

Forward Guidance and Heterogenous Beliefs

Philippe Andrade
(BdF)

Gaetano Gaballo
(ECB & BdF)

Eric Mengus
(HEC Paris)

Benoit Mojon
(BdF)

The Future of Forward Guidance
11-12 May 2017, Sveriges Riksbank

The views expressed here are the authors' and do not necessarily represent those of the Banque de France, the ECB or the Eurosystem.

FG in theory

Krugman, Eggertsson-Woodford, Werning

- ▶ Promise to keep interest rate at zero *beyond* the end of the trap
 - ▶ engineer expectations of a boom tomorrow;
 - ▶ positive impact today through real interest rate / Euler eq.;
 - ▶ second best: shortens recession but transitory future inflation;
 - ▶ time-inconsistent: CB prefers not to inflate at the end of the trap.
- ▶ Needs agents understand policy & trust CB's commitment (Woodford, 2012).

FG in practice: puzzling impacts

- ▶ Strong impact on expected int. rates (Swansson-Williams, 2014).
- ▶ But consumption, investment, activity, inflation did not react much.
- ▶ At odds with incredibly strong macroeconomic impact in models.
- ▶ The “FG puzzle” (Del Negro, Giannoni & Patterson, 2015).

Solutions to the puzzle

- ▶ Imperfect information (Angeletos-Lian, 2016).
- ▶ Credit constraints (McKay, Nakamura & Steinsson, 2016).
- ▶ Bounded rationality (Gabaix, 2016; Garcia-Schmidt & Woodford, 2016).
- ▶ Credit constraints & bounded rationality (Farhi & Werning, 2017).
- ▶ Introduce some form of 'discounting' in the Euler equation.

Our approach

- ▶ MP conveys info on **stance** / **state** (Ellingsen & Soderstrom, 2001)
- ▶ FG: promise to keep int. rates at zero can be interpreted differently
 - ▶ “**Odyssean**”: commitment to future accommodation;
 - ▶ “**Delphic**”: signal about future state.
 - ▶ (Terminology introduced by Campbell et al., 2012).

Contributions

1. New facts from surveys:

- ▶ Agreement on future int. rates;
- ▶ But the two interpretations of FG coexisted.

2. Simple NK model with heterogenous beliefs:

- ▶ Agents agree on int. rates but (agree to) disagree on policy;
- ▶ Such disagreement mitigates effectiveness of FG (FG puzzle).

3. Optimal monetary policy:

- ▶ Underline potential detrimental impact of FG;
- ▶ Trying to conduct odyssean FG is not always optimal.

Literature

1. FG less potent than in standard NK models
 - ▶ McKay et al. (2014), Wiederholt (2014), Del Negro et al. (2015), Angeletos-Lian (2016), McKay, Nakamura & Steinsson (2016), Farhi & Werning (2016), Gabaix (2016), Garcia-Schmidt & Woodford (2016), Michelacci & Paciello (2016)...
2. Monetary policy conveys info on future state
 - ▶ Romer & Romer (2000), Ellingsen & Soderstrom (2001), Gurkaynak et al. (2005), Melosi (2014), Nakamura & Steinsson (2016)...
3. Optimal monetary policy at the ZLB
 - ▶ Krugman (1998), Eggertsson & Woodford (2003), Werning (2012), Bassetto (2015), Bilbiie (2016)...
4. Expectation formation using survey data
 - ▶ Mankiw, Reis & Wolfers et al. (2003), Coibion & Gorodnichenko (2012), Andrade & Le Bihan (2013), Coibion & Gorodnichenko (2015), Carvalho & Necchio (2015), Andrade et al. (2016)...

Disagreement about future short-term interest rates

Historical low in Survey of Professional Forecasters starting date-based FG

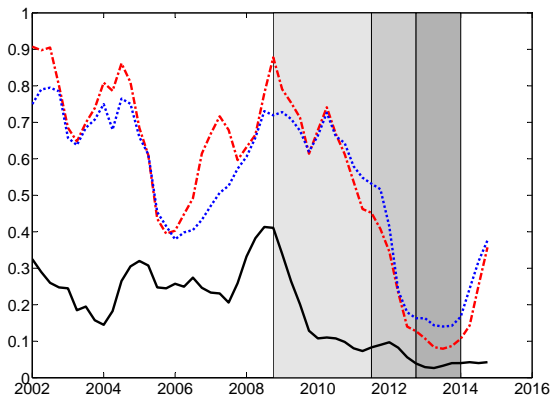


Figure: Disagreement about future 3-month interest rates 1Q (black), 1Y (red) and 2Y (blue) ahead. (Inter-quantile range in US-SPF, 4-quarter moving average)

