What Does Anticipated Monetary Policy Do?

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[1]The views expressed here do not represent those of the Chicago Fed or the Federal Reserve System.

Introduction

Do expectations of future monetary policy affect today's economy?

- To answer this question, must identify expectations for policy innovations that are orthogonal to the expected state of the economy.
- But this is hard because most changes in expected short rates reflect the anticipated response to economic conditions.
- E.g., Campbell et al. (2012):

Table 3. Regressions Estimating Private Forecast Responses to Target and Path Factors, 1990–2007 and 1994–2007[a]

	February 1990–June 2007 sample			*February 1994–June 2007 sample*		
Forecast	*Target factor*	*Path factor*	*Adjusted R^2*	*Target factor*	*Path factor*	*Adjusted R^2*
Unemployment rate						
Current quarter	–0.21***	–0.08	0.07	–0.01	–0.08	0.01
	(0.08)	(0.06)		(0.08)	(0.07)	
Next quarter	–0.18**	–0.12	0.05	0.07	–0.16**	0.03
	(0.09)	(0.08)		(0.10)	(0.08)	
2 quarters hence	–0.27***	–0.13*	0.09	–0.06	–0.16*	0.03
	(0.08)	(0.07)		(0.11)	(0.09)	
3 quarters hence	–0.26***	–0.08	0.07	–0.03	–0.19**	0.04
	(0.09)	(0.08)		(0.09)	(0.08)	
CPI inflation						
Current quarter	0.25	0.47	0.02	–0.13	0.57*	0.02
	(0.33)	(0.36)		(0.34)	(0.31)	
Next quarter	0.14	0.30	0.03	0.25**	0.12	0.03
	(0.11)	(0.24)		(0.13)	(0.12)	
2 quarters hence	0.11	–0.06	0.01	0.14	–0.04	0.01
	(0.14)	(0.13)		(0.10)	(0.16)	
3 quarters hence	0.13	0.07	0.01	0.04	0.27	0.03
	(0.20)	(0.20)		(0.14)	(0.25)	

Introduction

- Their interpretation: "Delphic" forward guidance – expectations for *systematic* policy.
- Theoretical discussion of forward guidance focus on expected *deviations* from the policy rule.
- Can't isolate such expectations with data on the expected policy rate alone.
- We use a survey-augmented structural VAR to find such shocks.
- Key identifying assumptions:
  - "Policy expectations shocks" cause expectations of output and inflation to move in the opposite direction of expectedshort rates.
  - These shocks are news – implies survey forecast = VAR forecast
- We are also able to test how the effects vary across expectational horizon by using survey data for different horizons.

Introduction

Why does this matter?

- Theory suggests that forward guidance (if credible) should have powerful effects.
  - Krugman (1998); Eggertsson and Woodford (2003); Laseen and Svensson (2011); Del Negro et al. (2015); etc...
- But we don't know how big these effects are in practice.
  - Only estimates come from estimated DSGE models, which impose a particular structure.
  - Our estimates impose only minimal restrictions.
- Also relevant for understanding transmission mechanism of unanticipated (conventional) policy shocks.
  - Our results suggest that such shocks only have macro effects *because* they change expectations of future rates.

Motivating NK model with policy news

NKPC:

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

IS curve:

$$y_t = E_t y_{t+1} - \frac{1}{\sigma}\left(i_t - E_t \pi_{t+1} - r^*\right)$$

Policy rule:

$$i_t = \phi_y y_t + \phi_\pi \pi_t + v_t$$

where

$$v_t = \rho v_{t-1} + \varepsilon_t$$

with ε_t *unconditionally* mean-zero and iid.

Motivating model

- Agents receive news about ε_t, potentailly every period before it occurs.
- a_t^{t+h} is the anticipated value of ε_{t+h} as of period t.
- For any fixed period $T > t$, rational expectations implies that $\{a_t^T\}$ follows a martingale:

$$a_t^T = a_{t-1}^T + \eta_t^T$$

- Also,

$$\varepsilon_t = a_{t-1}^t + u_t$$

where u_t is the unanticipated part of the innovation.

-

Motivating model

- Solution:

$$\begin{aligned}
\pi_t &= \psi_{0,\pi} v_t + \sum_{h=1}^{\infty} \psi_{h,\pi} a_t^{t+h} \\
y_t &= \psi_{0,y} v_t + \sum_{h=1}^{\infty} \psi_{h,y} a_t^{t+h} \\
i_t &= \psi_{0,i} v_t + \sum_{h=1}^{\infty} \psi_{h,i} a_t^{t+h}
\end{aligned}$$

- The effects of unanticipated shocks u_t are standard and are the same regardless of whether the anticipated component exists or not.
- In particular, $\psi_{0,\pi}$ and $\psi_{0,y}$ are negative, and $\psi_{0,i}$ is positive.
  - $\Longrightarrow$ Time-t inflation and output move in the *opposite* direction of the policy rate following an unanticipated shock u_t.

