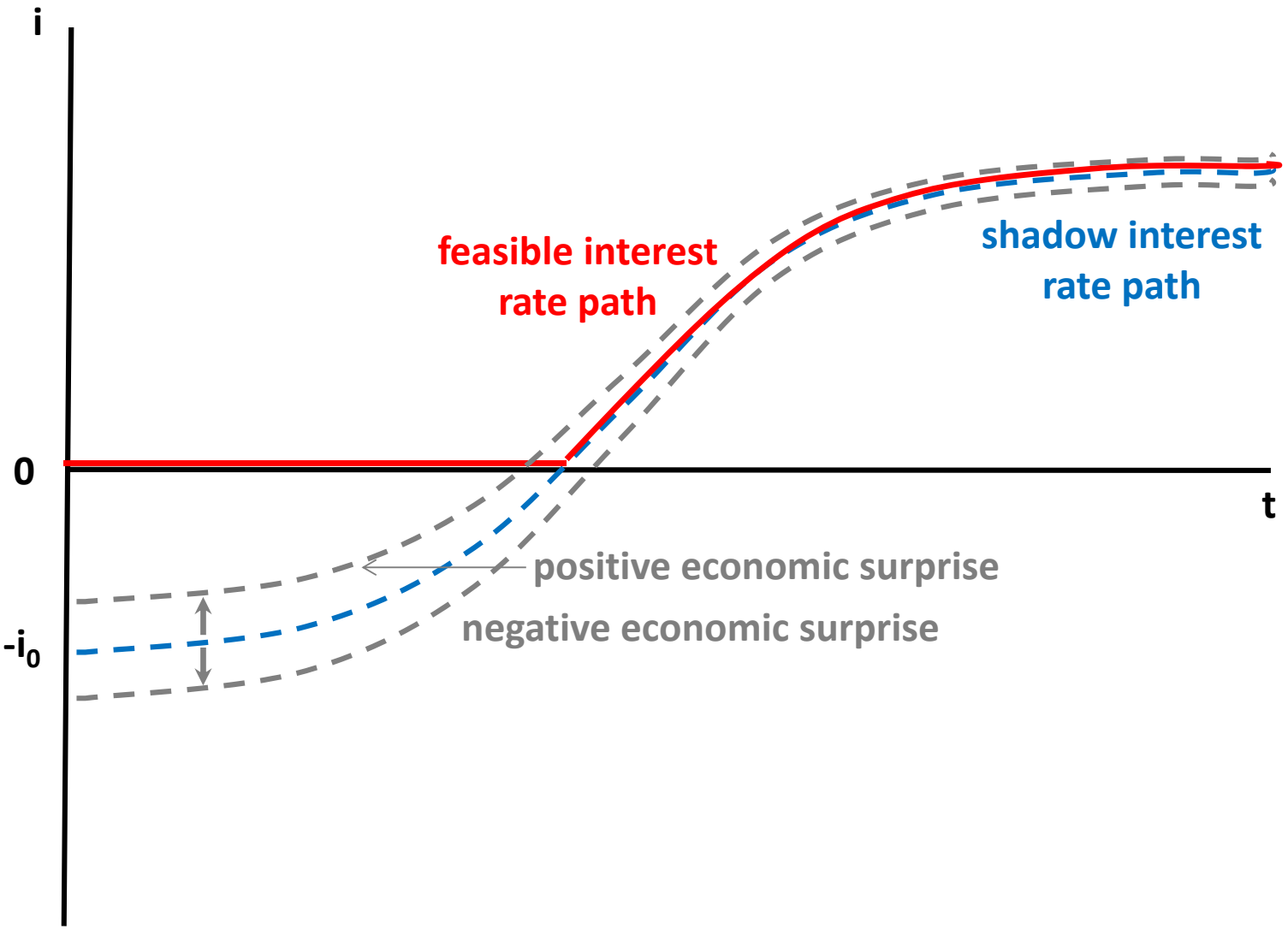

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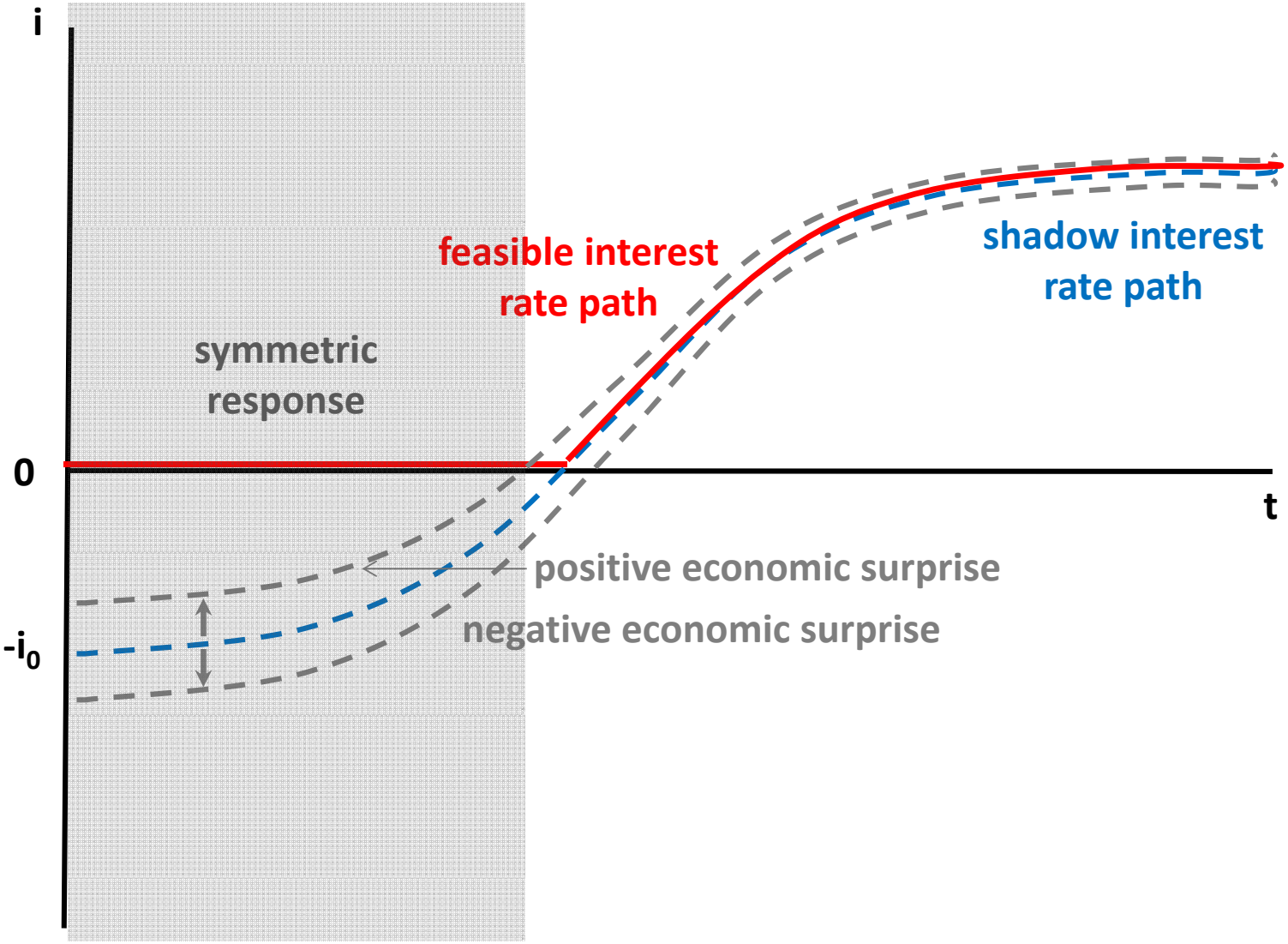

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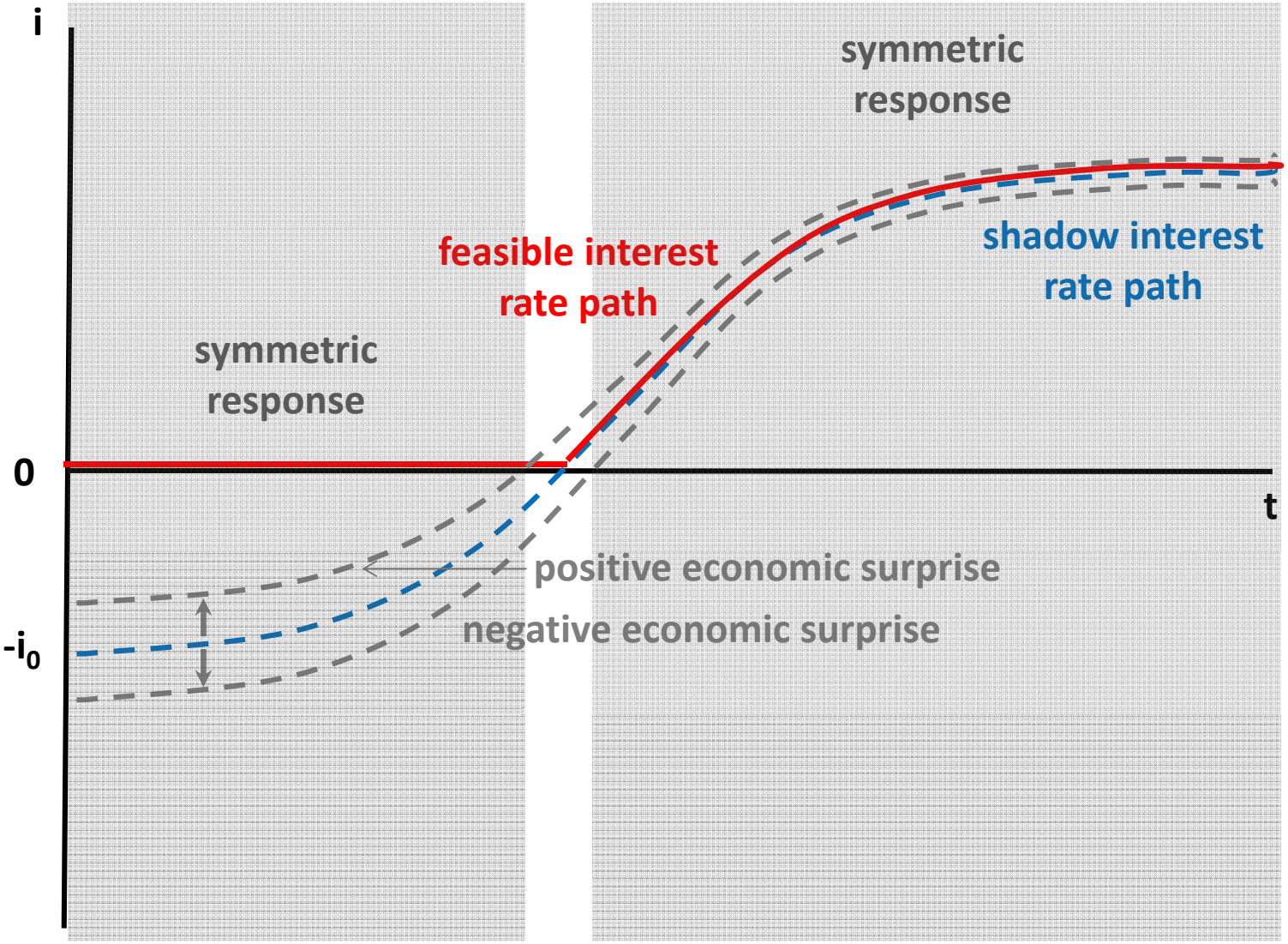
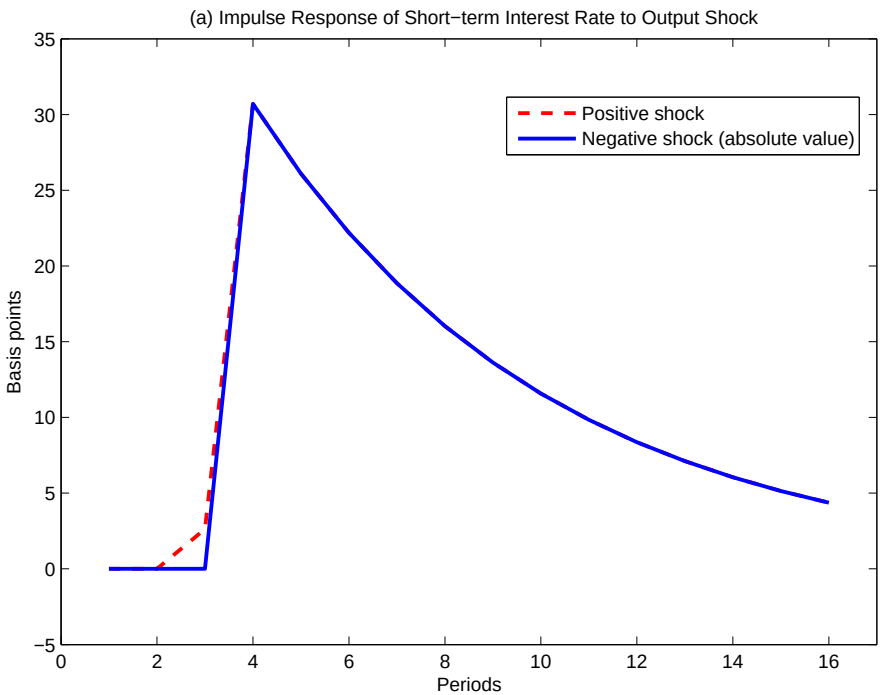


