Have We Underestimated the Probability of Hitting the Zero Lower Bound?

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Have We Underestimated the Probability of Hitting the Zero Lower Bound?

- Yes …
- … but, perhaps not by as much as you may think.

Have We Underestimated the Probability of Hitting the Zero Lower Bound?

- Four questions
  - How surprising have recent events been?
  - Has the estimated probability of hitting the ZLB changed over time?
  - How severely did the ZLB bind during the crisis?
  - What lessons do we take for the future?

Past as Prologue: Estimated Incidence of the Zero Lower Bound: 2 Percent Inflation Target

	FRB/US	
	Original Taylor Rule	Henderson-McKibbon Rule
Frequency of ZLB episodes	5	17
Mean duration of ZLB episodes	4	4
Frequency of deep recessions (output gap < -6 percent)	2	1

Source: Reifschneider and Williams (2000)

- Others were even more sanguine:

In light of the finding that the Ramsey-optimal inflation rate is negative, it is puzzling that most inflation-targeting countries pursue positive inflation goals. We show that the zero bound on the nominal interest rate, which is often cited as a rationale for setting positive inflation targets, is of no quantitative relevance in the present model.

Schmitt-Grohe and Uribe (2007)

Methodology

- Re-examine the probability of hitting the zero lower bound (ZLB) and the duration of such episodes using a broad set of estimated structural macro models and atheoretical statistical models.

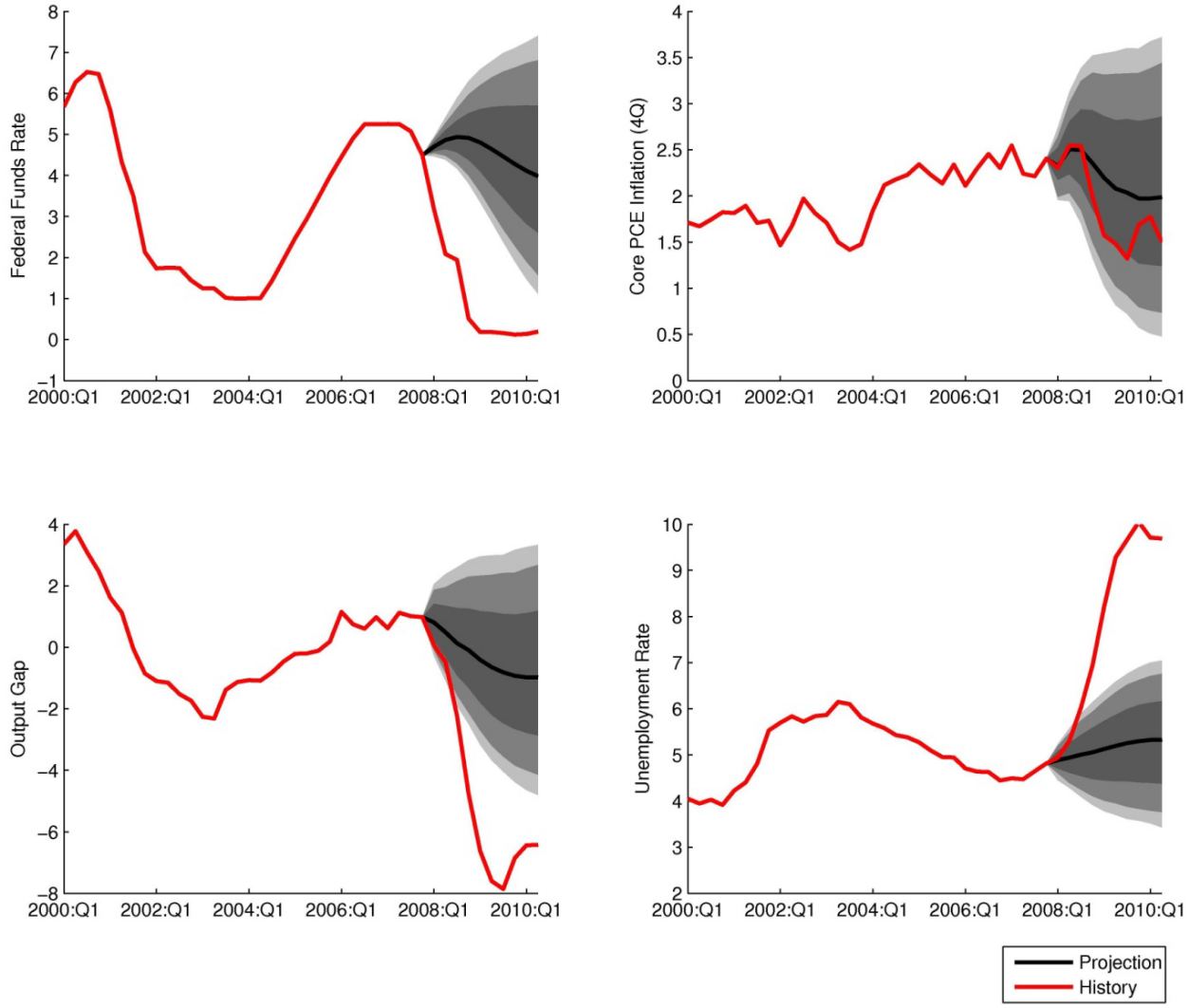
- Include models that allow for time-varying:
  - parameters
  - neutral real interest rate (r*)
  - variances.

