

Estimating Monetary Policy Rules

When Nominal Interest Rates Are Stuck at Zero

Jinill Kim and Seth Pruitt

(Korea University and Federal Reserve Board)

at NBB and DNB

on April 28–29, 2014

MOTIVATION

- Policy Rules at the Zero Lower Bound
 - “between 0 and 25 bp” since December 2008
 - how to estimate a policy rule when LHS is censored
 - especially when we suspect a policy change around the ZLB
 - use survey information as “artificial” or “synthetic” data

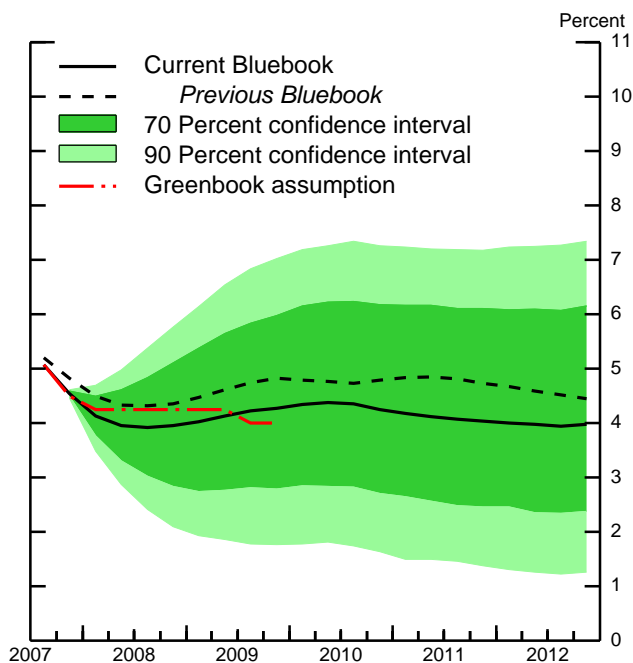
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- Personal Motivation
 - Policy Rules in the Bluebook

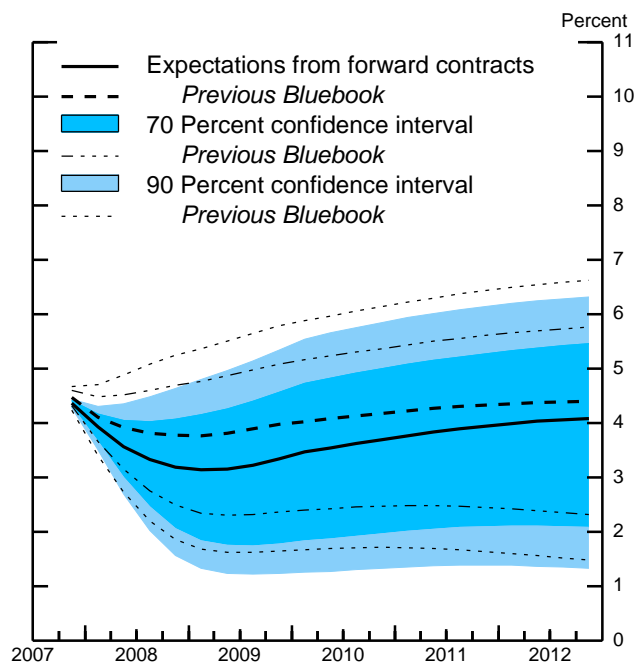
Chart 7

The Policy Outlook in an Uncertain Environment

FRB/US Model Simulations of Estimated Outcome-Based Rule



Information from Financial Markets



Near-Term Prescriptions of Simple Policy Rules

	1½ Percent Inflation Objective		2 Percent Inflation Objective	
	<u>2008Q1</u>	<u>2008Q2</u>	<u>2008Q1</u>	<u>2008Q2</u>
Taylor (1993) rule	4.1	4.3	3.9	4.0
<i>Previous Bluebook</i>	4.0	4.1	3.7	3.9
Taylor (1999) rule	4.2	4.2	3.9	4.0
<i>Previous Bluebook</i>	4.1	4.2	3.9	4.0
Taylor (1999) rule with higher r*	4.9	5.0	4.7	4.7
<i>Previous Bluebook</i>	4.9	5.0	4.6	4.7
First-difference rule	4.3	4.3	4.1	3.8
<i>Previous Bluebook</i>	5.0	5.0	4.5	4.3
Memo				
		<u>2008Q1</u>	<u>2008Q2</u>	
Estimated outcome-based rule		4.1	4.1	
Estimated forecast-based rule		4.1	4.0	
Greenbook assumption		4.2	4.2	
Fed funds futures		4.0	3.6	
Median expectation of primary dealers		3.9	3.8	

Note: Appendix B provides background information regarding the specification of each rule and the methodology used in constructing confidence intervals and near-term prescriptions.

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- Personal Motivation
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 - Chairman Bernanke’s 2010 Atlanta AEA meeting speech

