Measuring the Effect of the Zero Lower Bound on Yields and Exchange Rates in the U.K. and Germany

Eric T. Swanson John C. Williams

Federal Reserve Bank of San Francisco

FRBNY-HKMA Conference on Domestic and International Dimensions of Unconventional Monetary Policy

Hong Kong

March 20, 2014

The views expressed in this presentation are solely those of the authors and do not necessarily represent the views of any other individual in the Federal Reserve System.

Three Motivating Observations

1. New Keynesian IS curve:

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

Three Motivating Observations

1. New Keynesian IS curve:

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

Three Motivating Observations

1. New Keynesian IS curve:

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

2. Brian Sack: “The best measure of the stance of monetary policy is the 2-year Treasury yield.”

Three Motivating Observations

1. New Keynesian IS curve:

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

2. Brian Sack: “The best measure of the stance of monetary policy is the 2-year Treasury yield.”

3. The zero lower bound is not a substantial constraint on monetary policy if the central bank can affect longer-term interest rates:

Three Motivating Observations

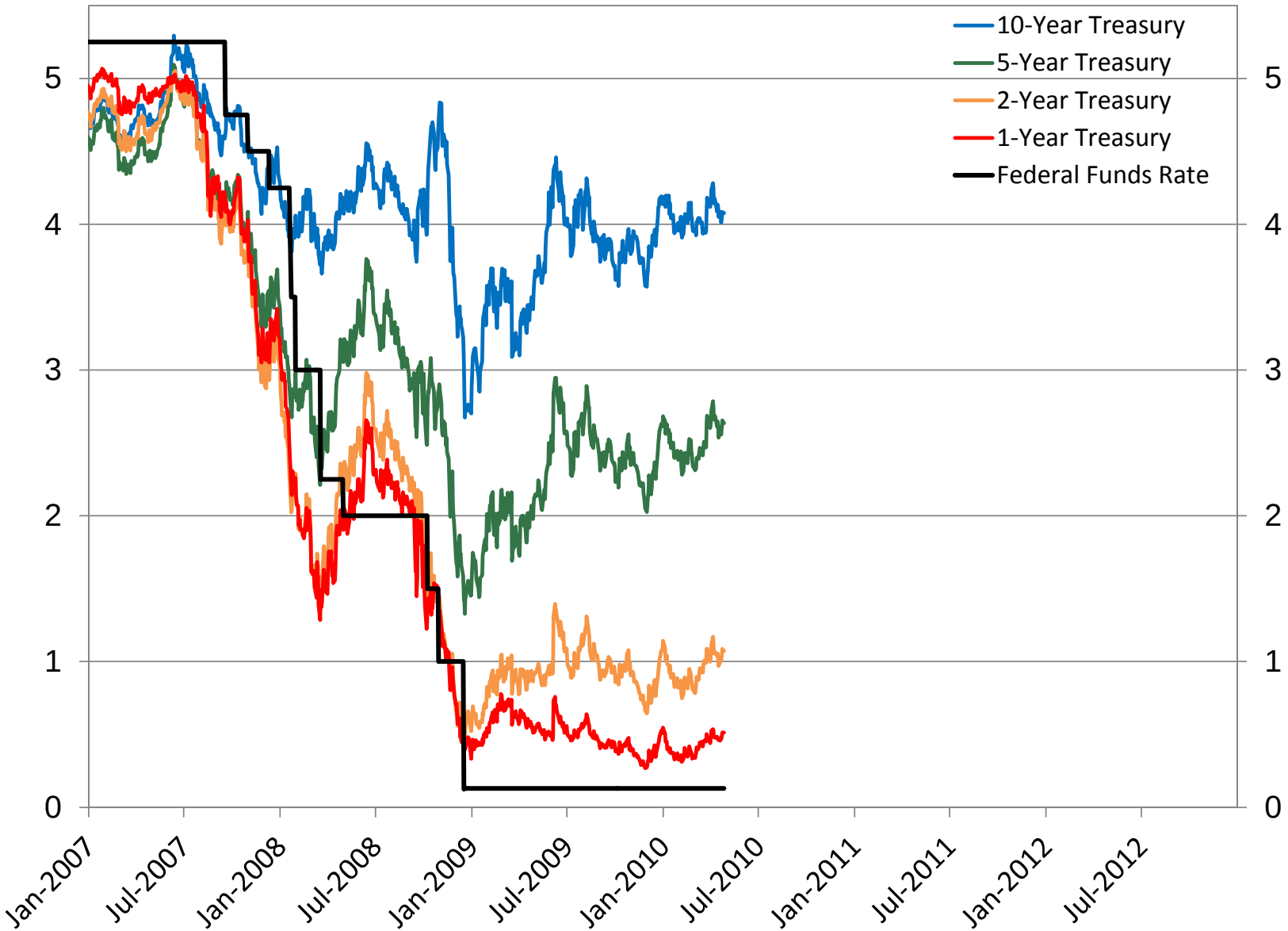
1. New Keynesian IS curve:

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

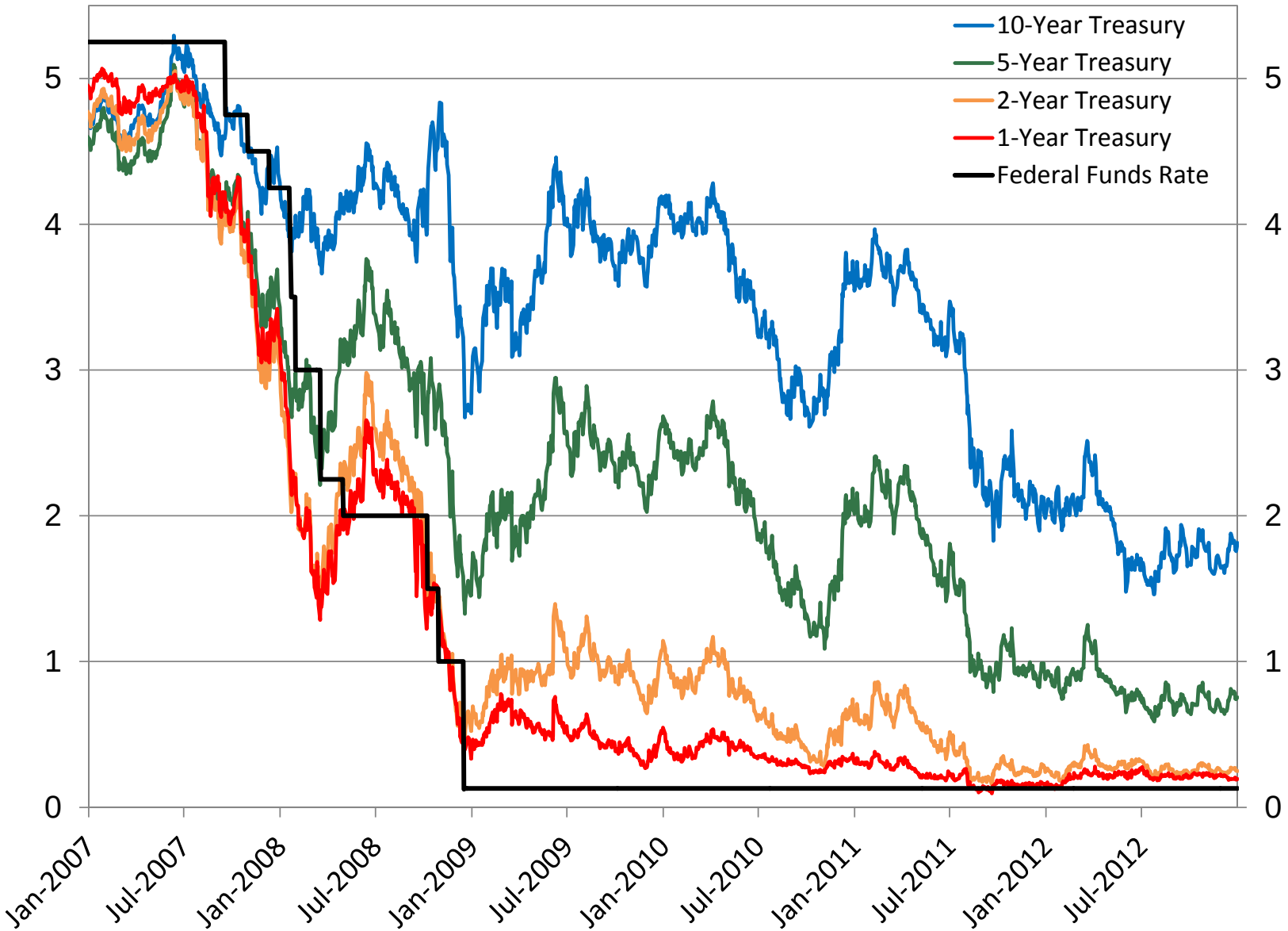
2. Brian Sack: "The best measure of the stance of monetary policy is the 2-year Treasury yield."

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

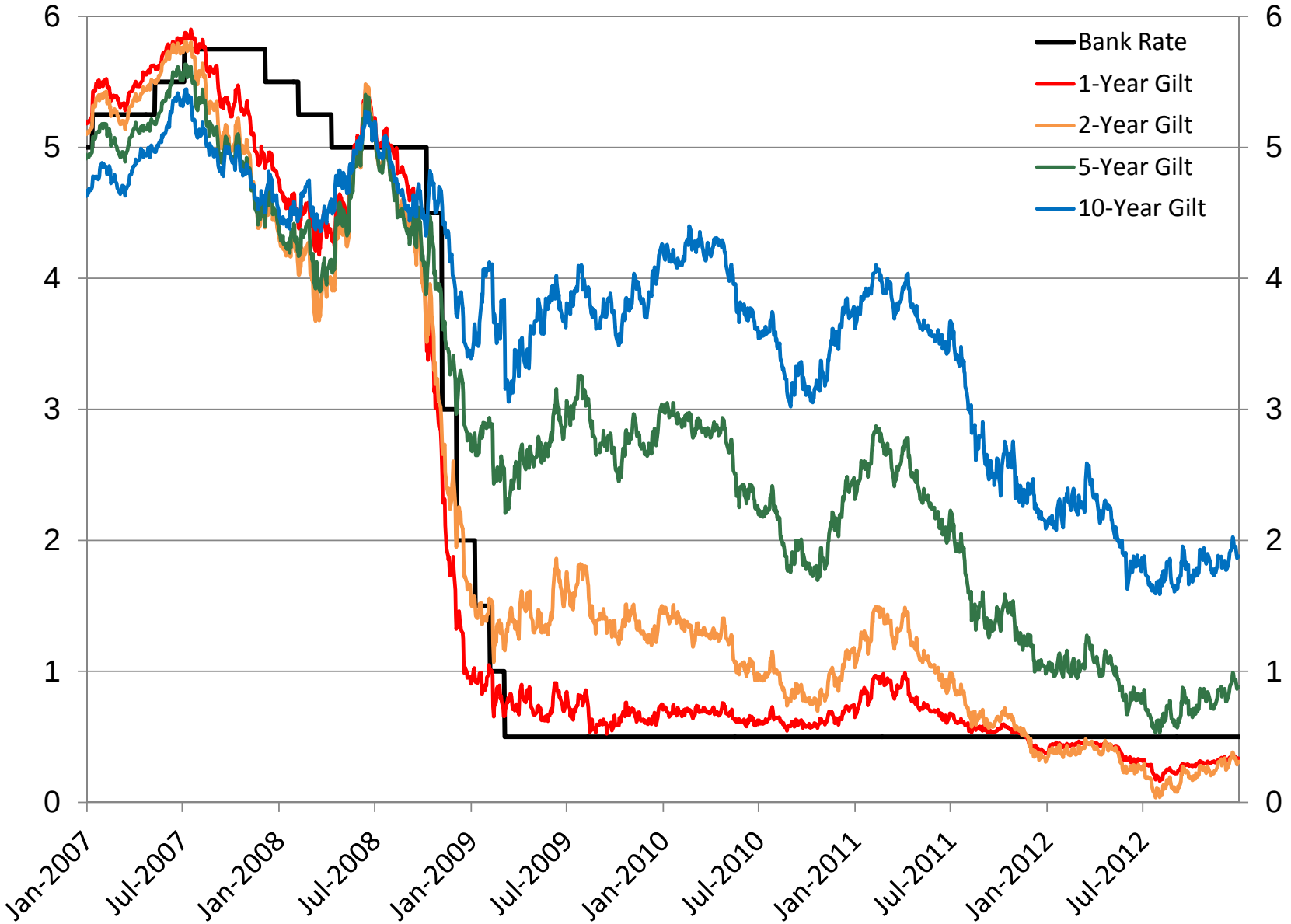
2-Year US Treasury Yield $\gg$ 0 for Much of 2008–10



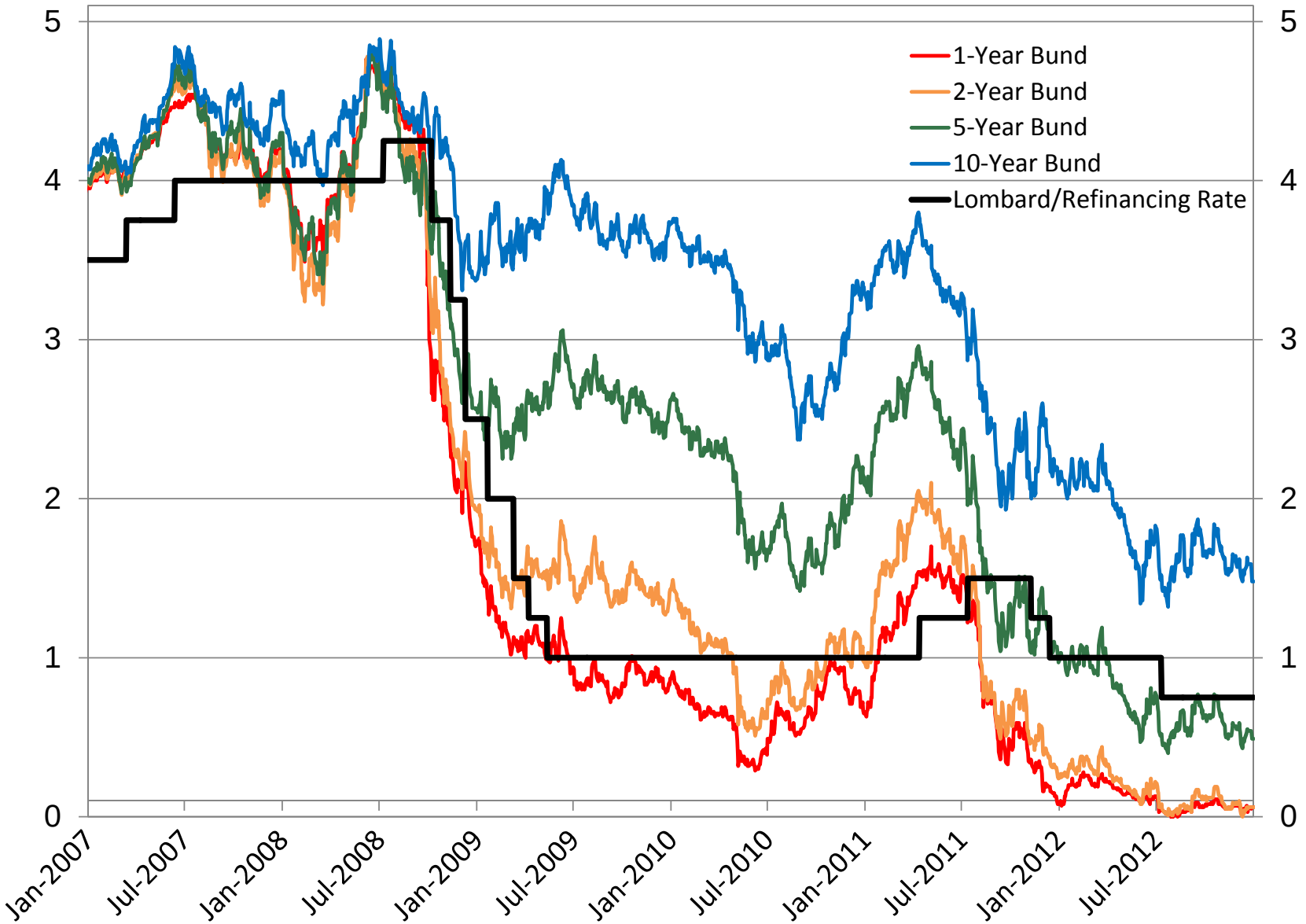
2-Year US Treasury Yield $\gg$ 0 for Much of 2008–10



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



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



Swanson-Williams (2013)

- Compute the sensitivity of interest rates of various maturities to macroeconomic news in normal times (1993–2006)
- And compare it to the sensitivity of those yields to news when the ZLB may have been a constraint.