- Incorporate uncertainty about:
  - Shocks
  - Parameters
  - latent variables (output gap, r*)

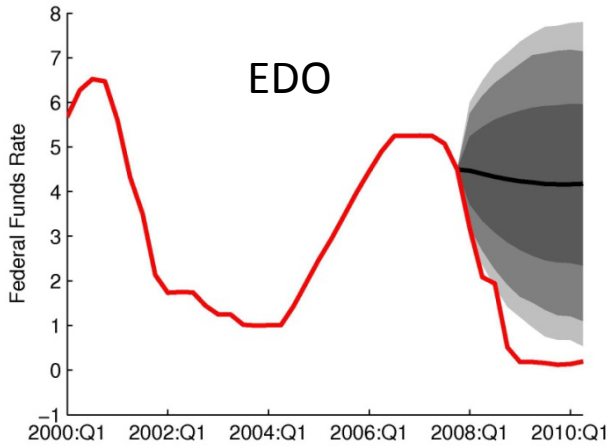
Model Summary

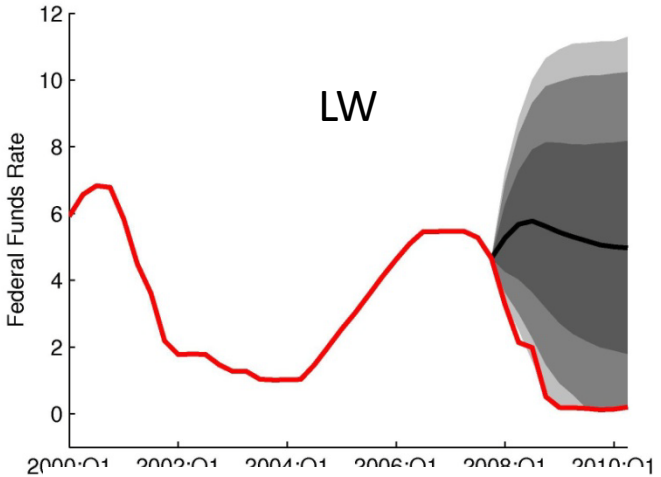
	EDO (DSGE)	FRB/US	TVP-VAR	Laubach-Williams	GARCH
Estimation sample size	1984	1968	1964	1961	1968
Estimation method	Bayes	OLS	Bayes	ML	ML
Estimated equations	28	56	3	8	3
Time-varying R*	No	No	Yes	Yes	No
Time-varying parameters	No	No	Yes	No	No
Time-varying variances	No	No	Yes	No	Yes

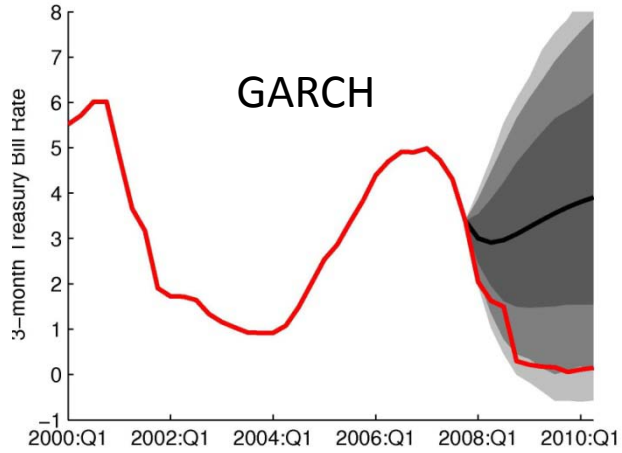
Decline in Output, Rise in Unemployment Rate and Hitting ZLB Huge Surprises to FRB/US