Motivating model

- Note that, in response to a policy-expectations shock, we have:

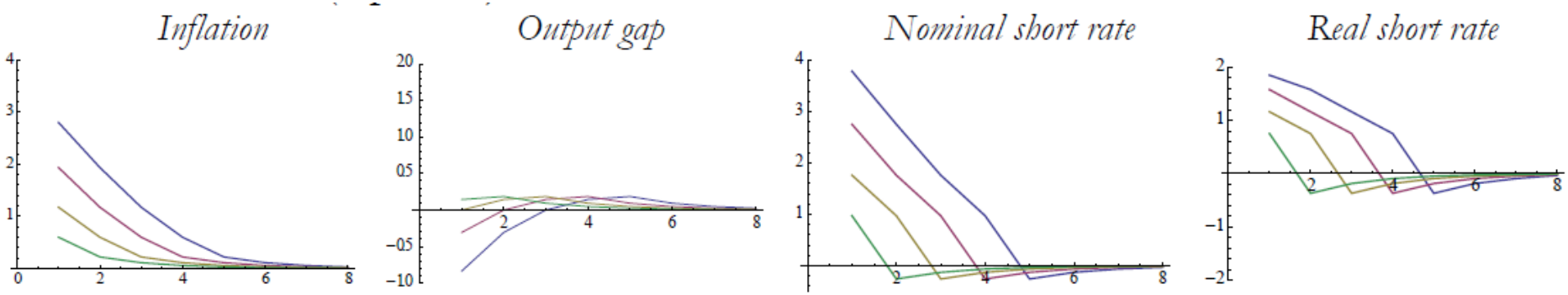
$$\Delta E_t\left[\pi_{t+h}\right] = \psi_{0,\pi}\eta_t^{t+h} \qquad \Delta E_t\left[y_{t+h}\right] = \psi_{0,y}\eta_t^{t+h} \qquad \Delta E_t[i_{t+h}] = \psi_{0,i}\eta_t^{t+h} \tag{1}$$

$\Longrightarrow$ *Expected* inflation and output move in the opposite direction of the *expected* policy rate.

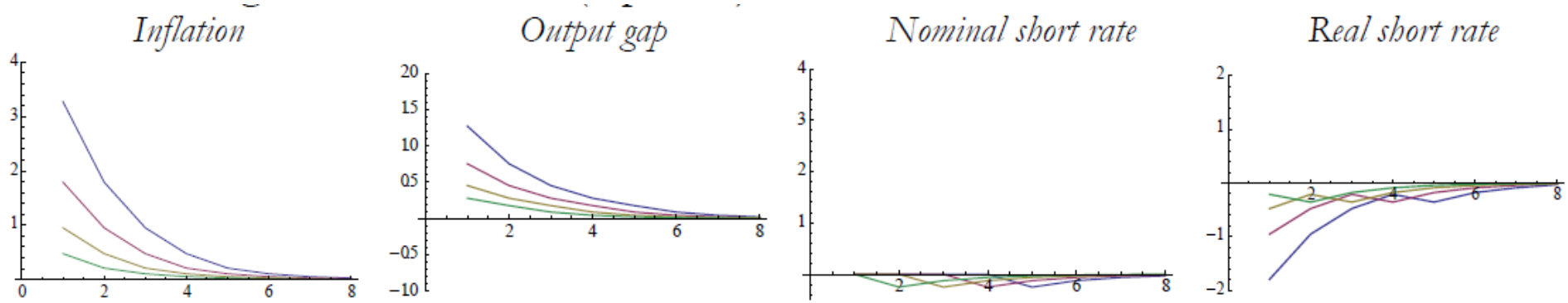
- This will be a key identifying assumption for us.
- While we can find the other ψ's in closed form, it is hard to make general statements about them. They can be positive or negative.
- Calibrate to standard values, and consider shocks η_0^1, ..., η_0^4.

Policy-expectations shocks in NK model

Policy news:



"Foward guidance" (short rate does not respond):



Summing up

Useful identifying restrictions from the model:

- Policy-expectations shocks move expected inflation and output in the opposite direction of expected short rates.
- Expectations for accomodative policy cause the *contemporaneous* short rate to rise.
- What's expected to happen does happen on average.

Hypotheses to test:

- If short rates can respond to expected policy, the economic reaction can take either sign.
- If the short-rate response is shut down, inflation and output necessarily rise.
- Expected policy in simple models is powerful—maybe too powerful to be believable (FG puzzle).

How big are these effects in reality?

Empirical reduced form

We will estimate the reduced-form VAR:

$$\begin{pmatrix} E_t^S\left[\mathbf{x}_{t+h}\right] \\ \mathbf{x}_t \end{pmatrix} = \boldsymbol{\theta}_0 + \Theta(L)\begin{pmatrix} E_t^S\left[\mathbf{x}_{t+h}\right] \\ \mathbf{x}_t \end{pmatrix} + \begin{pmatrix} \mathbf{e}_{1,t} \\ \mathbf{e}_{2,t} \end{pmatrix}$$

where $\mathbf{x}_t$ is economic data and $E_t^S\left[\mathbf{x}_{t+h}\right]$ is survey forecats of (a subset of) those data.

- Does this make any sense?
  - Many applications of survey data, but it is rare to put them in a VAR (only Leduc and Sill, 2013).
  - In a world without news, they are either redundant or inconsistent with the VAR itself.
  - But if news exists, the survey data can provide important identifying information about the independent effects of expectations.
  - Indeed, a VAR without direct measures of expectations will be misspecified.

Empirical reduced form

Proposition 1. In the linear rational-expectations economy with news shocks, the state vector $\mathbf{x}_t$ follows the process

$$\mathbf{x}_t = \boldsymbol{\theta}_1 \mathbf{x}_{t-1} + \boldsymbol{\theta}_2 \mathbf{x}_{t-2} + \mathbf{e}_{1,t-1} - \boldsymbol{\theta}_1 \mathbf{e}_{2,t-1} + \mathbf{e}_{2,t}$$

where $(\mathbf{e}_{1,t} \quad \mathbf{e}_{2,t}) \sim \mathit{Niid}[\mathbf{0}, \Sigma]$, and $\boldsymbol{\theta}_1$, $\boldsymbol{\theta}_2$, and Σ are matrices of reduced-form parameters.