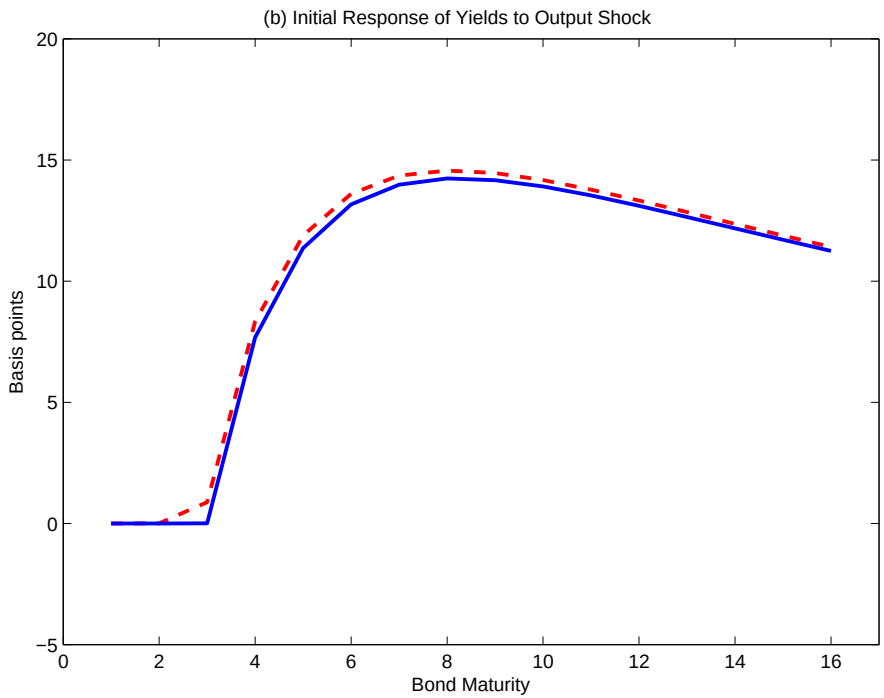
Symmetric Response to Positive, Negative Shocks

In simple NK model with ZLB, graph absolute value of response to large positive, negative shocks, relative to baseline path:

expected short-term rate



yield curve



Measuring Treasury Yield Sensitivity to News

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

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- regression is at daily frequency
- Δy_t denotes one-day change in Treasury yield 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:

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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.	0.73	(1.56)	1.49	(2.89)	0.68	(2.02)
Consumer Conf.	0.75	(2.90)	1.37	(3.71)	0.84	(2.43)
Core CPI	0.39	(1.88)	1.89	(5.00)	1.17	(3.60)
GDP	0.92	(3.15)	1.42	(2.40)	0.95	(1.69)
Initial Claims	−0.30	(−1.82)	−1.10	(−5.35)	−0.95	(−5.02)
ISM Manufact.	1.23	(3.24)	2.72	(7.09)	1.98	(5.96)
New Home Sales	0.83	(2.65)	0.65	(1.99)	0.50	(1.93)
Nonfarm Payrolls	3.03	(7.67)	4.79	(9.54)	2.95	(6.79)
Retail Sales	0.83	(3.76)	1.86	(4.92)	1.62	(4.31)
Unemployment	−1.24	(−3.53)	−1.26	(−2.78)	−0.41	(−1.07)
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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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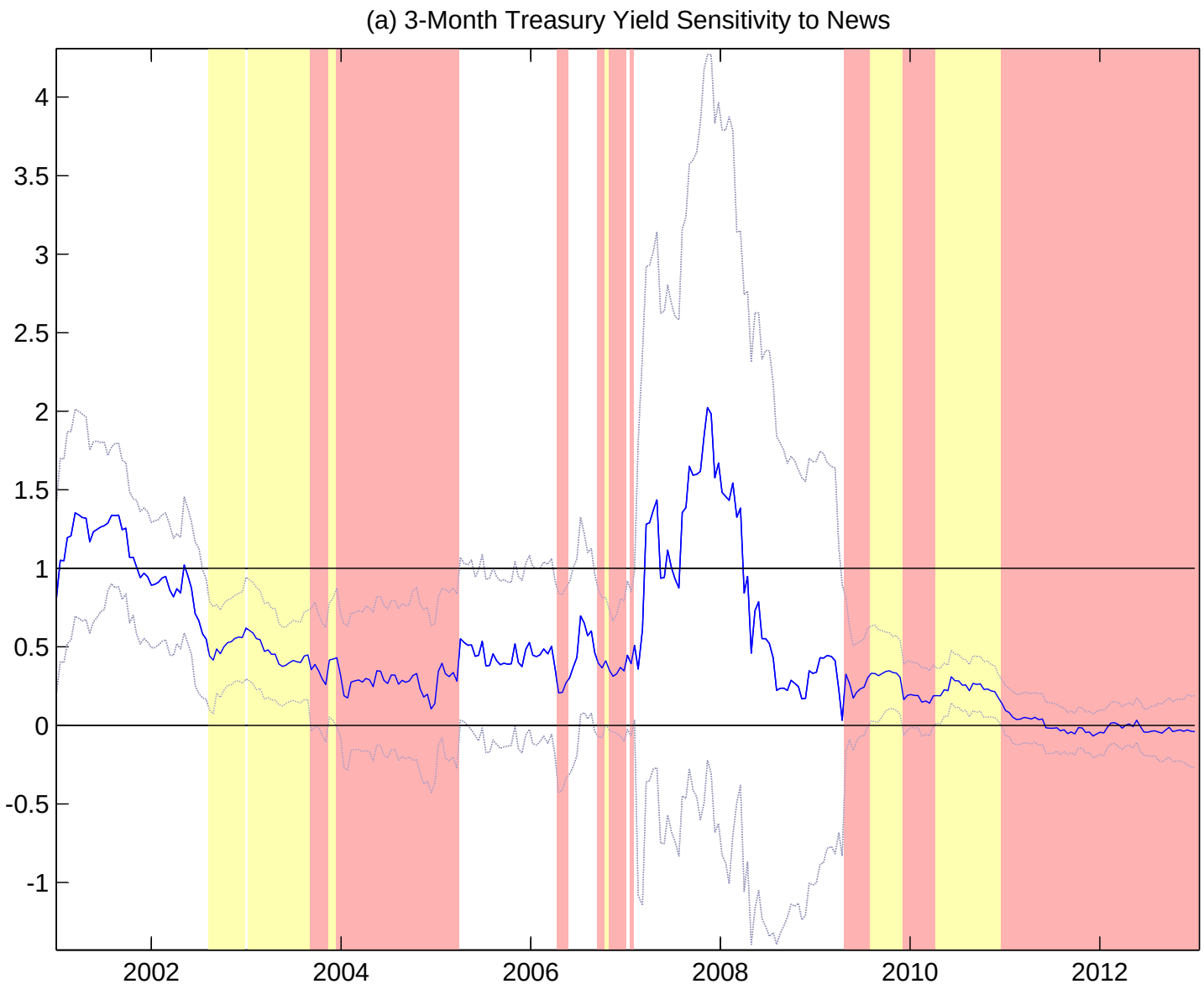
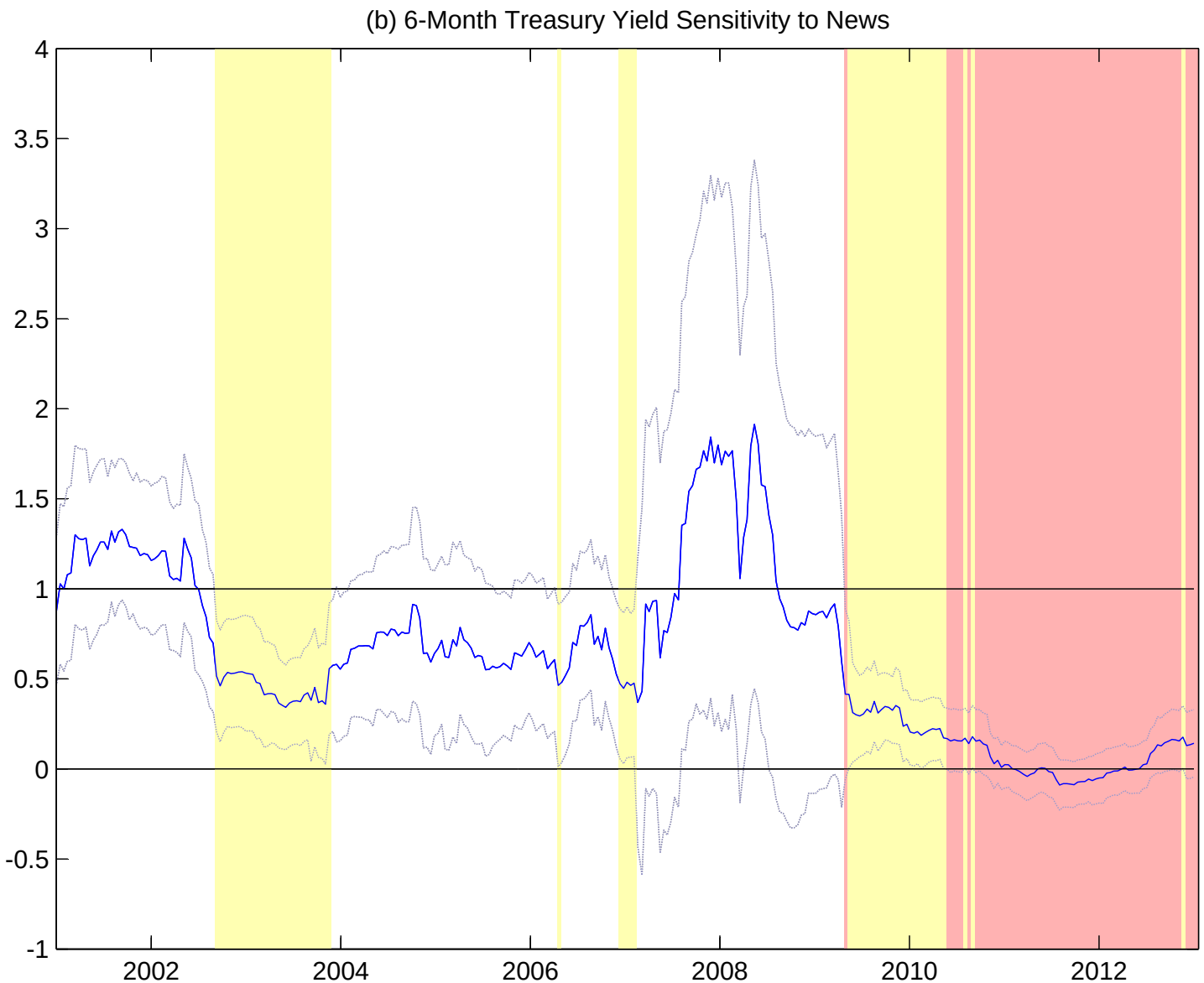
Account for 2-stage sampling uncertainty in rolling regressions:

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

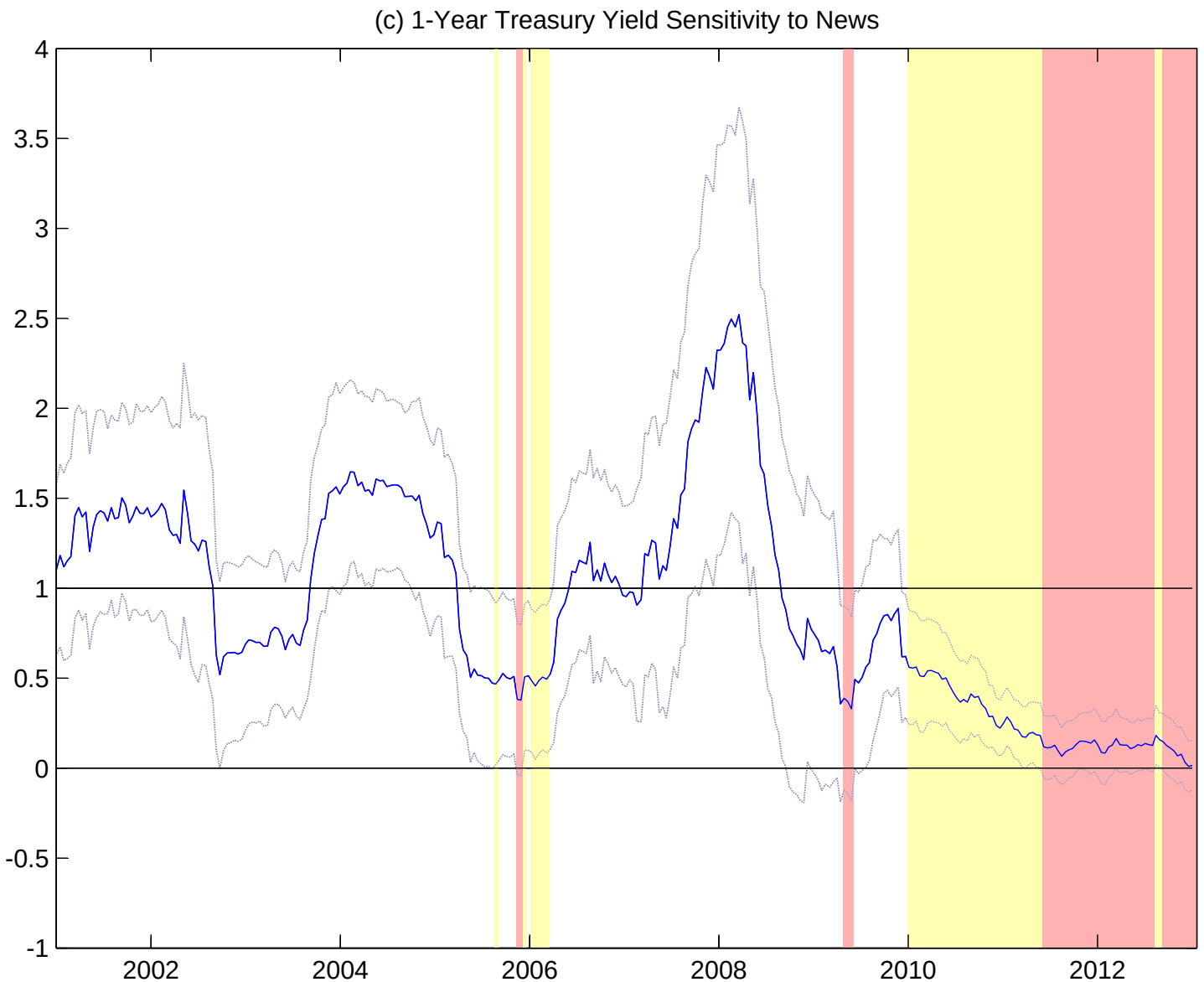
Time-Varying Sensitivity δ^{τ}, 3-month Treasury



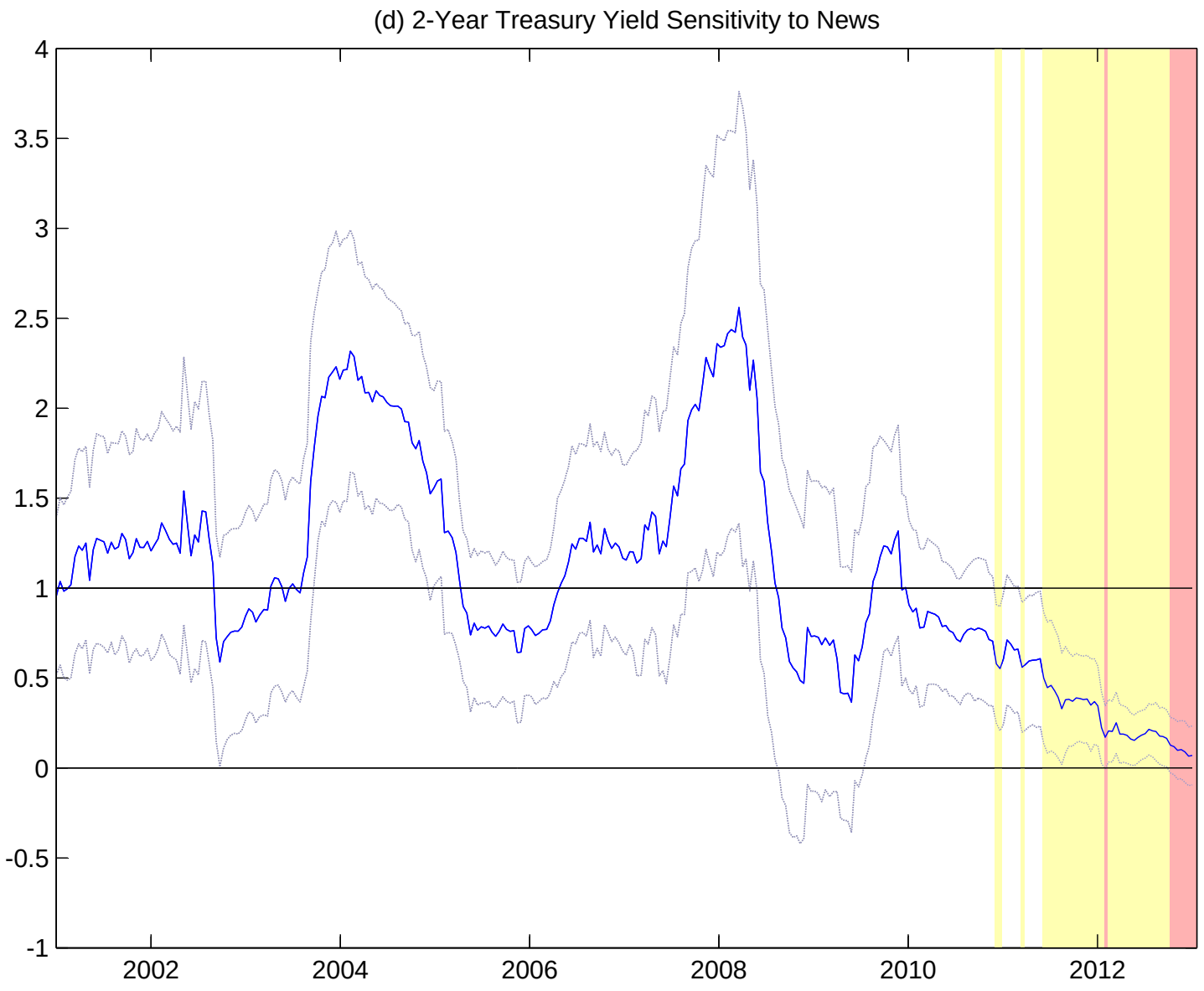
Time-Varying Sensitivity δ^{τ}, 6-month Treasury



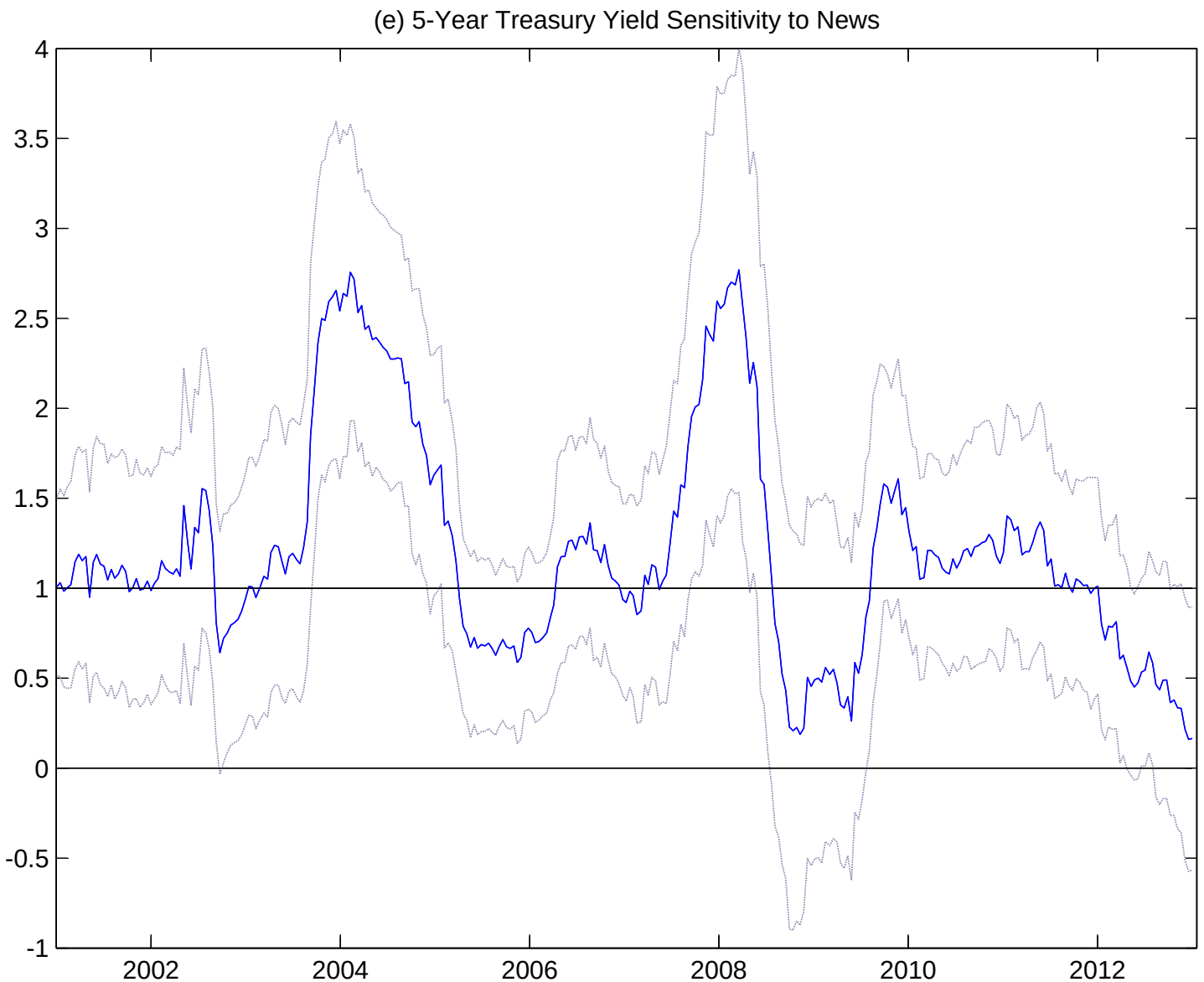
Time-Varying Sensitivity δ^{τ}, 1-year Treasury