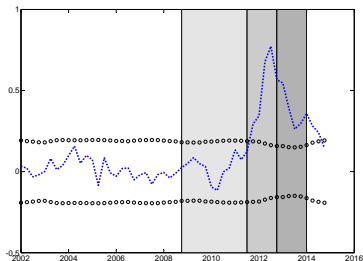
Disagreement on future infl. / cons.

Excess disagreement in SPF starting date-based FG

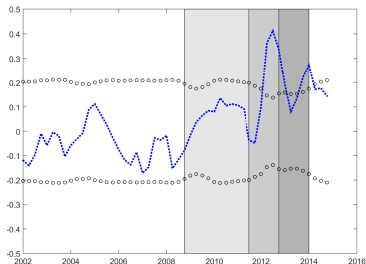
- Historical link with disagreement on interest rate (pre-crisis sample)

$$\text{DIS}(x^h) = \alpha + \beta \text{DIS}(i^h) + \gamma \text{DIS}(x^{1q}) + \epsilon$$

$\hat{\epsilon}(x = \text{INF}, h = 2y)$



$\hat{\epsilon}(x = \text{CONS}, h = 2y)$



Forecasters understood (date-based) FG differently

Define two groups of forecasters using 2-year ahead forecasts:

optimists: revision of both consumption and inflation $>$ average

pessimists: revision of both consumption and inflation $<$ average

After date based FG announcements

1. The average revision of consumption (resp. inflation) by optimists *statistically* differs from the one of pessimists

Forecasters understood (date-based) FG differently

Forecast revisions	Optimists	Pessimists	Not Optimists
2011Q4			
Share of individuals	19%	29%	81%
Consumption	.32 (.28) [** ,#]	-.20 (.19)	-.05 (.41)
Inflation	.19 (.22) [** /#]	-.22 (.14)	-.12 (.55)
Nominal rates	-.41 (.46)	-.38 (.30)	-.42 (.44)
Shadow Taylor-rate	.35 (.25) [*** /###]	-.37 (.14)	-.16 (.37)
2012Q1			
Share of individuals	22%	23%	78%
Consumption	.79 (.33) [*** /##]	.13 (.24)	.19 (.24)
Inflation	.48 (.29) [*** /###]	-.26 (.29)	-.12 (.30)
Nominal rates	-.37 (.55)	-.04 (.08)	-.04 (.07)
Shadow Taylor-rate	.86 (.55) [** /#]	-.17 (.31)	.05 (.35)
2012Q4			
Share of individuals	36%	24%	64%
Consumption	.20 (.19) [*** /###]	-.26 (.22)	-.21 (.26)
Inflation	.19 (.23) [*** /#]	-.32 (.32)	-.17 (.36)
Nominal rates	-.04 (.15)	.02 (.02)	-.02 (.06)
Shadow Taylor-rate	.23 (.30) [*** /##]	-.36 (.27)	-.27 (.26)
Corr(rev. inflation, rev. rates)			
2009Q1-2011Q3	.41 (.07)	.15 (.07)	.24 (.07)
2011Q4-2012Q4	-.26 (.20)	.38 (.25)	.22 (.15)

Forecasters understood (date-based) FG differently

Define two groups of forecasters at DBFG dates using 2-year ahead forecasts:

optimists: revision of both consumption and inflation $>$ average

pessimists: revision of both consumption and inflation $<$ average

After date based FG announcements

1. The average revision of consumption (resp. inflation) by optimists *statistically* differs from the one of pessimists
2. There is no statistical difference in the revision of interest rate of optimists and pessimists