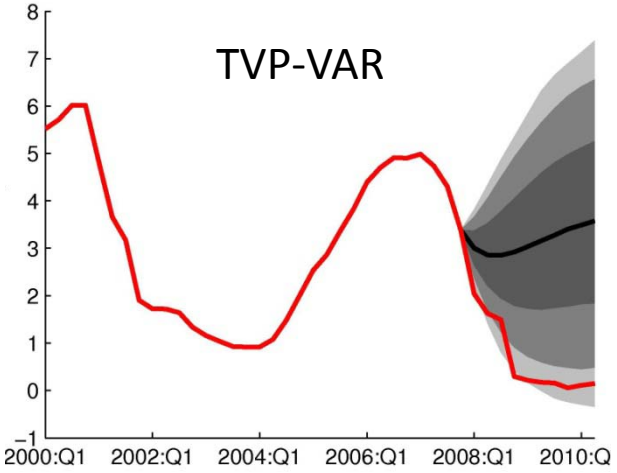


Statistical Models Less Surprised







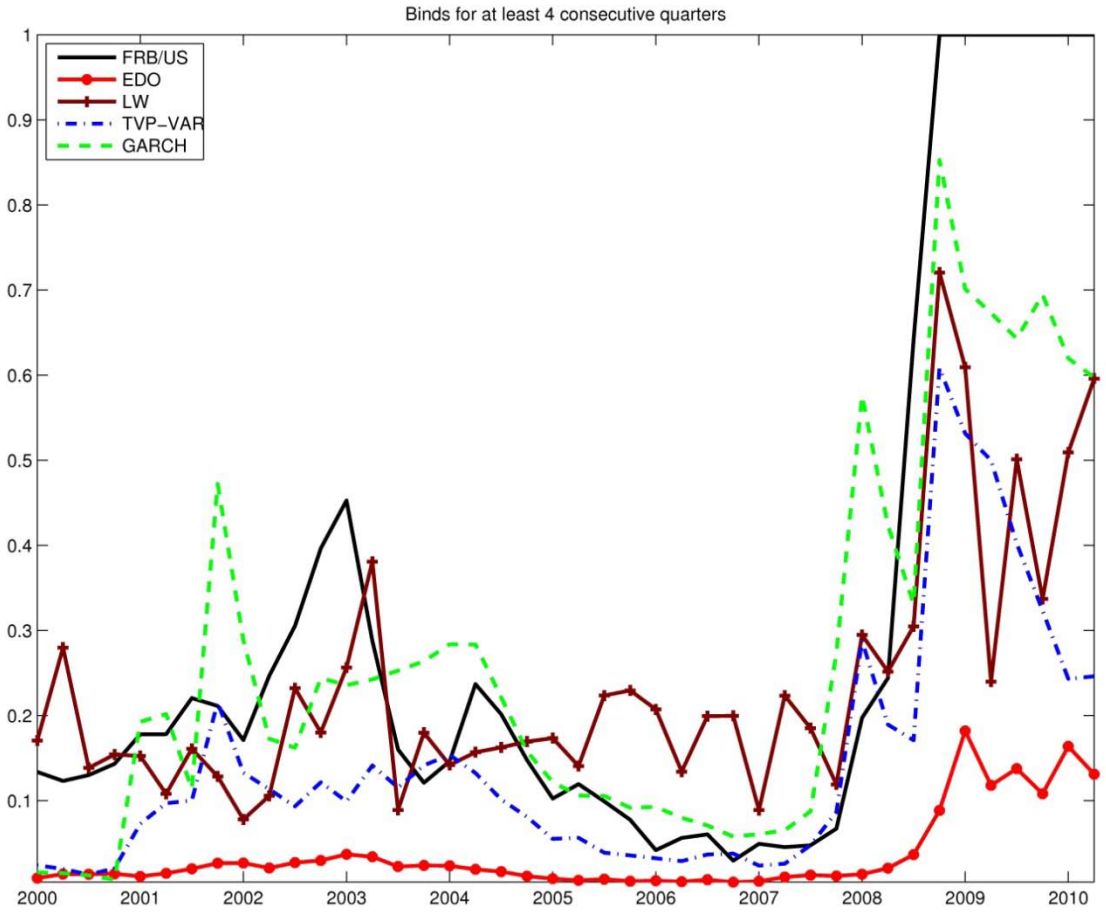


Importance of Parameter/Latent Variable Uncertainty
Estimated Probability of Hitting the ZLB by 2010Q2
Based on 2007Q4 Projections

	Estimates Include Parameter Uncertainty			Estimates Exclude Parameter Uncertainty			
	EDO	TVP-VAR	LW	EDO	TVP-VAR	LW	FRB/US
Probability of reaching the ZLB on or before 2010Q2	1.5	3.5	23	0.5	1.6	16	0.6