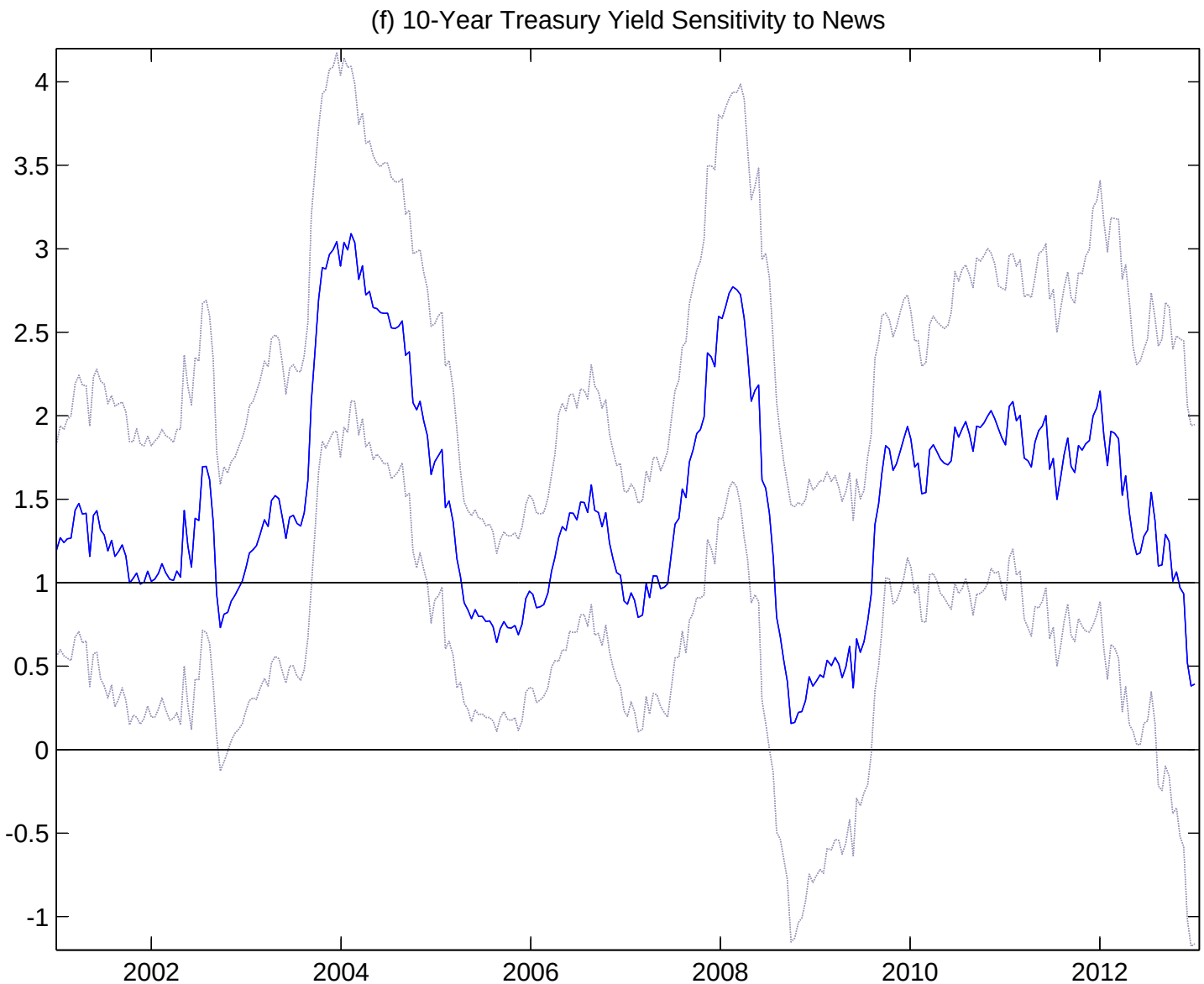
Time-Varying Sensitivity δ^{τ}, 2-year Treasury



Time-Varying Sensitivity δ^{τ}, 5-year Treasury



Time-Varying Sensitivity δ^{τ}, 10-year Treasury



Private-Sector Expectations of Funds Rate “Liftoff”

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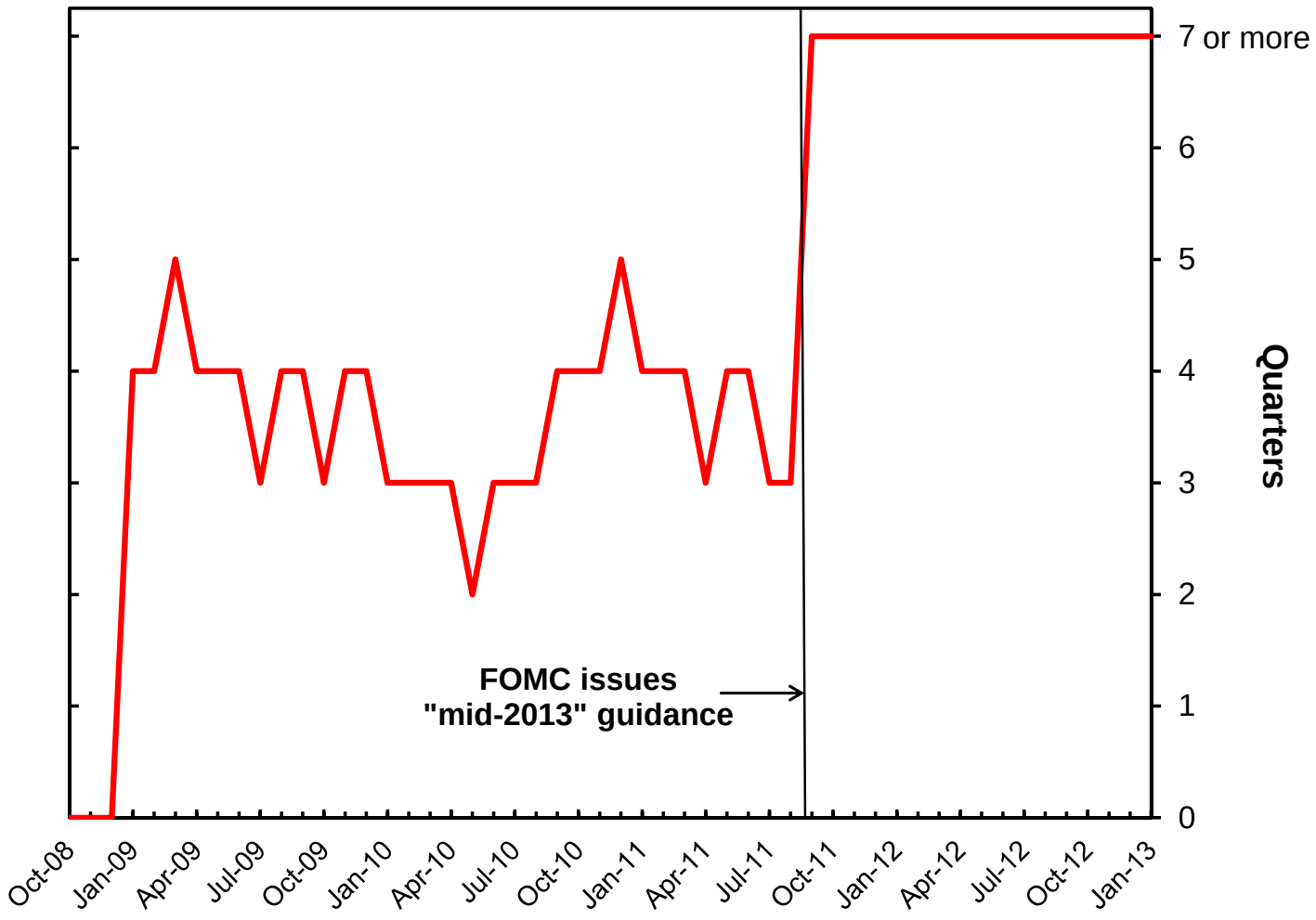
Look at private sector expectations of funds rate "liftoff":

- Blue Chip survey
- interest rate options
- Eurodollar futures

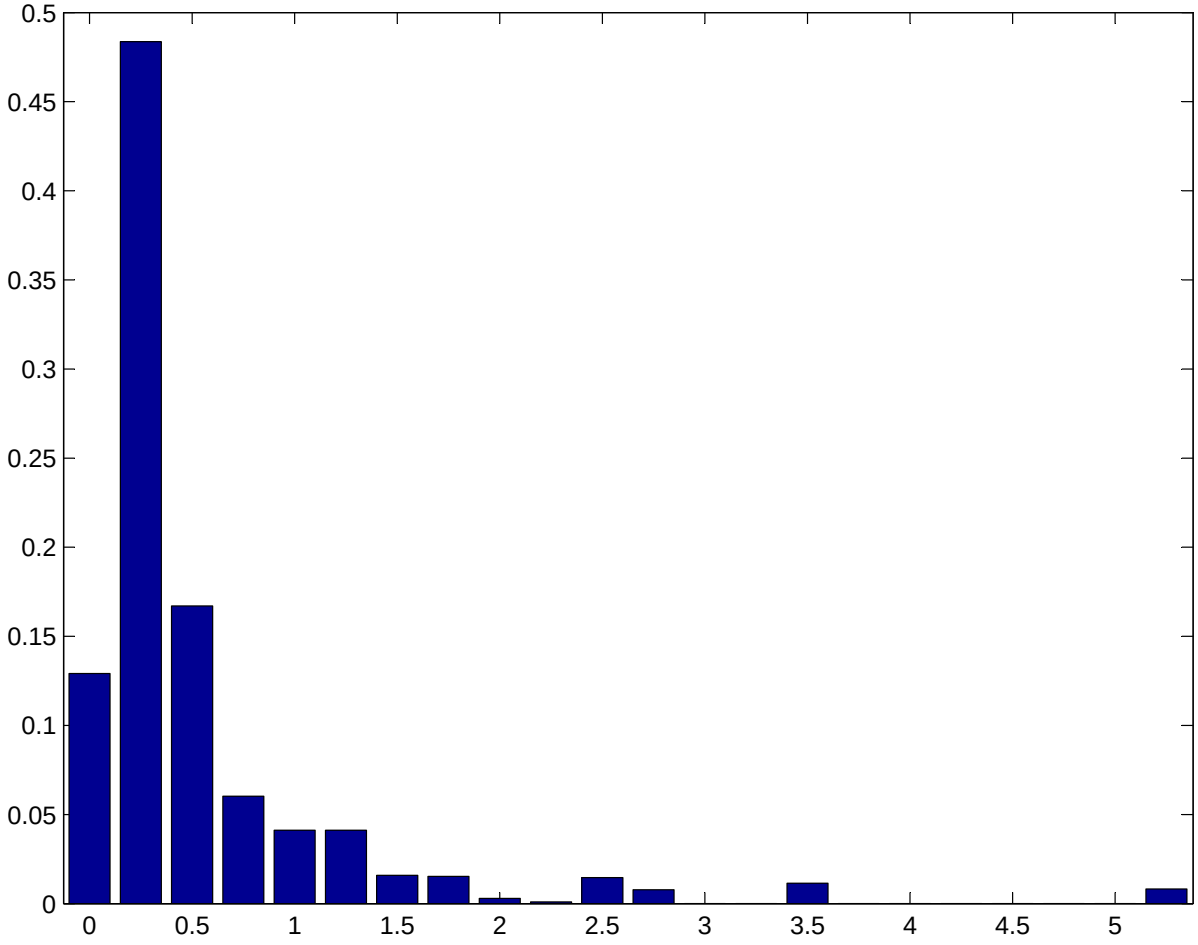
Private-Sector Expectations of Funds Rate "Liftoff"

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:



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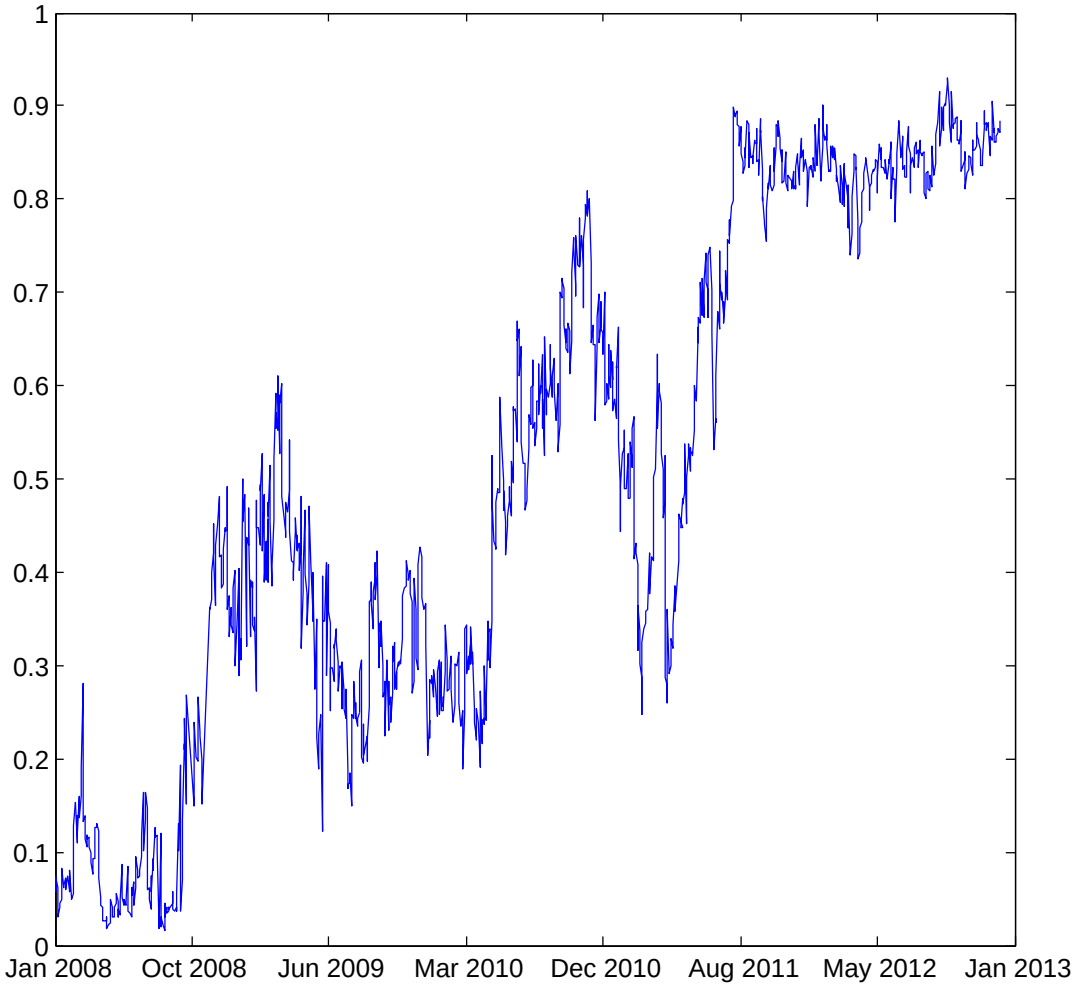
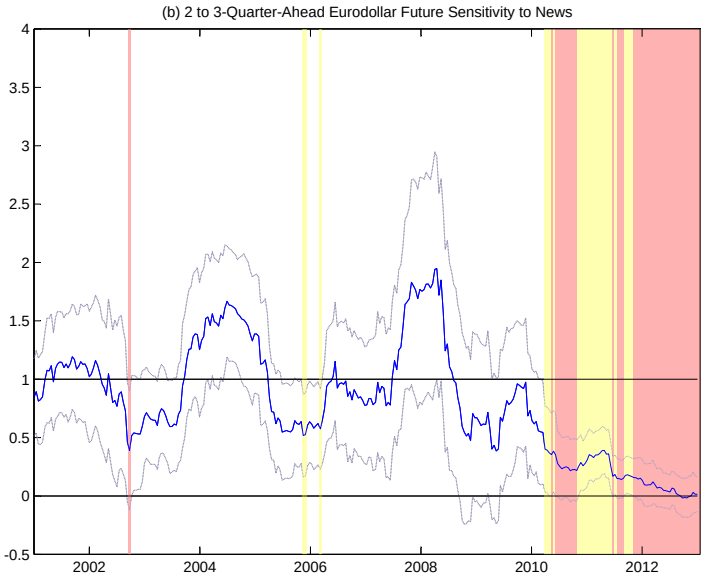
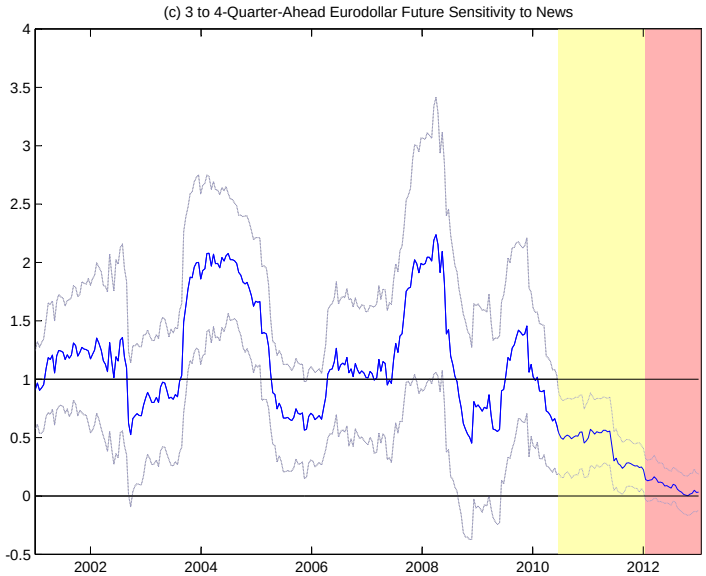
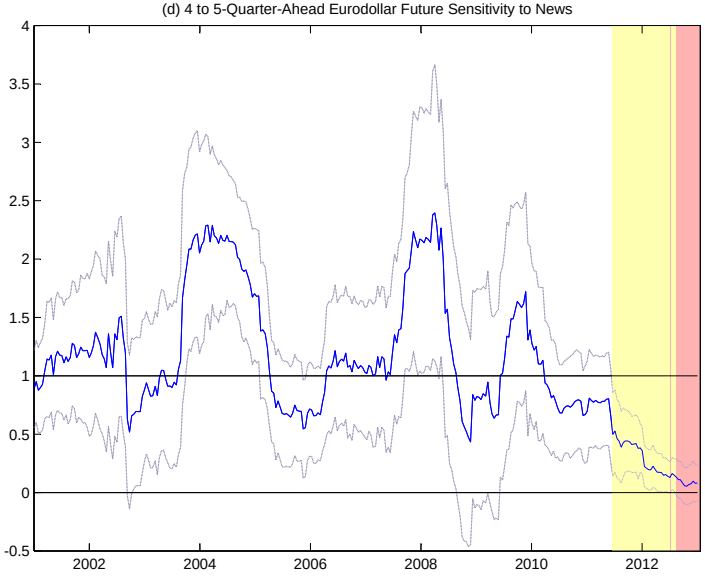
Probability of funds rate < 50bp in 5 quarters, from options:

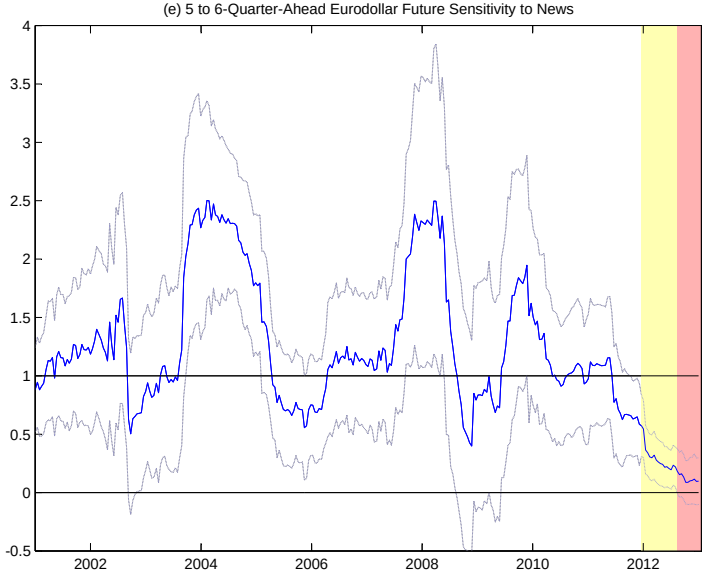


Monetary Policy Expectations from Eurodollar Futures









Federal Reserve Forward Guidance

Can the Fed manage expectations of future monetary policy?

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Theory:

- Partial commitment:
  Schaumburg-Tambalotti (2007), Debortoli-Nuñes (2010)
- Discretion (Kydland-Prescott 1977) is a limiting, extreme case

Federal Reserve Forward Guidance

Can the Fed manage expectations of future monetary policy?

Empirics:

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  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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- Three recent examples:

	Treasury yields					
	3-month	6-month	1-year	2-year	5-year	10-year
FOMC drops "considerable period" language on Jan. 28, 2004						
change (bp)	3	2	12.5	16.6	13.9	10.3
FOMC projects zero funds rate "at least through mid-2013" on Aug. 9, 2011						
change (bp)	−2	−1	−4.3	−9.9	−20.5	−22.9
FOMC projects zero funds rate "at least through late 2014" on Jan. 25, 2012						
change (bp)	0	0	−0.2	−3.7	−9.4	−8.0

Federal Reserve Long-Term Bond Purchases

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

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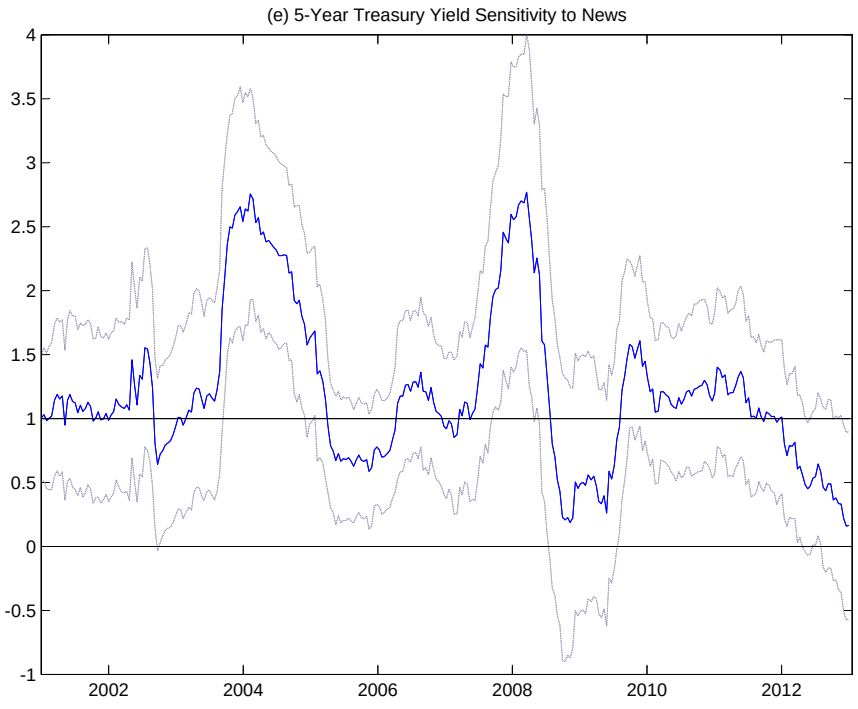