Forecasters understood (date-based) FG differently

Forecast revisions	Optimists	Pessimists	Not Optimists
2011Q4			
Share of individuals	19%	29%	81%
Consumption	.32 (.28) [** ,#]	-.20 (.19)	-.05 (.41)
Inflation	.19 (.22) [** /#]	-.22 (.14)	-.12 (.55)
Nominal rates	-.41 (.46)	-.38 (.30)	-.42 (.44)
Shadow Taylor-rate	.35 (.25) [*** /###]	-.37 (.14)	-.16 (.37)
2012Q1			
Share of individuals	22%	23%	78%
Consumption	.79 (.33) [*** /##]	.13 (.24)	.19 (.24)
Inflation	.48 (.29) [*** /###]	-.26 (.29)	-.12 (.30)
Nominal rates	-.37 (.55)	-.04 (.08)	-.04 (.07)
Shadow Taylor-rate	.86 (.55) [** /#]	-.17 (.31)	.05 (.35)
2012Q4			
Share of individuals	36%	24%	64%
Consumption	.20 (.19) [*** /###]	-.26 (.22)	-.21 (.26)
Inflation	.19 (.23) [*** /#]	-.32 (.32)	-.17 (.36)
Nominal rates	-.04 (.15)	.02 (.02)	-.02 (.06)
Shadow Taylor-rate	.23 (.30) [*** /##]	-.36 (.27)	-.27 (.26)
Corr(rev. inflation, rev. rates)			
2009Q1-2011Q3	.41 (.07)	.15 (.07)	.24 (.07)
2011Q4-2012Q4	-.26 (.20)	.38 (.25)	.22 (.15)

Forecasters understood (date-based) FG differently

Define two groups of forecasters at DBFG dates using 2-year ahead forecasts:

optimists: revision of both consumption and inflation $>$ average

pessimists: revision of both consumption and inflation $<$ average

After date based FG announcements

1. The average revision of consumption (resp. inflation) by optimists *statistically* differs from the one of pessimists
2. There is no statistical difference in the revision of interest rate of optimists and pessimists
3. Extrapolating Taylor rules from past revisions to project implied shadow rates from current expectations on inflation and consumption, optimists understand FG as future accommodation \neq pessimists as future contraction

Forecasters understood (date-based) FG differently

Forecast revisions	Optimists	Pessimists	Not Optimists
2011Q4			
Share of individuals	19%	29%	81%
Consumption	.32 (.28) [** ,#]	-.20 (.19)	-.05 (.41)
Inflation	.19 (.22) [** /#]	-.22 (.14)	-.12 (.55)
Nominal rates	-.41 (.46)	-.38 (.30)	-.42 (.44)
Shadow Taylor-rate	.35 (.25) [*** /###]	-.37 (.14)	-.16 (.37)
2012Q1			
Share of individuals	22%	23%	78%
Consumption	.79 (.33) [*** /##]	.13 (.24)	.19 (.24)
Inflation	.48 (.29) [*** /###]	-.26 (.29)	-.12 (.30)
Nominal rates	-.37 (.55)	-.04 (.08)	-.04 (.07)
Shadow Taylor-rate	.86 (.55) [** /#]	-.17 (.31)	.05 (.35)
2012Q4			
Share of individuals	36%	24%	64%
Consumption	.20 (.19) [*** /###]	-.26 (.22)	-.21 (.26)
Inflation	.19 (.23) [*** /#]	-.32 (.32)	-.17 (.36)
Nominal rates	-.04 (.15)	.02 (.02)	-.02 (.06)
Shadow Taylor-rate	.23 (.30) [*** /##]	-.36 (.27)	-.27 (.26)
Corr(rev. inflation, rev. rates)			
2009Q1-2011Q3	.41 (.07)	.15 (.07)	.24 (.07)
2011Q4-2012Q4	-.26 (.20)	.38 (.25)	.22 (.15)

Forecasters understood (date-based) FG differently

Define two groups of forecasters at DBFG dates using 2-year ahead forecasts:

optimists: revision of both consumption and inflation $>$ average

pessimists: revision of both consumption and inflation $<$ average

After date based FG announcements

1. The average revision of consumption (resp. inflation) by optimists *statistically* differs from the one of pessimists
2. There is no statistical difference in the revision of interest rate of optimists and pessimists
3. Extrapolating Taylor rules from past revisions to project implied shadow rates from current expectations on inflation and consumption, optimists understand FG as future accommodation \neq pessimists as future contraction
4. The correlation between individual revisions of interest rate and inflation expectation flip sign for optimists only