Probability of having been at the ZLB for four consecutive quarters on or before 2010Q2	0.4	2.5	12	0.2	0.7	6.0	0.2
Width of 95% conf. intervals for proj. 2010Q2 conditions:							
Short-term interest rate	7.3	7.7	11.2	6.2	6.0	9.9	6.3
Inflation rate	3.4	5.7	5.9	2.7	4.7	4.8	3.2
Output gap	8.1	—	15.9	6.7	—	7.6	8.1
Unemployment rate	—	3.5	—	—	2.6	—	3.6

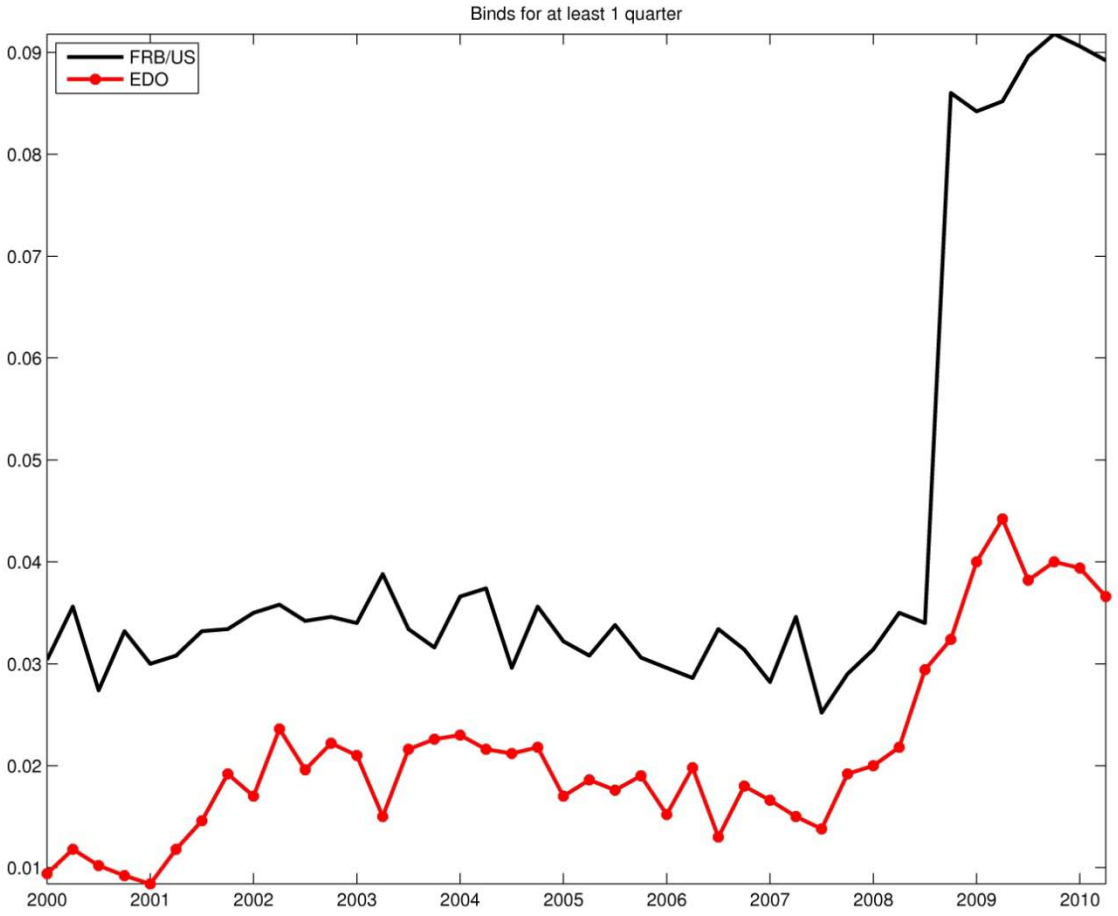
Has the Probability of Hitting the ZLB Changed Much Over Time?