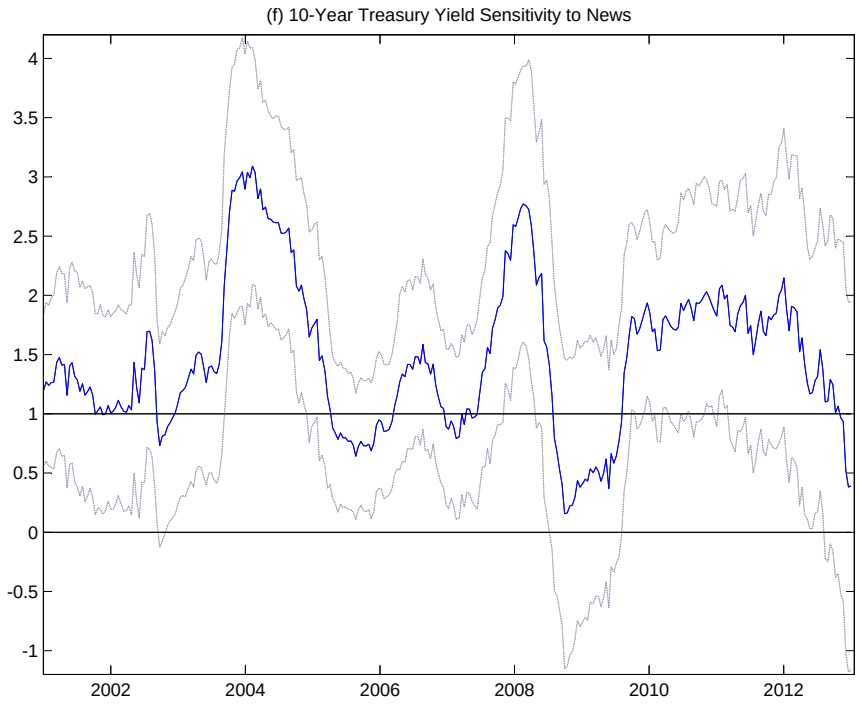

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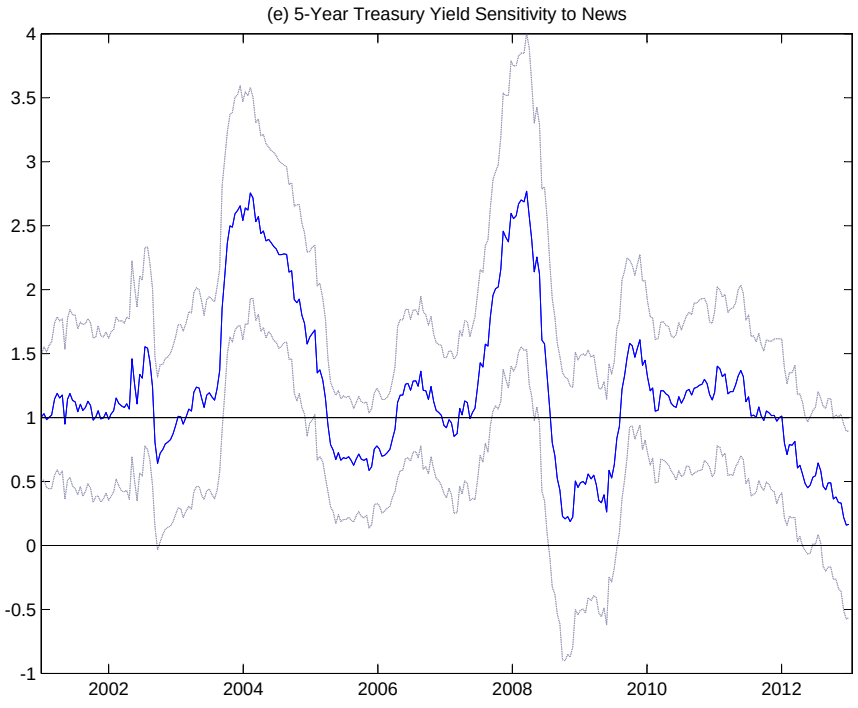

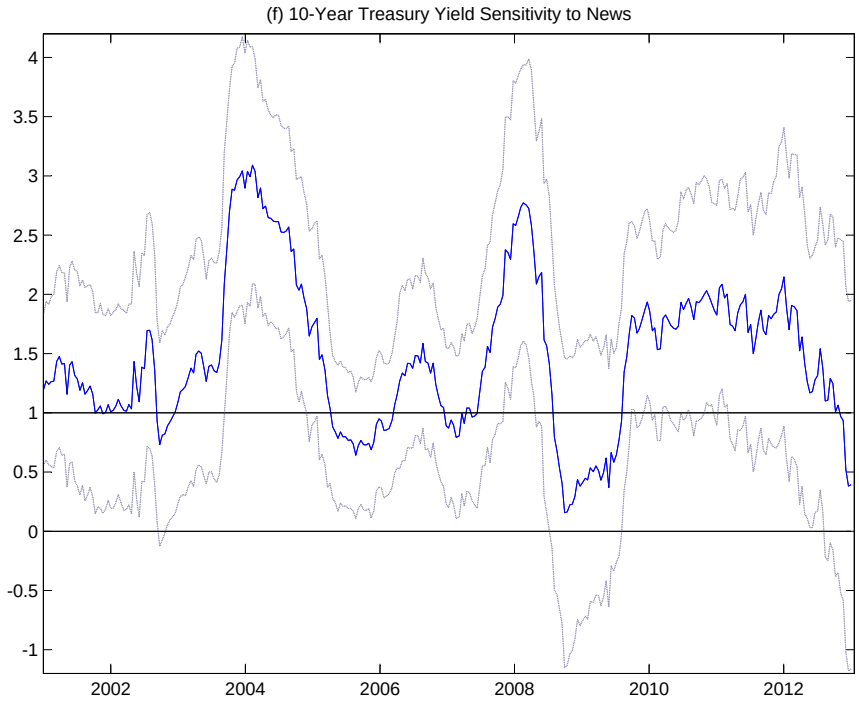

In the illustrative model, all yields are attenuated by the ZLB (although longer-term yields are attenuated less)

Federal Reserve Long-Term Bond Purchases

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Forward Guidance:

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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"
- 6/20/12: $270B extension of "Operation Twist"
- 9/13/12: $40B/mo MBS

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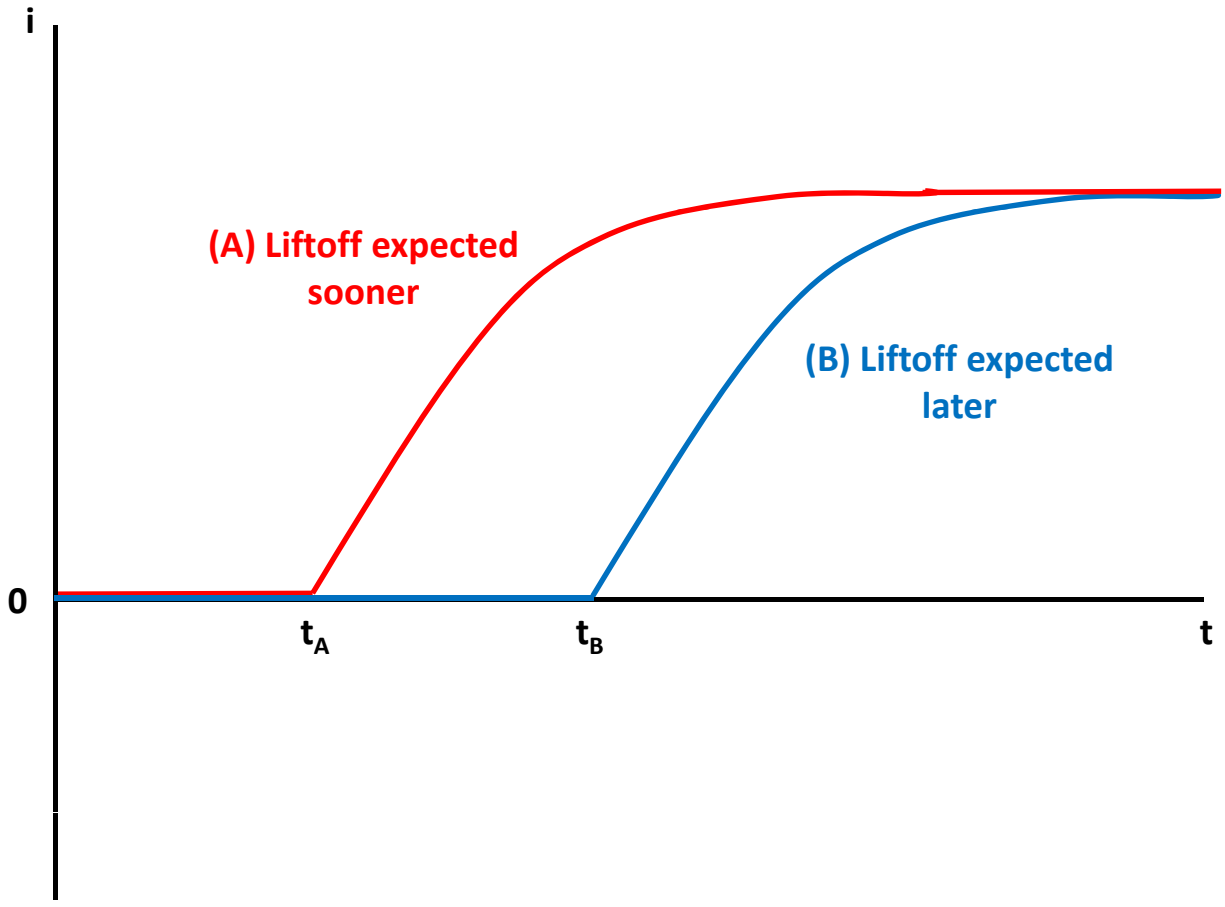
Theoretical and empirical studies:

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

Implications for the Fiscal Multiplier



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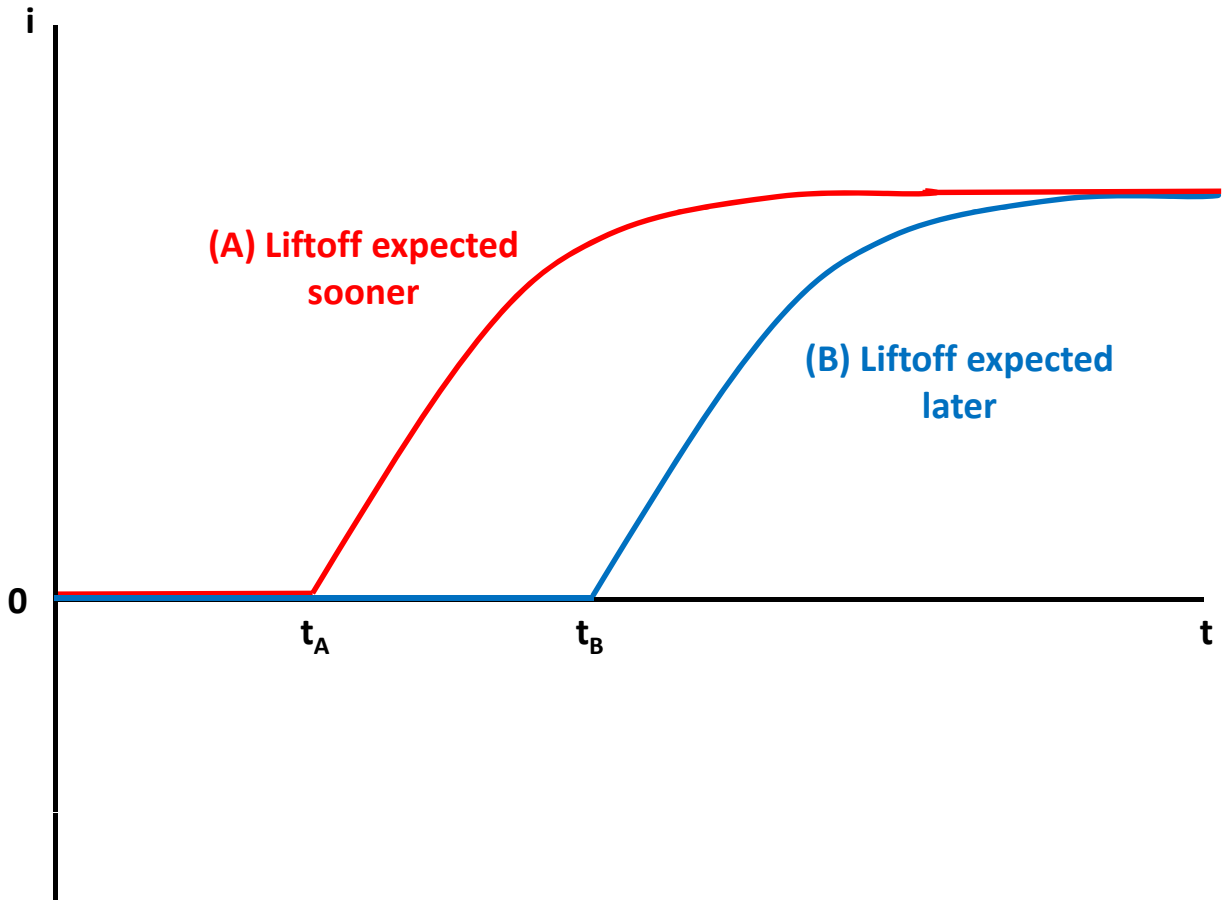