Equivalently, the joint dynamics of $\mathbf{x}_t$ and its one-period-ahead expectation can be written as the VAR

$$\begin{pmatrix} E_t[\mathbf{x}_{t+1}] \\ \mathbf{x}_t \end{pmatrix} = \begin{pmatrix} \boldsymbol{\theta}_1 & \boldsymbol{\theta}_2 \\ \mathbf{I} & \mathbf{0} \end{pmatrix} \begin{pmatrix} E_{t-1}[\mathbf{x}_t] \\ \mathbf{x}_{t-1} \end{pmatrix} + \begin{pmatrix} \mathbf{e}_{1,t} \\ \mathbf{e}_{2,t} \end{pmatrix}$$

Our model is consistent with this reduced form.

Structural restrictions

Let Γ be a factor of Σ such that

$$\begin{pmatrix} \mathbf{e}_{1,t} \\ \mathbf{e}_{2,t} \end{pmatrix} = \Gamma \begin{pmatrix} \eta_t \\ \mathbf{u}_t \end{pmatrix}$$

To identify the **policy-expectations shock**, we impose the following conditions on Γ, motivated by the NK model:

- Sign restrictions:

$$\Gamma_\eta^{E^S[i]} \leq 0, \quad \left\{\Gamma_\eta^{E^S[GDP]}, \Gamma_\eta^{E^S[CPI]}\right\} \geq 0, \quad \Gamma_\eta^{i} \geq 0$$

- News restrictions:

$$\Gamma_\eta^{E^S[GDP]} = E_t\left[\frac{\partial GDP_{t+H}}{\partial \eta_t}\right], \quad \Gamma_\eta^{E^S[CPI]} = E_t\left[\frac{\partial CPI_{t+H}}{\partial \eta_t}\right],$$

$$\Gamma_\eta^{E^S[i]} = \frac{1}{H}\sum_{h=1}^{H} E_t\left[\frac{\partial i_{t+h}}{\partial \eta_t}\right]$$

Structural restrictions

For comparison, we will also identify the **unanticipated policy shock** using a *symmetric* set of restrictions:

- Sign restrictions:

$$\Gamma_u^{E^S[i]} \leq 0, \quad \left\{\Gamma_u^{E^S[GDP]}, \Gamma_u^{E^S[CPI]}\right\} \geq 0, \quad \Gamma_u^i < 0$$

- News restrictions:

$$\Gamma_u^{E^S[GDP]} = E_t\left[\frac{\partial GDP_{t+H}}{\partial u_t}\right], \quad \Gamma_u^{E^S[CPI]} = E_t\left[\frac{\partial CPI_{t+H}}{\partial u_t}\right],$$

$$\Gamma_u^{E^S[i]} = \frac{1}{H}\sum_{h=1}^{H} E_t\left[\frac{\partial i_{t+h}}{\partial u_t}\right]$$

- Only difference between the two shocks is the contemporaneous response of the short rate.
  - For robustness, also do this using Christiano et al. (1999) and Uhlig (2005) approaches.

Estimation details

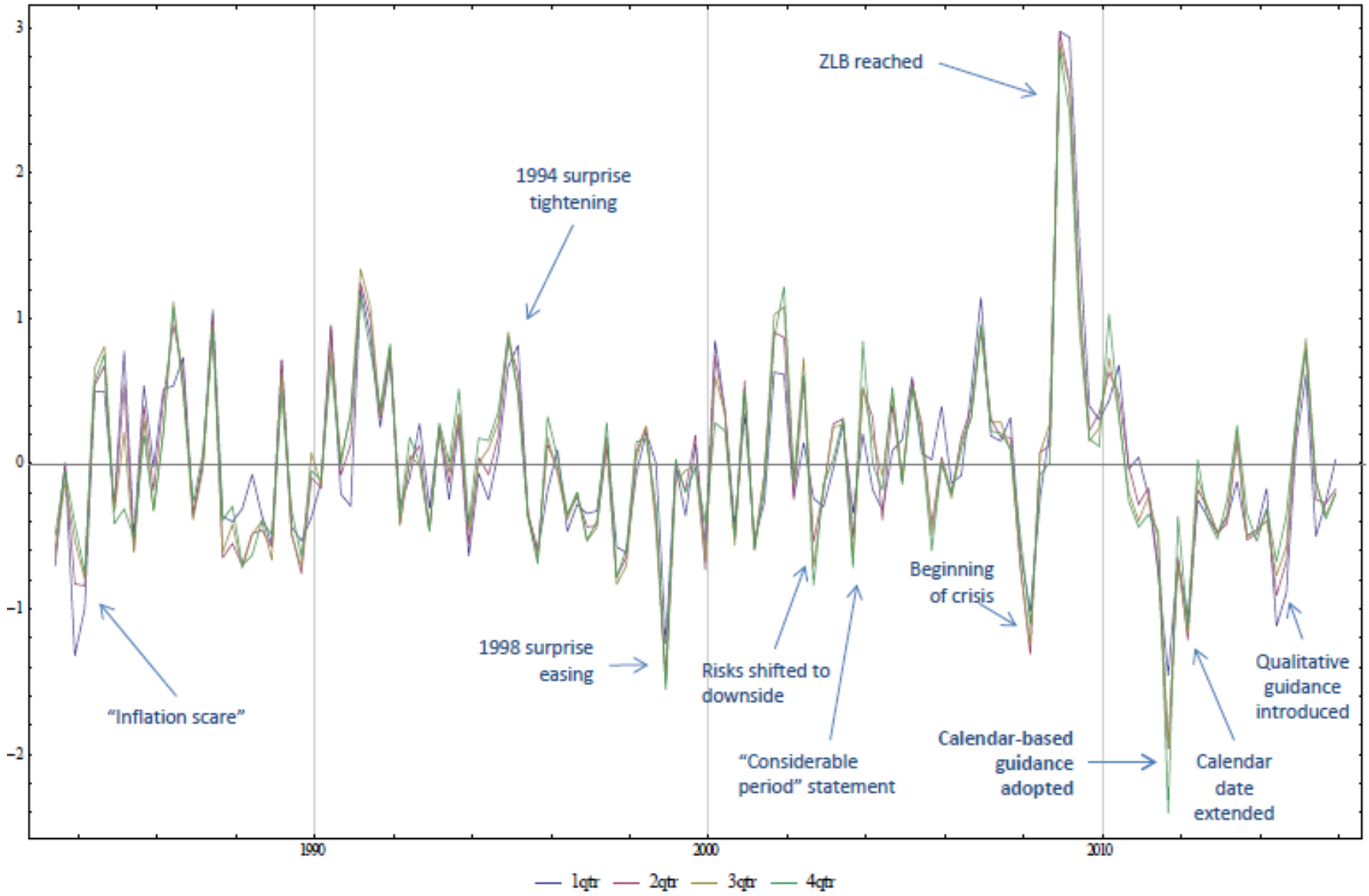
Our baseline model contains:

- GDP, CPI, 3m TBill, Hours, M2 growth
- Blue Chip survey data on GDP, CPI, and 3m TBill.
  - Surveys are from 1 quarter to 11 years.
  - We estimate a separate model for each survey horizon.

Estimation is Bayesian, with flat normal-Wishart prior.

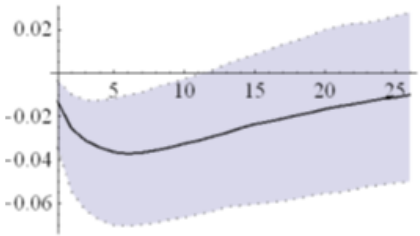
Sign and zero restrictions are imposed jointly using Arias et al. (2016) algorithm with flat prior over IRFs.

Results: Policy expectations shocks

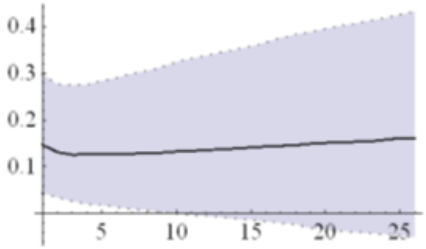


Results: Policy expectations shocks at 1Y horizon

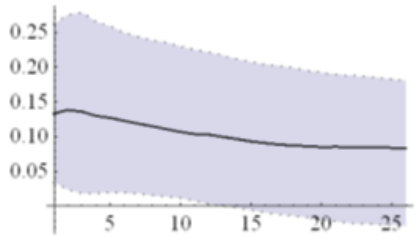
$E^S[i]$



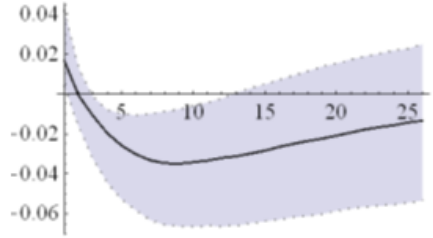
$E^S[GDP]$



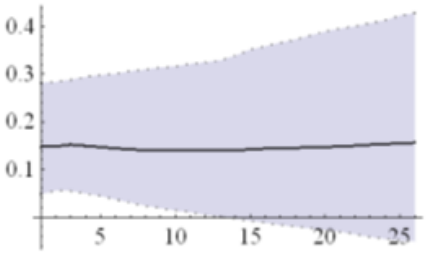
$E^S[CPI]$



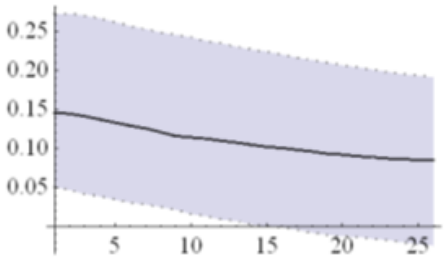