Sensitivity Of Estimates: Probability of a Persistent Zero Bound Event in the Next 5 Years



Has the Probability of Hitting the ZLB Changed Much Over Time?

Sensitivity to the Great moderation: Probability of a Persistent Zero Bound Event in the Next 5 Years Steady-state Initial Conditions; Expanding-sample Volatility Estimates



Summary Part I

- Model uncertainty matters.
  - Statistical models that do not impose “well-behaved” stationary dynamics suggest higher incidence of ZLB than structural models.
  - Time-varying natural rate of interest increase ZLB incidence.
  - DSGE model falsely predicts that ZLB episodes are short lived – lacks intrinsic persistence.
- Parameter/latent variable uncertainty can matter a lot.
- Great moderation period has large effect on estimates of ZLB incidence; need for tail events in sample or imposed on simulations.

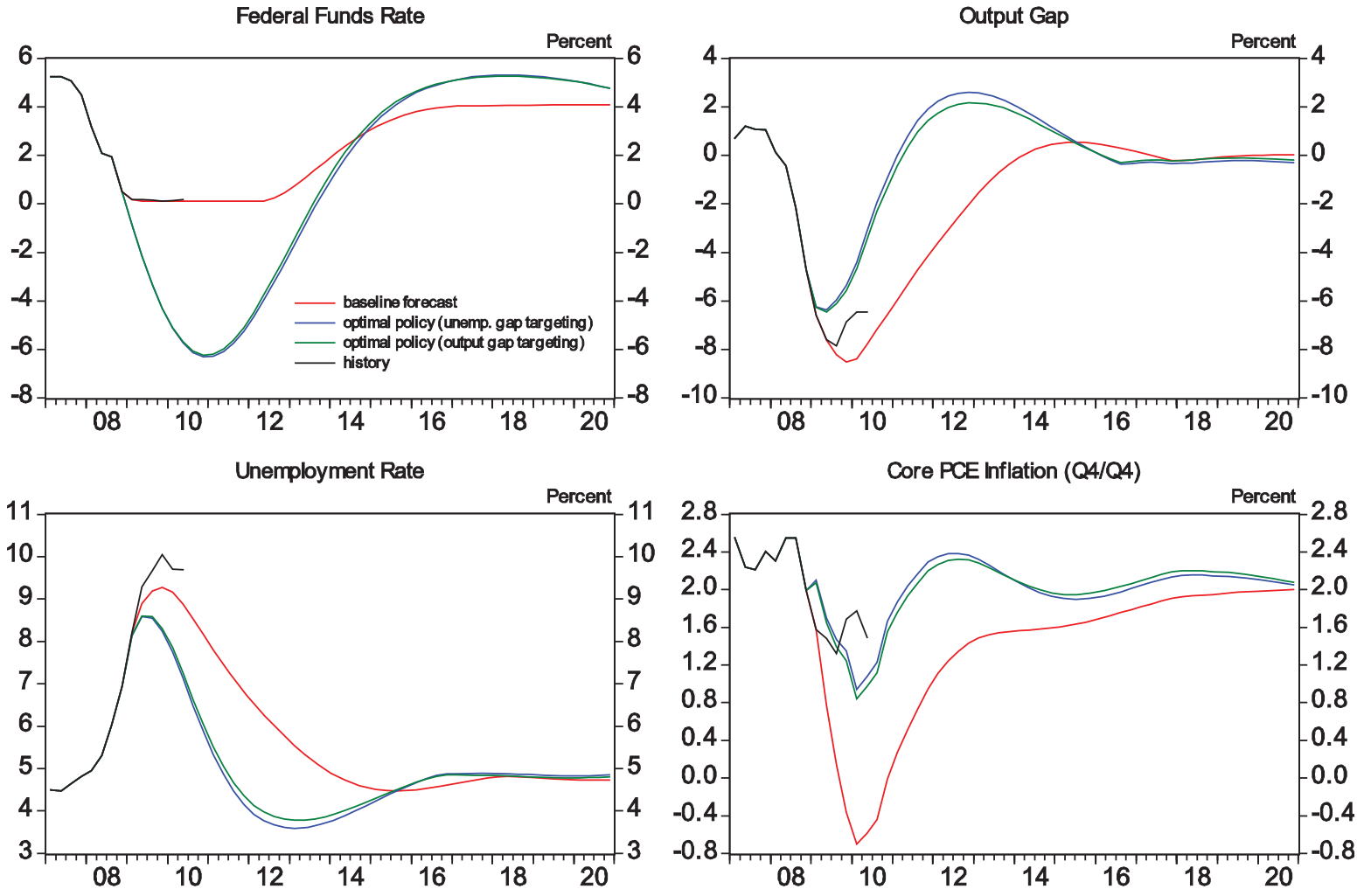
How Severely Did the ZLB Bind During the Crisis?