Monetary Policy and the Housing Bubble

by

Jane Dokko

Brian Doyle

Michael Kiley

Jinill Kim

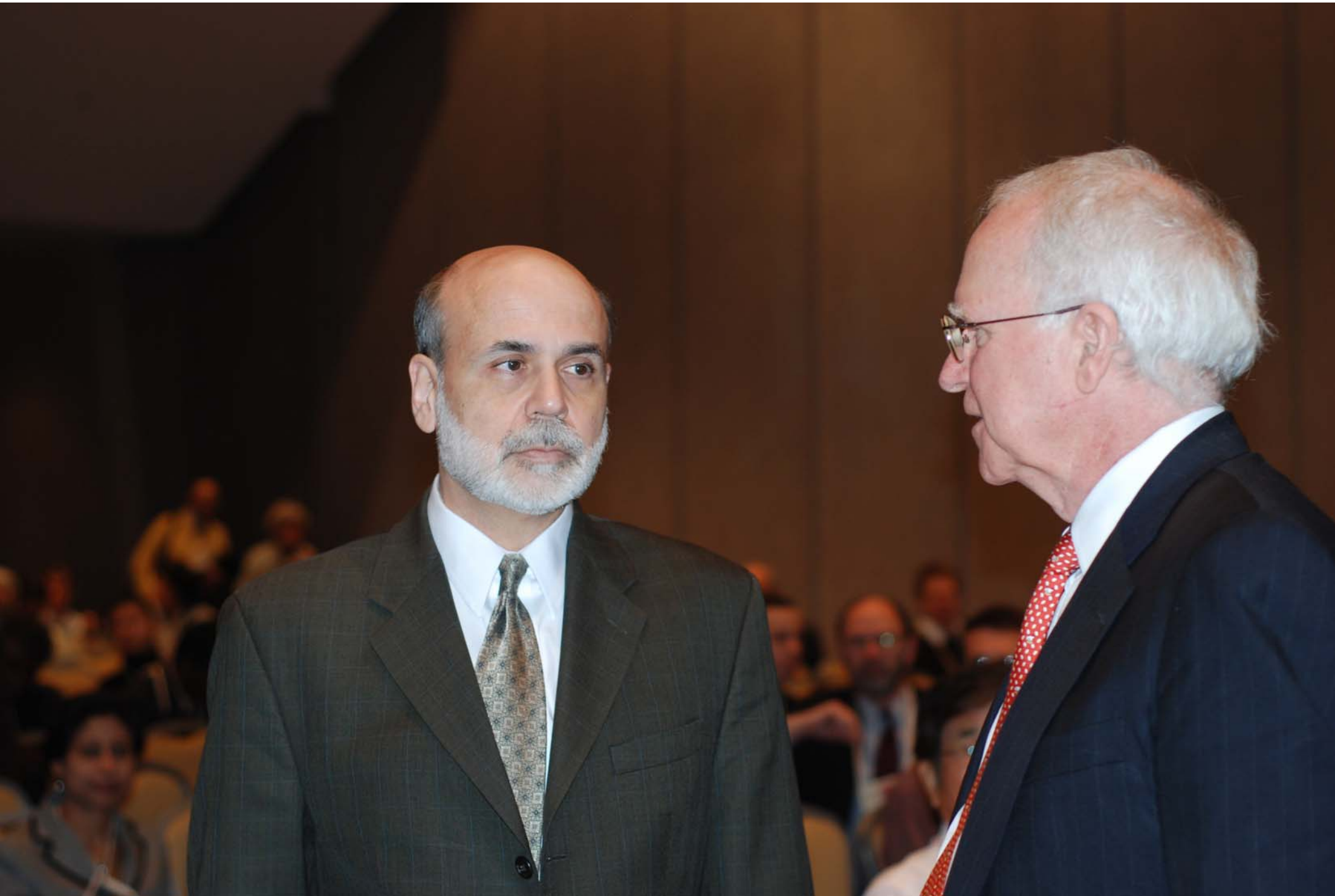
Shane Sherlund

Jae Sim

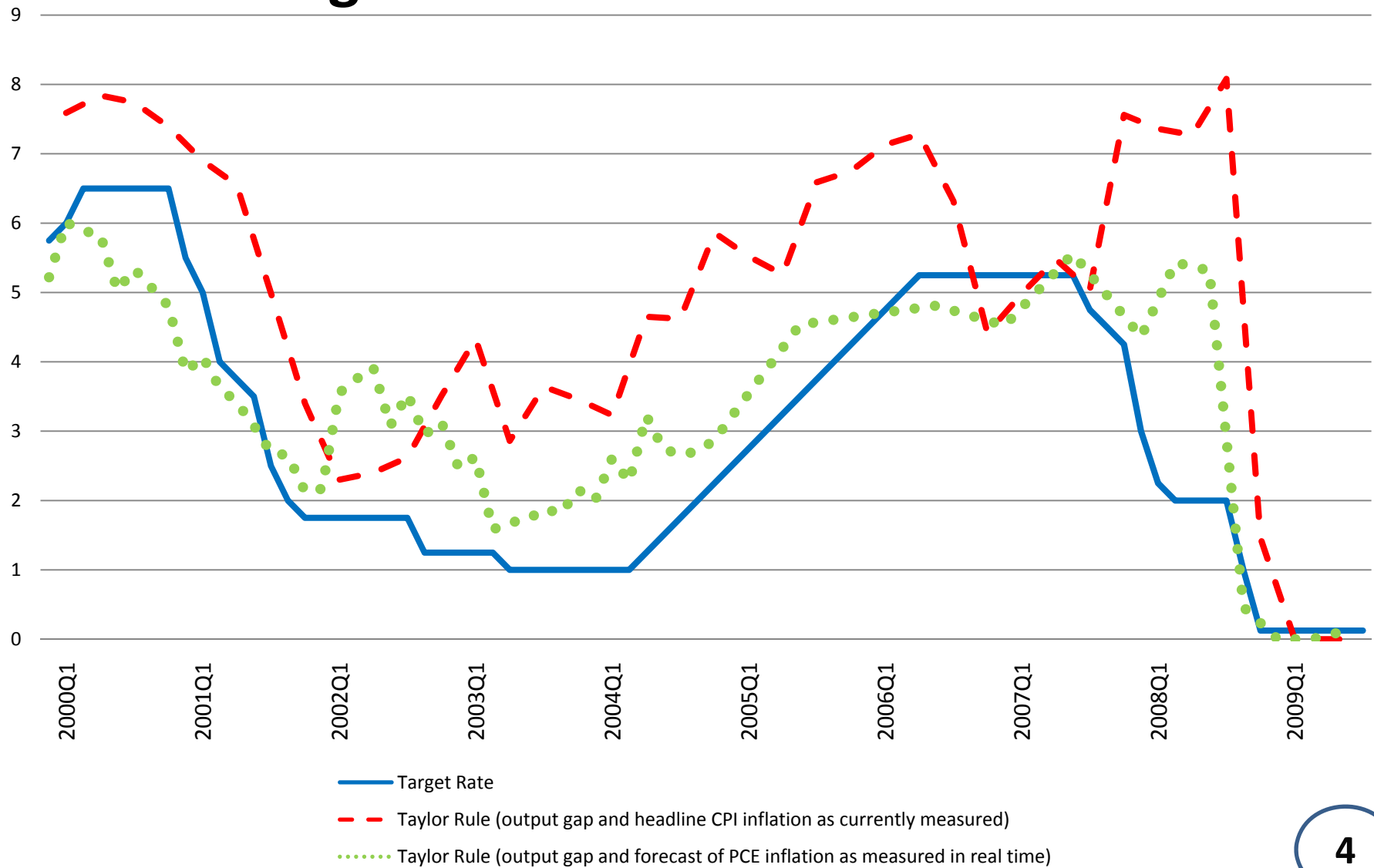
Skander van den Heuvel

This discussion represents the views of the author(s) and should not be interpreted as reflecting those of the Board of Governors of the Federal Reserve System or any other person associated with the Federal Reserve System.





The Target Rate and the Taylor Rule Prescriptions Using Real-Time Inflation Forecasts



Source: Federal Reserve Board, Bureau of Labor Statistics, Bureau of Economic Analysis, and Federal Reserve staff calculations.