A) liftoff in 4 qtrs. $\Longrightarrow$ multiplier same as normal (CER 2011)

B) liftoff in 8 qtrs. or more $\Longrightarrow$ large multiplier (CER 2011)

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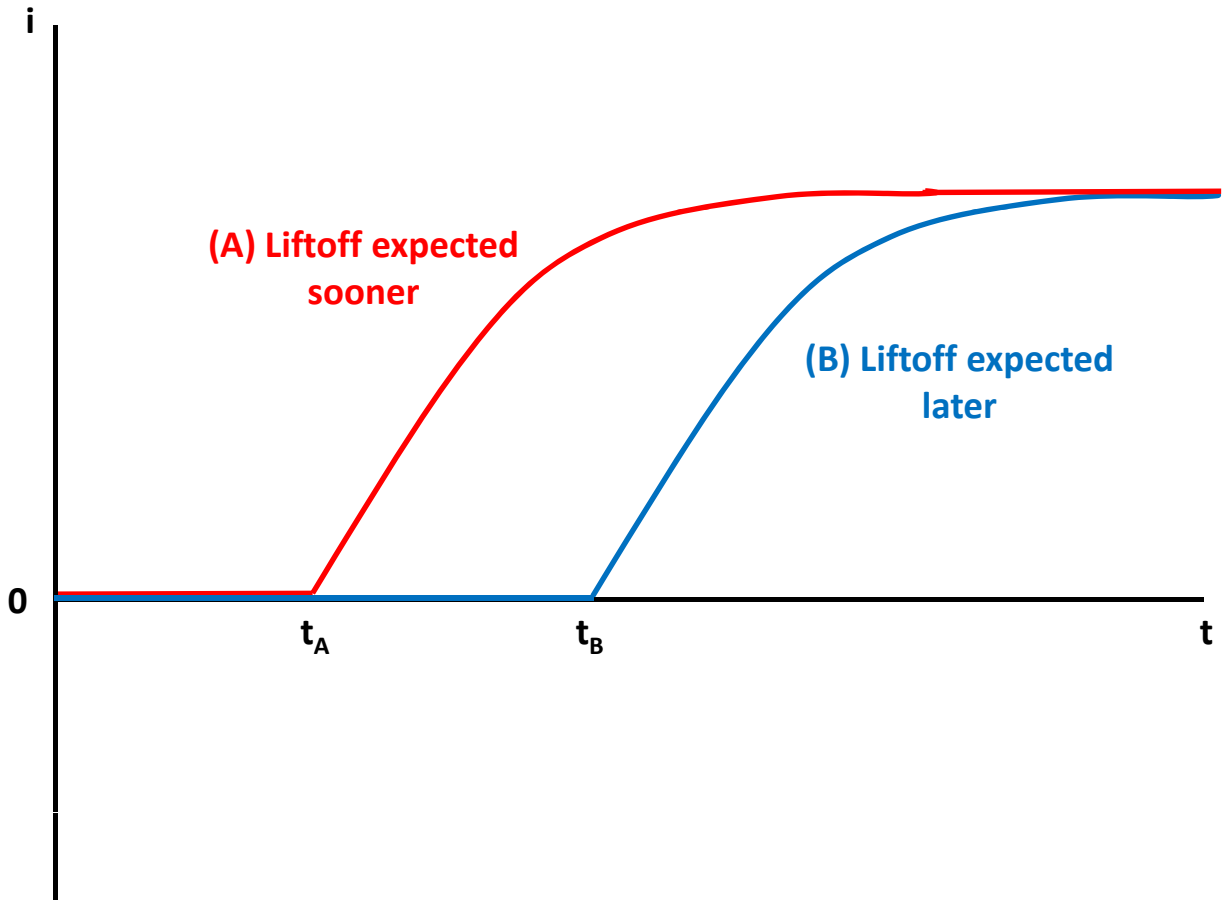

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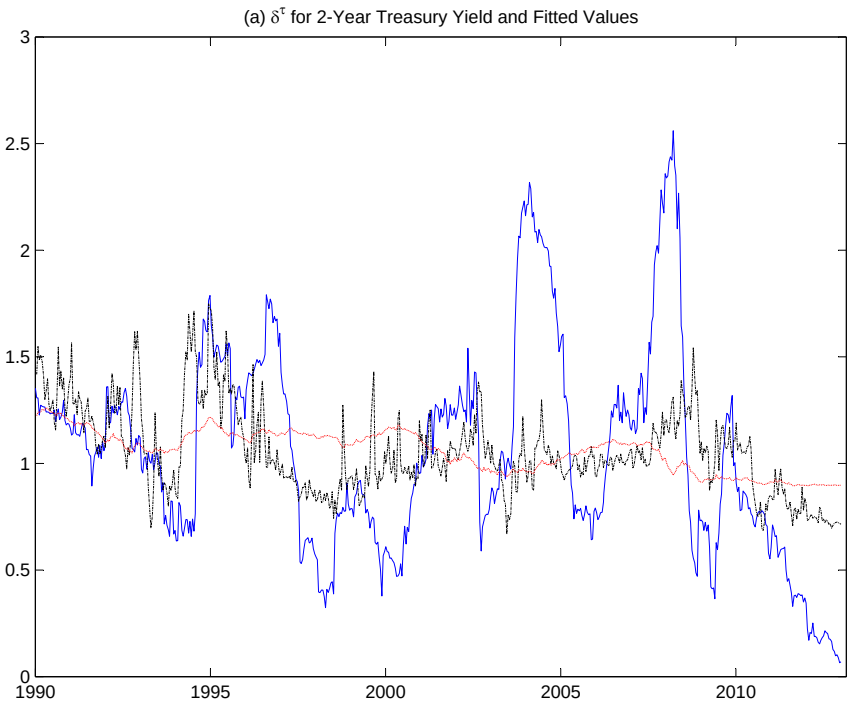
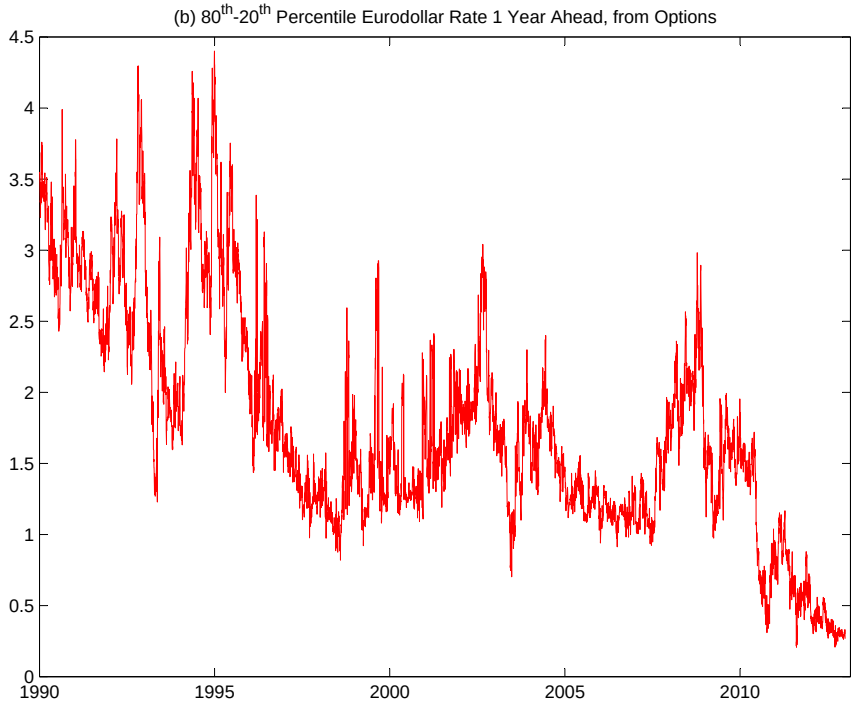
B) liftoff in 8 qtrs. or more $\Longrightarrow$ large multiplier (CER 2011)

This paper: 2008–10 look like scenario A

Other Explanations for Time-Varying Sensitivity?

Natural candidates are level of yields and monetary policy uncertainty:





Conclusions

What we do:

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

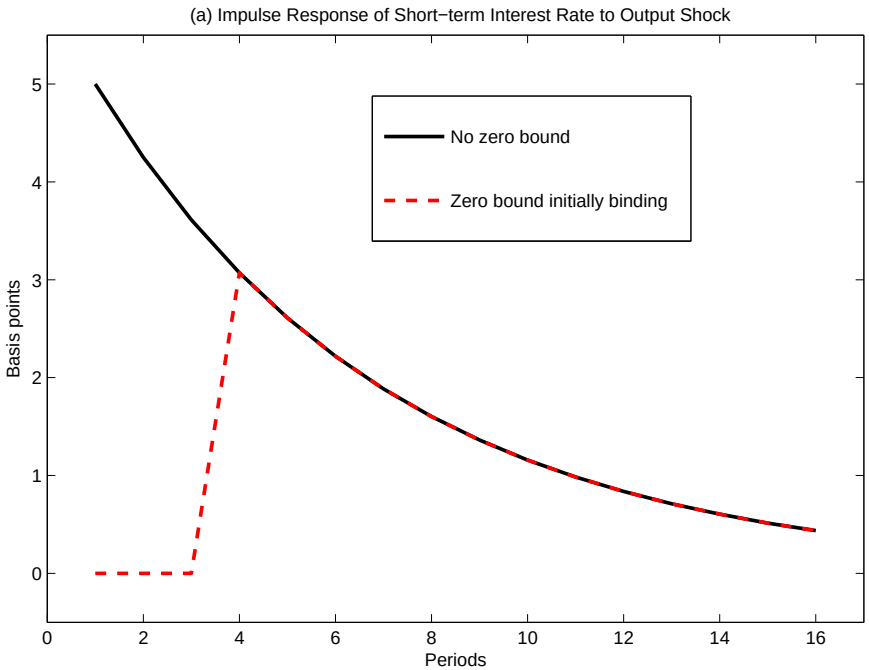
What we find:

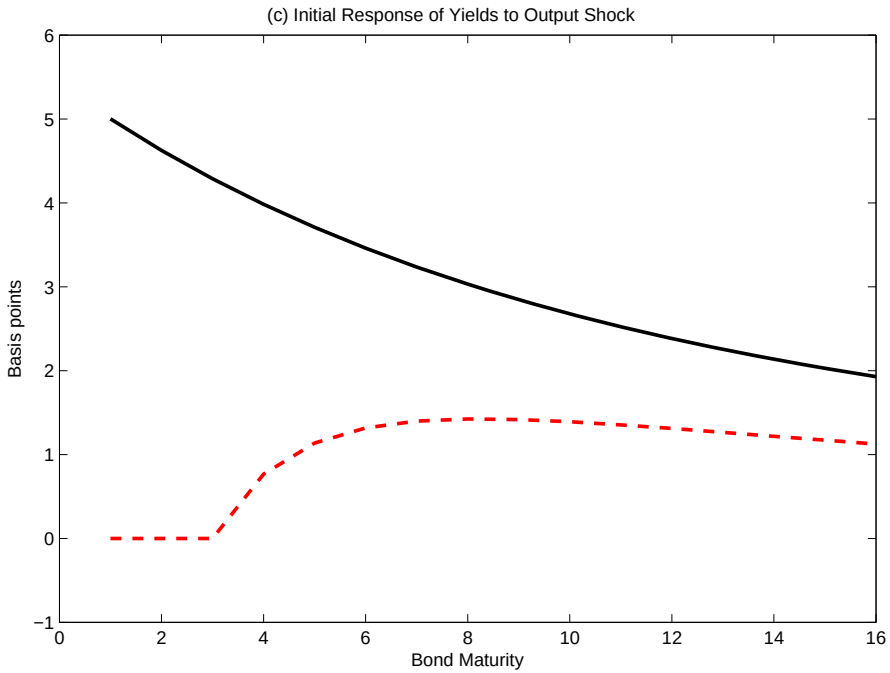
- 1- and 2-year Treasury yields were surprisingly responsive to news throughout much of 2008–10.