- Run counterfactual simulation allowing nominal funds rate to fall below zero starting in 2009Q1
- Assume funds rate path chosen to minimize a loss function, conditional on:
  - Baseline forecast in 2009Q1 (FRB/US or Blue Chip)
  - Model of the transmission mechanism (FRB/US)
- Baseline loss function:

$$L = E_t \sum_{j=0}^{m} .99^j \left[\left(U_{t+j} - U^*_{t+j} \right)^2 + \left(\pi_{t+j} - 2 \right)^2 + \Delta R^2_{t+j} \right]$$

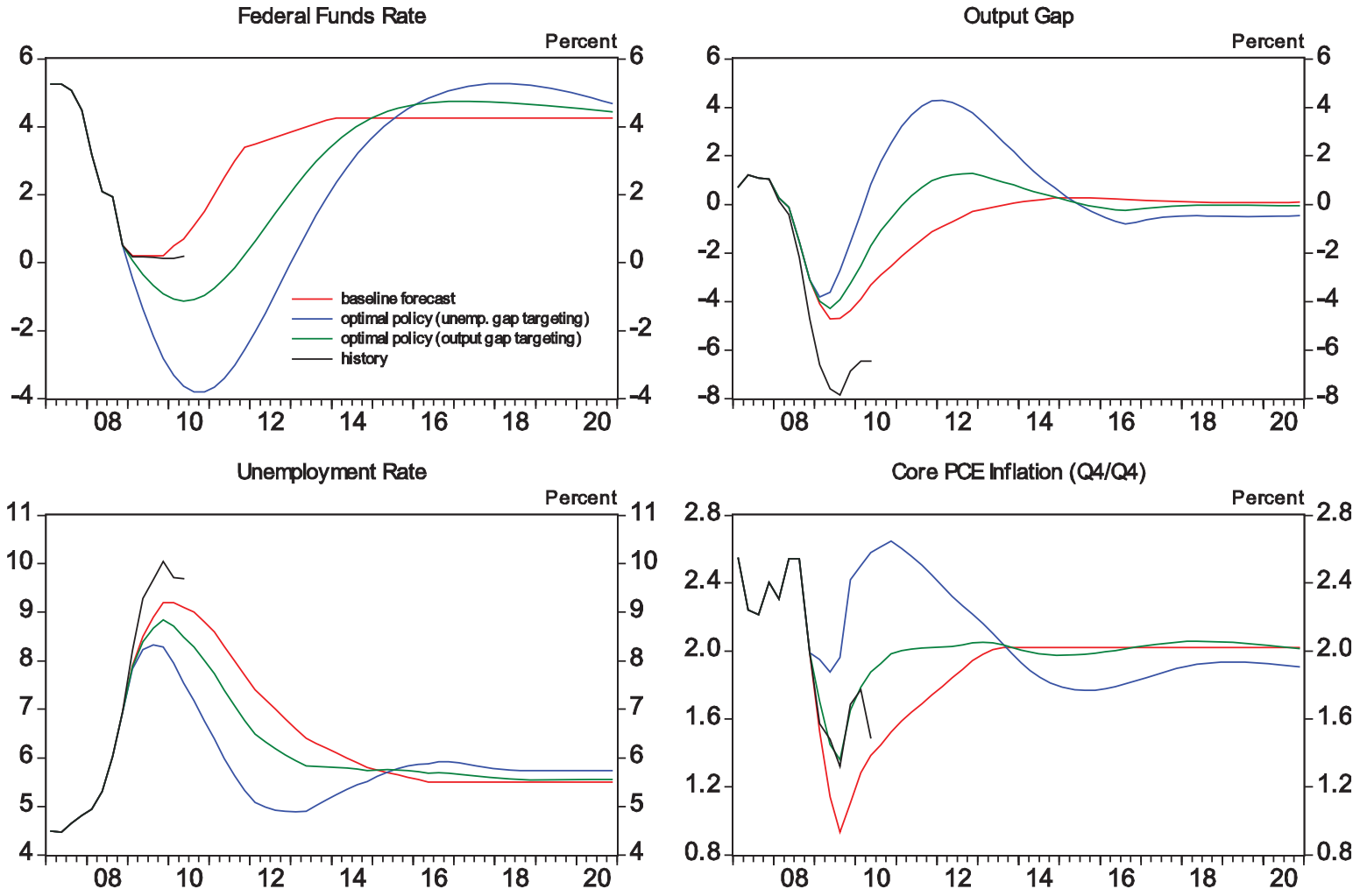
How Severely Did the ZLB Bind During the Crisis?