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 - Chairman Bernanke’s 2010 Atlanta AEA meeting speech
 - Blue Chip survey (cf. SPF and weekly newsletters)

Blue Chip Economic Indicators®

Top Analysts' Forecasts of the U.S. Economic Outlook for the Year Ahead
Vol. 38, No. 9, September 10, 2013



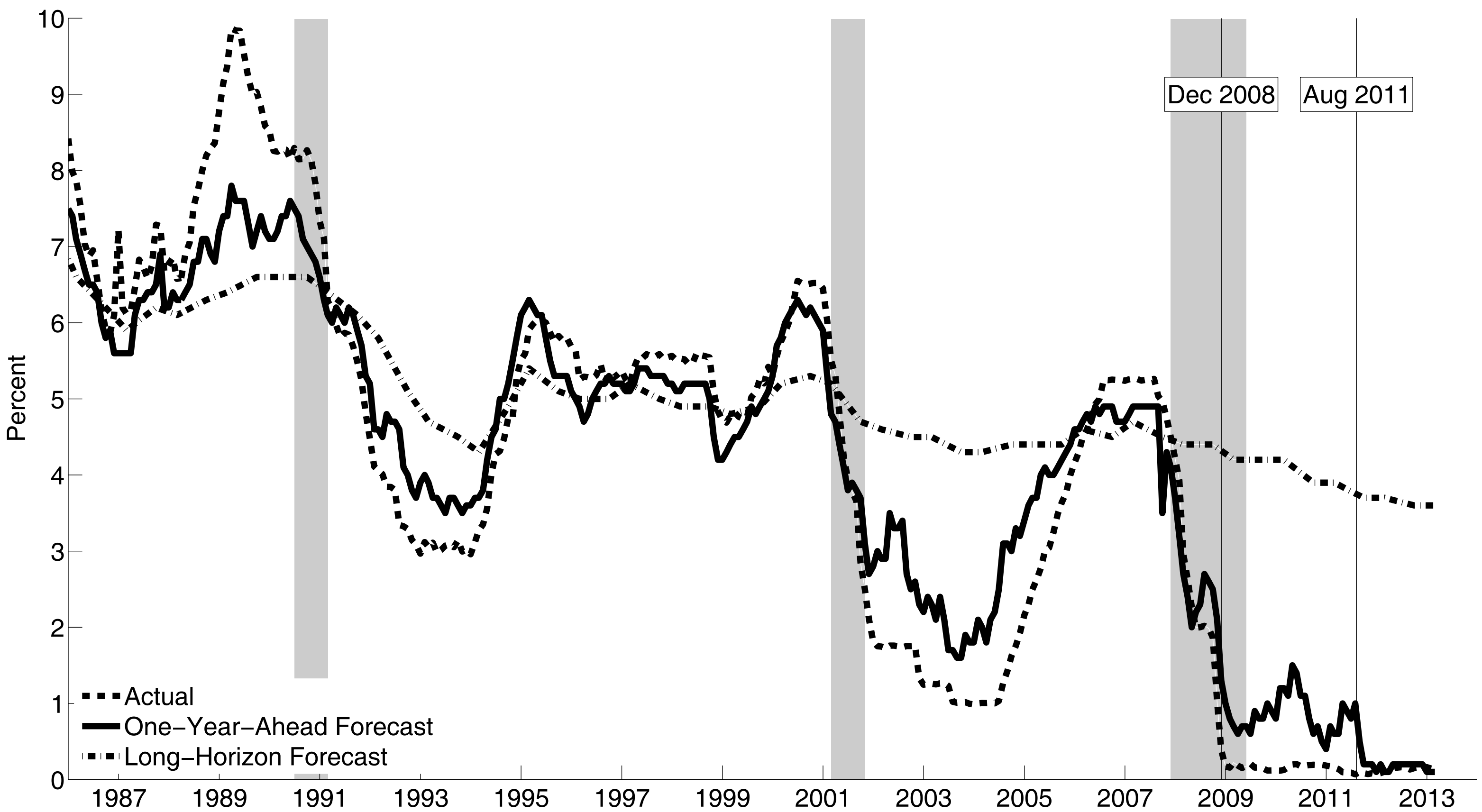
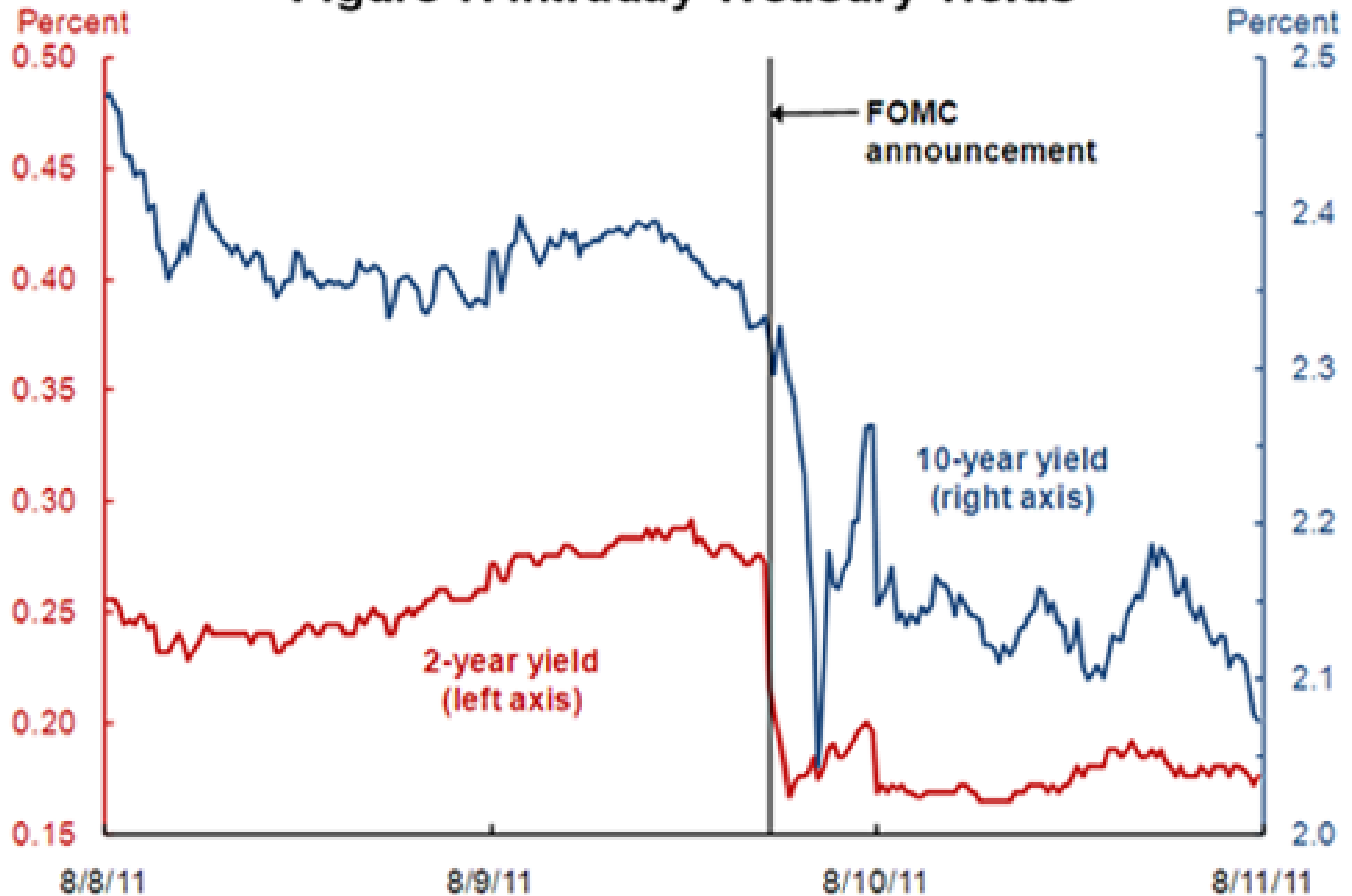
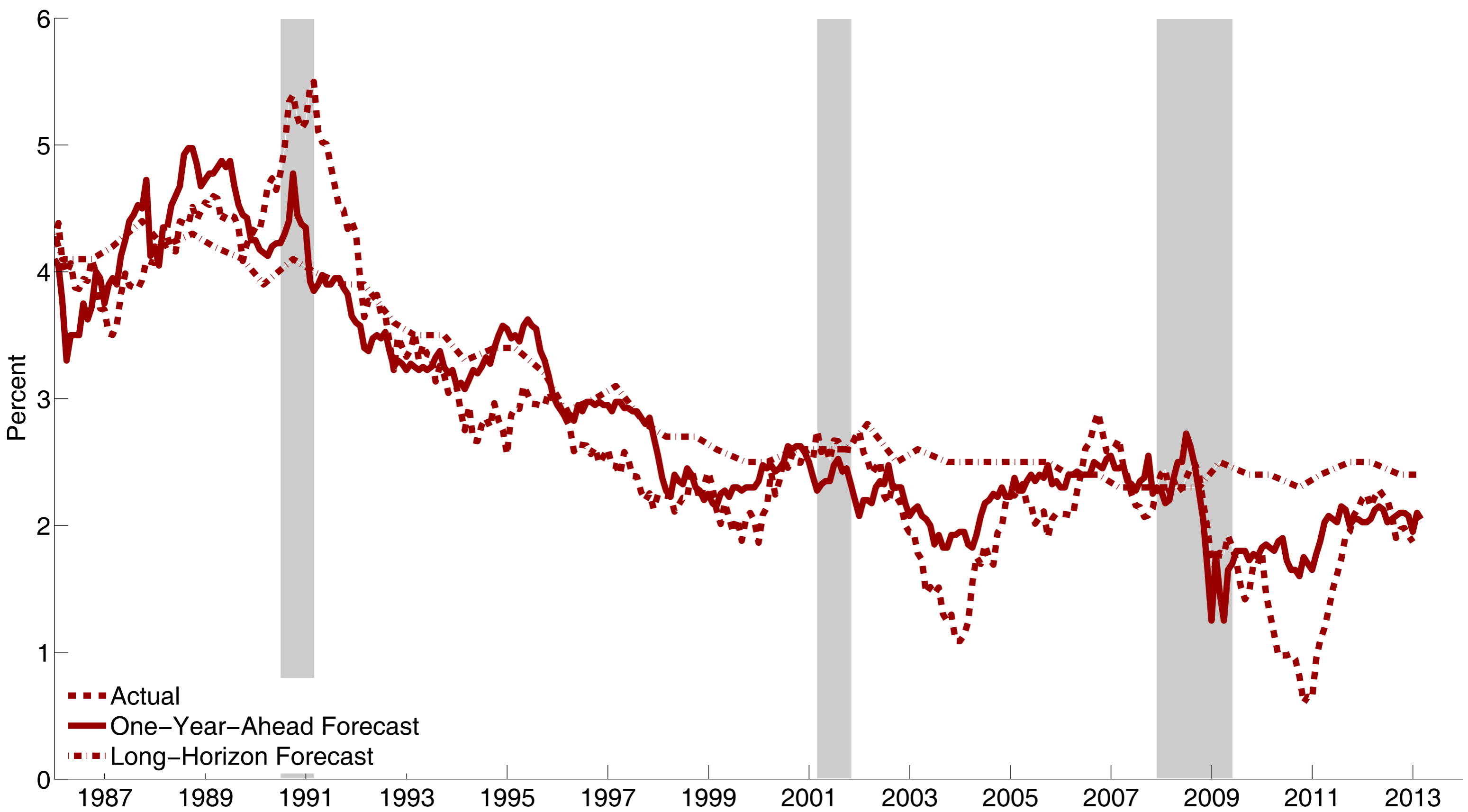
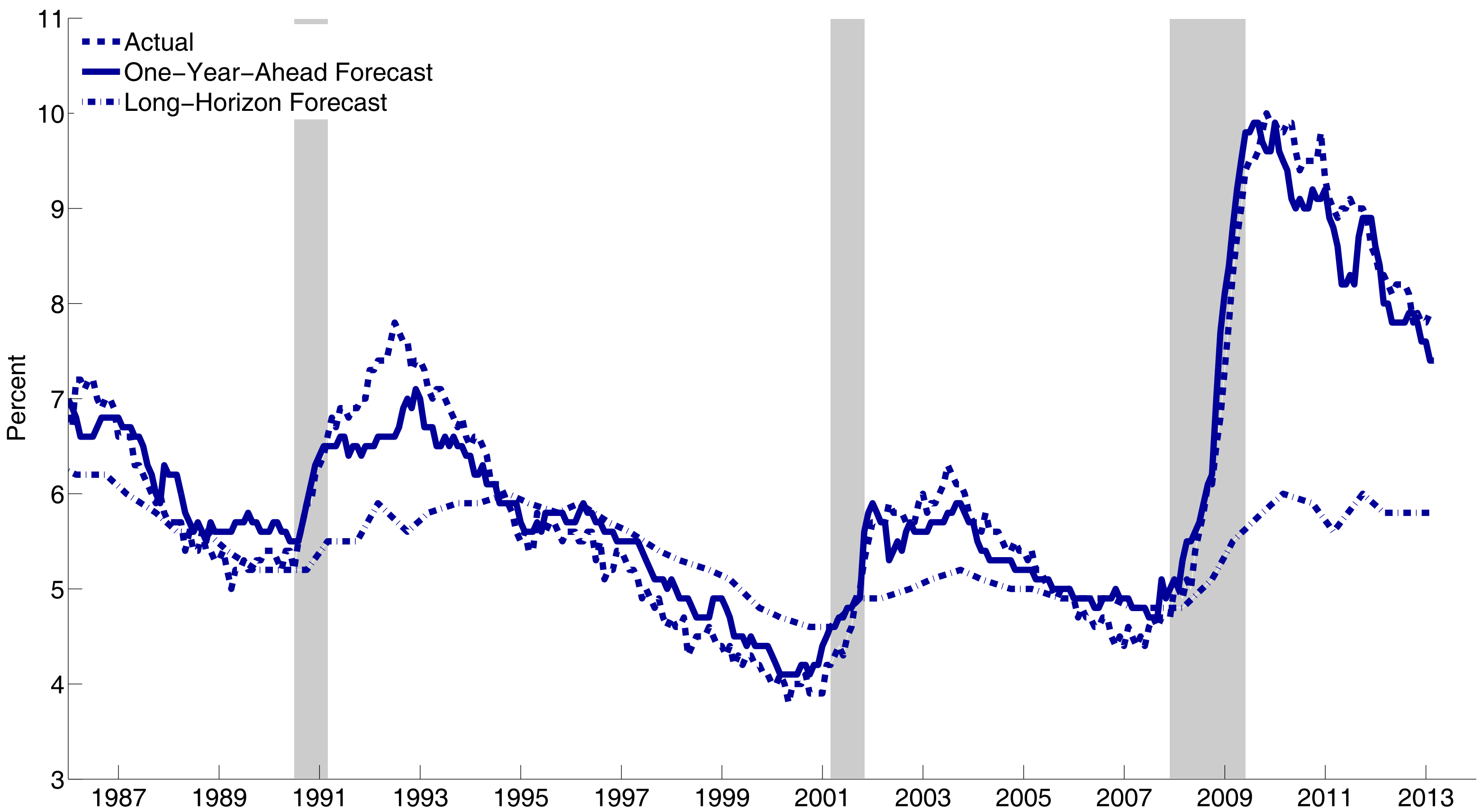