Forecasters understood (date-based) FG differently

Forecast revisions	Optimists	Pessimists	Not Optimists
2011Q4			
Share of individuals	19%	29%	81%
Consumption	.32 (.28) [** ,#]	-.20 (.19)	-.05 (.41)
Inflation	.19 (.22) [** /#]	-.22 (.14)	-.12 (.55)
Nominal rates	-.41 (.46)	-.38 (.30)	-.42 (.44)
Shadow Taylor-rate	.35 (.25) [*** /###]	-.37 (.14)	-.16 (.37)
2012Q1			
Share of individuals	22%	23%	78%
Consumption	.79 (.33) [*** /##]	.13 (.24)	.19 (.24)
Inflation	.48 (.29) [*** /###]	-.26 (.29)	-.12 (.30)
Nominal rates	-.37 (.55)	-.04 (.08)	-.04 (.07)
Shadow Taylor-rate	.86 (.55) [** /#]	-.17 (.31)	.05 (.35)
2012Q4			
Share of individuals	36%	24%	64%
Consumption	.20 (.19) [*** /###]	-.26 (.22)	-.21 (.26)
Inflation	.19 (.23) [*** /#]	-.32 (.32)	-.17 (.36)
Nominal rates	-.04 (.15)	.02 (.02)	-.02 (.06)
Shadow Taylor-rate	.23 (.30) [*** /##]	-.36 (.27)	-.27 (.26)
Corr(rev. inflation, rev. rates)			
2009Q1-2011Q3	.41 (.07)	.15 (.07)	.24 (.07)
2011Q4-2012Q4	-.26 (.20)	.38 (.25)	.22 (.15)

Comparable evidence in HHs survey (Michigan)

- ▶ The share of HHs expecting constant / decreasing IR over next 12M reached a historical high >70%
- ▶ **Optimists**: better business condition & inflation above average
Pessimists: worse business conditions & inflation below average

	Optimists	Pessimists	Not Optimists
Averages observed in 2011m9			
Fraction of respondents	5%	50%	95%
Good times for durable	.50	.27	.25
Inflation	6.64	1.77	3.51
Averages observed in 2012m2			
Fraction of respondents	13%	28%	87%
Good times for durable	.55	.30	.36
Inflation	5.50	1.37	3.10
Averages observed in 2012m10			
Fraction of respondents	15%	30%	85%
Good times for durable	.46	.24	.29
Inflation	7.34	1.95	3.37

Table: Average of qualitative forecasts across groups of households.

A simple NK model with heterogenous beliefs on policy

Standard Eggertsson-Woodford setup with two types of agents

- ▶ Continuum of agents i of two types $(0, 1)$

- ▶ Euler equation

$$c_{i,t} = -\gamma^{-1}(E_{i,t}[\xi_{t+1}] - \xi_t + r_t - E_{i,t}[\pi_{t+1}]) + E_{i,t}[c_{i,t+1}]$$

- ▶ Preference shocks: $t = T^{ZLB}$ is the first period out of the trap

$$\xi_\tau - \xi_{\tau+1} = -\xi \text{ for } \tau = 0, \dots, T^{ZLB} - 1 \text{ zero afterwards}$$

- ▶ Phillips' curve

$$\pi_t = \kappa c_t + \beta \int_0^1 E_{i,t}[\pi_{t+1}] di$$

- ▶ Monetary policy:

$$R_t = (1 + r_t) = \max\{R\Delta_t \Pi_t^\phi, 1\}.$$

- ▶ CB can set $\Delta_t = 0$ to keep rate at the ZLB for T^{CB} .

A simple NK model with heterogenous beliefs on policy

Heterogeneity of beliefs

- ▶ Shocks to the discount factor \Rightarrow ZLB for T^{ZLB} periods.
- ▶ Agents agree CB sets rates at zero for T^{CB} periods.
- ▶ Private sector does not observe T^{ZLB} and disagree on CB's type:

α believe CB is *Delphic* type:

$$E_{0,pes}[T^{ZLB}] = T^{CB},$$

$1 - \alpha$ believe CB is *Odyssean* type:

$$E_{0,opt}[T^{ZLB}] < T^{CB}.$$

- ▶ Agreement on T^{CB} but disagreement on periods of extra accommodation $T^{CB} - T^{ZLB}$.