i



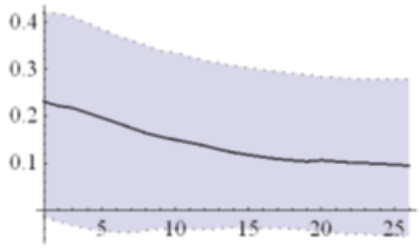
GDP



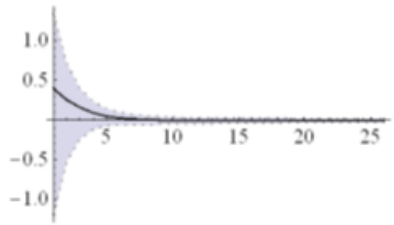
CPI



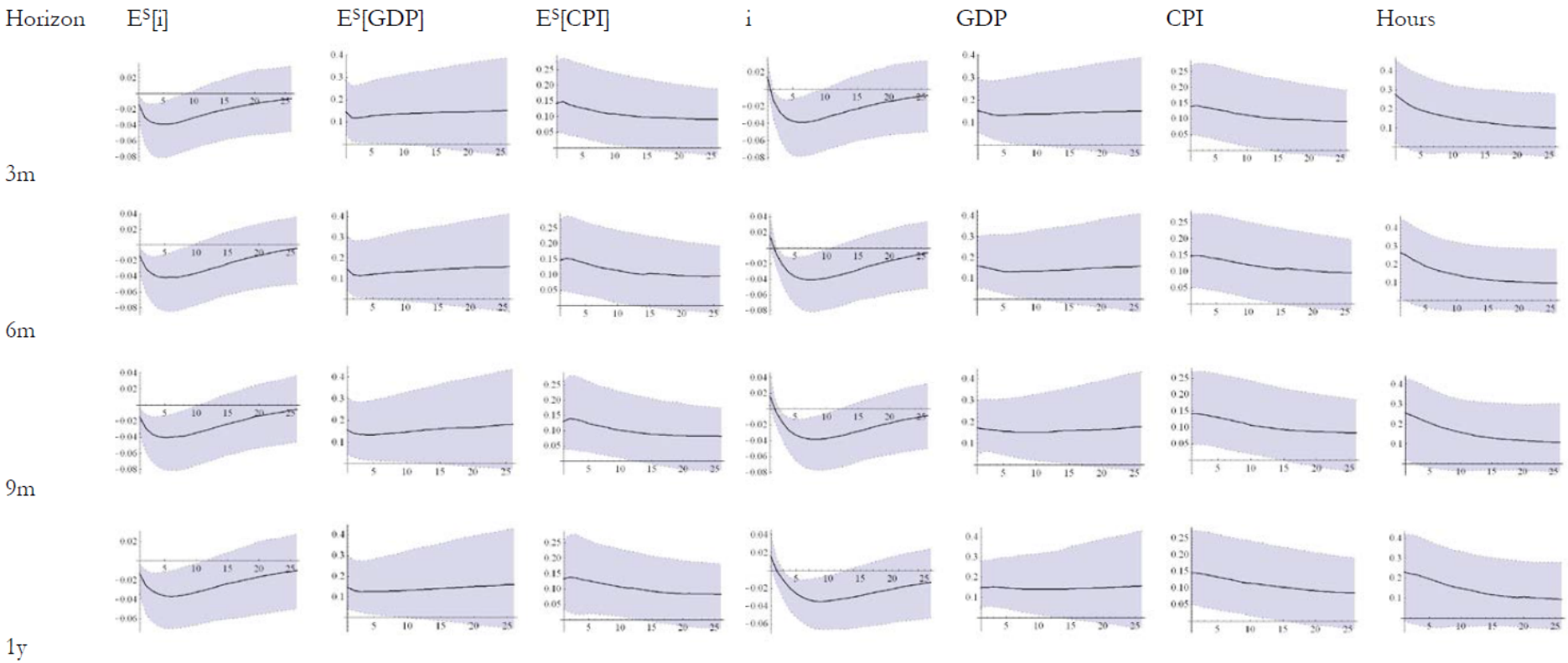
Hours



$\%\Delta M2$

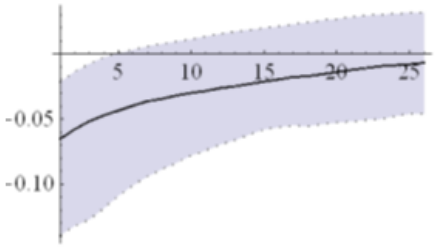


Results: Policy expectations shocks, all short horizons

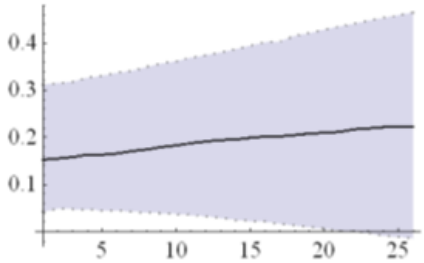


Results: Unanticipated policy shocks, 1Y horizon

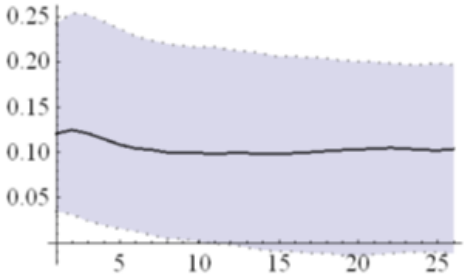
$E^S[i]$



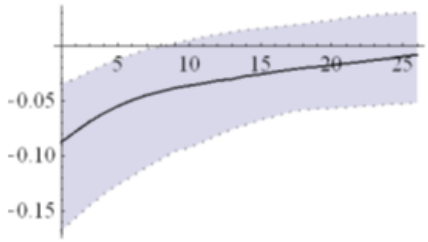
$E^S[GDP]$



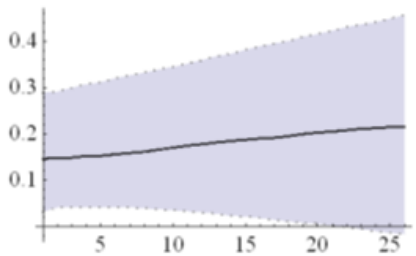
$E^S[CPI]$



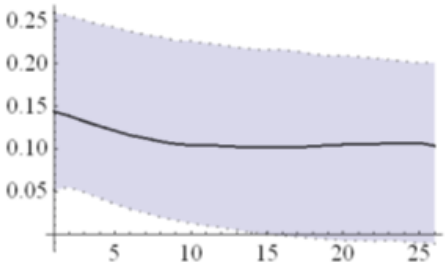
i



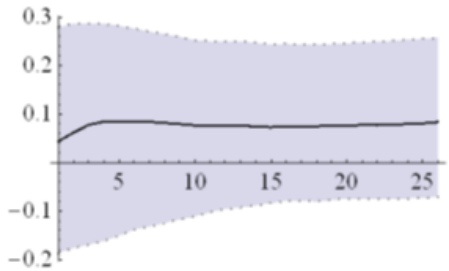
GDP



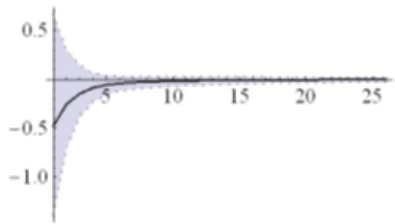
CPI



Hours



$\%\Delta M2$



- Other short horizons look very similar.