Swanson-Williams (2013)

- Compute the sensitivity of interest rates of various maturities to macroeconomic news in normal times (1993–2006)
- And compare it to the sensitivity of those yields to news when the ZLB may have been a constraint.
- Provides an econometric test whether a yield was constrained
- And a quantitative measure of severity of constraint.

Swanson-Williams (2013)

- Compute the sensitivity of interest rates of various maturities to macroeconomic news in normal times (1993–2006)
- And compare it to the sensitivity of those yields to news when the ZLB may have been a constraint.
- Provides an econometric test whether a yield was constrained
- And a quantitative measure of severity of constraint.

The level of yields alone is not a good measure of ZLB constraint:

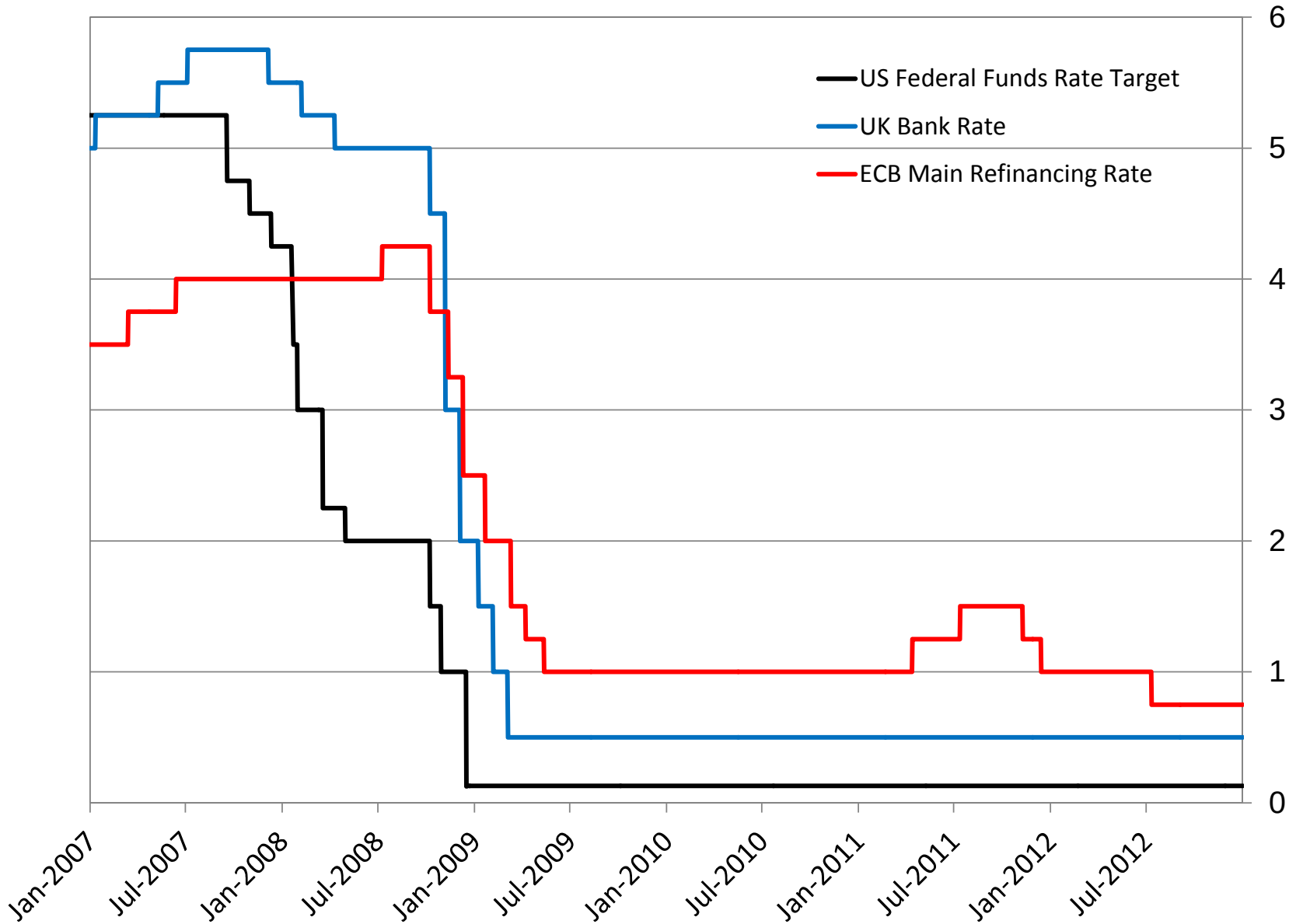
Swanson-Williams (2013)

- Compute the sensitivity of interest rates of various maturities to macroeconomic news in normal times (1993–2006)
- And compare it to the sensitivity of those yields to news when the ZLB may have been a constraint.
- Provides an econometric test whether a yield was constrained
- And a quantitative measure of severity of constraint.

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

Monetary Policy Rates in U.S., U.K., Germany



Measuring Sensitivity of Yields, Exch. Rates to News

Measure sensitivity of a given yield (or exchange rate) to news in normal times using a high-frequency regression:

$$\Delta y_t = \alpha + \beta X_t + \varepsilon_t$$

Measuring Sensitivity of Yields, Exch. Rates to News

Measure sensitivity of a given yield (or exchange rate) to news in normal times using a high-frequency regression:

$$\Delta y_t = \alpha + \beta X_t + \varepsilon_t$$

- regression is at daily frequency
- Δy_t denotes one-day change in given yield on date t
- X_t is a vector of surprises in macroeconomic data releases (GDP, CPI, unemploymenet, etc.) on date t
- ε_t denotes effects of other news and other factors on yields

Measuring Sensitivity of Yields, Exch. Rates to News

Measure sensitivity of a given yield (or exchange rate) to news in normal times using a high-frequency regression:

$$\Delta y_t = \alpha + \beta X_t + \varepsilon_t$$

- regression is at daily frequency
- Δy_t denotes one-day change in given yield on date t
- X_t is a vector of surprises in macroeconomic data releases (GDP, CPI, unemploymenet, etc.) on date t
- ε_t denotes effects of other news and other factors on yields

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 δ^i scalar, $i \in 1993, 1994, \ldots, 2012$.

Measuring Time-Varying Sensitivity to News

Time-varying sensitivity version:

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

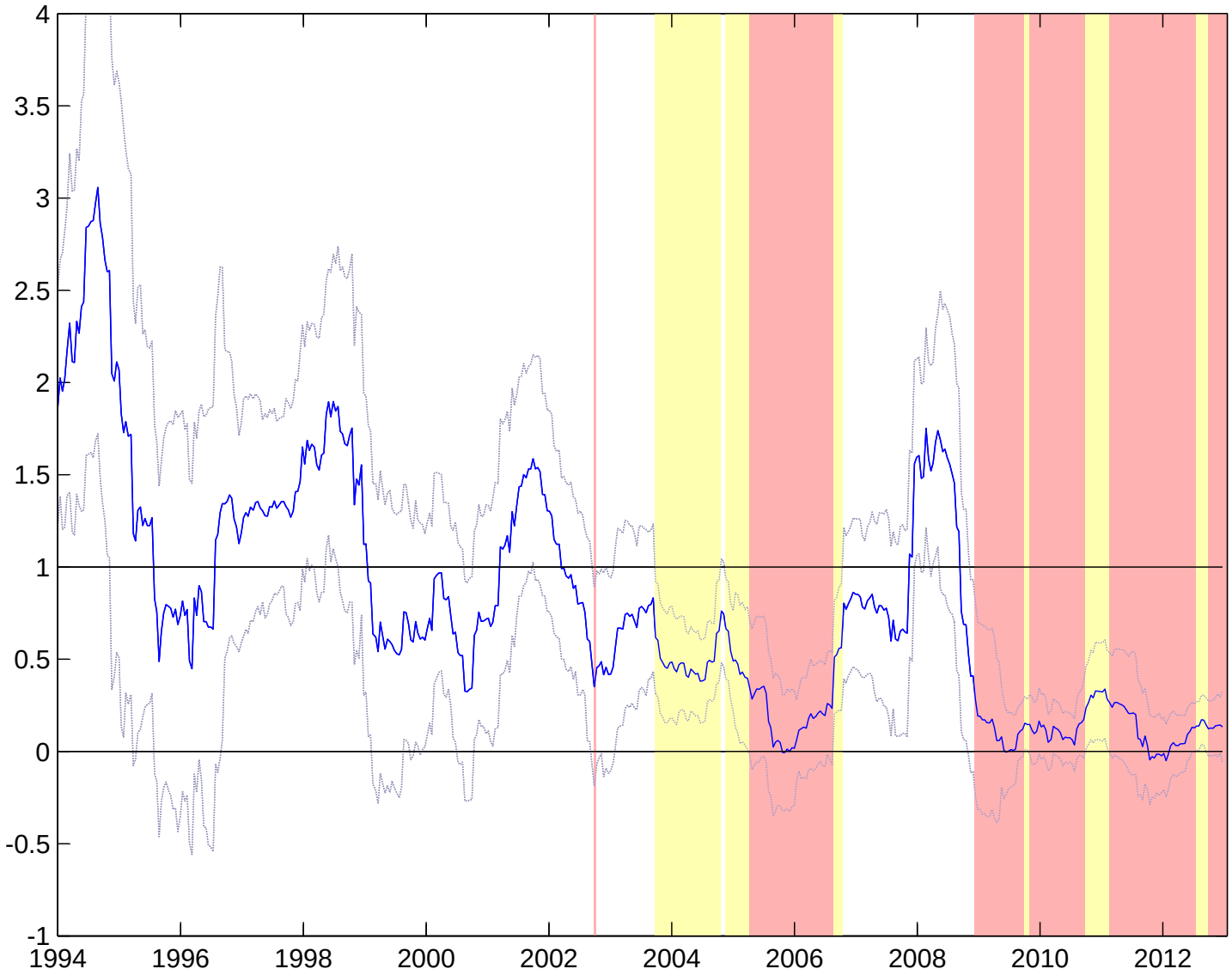
where δ^i scalar, $i \in 1993, 1994, \ldots, 2012$.

- Assumption: *relative* responses β constant over time
- Estimate δ^i, β by nonlinear least squares
- Normalize δ^i so that average δ^i from 1993–2006 is 1

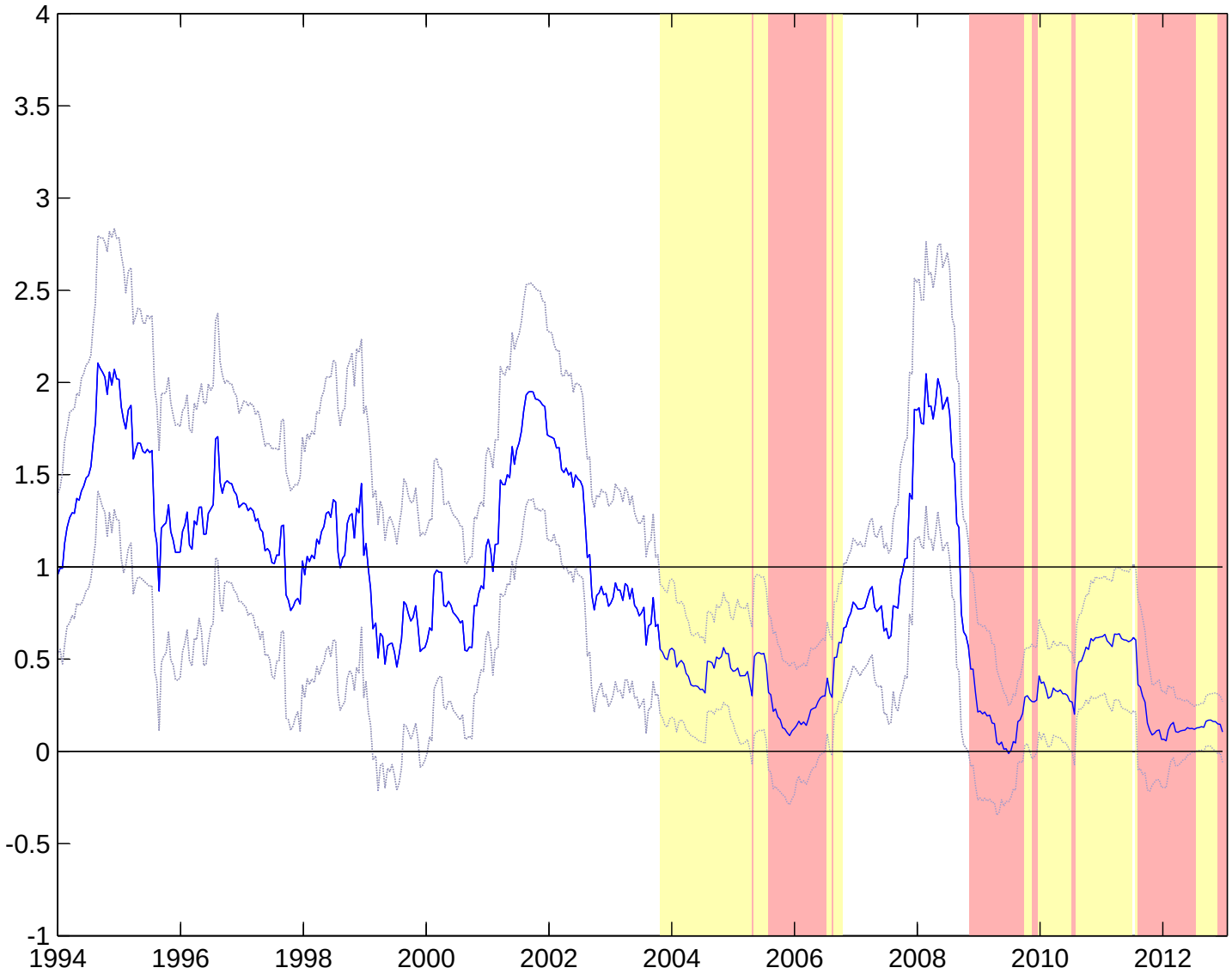
Nonlinear Regression Results for β, 1993–2012

	6-month UK gilt		2-year UK gilt		10-year UK gilt	
UK Average Earnings	2.28	(5.73)	2.90	(5.79)	0.71	(1.59)
UK GDP (advance)	0.69	(1.39)	3.17	(3.44)	1.21	(2.38)
UK Manufact. Prod.	0.42	(1.14)	1.10	(3.87)	0.60	(1.24)
UK PPI	1.00	(2.98)	1.40	(2.48)	1.28	(2.63)
UK Retail Sales	0.92	(2.94)	1.69	(4.96)	0.70	(1.52)
UK RPIX	1.48	(5.20)	2.23	(4.33)	1.71	(4.30)
UK Unemployment	−0.23	(−0.80)	−1.29	(−2.76)	−0.16	(−0.48)
US Capacity Util.	0.29	(1.02)	1.51	(3.32)	0.90	(1.93)
US Core CPI	0.62	(1.71)	0.67	(1.86)	0.88	(2.18)
US GDP (advance)	−0.68	(−1.70)	0.48	(0.92)	−0.82	(−0.97)
US Initial Claims	−0.08	(−0.61)	−0.63	(−3.79)	−0.64	(−3.10)
US ISM Manufacturing	1.04	(3.98)	1.57	(5.27)	2.52	(5.92)
US Nonfarm Payrolls	0.47	(1.81)	1.58	(3.58)	1.60	(3.25)
US Core PPI	0.31	(1.40)	0.77	(2.19)	0.56	(1.43)
US Ret. Sales ex. autos	0.58	(2.56)	0.96	(2.28)	1.34	(2.62)
US Unempl. rate	0.27	(0.66)	0.28	(0.67)	1.01	(1.92)
# Observations	2592		2708		2708	
$H_0 : \beta = 0$, p-value	$< 10^{-13}$		$< 10^{-16}$		$< 10^{-15}$	