Unconstrained Optimal Monetary Policy Paths Conditional on Early 2009 FRB/US Baseline and FRB/US Dynamics



How Severely Did the ZLB Bind During the Crisis?

Unconstrained Optimal Monetary Policy Paths Conditional on Early 2009 Blue Chip Consensus Projection and FRB/US Dynamics



Summary of Optimal-Control Results

- The constraint on optimal policy appears considerable ex ante
  - Optimal policy would have cut the funds rate to -4 percent or more
  - Predicted improvement to macro conditions substantial
- But the bigger the estimated hit to potential, the less severe the constraint
  - Defining L in terms of output gap can lower the policy shortfall
  - But dual mandate defined in terms of employment and inflation
- Constraint looks even more severe in hindsight
  - Rerunning with 09Q1-10Q1 data plus March 2010 Blue Chip forecast yields optimal peak decline to -4 percent, even though U* now 6%
  - Moreover, ex post baseline history/projection incorporates LSAP effects (roughly equivalent to 120 to 360 bp cut in funds rate)

Revisiting Reifschneider-Williams (2000)

- How much has recent macro-economic volatility changed the models' views about the danger posed by the zero lower bound?

- Run stochastic simulations of FRB/US and EDO to estimate unconditional moments and distribution of ZLB events
  - Under a 2 percent inflation target
  - Under a range of inflation targets

- How different are these estimates relative to those reported in RW 2000?

Revisiting Reifschneider-Williams (2000)

Alternative Estimates of Macroeconomic Performance with an Inflation Target of 2 Percent

	FRB/US			EDO
	Current Version	2000 version, 1993 Taylor Rule	2000 version, Henderson-McKibbon rule	Current version
Frequency of ZLB episodes	6	5	17	4
Mean duration of ZLB episodes	5	4	4	2
Frequency of deep recessions	1	2	1	1
Frequency of deep recession and binding ZLB	1	2	1	1
Std dev of output gap	2.5	3.0	1.9	2.2
Std dev of core PCE inflation	1.0	1.9	1.9	1.0
Std dev of funds rate	2.7	2.5	3.9	2.0