Expectations channel in unanticipated policy

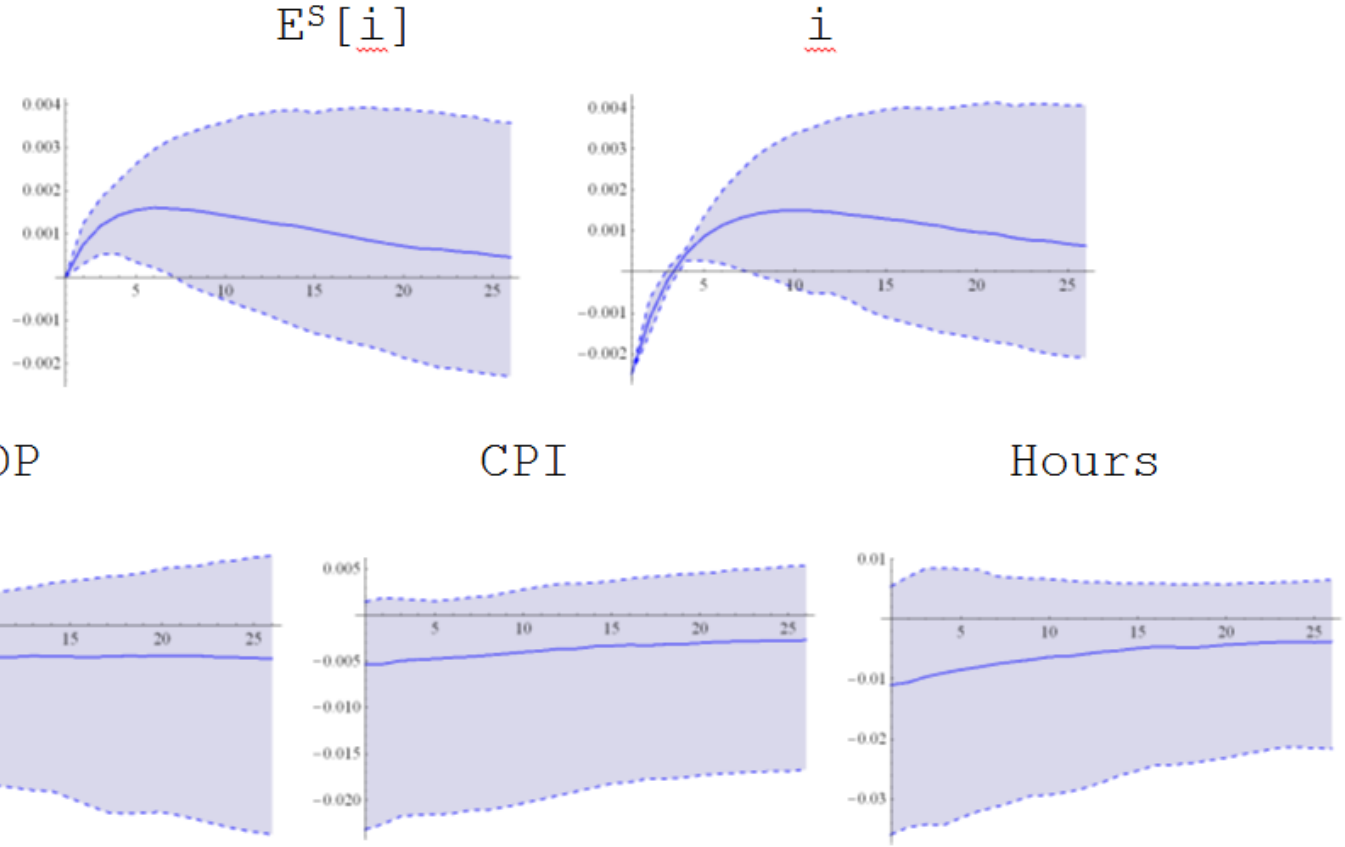
Part of the effects of unanticipated shocks presumably work by changing expectations of future rates.

What happens when we shut that channel down?

- Consider 25-bp unanticipated policy shock in period 0.
- Simultaneously, consider a policy-expectations shock that exactly offsets the effect on the expected TBill rate over 4 quarters.
- This isolates the effect of a change in today's rate that doesn't change expected future rates.
- Can similarly ensure that expectations stay fixed in subsequent periods.