Figure 1: Intraday Treasury Yields



Note: Trading data from 9:30am to 4:00p m EDT, at five-minute intervals (source: Bloomberg)





Estimating Policy Rules

$$i_t = (1 - \rho) [(r_t^* + \pi_t^*) + \beta(\pi_t - \pi_t^*) + \delta(u_t - u_t^*)] + \rho i_{t-1} \quad (1)$$

- Rules Using Forecasts Data

- non-censored one-year-ahead forecasts and long-horizon forecasts

$$i_{E,t} = (r_t^* + \pi_t^*) + \beta(\pi_{E,t} - \pi_t^*) + \delta(u_{E,t} - u_t^*) \quad (2)$$

- Rules Using Historical Data

$$i_{A,t} = C + \beta\pi_{A,t} + \delta u_{A,t} \quad (3)$$

- Estimation Methodology

$$i_t = \sum_{b=1}^B \mathbf{1}(t \in \tau_b) \text{Rule}(\beta_b, \delta_b, \pi_t, u_t, \pi_t^*, u_t^*) + \epsilon_t \quad (4)$$

- heteroskedasticity-robust Chow test

- Table 1-A: OLS, Historical-Forecast Data Combination

	Inflation	Activity
1986–2008	1.358	–1.402
<i>standard error</i>	(0.186)	(0.149)
1986–2013	0.926	–1.014
<i>standard error</i>	(0.238)	(0.104)
until ZLB	1.358	–1.402
<i>standard error</i>	(0.183)	(0.129)
during ZLB	–0.880	–1.414
<i>standard error</i>	(0.637)	(0.201)

- Table 1-B: Tobit, Historical-Forecast Data Combination

	Inflation	Activity
1986–2008	1.358	–1.402
<i>standard error</i>	(0.188)	(0.150)
1986–2013	1.422	–1.584
<i>standard error</i>	(0.346)	(0.193)
until ZLB	1.367	–1.422
<i>standard error</i>	(1.167)	(0.872)
during ZLB	0.878	–4.489
<i>standard error</i>	(10.219)	(2.557)

- Table 1-C: Tobit, Only Forecast Data

	Inflation	Activity
1986–2008	1.550	–0.786
<i>standard error</i>	(0.186)	(0.138)
1986–2013	1.286	–0.883
<i>standard error</i>	(0.276)	(0.087)
until ZLB	1.546	–0.779
<i>standard error</i>	(0.255)	(0.131)
during ZLB	–1.354	–2.119
<i>standard error</i>	(1.184)	(0.244)

Estimation Results: road map

- Break for Subsamples
 - August 2007, March 2008, September 2008, December 2008.
- Comparing Results between Historical and Forecasts Data
 - pre-Crisis: Similar
 - post-Crisis: Different
- short-rate residuals and measures of risk
- “unconstrained” nominal interest rates

- Table 1: Estimates from Historic Data Including the ZLB Period

	pre-Crisis	post-Crisis
<u>August 2007 Break</u>		
Inflation response	1.893	-0.275
<i>standard error</i>	(0.108)	(0.237)
<i>Chow test</i>	< 0.001	
Unemployment response	-1.257	-0.568
<i>standard error</i>	(0.097)	(0.136)
<i>Chow test</i>	< 0.001	
Constant	6.018	1.529
<i>standard error</i>	(0.543)	(0.785)
R^2	0.867	

Skeptical for two reasons

- Statistical
 - censoring problem

- Economic

$$r^* = C + (\beta - 1)\pi^* + \delta u^*. \quad (5)$$

- implied r^* in Figure 4

- Table 2-1: Estimates from Historical Data Excluding the ZLB Period

	pre-Crisis	post-Crisis
<u>August 2007 Break</u>		
Inflation response	1.893	−0.723
<i>standard error</i>	(0.108)	(0.957)
<i>Chow test</i>	0.047	
Unemployment response	−1.257	−1.352
<i>standard error</i>	(0.097)	(0.308)
<i>Chow test</i>	0.689	
Constant	6.018	11.08
<i>standard error</i>	(0.524)	(3.877)
R^2	0.807	

– reasonable value for implied r^* (Figure 5)

- Table 2-2: Estimates from Historical Data Excluding the ZLB Period

	pre-Crisis	post-Crisis
	<u>March 2008 Break</u>	
Inflation response	1.908	1.763
<i>standard error</i>	(0.107)	(0.331)
<i>Chow test</i>	0.973	
Unemployment response	-1.243	-0.375
<i>standard error</i>	(0.097)	(0.112)
<i>Chow test</i>	0.585	
Constant	5.864	-0.517
<i>standard error</i>	(0.531)	(1.294)
R^2	0.549	