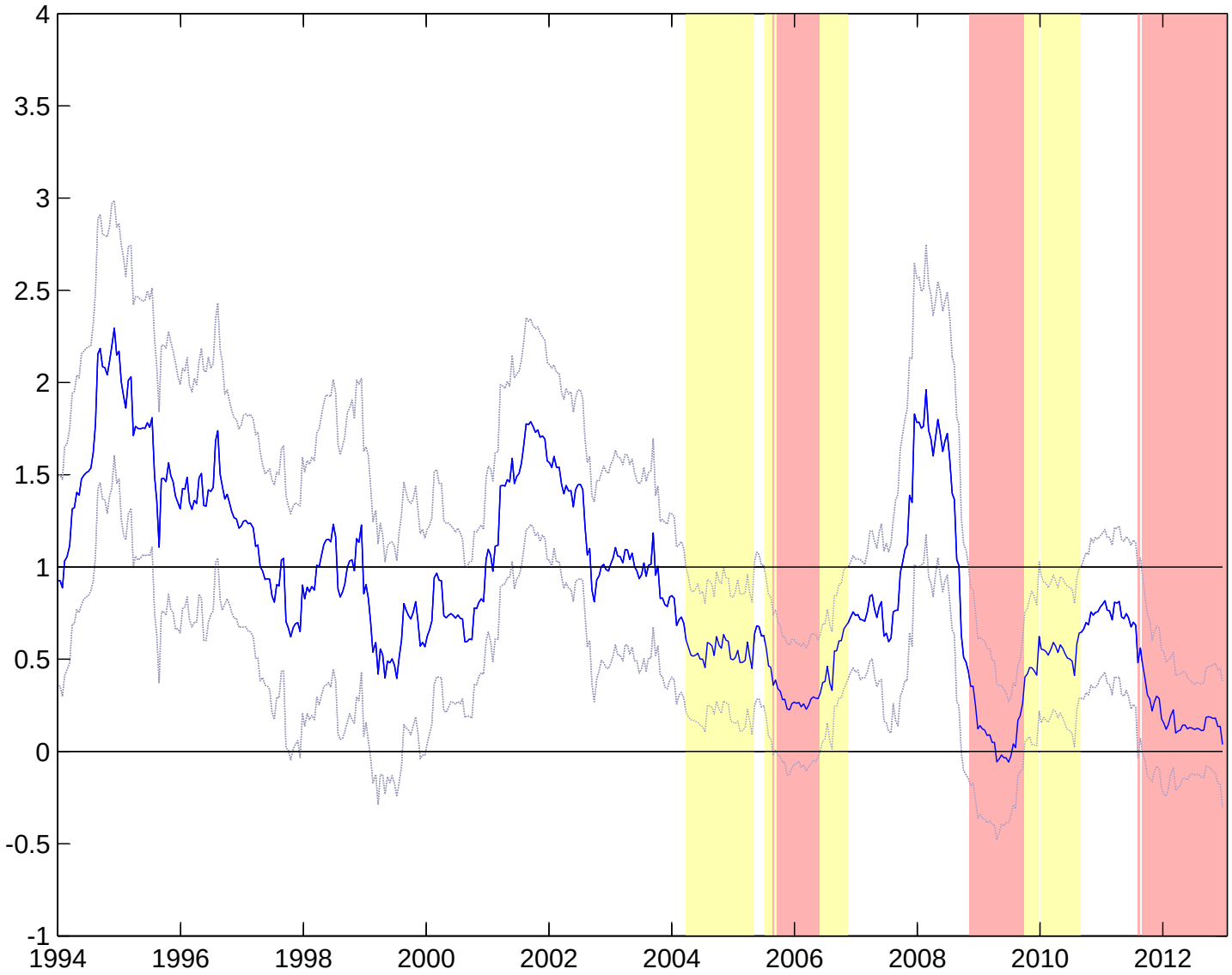
Time-Varying Sensitivity δ^{τ}, 6-month UK Gilt



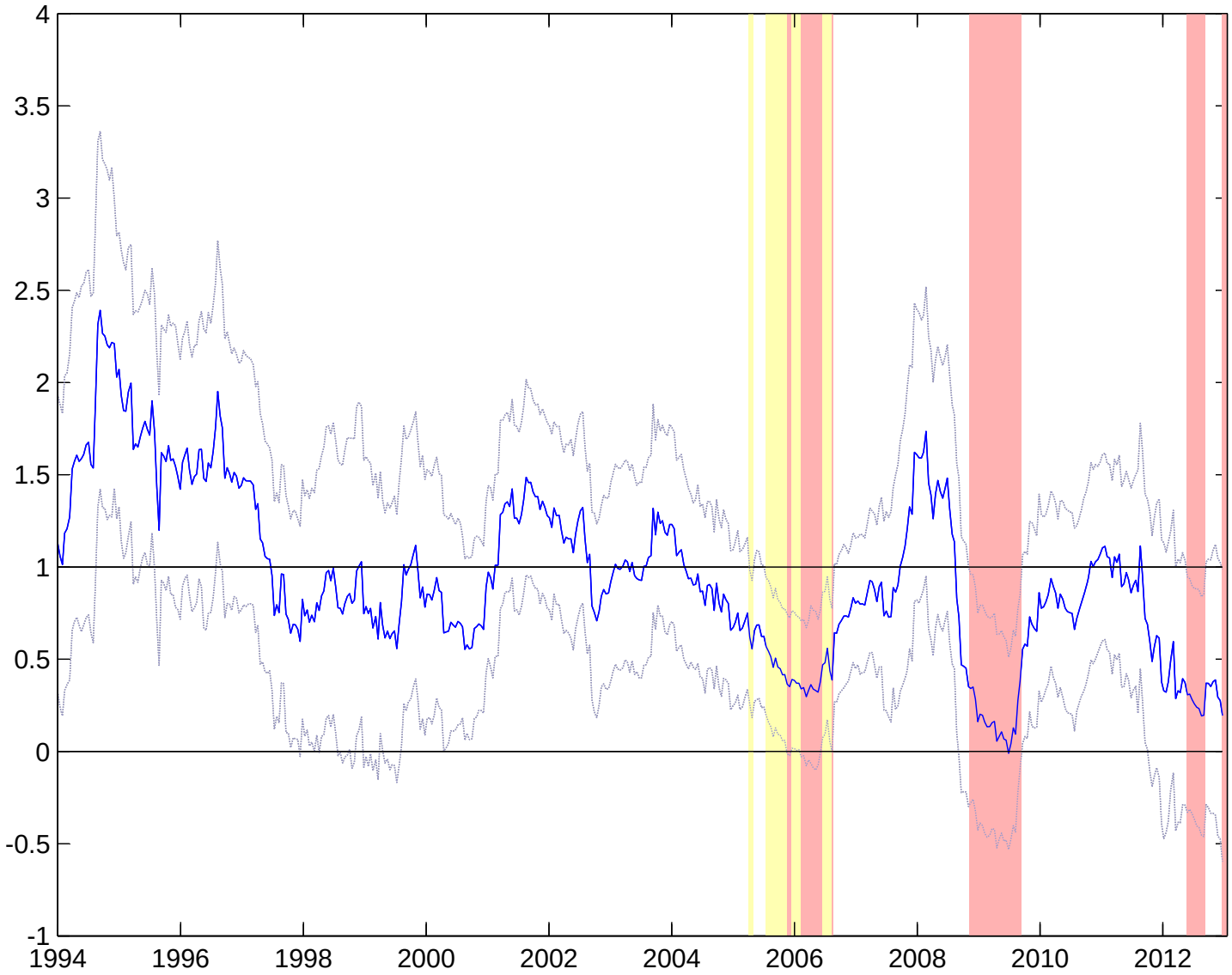
Time-Varying Sensitivity δ^{τ}, 1-year UK Gilt



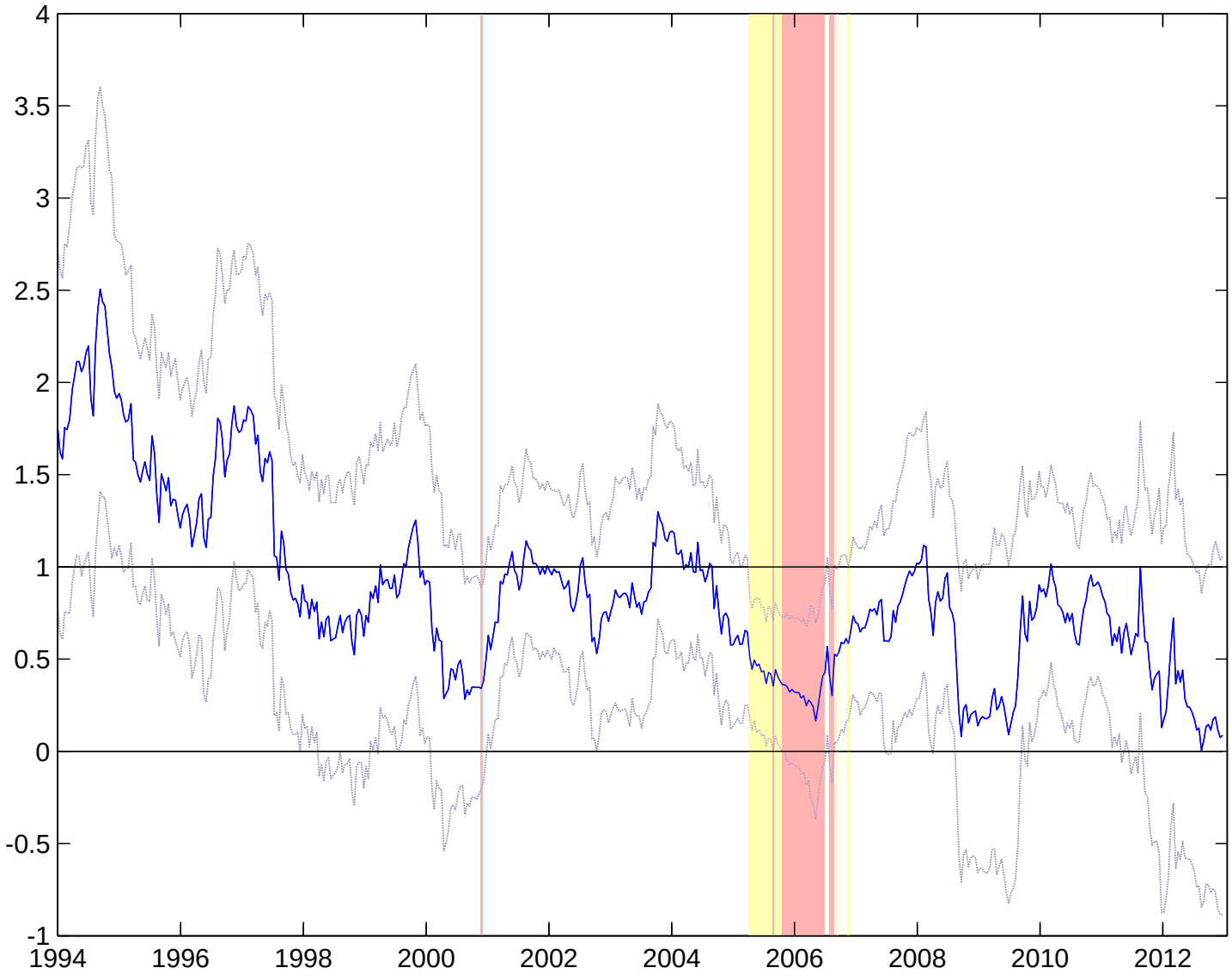
Time-Varying Sensitivity δ^{τ}, 2-year UK Gilt



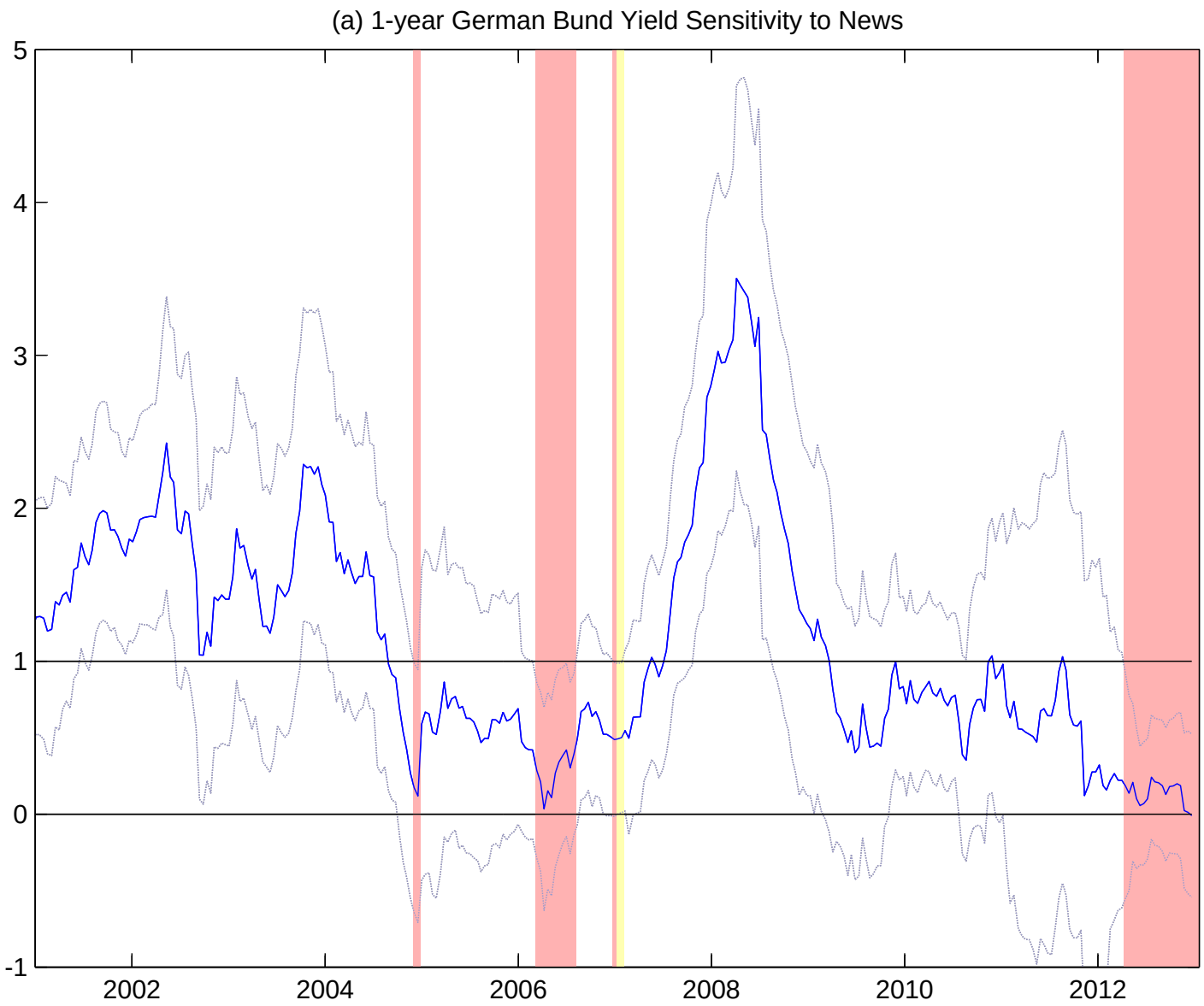
Time-Varying Sensitivity δ^{τ}, 5-year UK Gilt



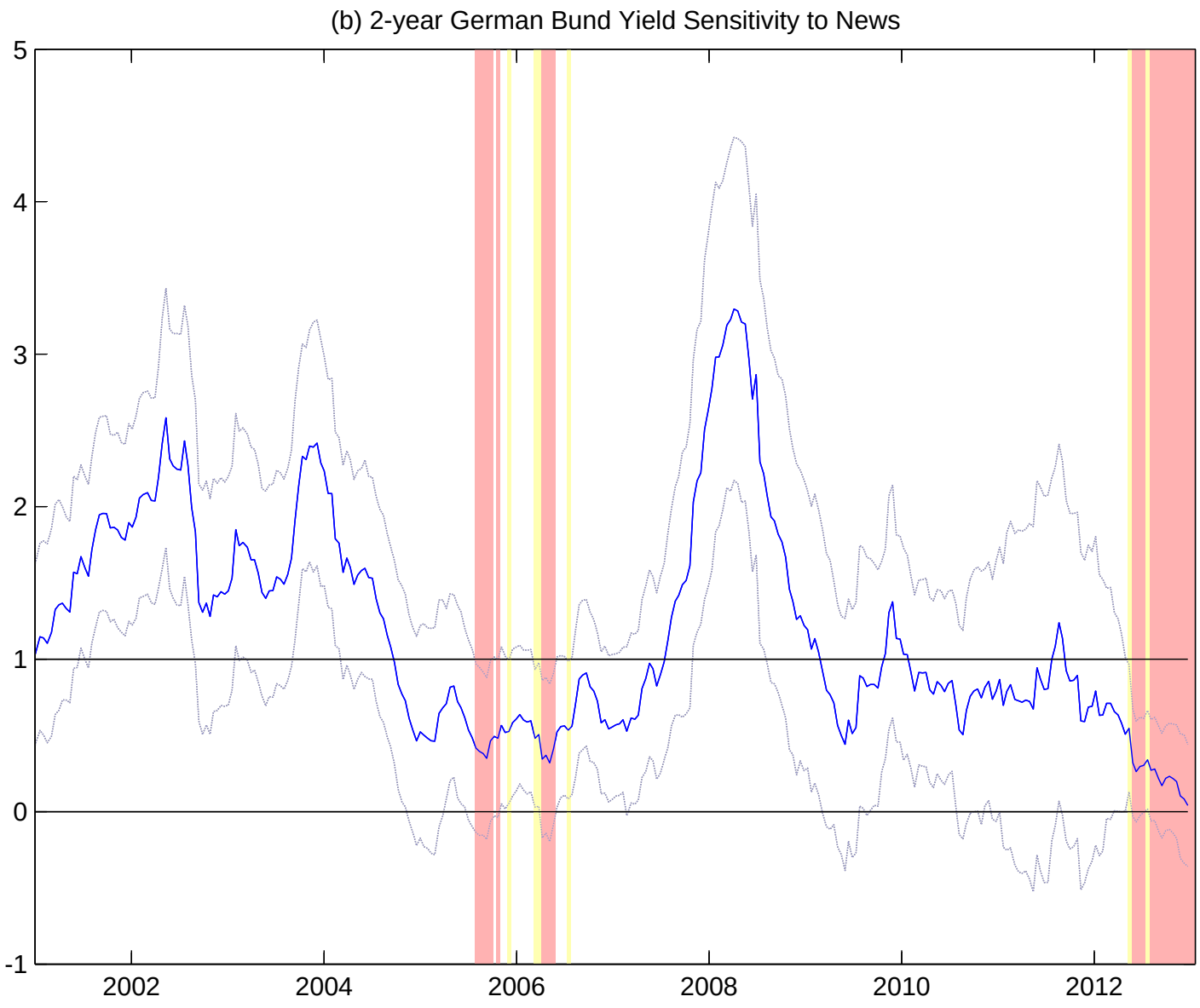
Time-Varying Sensitivity δ^{τ}, 10-year UK Gilt