Main Results

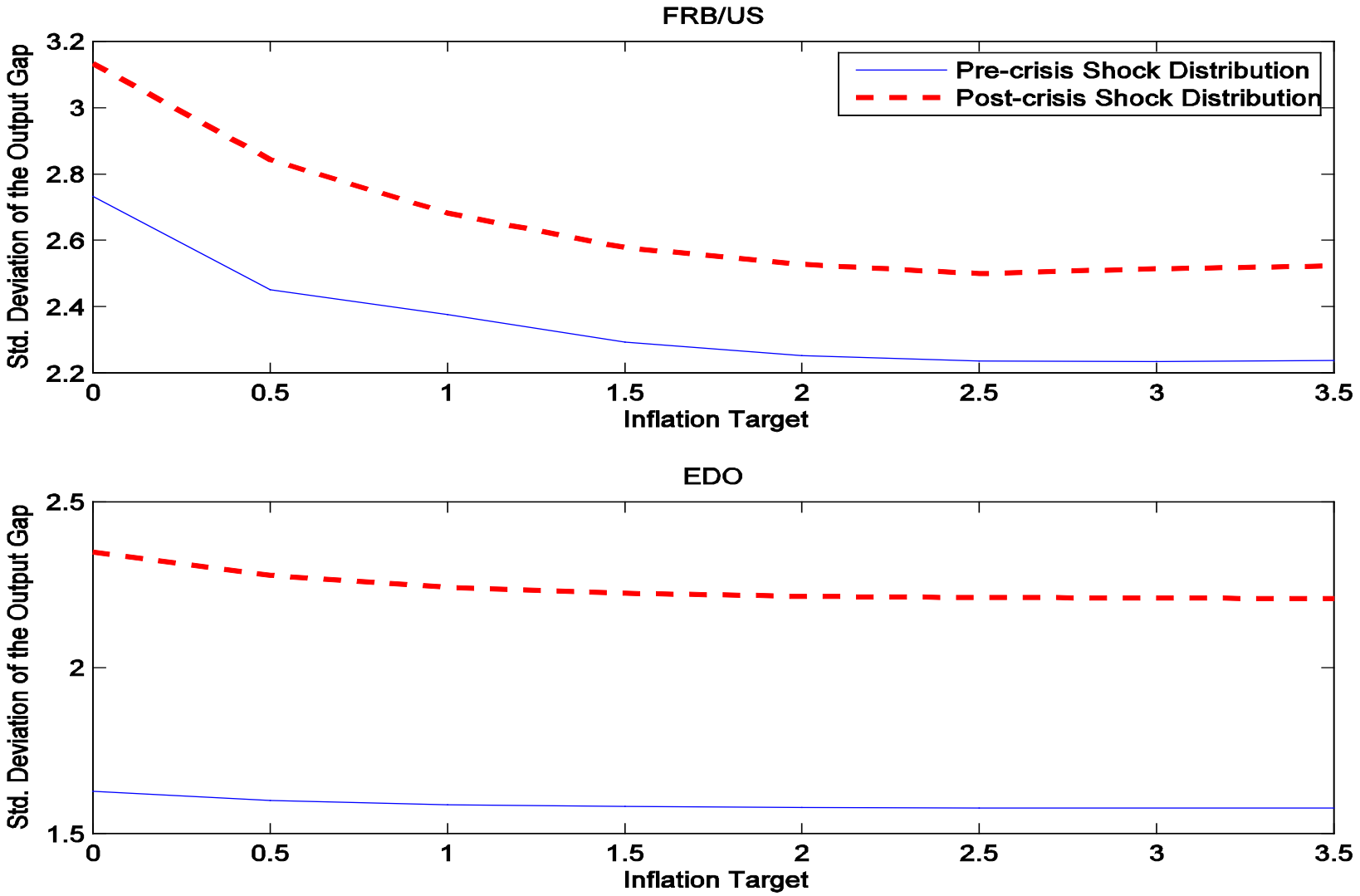
- Despite recent events …
  - Frequency of ZLB events still about 5% under moderately aggressive policy rules and 2% target
  - Duration of ZLB events short (especially in EDO)
  - Frequency of deep recessions still low

- Why?
  - FRB/US structure has changed (less inflation variance)
  - FRB/US and EDO probably underestimate frequency and persistence of low R* states (more work needed)

- Nonetheless, recent events do imply a worse tradeoff between macro performance and target inflation

Revisiting Reifschneider-Williams (2000)

Standard Deviation of the Output Gap as a Function of the Inflation Target, in FRB/US and EDO



Conclusions

- Recent events suggest that previous research was too sanguine about ZLB risks
  - Too focused on "well-behaved" stationary models
  - Made insufficient allowance for persistently low R* states and time-varying volatility
  - Neglected uncertainty about parameters, latent variables, and models
  - Placed too much weight on Great Moderation period
- Future research should correct these deficiencies
- Implications for monetary policy still open question