– problem: too few observations

Results with Forecast Data

- The fit is quite good.
 - RHS variables explain more than 75% of expected short rates.
- Some concerns
 - negative inflation coefficients for post-Crisis with early breakpoints
 - much variation in unemployment coefficients post-Crisis
 - sizable variation even for pre-Crisis coefficients

- Table 3-1: Estimates from Forecast Data

	pre-Crisis	post-Crisis
<u>August 2007 Break</u>		
Inflation response	1.968	-0.894
<i>standard error</i>	(0.260)	(0.889)
<i>Chow test</i>	0.002	
Unemployment response	-0.608	-1.137
<i>standard error</i>	(0.112)	(0.170)
<i>Chow test</i>	< 0.001	
R^2	0.810	

- Table 3-2: Estimates from Forecast Data

	pre-Crisis	post-Crisis
<u>March 2008 Break</u>		
Inflation response	1.954	-0.770
<i>standard error</i>	(0.259)	(0.918)
<i>Chow test</i>	0.004	
Unemployment response	-0.650	-1.11
<i>standard error</i>	(0.117)	(0.175)
<i>Chow test</i>	0.002	
R^2	0.805	

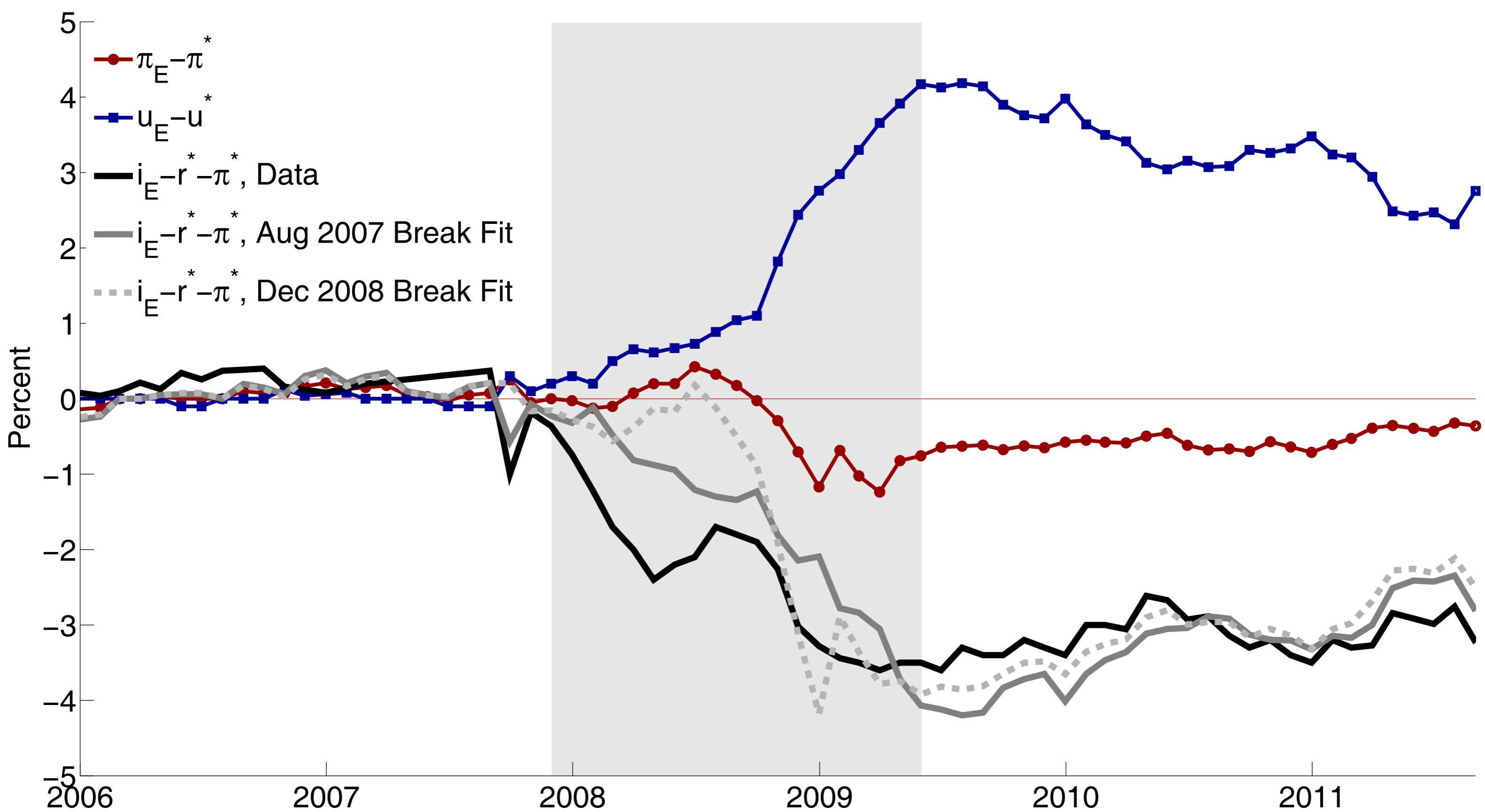
- Table 3-3: Estimates from Forecast Data