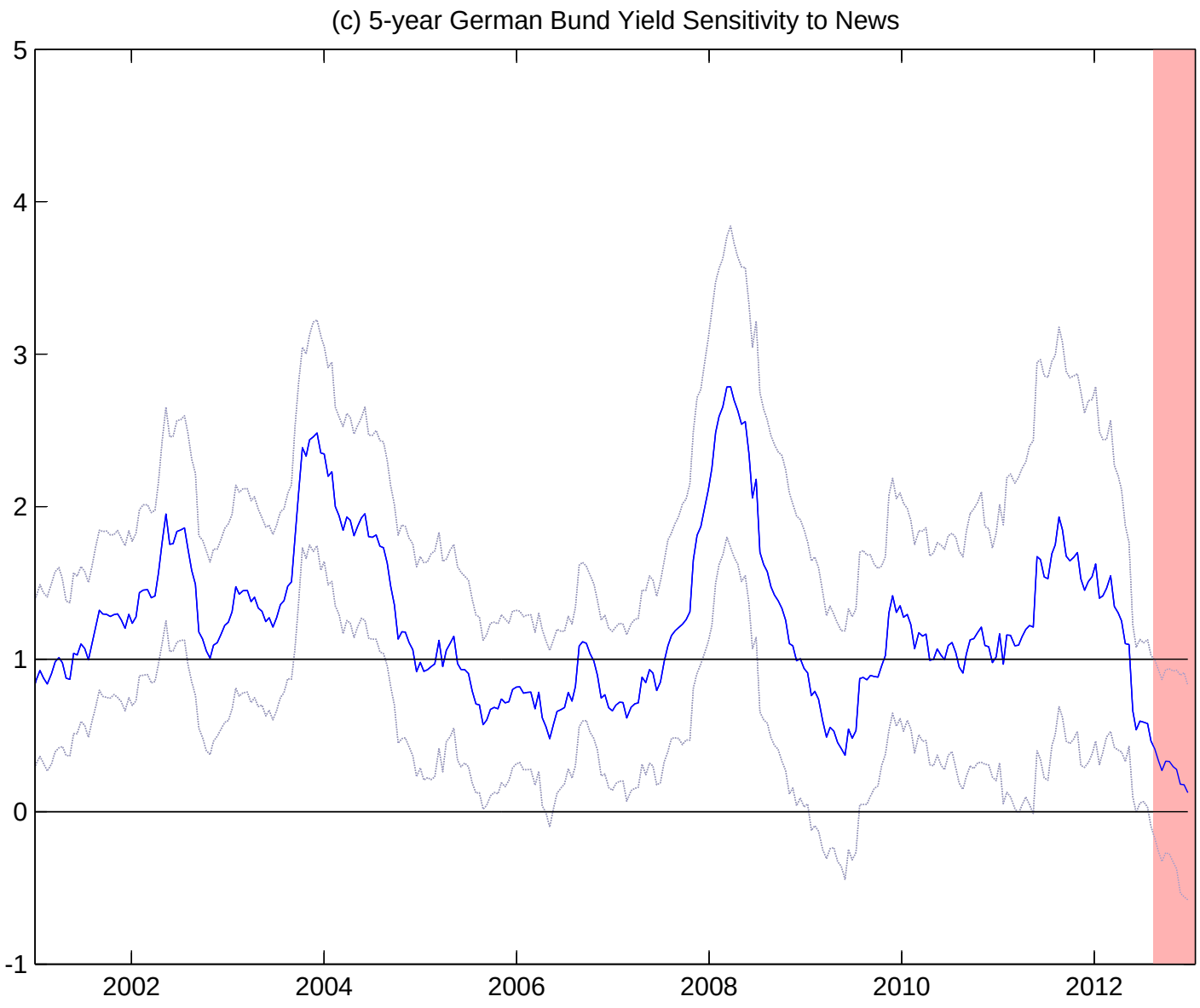
Time-Varying Sensitivity δ^{τ}, 1-year German Bund



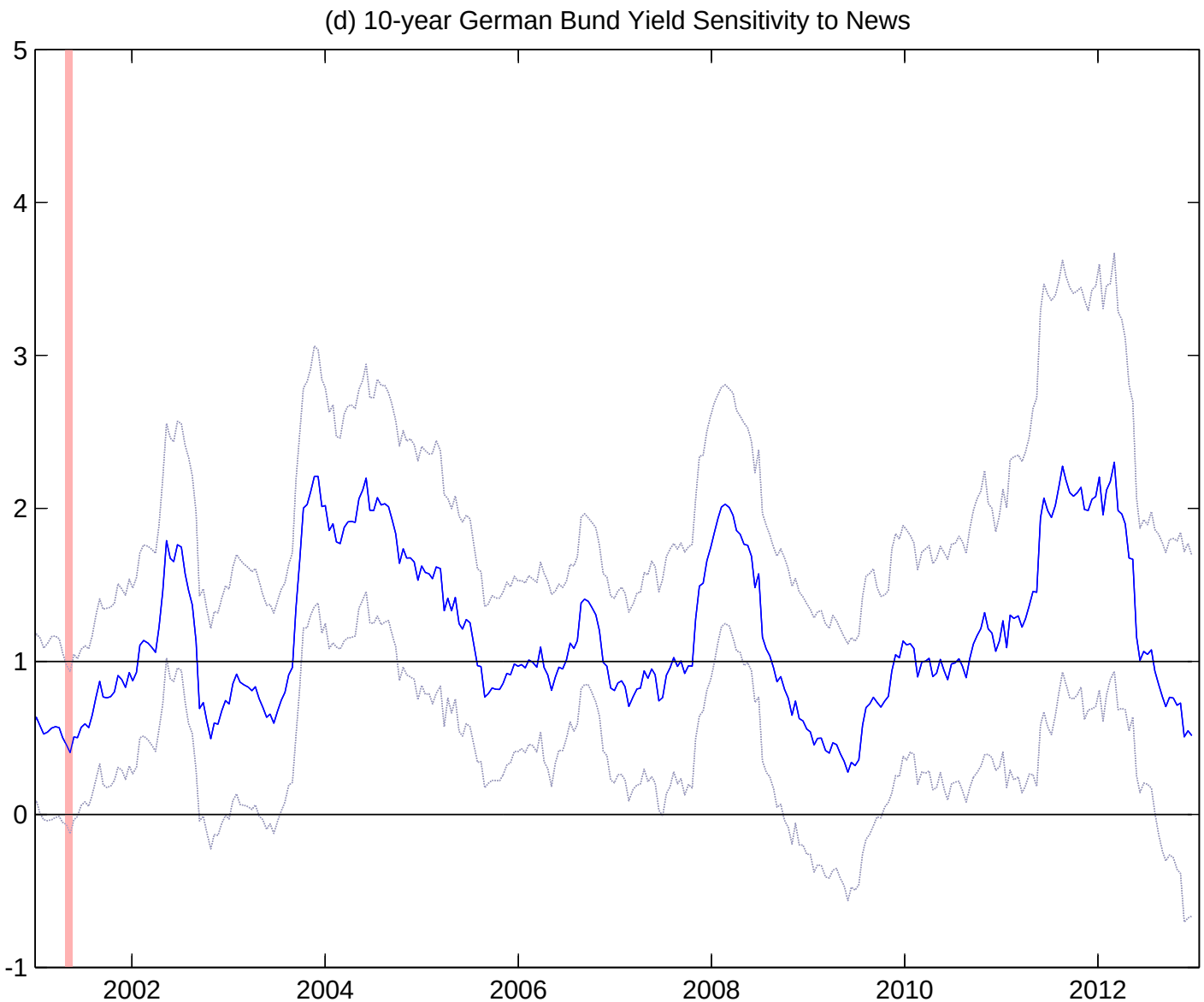
Time-Varying Sensitivity δ^{τ}, 2-year German Bund



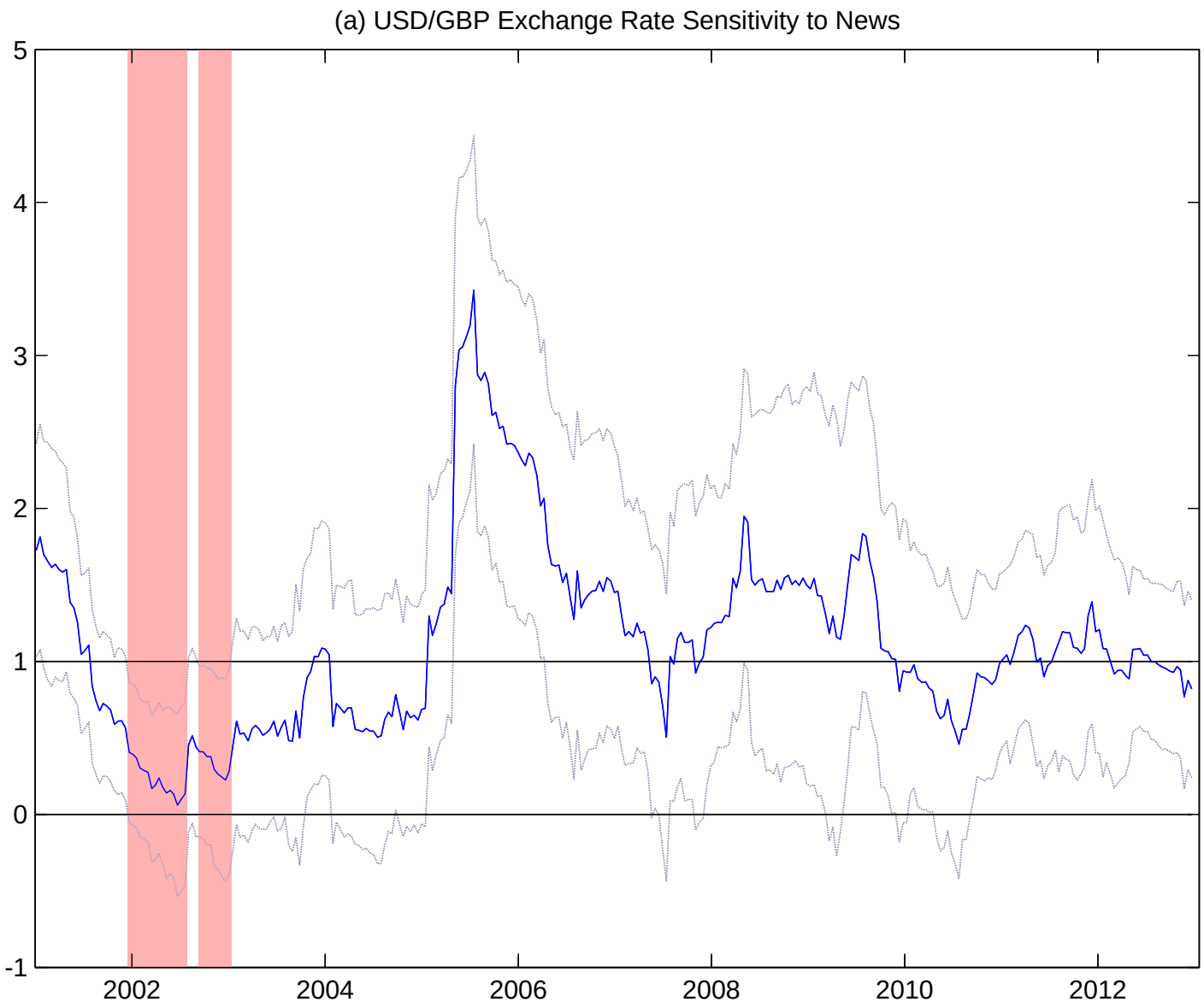
Time-Varying Sensitivity δ^{τ}, 5-year German Bund



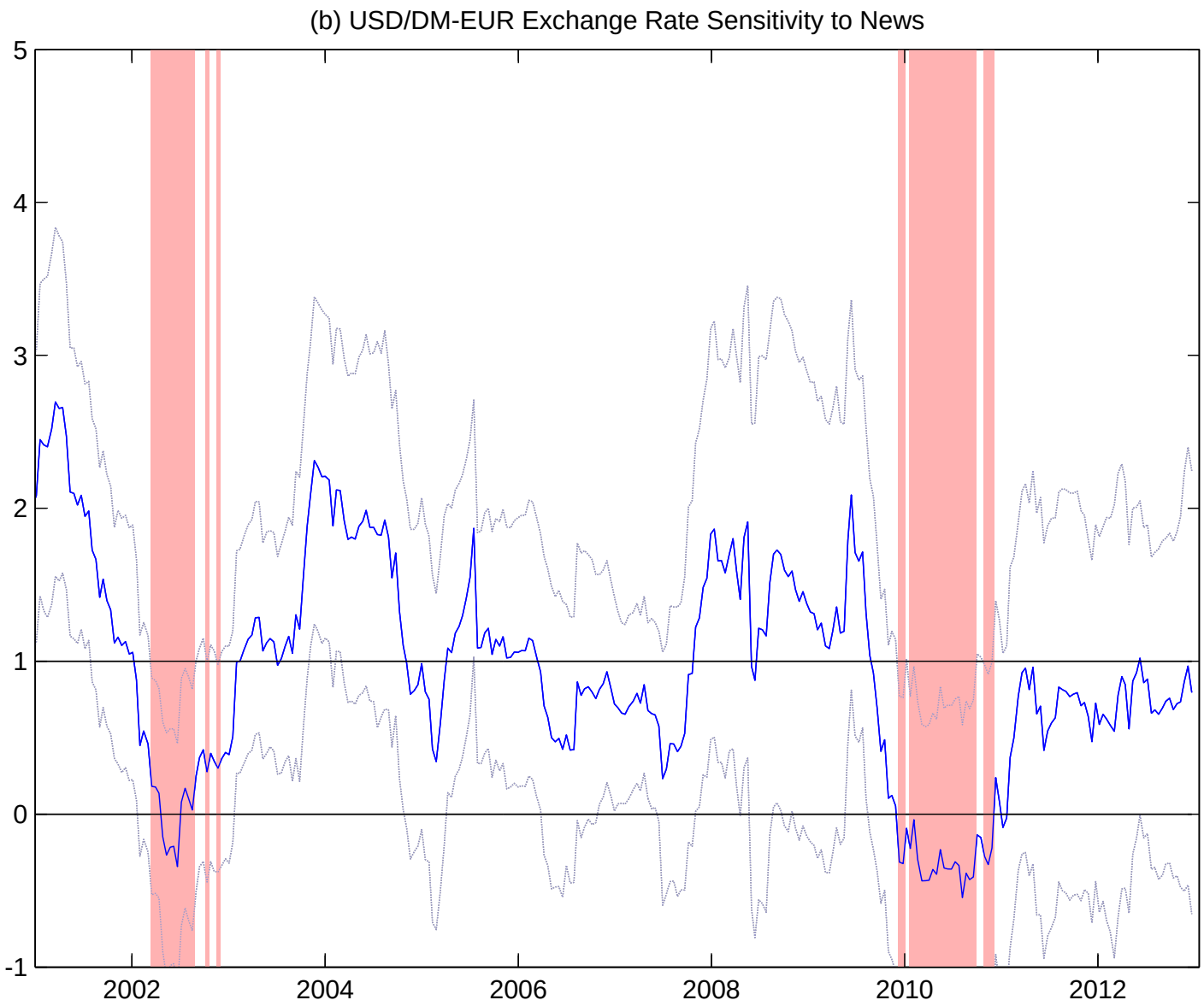
Time-Varying Sensitivity δ^{τ}, 10-year German Bund