What we conclude:

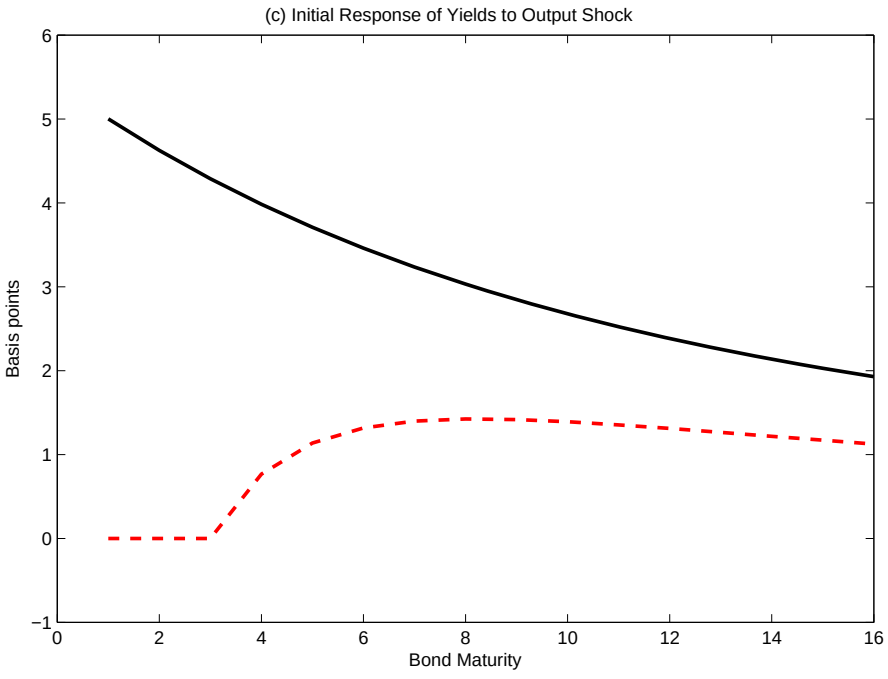
- Effectiveness of monetary and fiscal policy likely close to normal throughout 2008–10.
- Zero lower bound a more severe constraint since mid-2011.

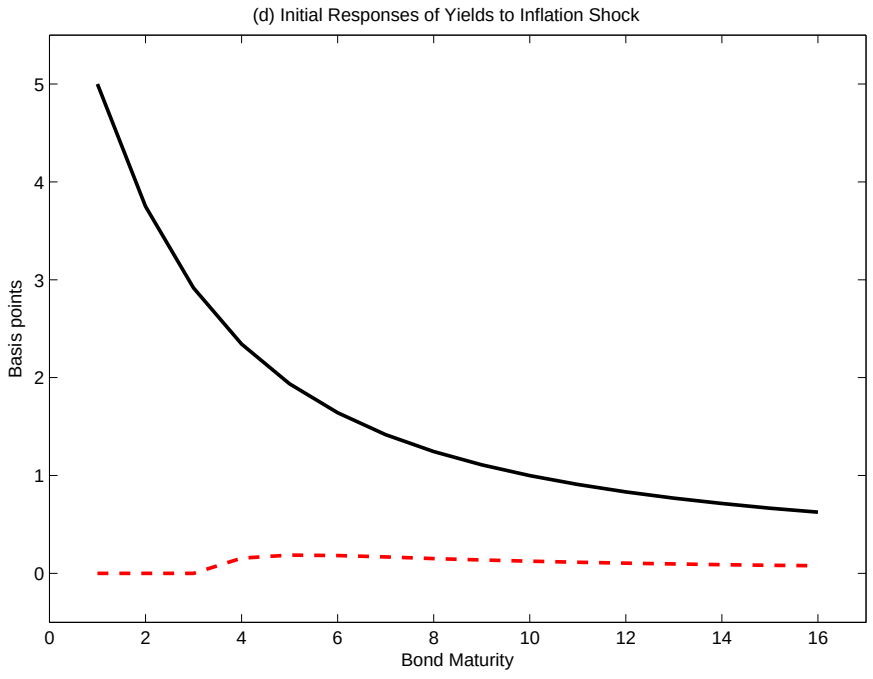
ZLB Attenuates All Yields, But Short Yields Most





Yield Curve Response to Ouput, Inflation Shocks





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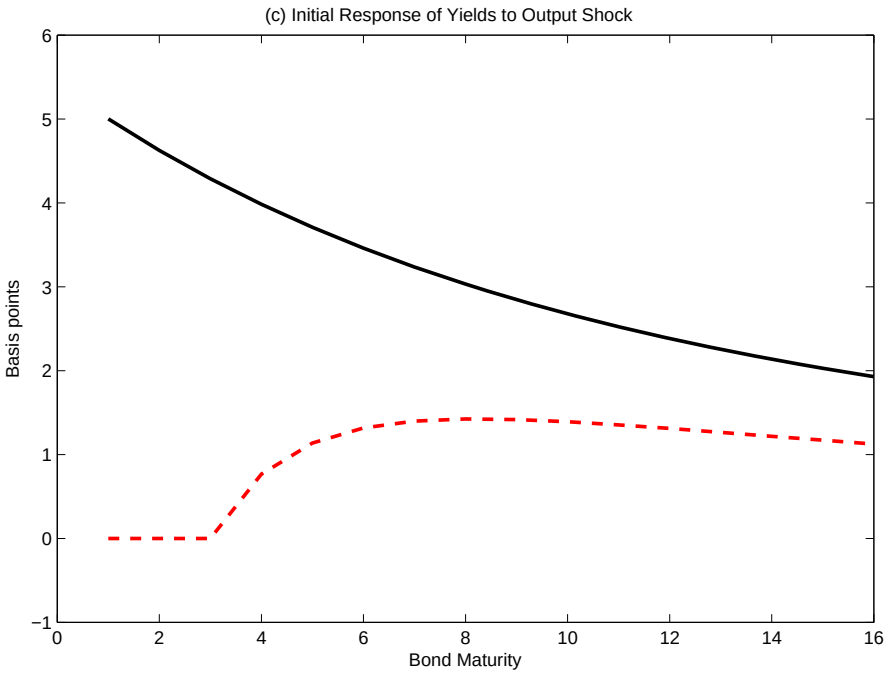

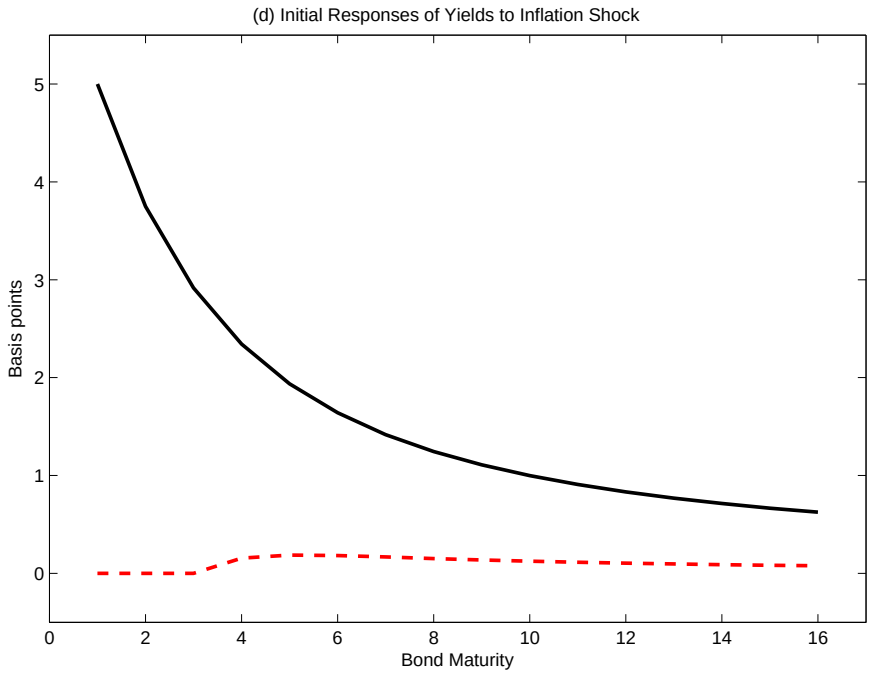

Degree of attenuation related to persistence of shock.

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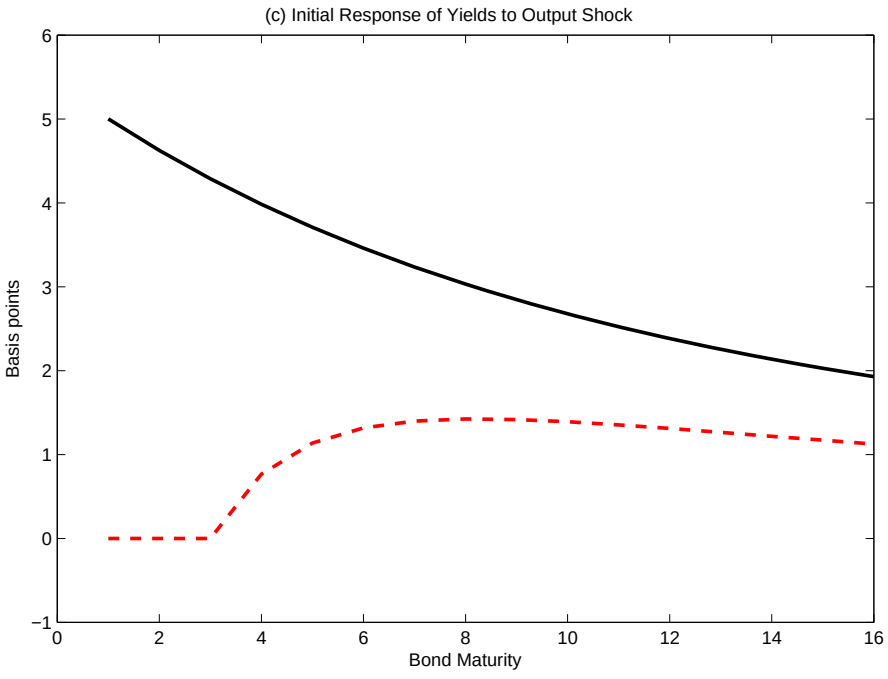

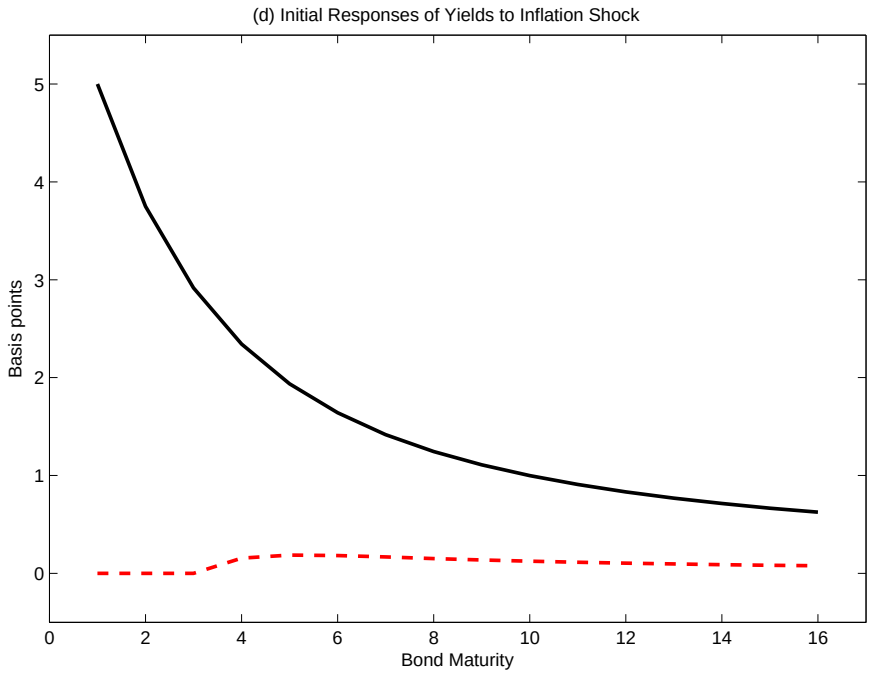

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For shocks with similar persistence, attenuation effects are similar.