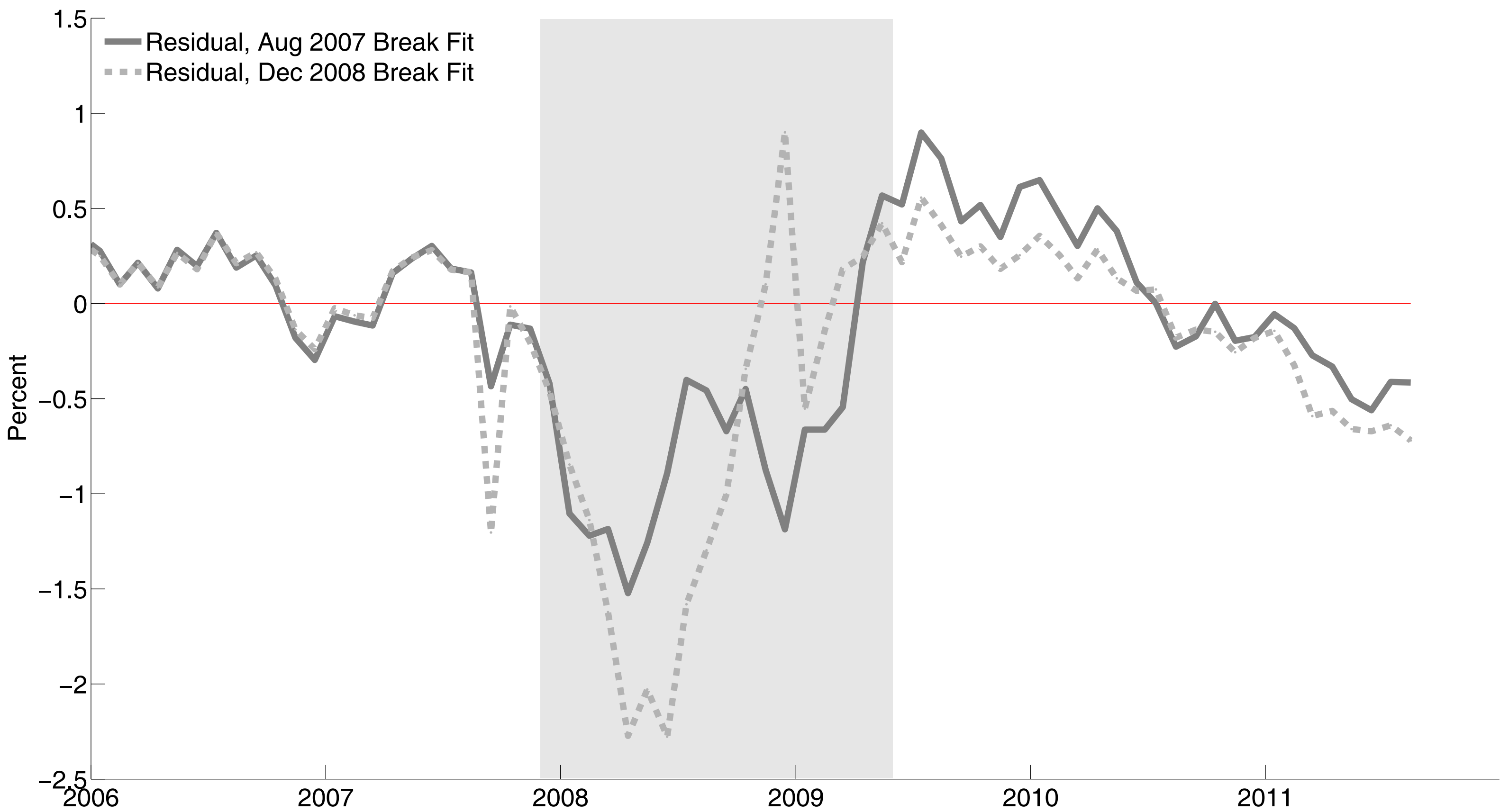
	pre-Crisis	post-Crisis
	September 2008 Break	
Inflation response	1.774	0.832
<i>standard error</i>	(0.282)	(0.364)
<i>Chow test</i>	0.069	
Unemployment response	-0.800	-0.796
<i>standard error</i>	(0.162)	(0.091)
<i>Chow test</i>	0.972	
R^2	0.781	

- Table 3-4: Estimates from Forecast Data

	pre-Crisis	post-Crisis
<u>December 2008 Break</u>		
Inflation response	1.745	0.599
<i>standard error</i>	(0.277)	(0.441)
<i>Chow test</i>	0.111	
Unemployment response	-0.775	-0.831
<i>standard error</i>	(0.139)	(0.108)
<i>Chow test</i>	0.605	
R^2	0.780	

- Pinning Down the Crisis Period
 - Instability in the coefficient estimates
 - * Figure 6: Forecasts data
 - * Figure 7: Residuals





- Pinning Down the Crisis Period

- Instability in the coefficient estimates

- * Figure 6: Forecasts data

- * Figure 7: Residuals

- Sensitivity

- * Statistical fixes: WLS and median regression

- * Economic fix: Exclude the chaotic 2007:09 to 2008:12 period.

- Table 4-1: Estimates from Forecast Data, Excluding 2007:09 to 2008:12

	pre-Crisis	post-Crisis
<u>Ordinary Least Squares</u>		
Inflation response	1.968	0.599
<i>standard error</i>	(0.260)	(0.441)
<i>Chow test</i>	0.091	
Unemployment response	-0.608	-0.831
<i>standard error</i>	(0.112)	(0.108)
<i>Chow test</i>	0.071	
R^2	0.828	

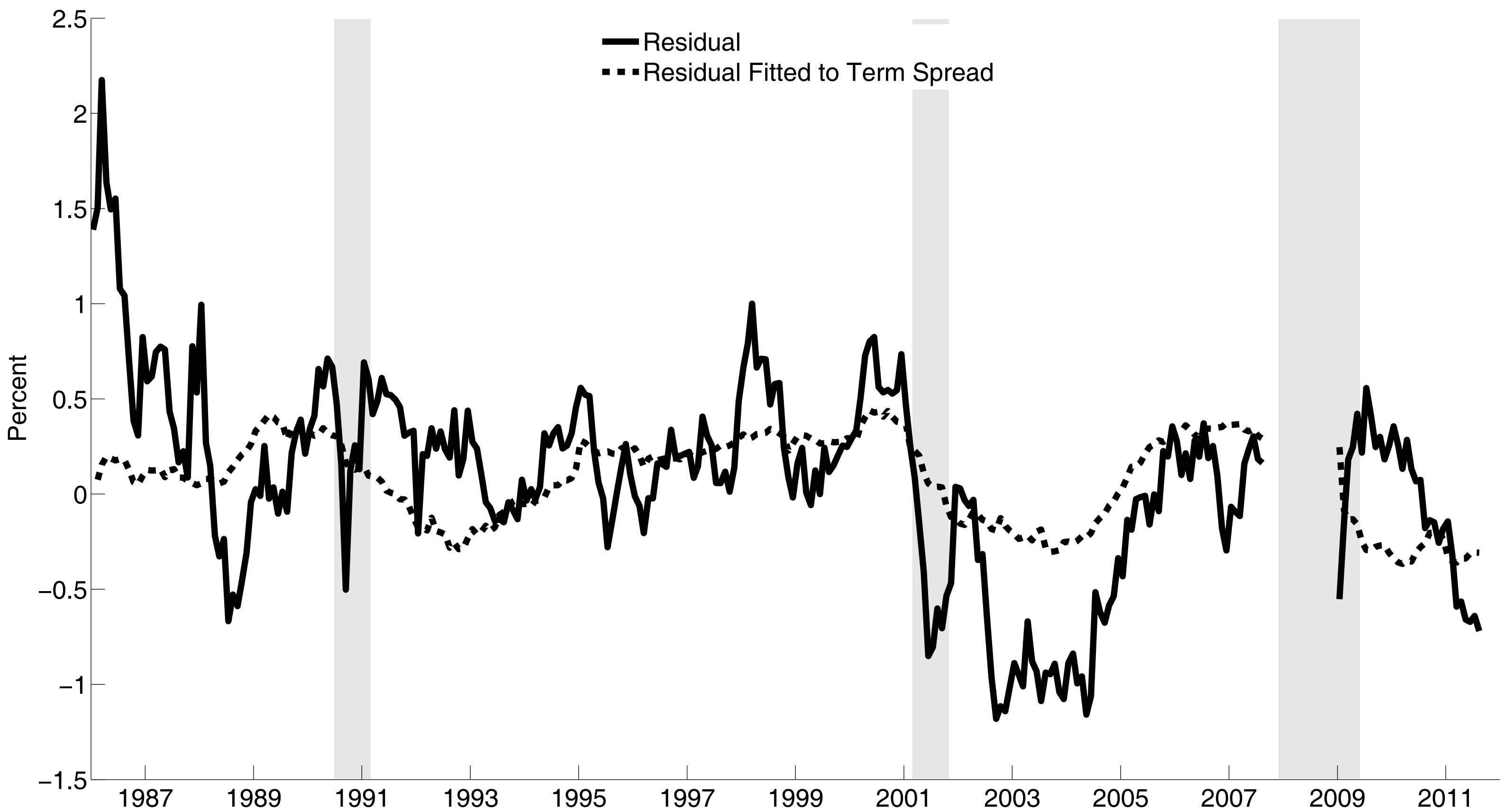
- Table 4-2: Estimates from Forecast Data, Excluding 2007:09 to 2008:12