Time-Varying Sensitivity δ^{τ}, USD/GBP Exchange Rate



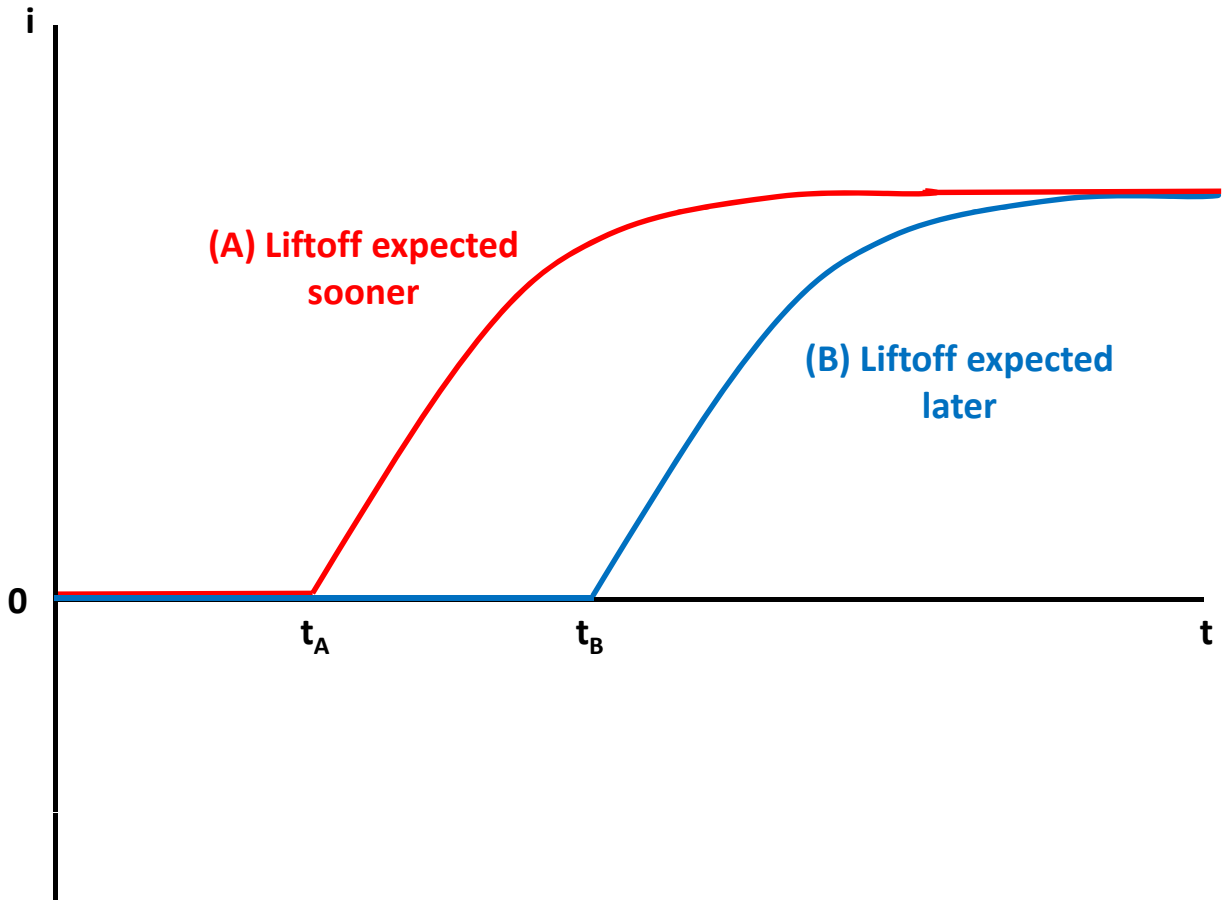
Time-Varying Sensitivity δ^{τ}, USD/DM-EUR Exch. Rate



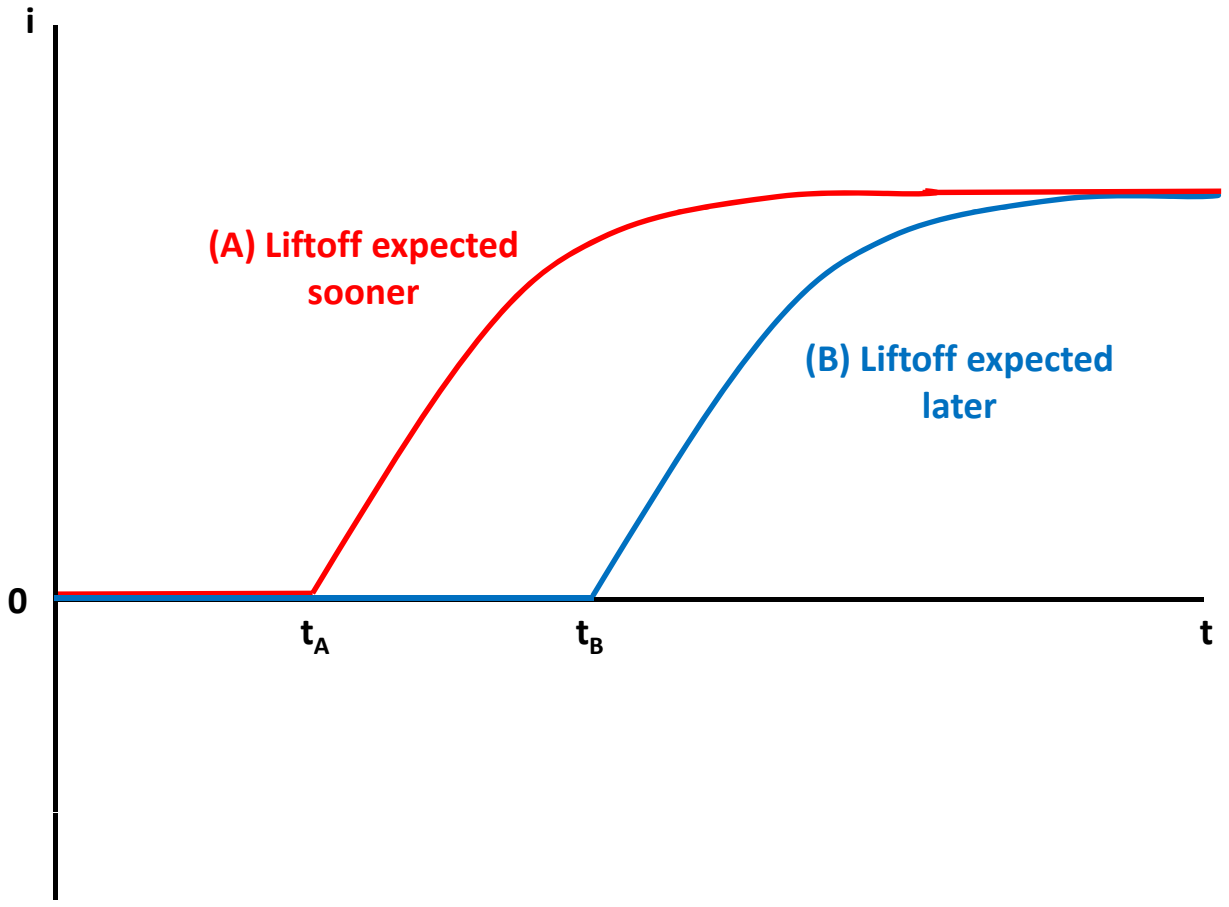
Summary of Results

- Exchange rates largely unaffected by the zero lower bound
- German bunds largely unaffected by zero bound until late 2012
- UK gilts behave in a constrained manner in 2009 and 2012, but largely unconstrained from 2010 to late 2011

Implications for the Fiscal Multiplier

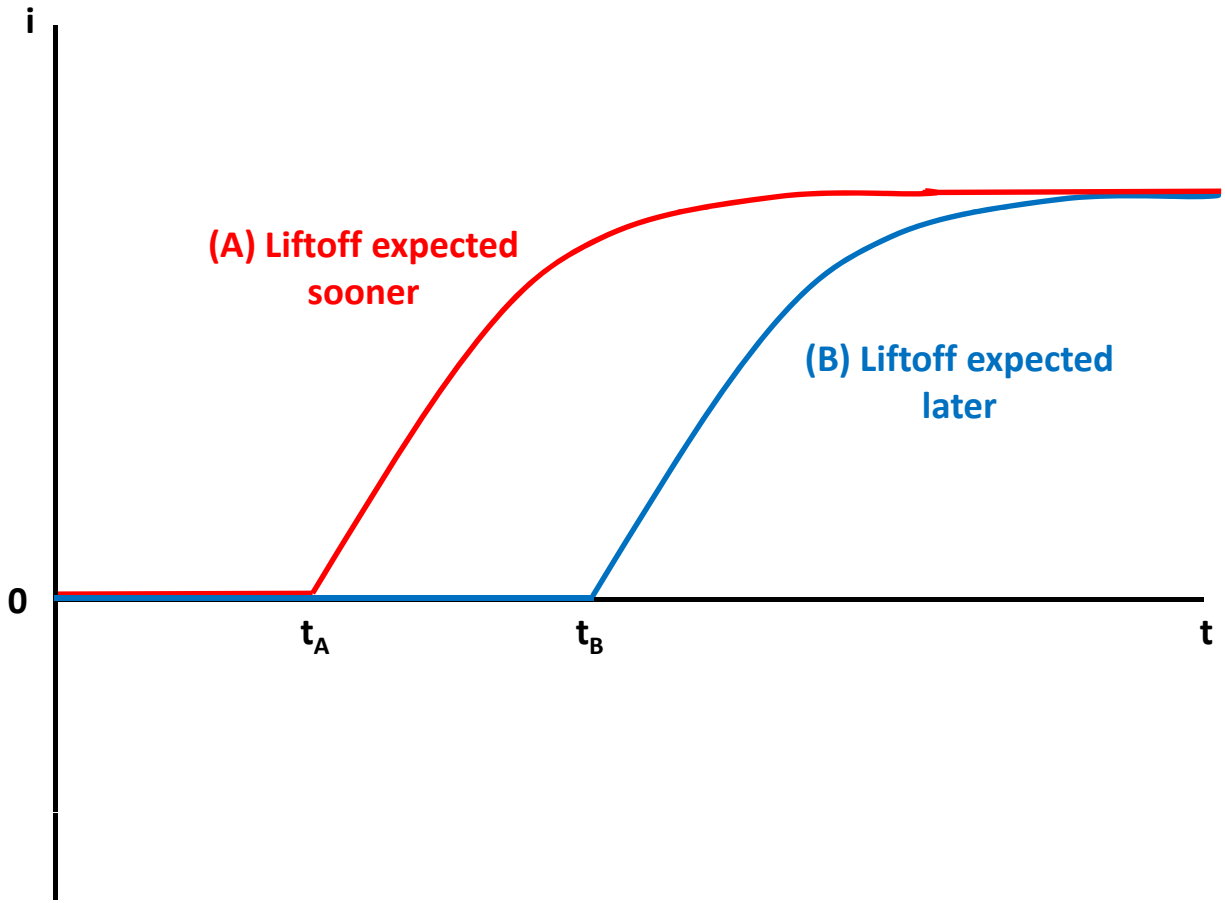


Implications for the Fiscal Multiplier



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

Implications for the Fiscal Multiplier

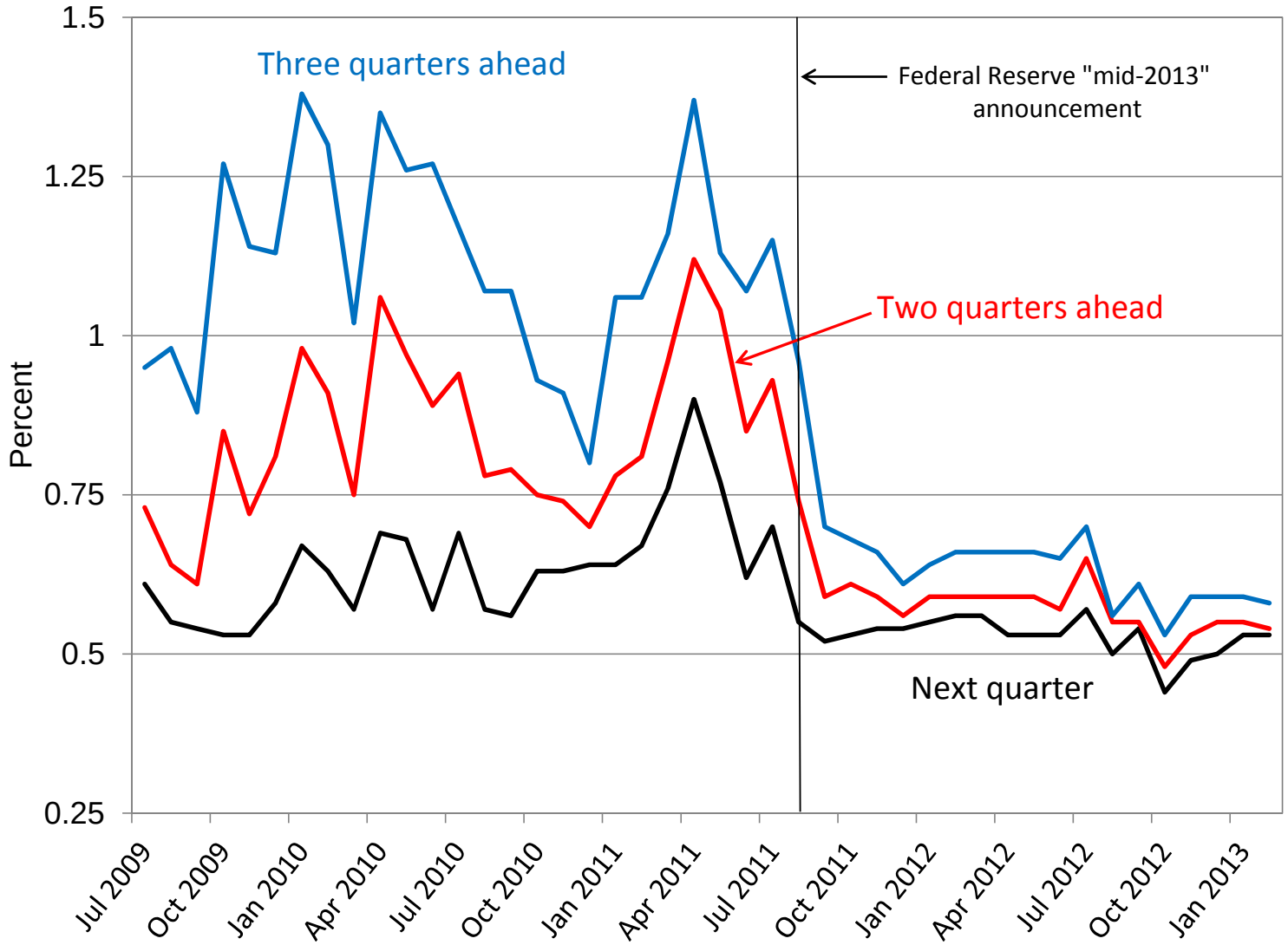


A) liftoff in 4 qtrs. $\Longrightarrow$ multiplier same as normal (CER 2011)

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

This paper: much of pre-2012 period looks like scenario A

Private-Sector Expectations of UK Bank Rate



Conclusions

What we do:

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

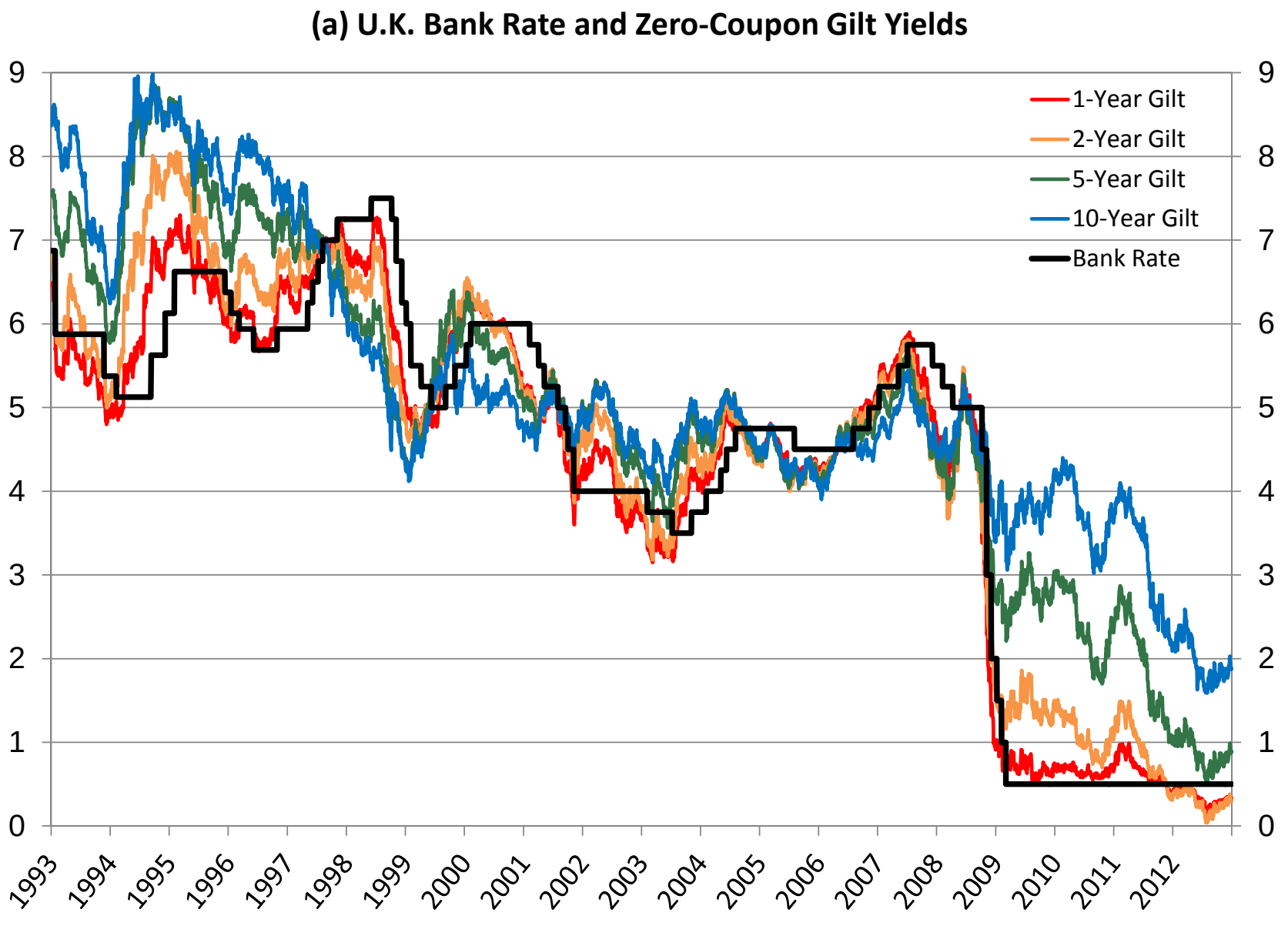
What we find:

- Exchange rates unaffected by the zero lower bound
- German bunds unaffected by the zero bound until late 2012
- UK gilts constrained in 2009, 2012, but largely unconstrained in 2010–11

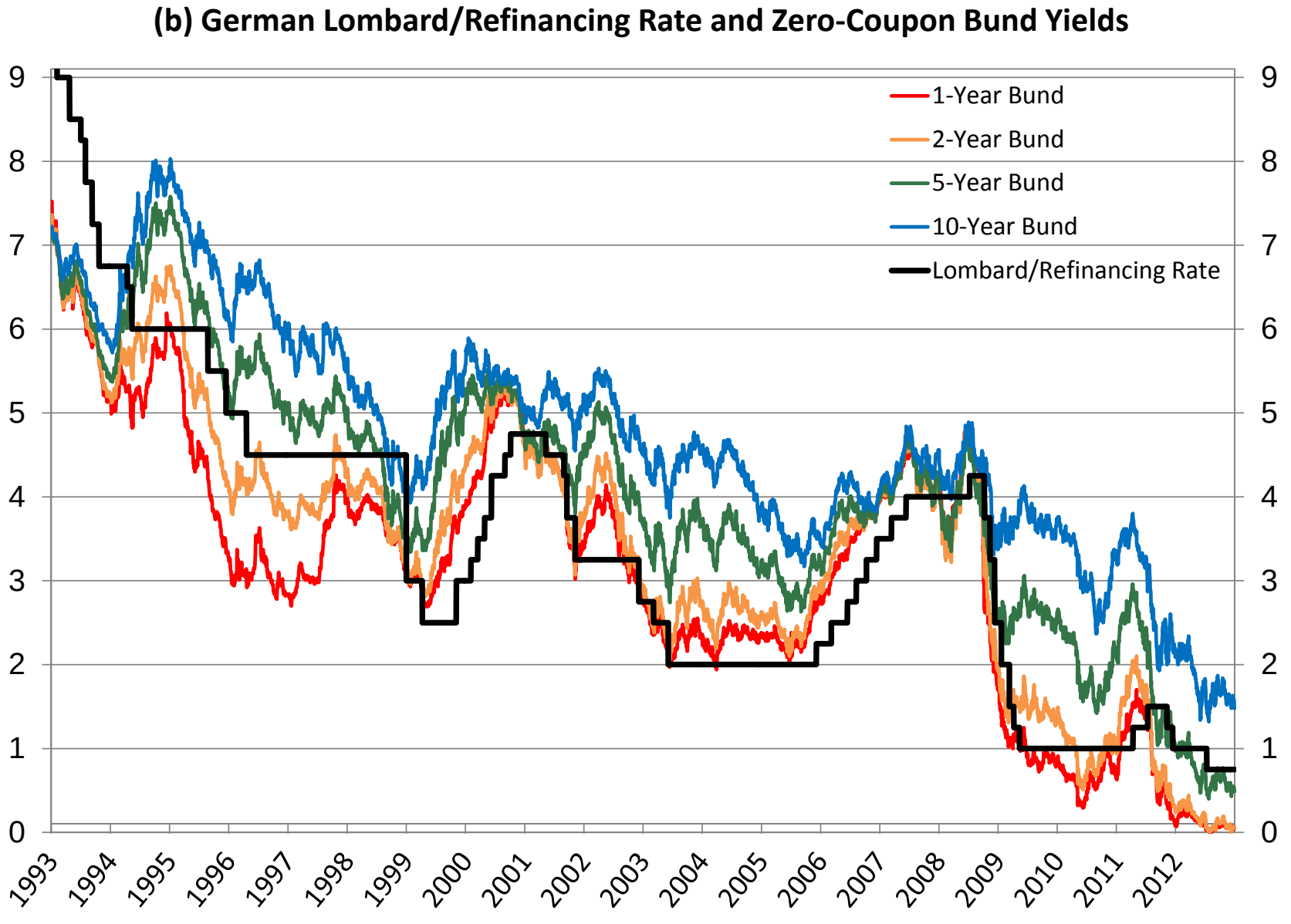
What we conclude:

- Effectiveness of monetary and fiscal policy in Germany likely close to normal until late 2012
- Effectiveness of monetary and fiscal policy in UK likely close to normal in 2010–11 (but not 2009 or 2012)

UK Gilt Yields, 1993–2012

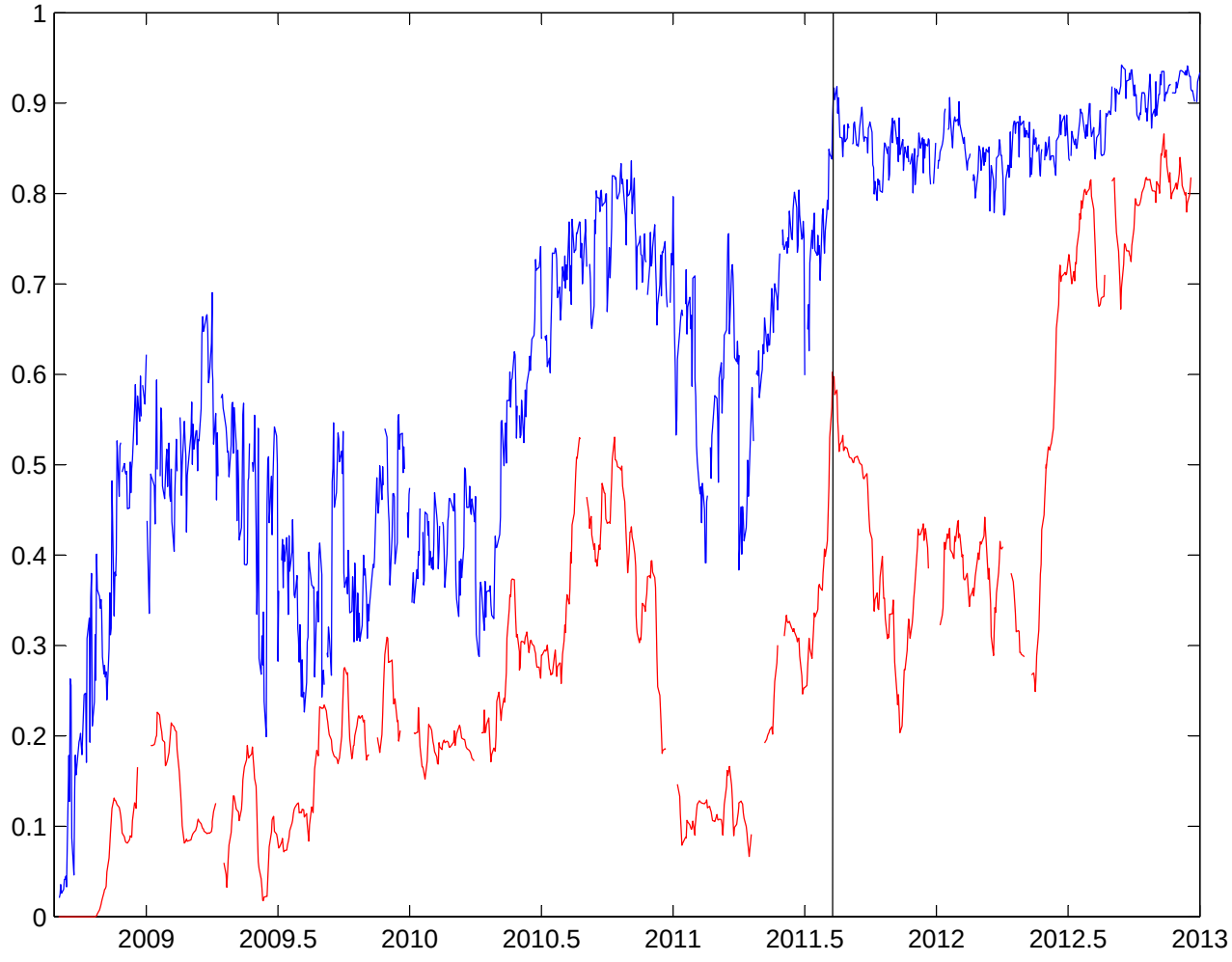


German Bund Yields, 1993–2012

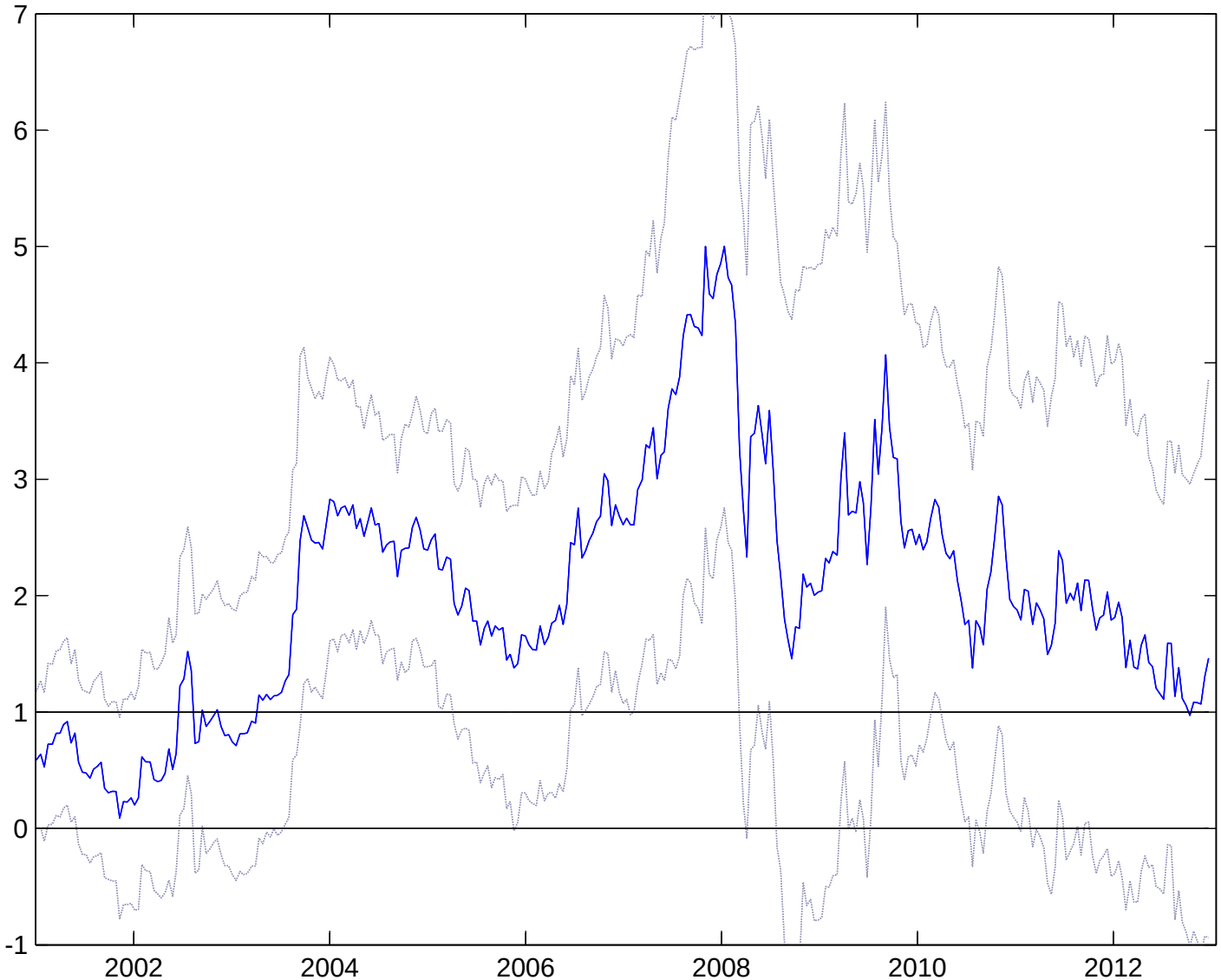


Private-Sector Expectations of UK Libor Rate

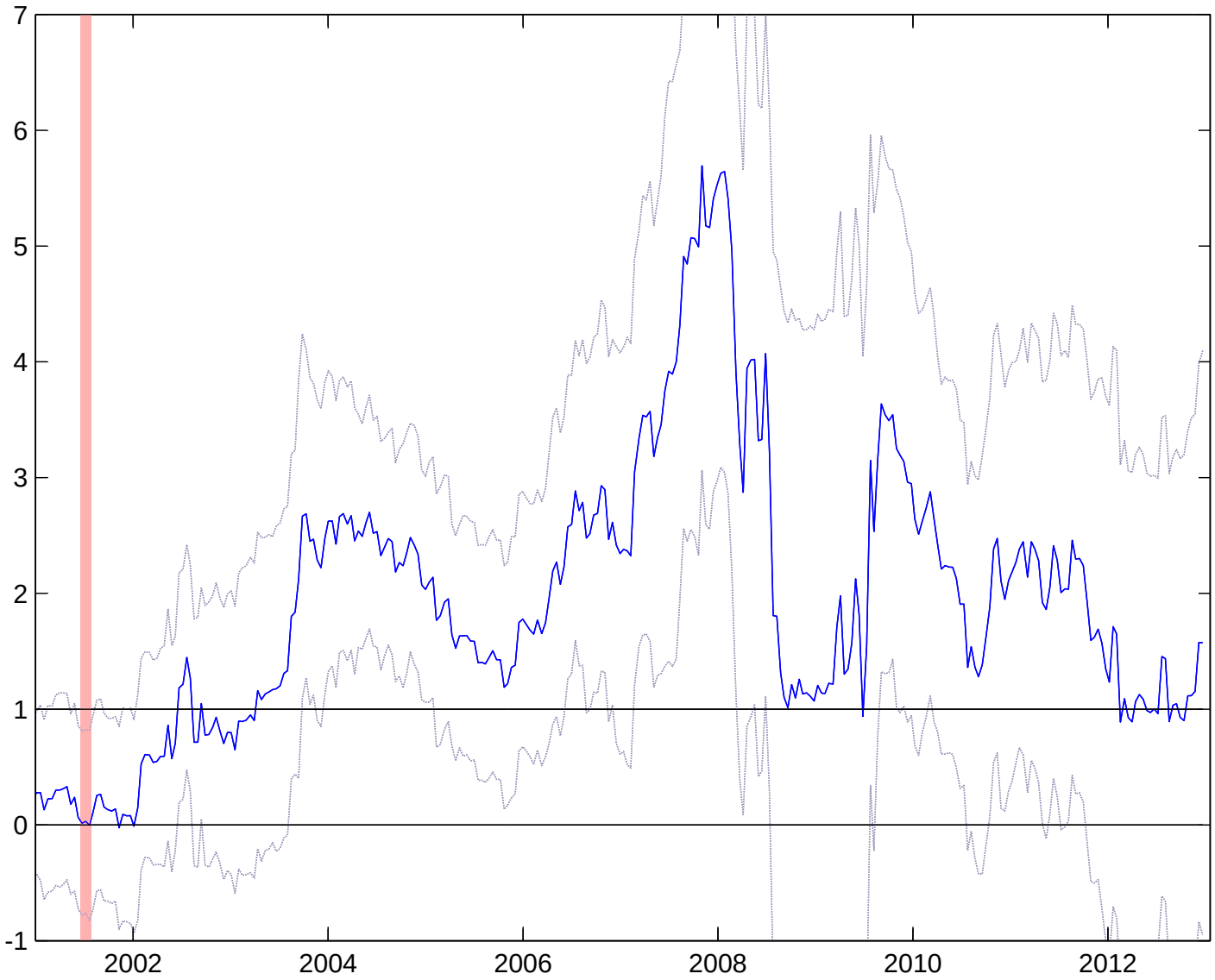
Probability of sterling Libor < 75bp in 4 quarters, from options:



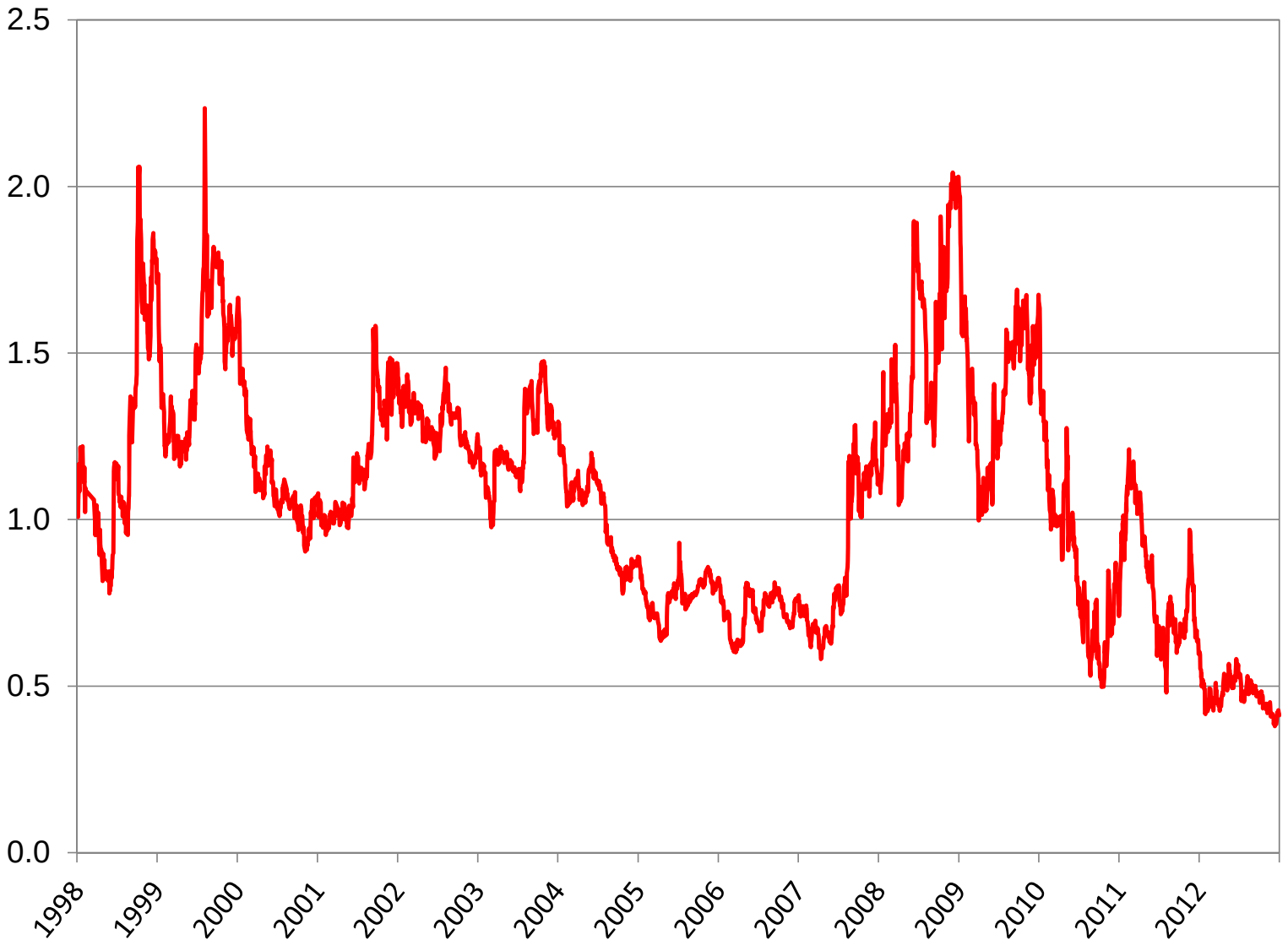
Time-Varying Sensitivity, 10-year UK Indexed Gilt



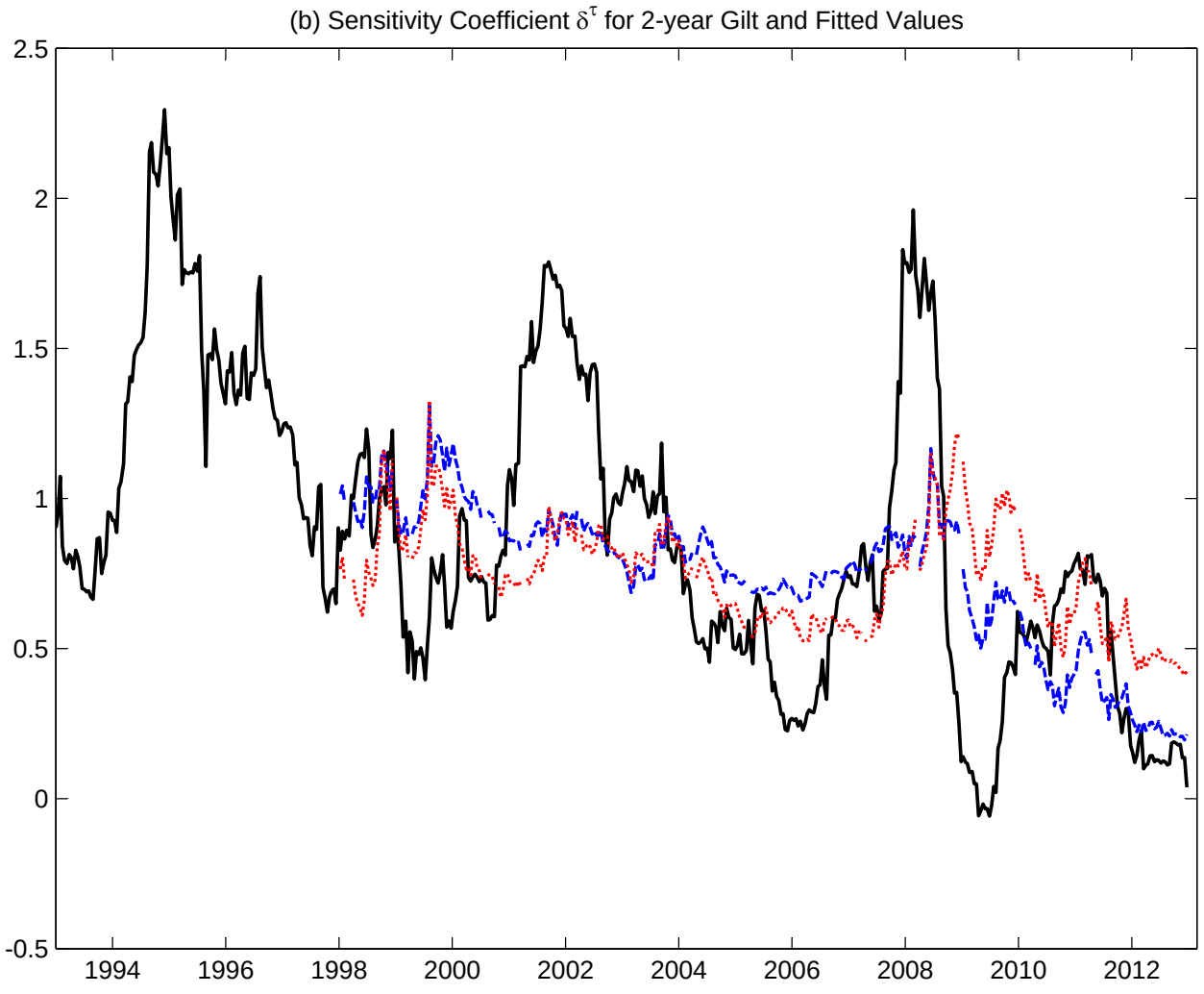
Time-Varying Sensitivity, 5-year UK Indexed Gilt



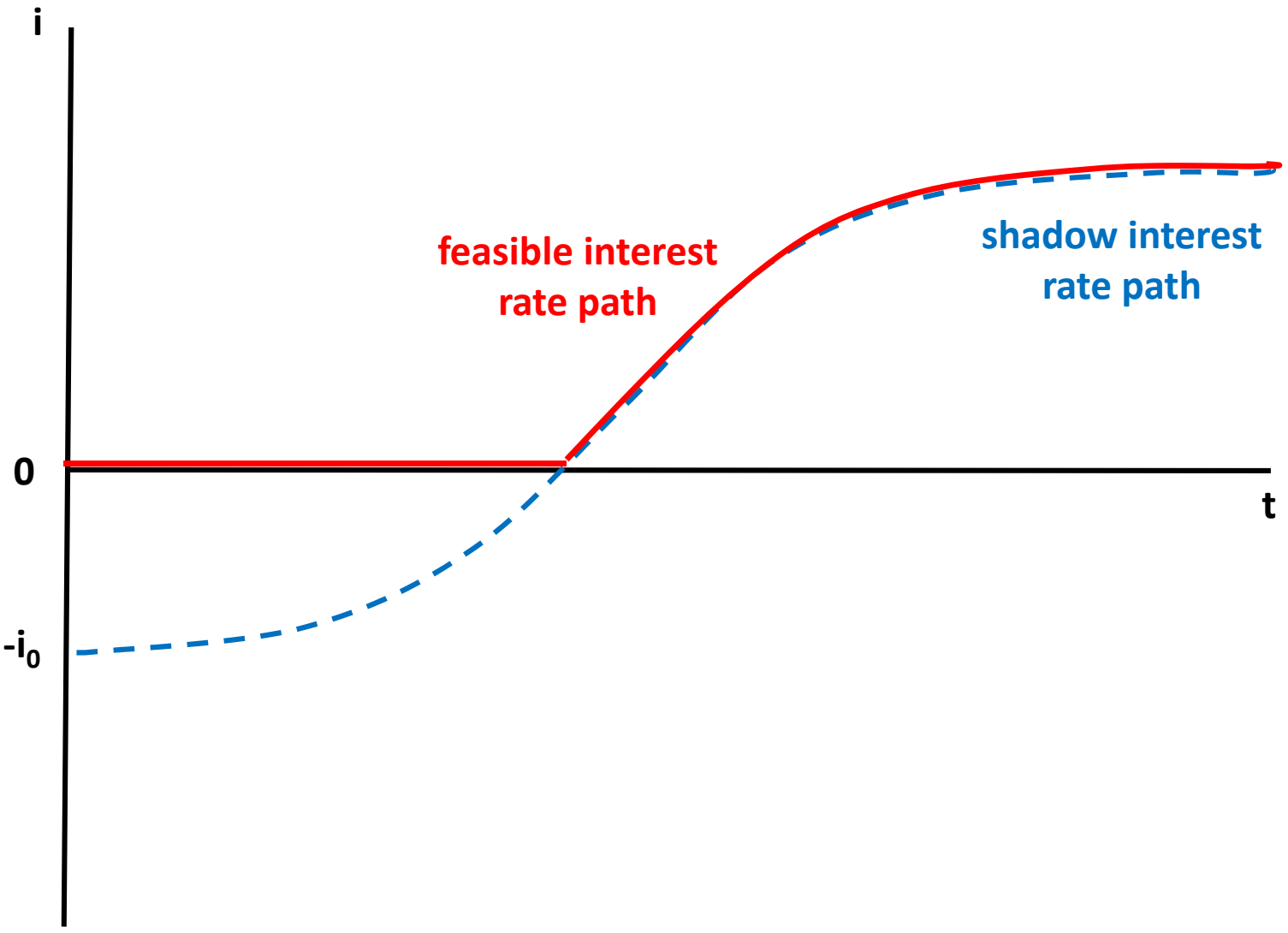
Monetary Policy Uncertainty



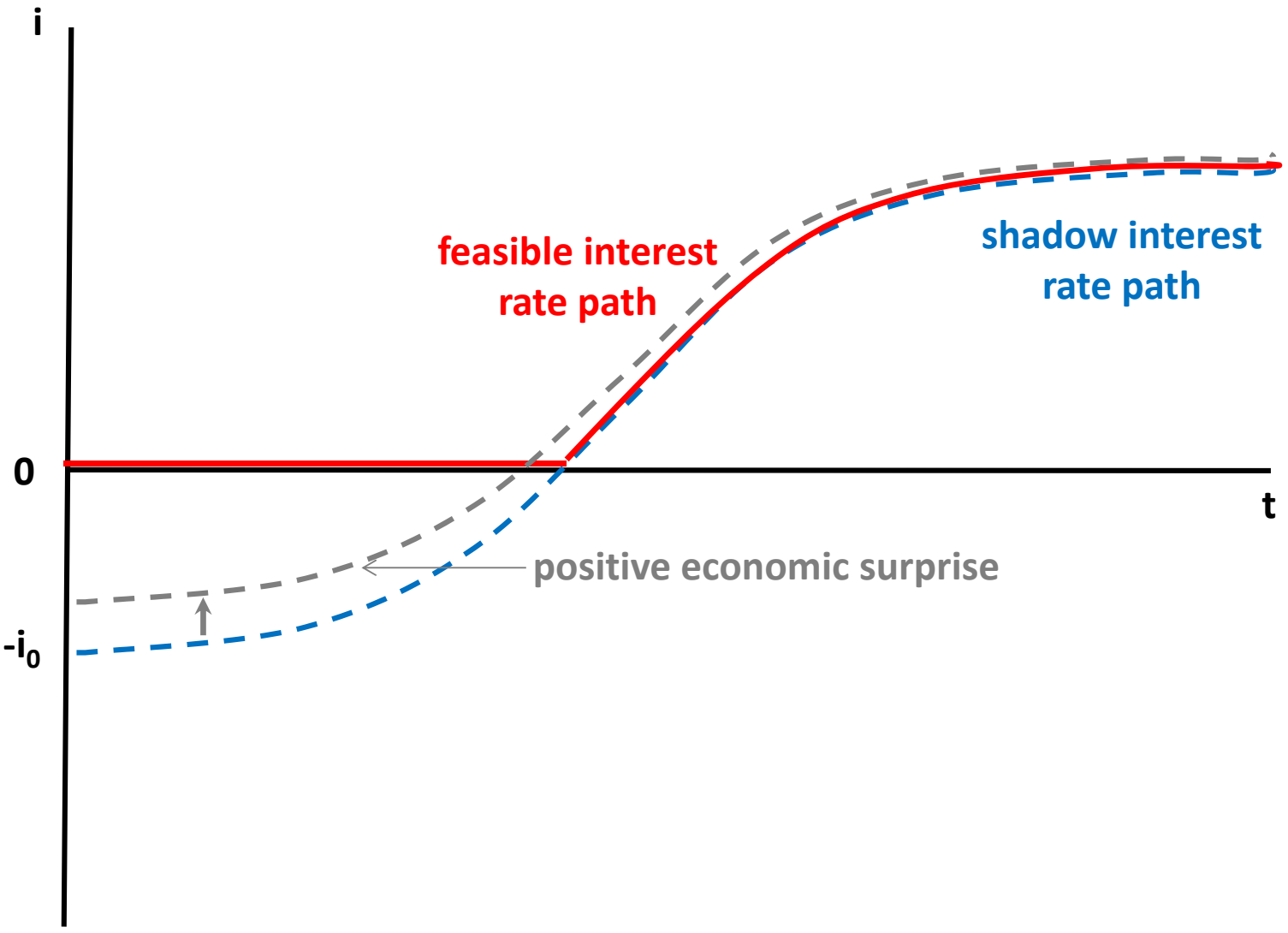
Regressions of δ^{τ} on Level, Mon. Pol. Uncertainty