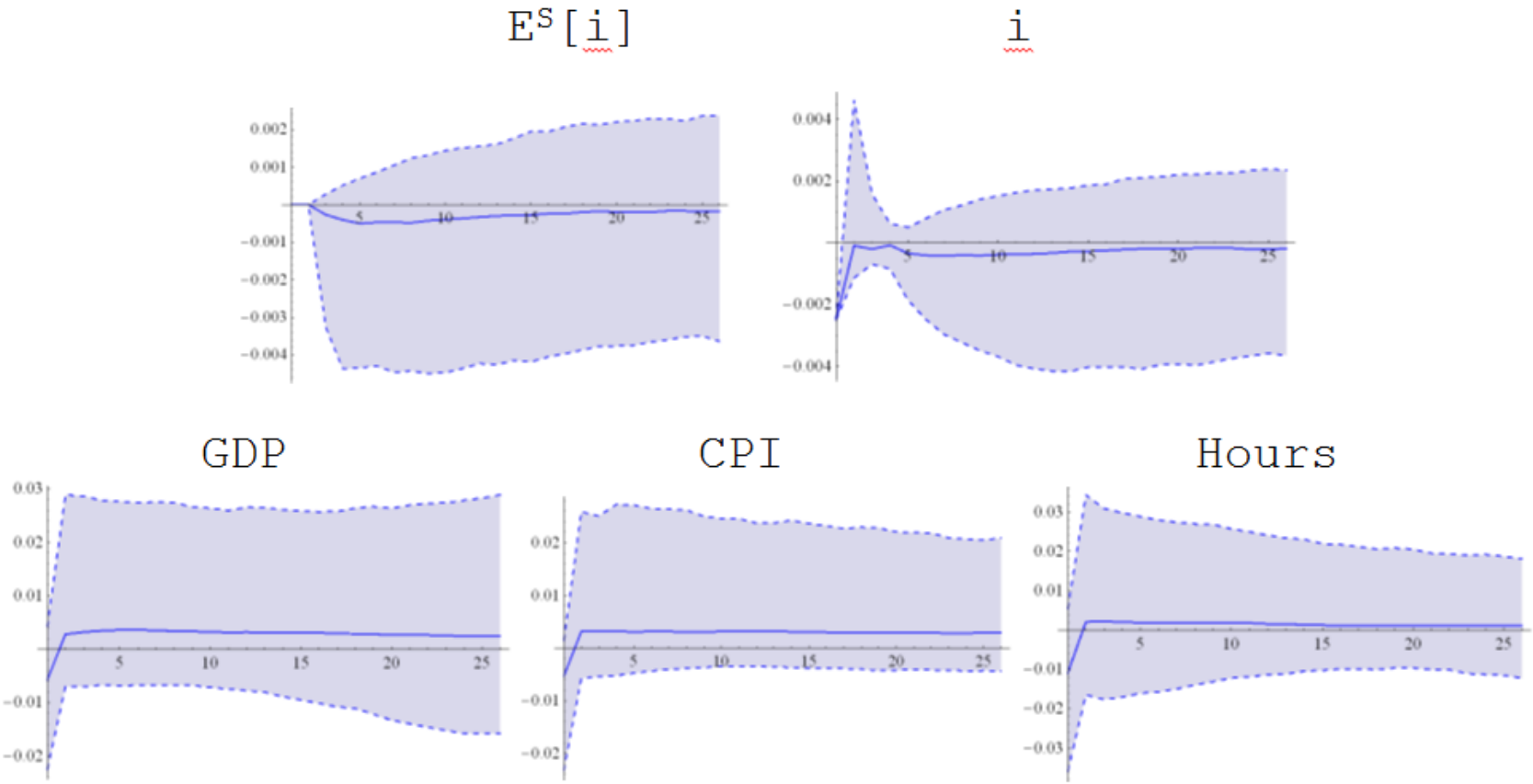
Expectations channel in unanticipated policy

A. Period of shock only (u_0, η_0)



Expectations channel in unanticipated policy

B. Period of shock and subsequent period (u_0, η_0, η_1)

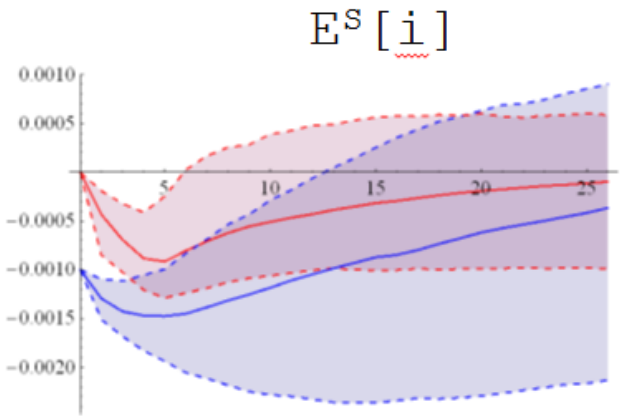


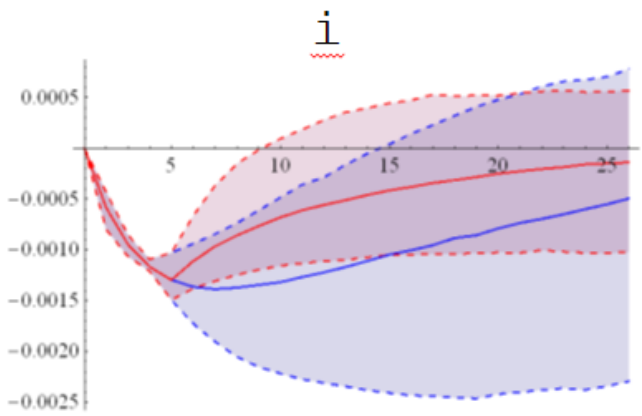
Simuating forward guidance

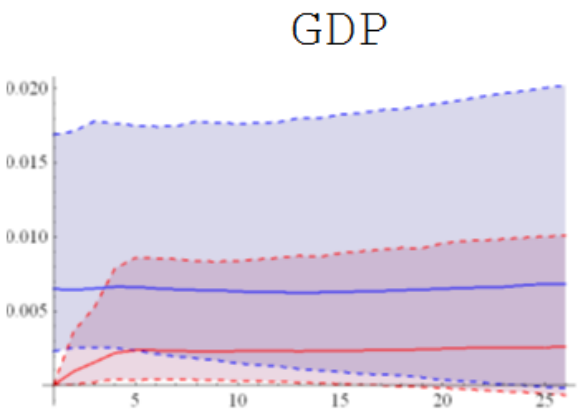
- 10-bp policy-expectations shock in period 0 (4Q horizon)
  - This is approximately the estimated effect of the Q3 2011 forward guidance.
- Compare to a series of unanticipated policy shocks that give the *same TBill path*

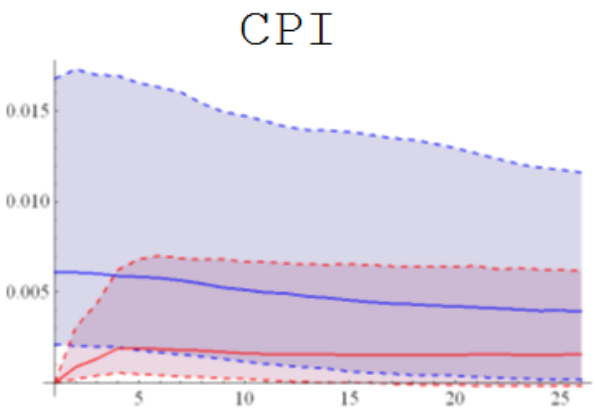
Difference is the marginal effect of FG.