	pre-Crisis	post-Crisis
<u>Weighted Least Squares</u>		
Inflation response	1.982	0.669
<i>standard error</i>	(0.104)	(0.584)
<i>Chow test</i>	0.086	
Unemployment response	-0.585	-0.814
<i>standard error</i>	(0.065)	(0.110)
<i>Chow test</i>	0.077	

- Table 4-3: Estimates from Forecast Data, Excluding 2007:09 to 2008:12

	pre-Crisis	post-Crisis
<u>Median Regression</u>		
Inflation response	1.959	1.218
<i>standard error</i>	(0.105)	(0.593)
<i>Chow test</i>	0.068	
Unemployment response	-0.576	-0.682
<i>standard error</i>	(0.056)	(0.108)
<i>Chow test</i>	0.059	

- Understanding the residuals
 - What accounts for residuals' fluctuations?
 - Figure 8, based on OLS of Table 4
 - Atkeson and Kehoe (2009) on risk
 - * proxy risk by term spread
 - * economically and statistically significant
 - * 100 bp increase in term spread to 25 bp decrease in rates



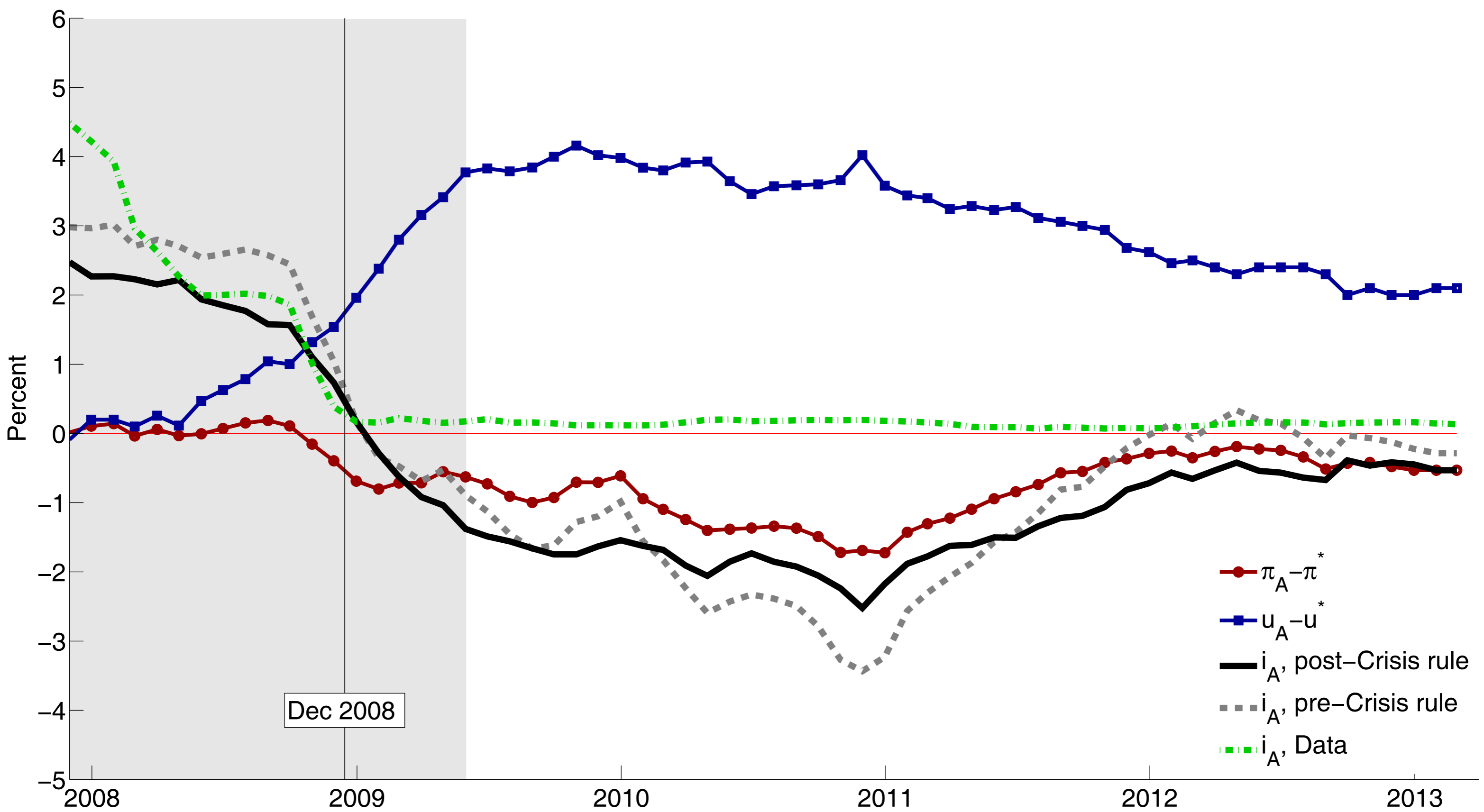
- Unconstrained Short Rates

- out-of-sample analysis

- What would the rates be without the ZLB?

- Figure 9

- Size of LSAPs



- Conclusion

- Estimating policy rules at the zero lower bound
- Inflation response weaker than before
- Unemployment response as strong as before