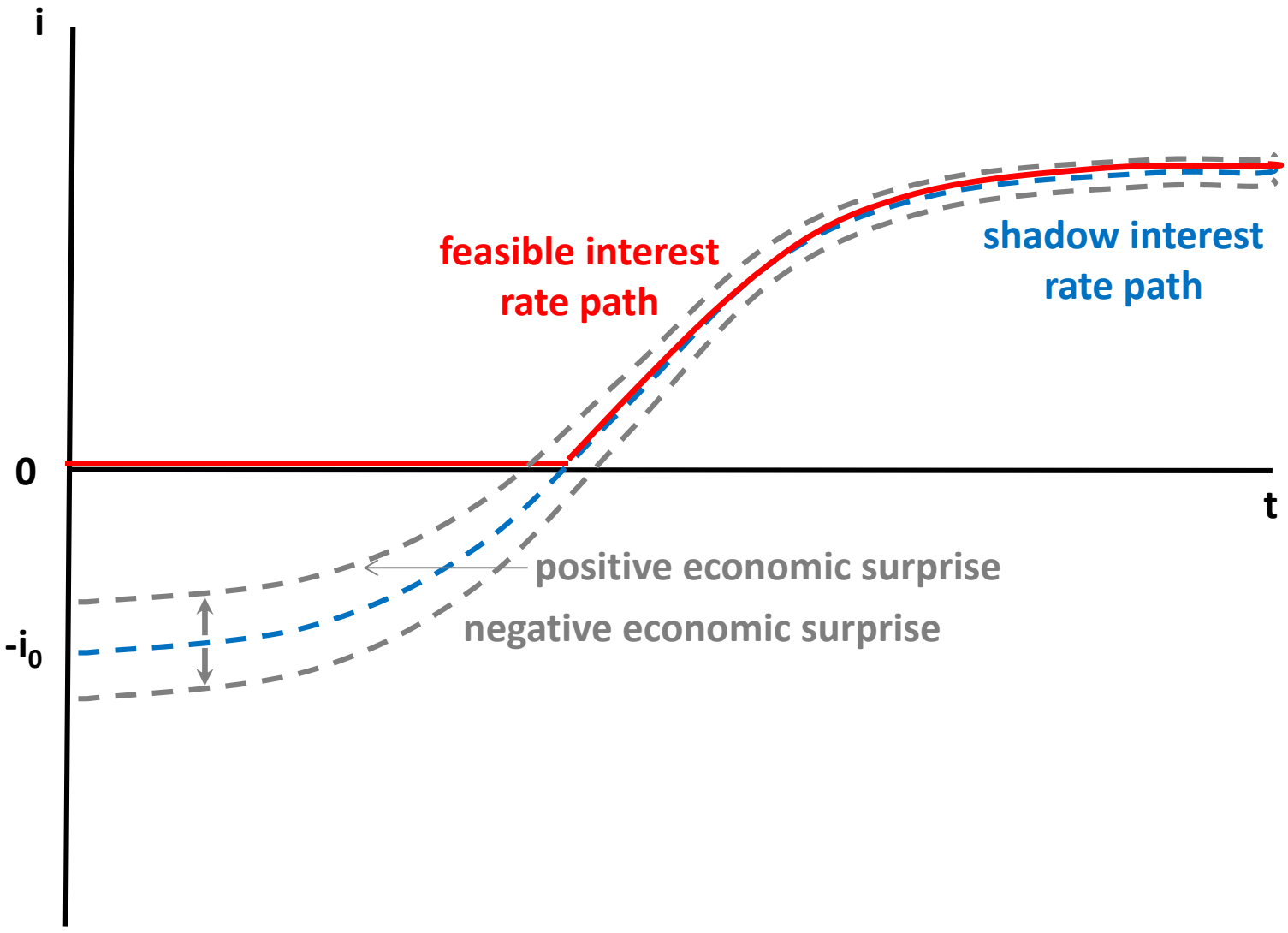
Symmetric Response to Positive, Negative Shocks



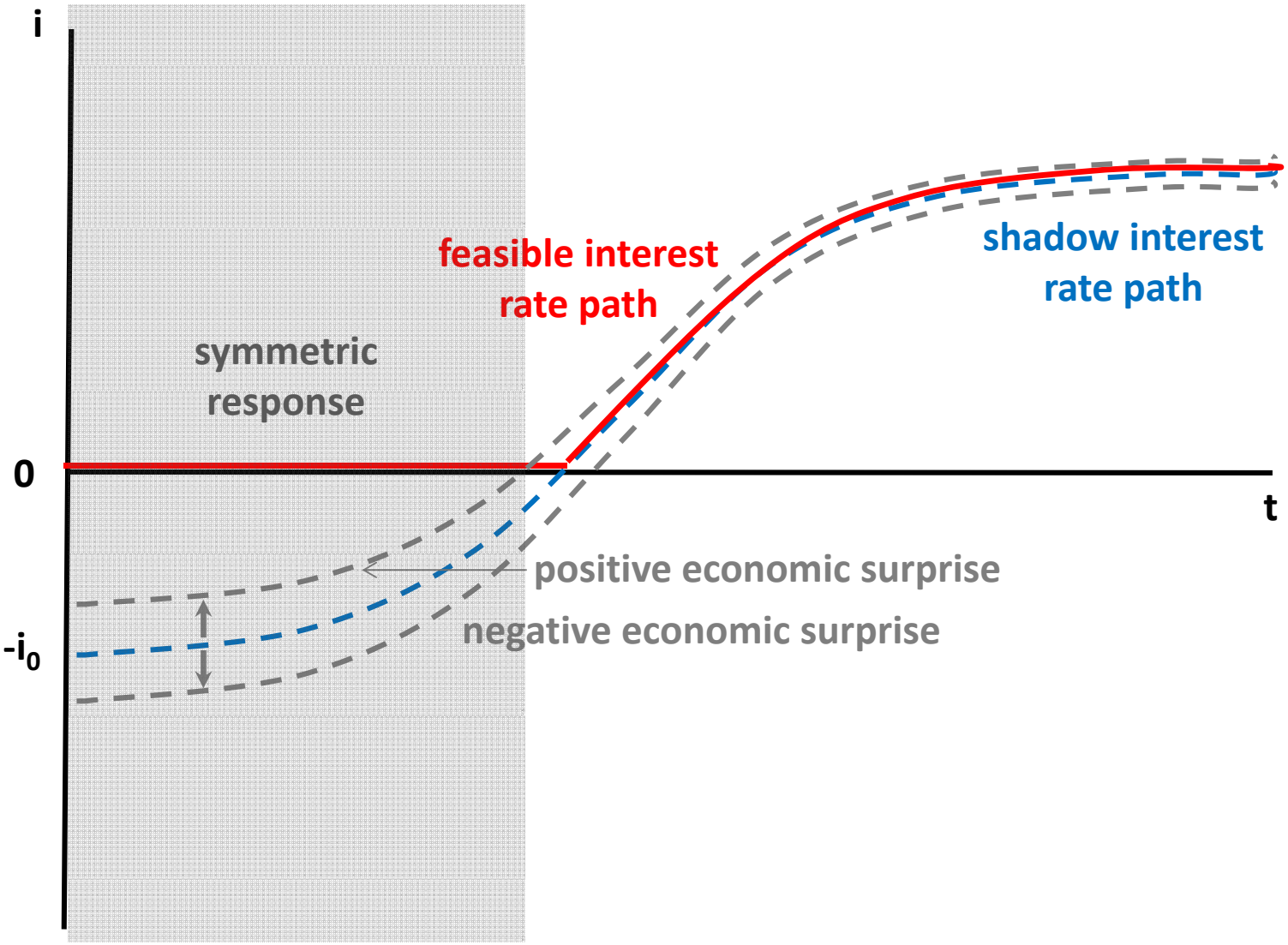
Symmetric Response to Positive, Negative Shocks



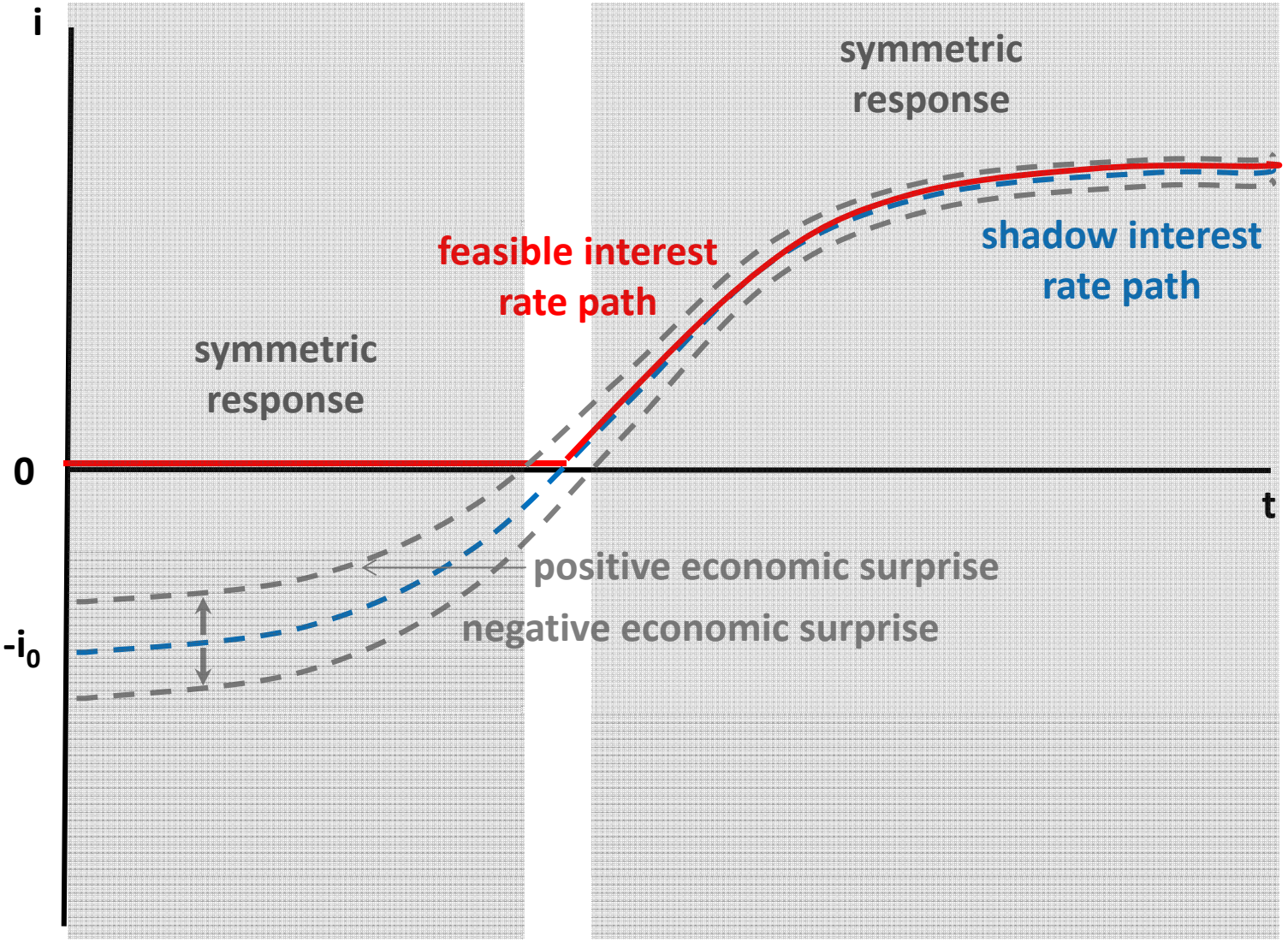
Symmetric Response to Positive, Negative Shocks



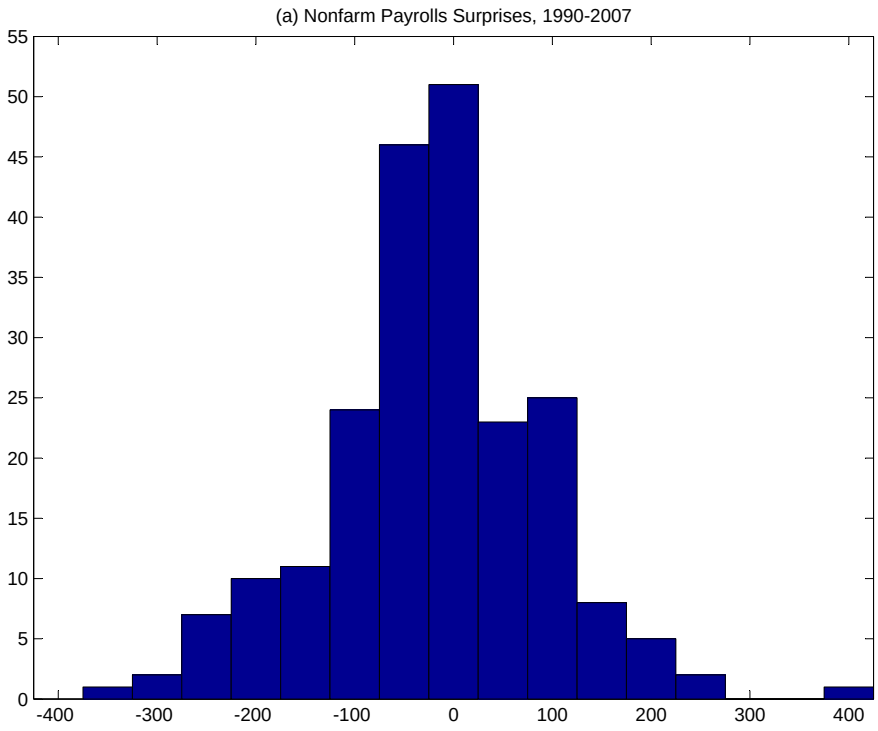
Symmetric Response to Positive, Negative Shocks

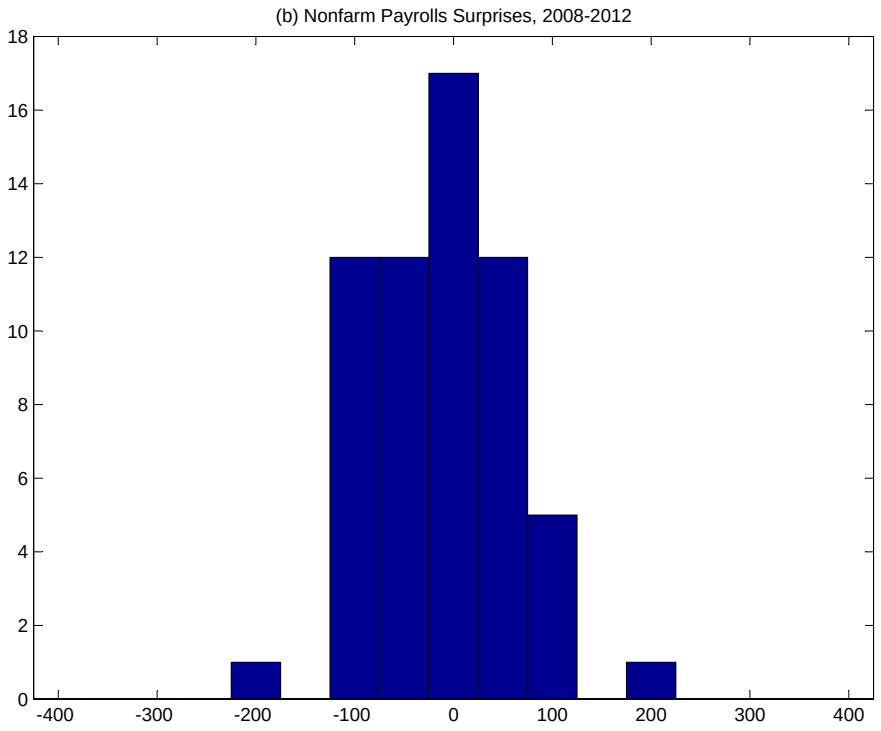


Symmetric Response to Positive, Negative Shocks



Macro Data Surprises Pre- and Post-2008





Exchange Rate

Cross-currency arbitrage:

$$s_t = -(i_t - i_t^*) + E_t s_{t+1} + \psi_t,$$

$$q_t \equiv s_t + p_t^* - p_t$$

$$q_t = -(i_t - i_t^*) + E_t(\pi_{t+1} - \pi_{t+1}^*) + E_t q_{t+1} + \psi_t.$$

Exchange Rate

Cross-currency arbitrage:

$$s_t \;=\; -(i_t - i_t^*) \;+\; E_t s_{t+1} \;+\; \psi_t,$$

$$q_t \;\equiv\; s_t + p_t^* - p_t$$

$$q_t \;=\; -(i_t - i_t^*) \;+\; E_t(\pi_{t+1} - \pi_{t+1}^*) \;+\; E_t q_{t+1} \;+\; \psi_t.$$

Solving forward gives:

$$q_t \;=\; E_t \sum_{j=0}^{\infty} \Big[-(i_{t+j} - i_{t+j}^*) + (\pi_{t+j+1} - \pi_{t+j+1}^*) + \psi_{t+j} \Big] \;+\; \bar{q}.$$