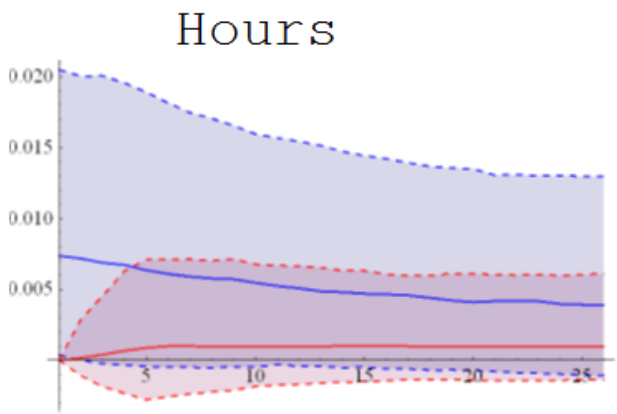
Results: Forward guidance scenario











- Similar marginal effects using standard approaches for unanticipated shocks.

Results: Hypothetical forward guidance at long horizons

Effect on impact

	GDP		CPI		Hours	
FG horizon	Median	*Prob. > 0*	Median	*Prob. > 0*	Median	*Prob. > 0*
1y	0.65	*0.96*	0.61	*0.99*	0.74	*0.85*
6y	1.07	*0.91*	0.85	*0.92*	0.57	*0.83*
11y	1.30	*0.91*	1.21	*0.93*	1.16	*0.89*

Effect after 4 qtrs

	GDP		CPI		Hours	
FG horizon	Median	*Prob. > 0*	Median	*Prob. > 0*	Median	*Prob. > 0*
1y	0.29	*0.75*	0.27	*0.75*	0.53	*0.72*
6y	1.04	*0.91*	0.77	*0.83*	0.59	*0.75*
11y	1.32	*0.93*	1.11	*0.89*	1.15	*0.89*

Effect after 20 qtrs

	GDP		CPI		Hours	
FG horizon	Median	*Prob. > 0*	Median	*Prob. > 0*	Median	*Prob. > 0*
1y	0.26	*0.65*	0.18	*0.66*	0.24	*0.68*
6y	0.70	*0.82*	0.51	*0.81*	0.39	*0.71*
11y	1.01	*0.90*	0.82	*0.85*	0.89	*0.82*

Robustness checks

1-Year Survey Horizon

MODEL	Initial Reaction of $E^S[i]$	GDP 0	GDP 1y	GDP 5y	CPI 0	CPI 1y	CPI 5y	Hours 0	Hours 1y	Hours 5y
Baseline	-0.02*	0.16*	0.17*	0.18	0.16*	0.15*	0.09	0.21	0.18	0.11
Flat IRF prior	-0.01*	0.21*	0.23*	0.23*	0.14*	0.15*	0.11*	0.27*	0.23*	0.16*
$\Gamma^i_q = 0$	-0.01*	0.16*	0.17*	0.17	0.14*	0.14*	0.10*	0.18	0.15	0.10
Excluding ZLB	-0.02*	0.17*	0.14*	0.10	0.12*	0.15*	0.12*	0.12	0.05	0.02
SPF	-0.01*	0.19*	0.14*	0.11	0.18*	0.18*	0.14*	0.14	0.08	0.06
CEE	-0.02*	0.18*	0.18*	0.18	0.18*	0.17*	0.11	0.23*	0.19	0.13
Uhlig	-0.02*	0.18*	0.22*	0.25*	0.14*	0.13*	0.10*	0.22*	0.17	0.14

6-Year Survey Horizon

MODEL	Initial Reaction of $E^S[i]$	GDP 0	GDP 1y	GDP 5y	CPI 0	CPI 1y	CPI 5y	Hours 0	Hours 1y	Hours 5y
Baseline	-0.01*	0.18*	0.19*	0.21*	0.15*	0.17*	0.14*	0.13*	0.14	0.09
Flat IRF prior	-0.01*	0.19*	0.21*	0.22*	0.18*	0.18*	0.13*	0.24*	0.22*	0.13
$\Gamma^i_q = 0$	-0.02*	0.14*	0.17*	0.20*	0.14*	0.13*	0.11*	0.16	0.13	0.10
Excluding ZLB	-0.01*	0.16*	0.16*	0.20*	0.16*	0.19*	0.15*	0.19*	0.19*	0.10*
CEE	-0.02*	0.18*	0.19*	0.23*	0.15*	0.13*	0.11*	0.19*	0.14	0.12*
Uhlig	-0.01*	0.22*	0.21*	0.19*	0.20*	0.21*	0.15*	0.26*	0.25*	0.13*

Conclusion

- We develop a novel method for identifying anticipated deviations from the monetary policy rule.
  - The identification restrictions are consistent with NK theory.
  - The shocks are intepretable as "news" of the type associated with Odyssean forward guidance.
  - The identified shocks correspond to known episodes of forward guidance in the data.
- Policy-expectations shocks have large effects on GDP and inflation (and maybe hours).
  - The effects are immediate and persistent.
  - They are larger than those of unanticipated shocks.
  - They get bigger for longer horizons.
  - These results are all consitent with NK predictions.
- This suggests that forward guidance may be a very effective tool at (and away from) the ZLB.
  - Assuming it is credible and Odyssean.