A simple NK model with heterogenous beliefs on policy

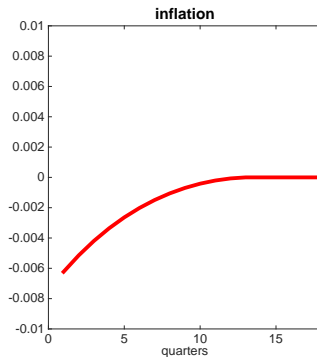
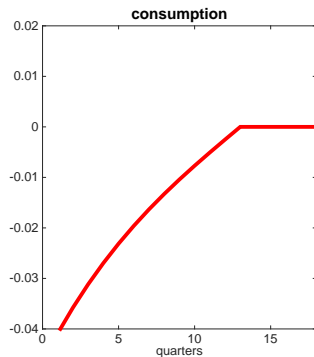
Equilibrium

For a given sequence of shocks $\{\xi_0, \xi_1, \dots\}$, we focus on an equilibrium at time $t = 0$ that satisfies:

- ▶ agents optimize given homogeneous beliefs about the length of the trap and the type of the central bank
- ▶ agents believe CB sets rates optimally given its type
- ▶ beliefs (length of the trap; commitment) are consistent with the current allocation
- ▶ markets clear

Optimal policy

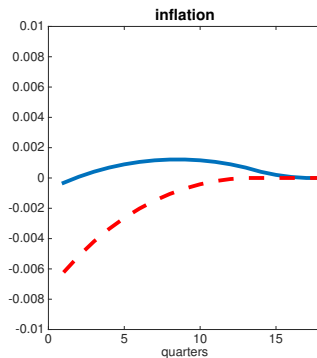
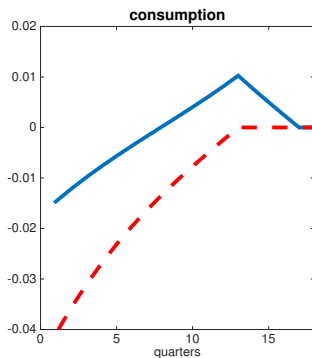
$\alpha = 1$: every agent considers CB is Delphic



- ▶ The shock lasts for 12 quarters.
- ▶ Interest rate is at ZLB for 12 quarters.
- ▶ Optimal policy is Inflation Targeting (Delphic Forward Guidance)

Optimal policy

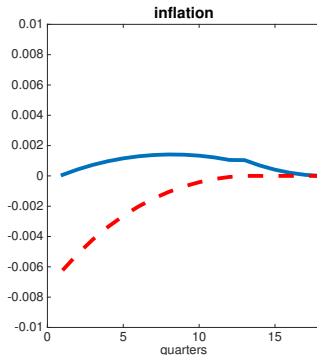
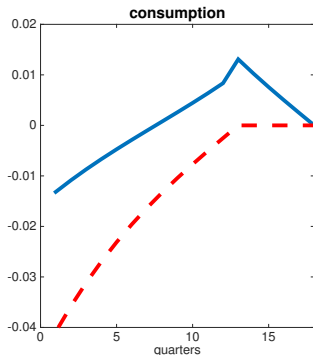
$\alpha = 0$: every agent considers CB is Odyssean



- ▶ The shock lasts for 12 quarters.
- ▶ Interest rate is at ZLB for 12+5 quarters.
- ▶ Optimal policy is Odyssean FG

Optimal policy

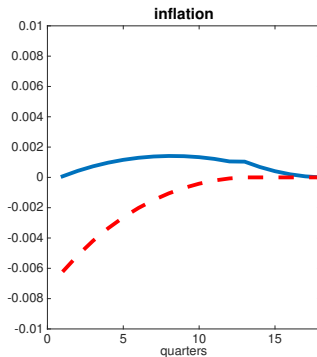
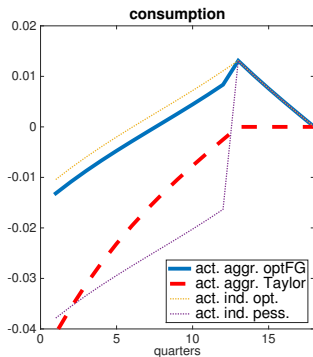
$\alpha = 0.1$: 10% considers CB is Delphic



- ▶ The shock lasts for 12 quarters.
- ▶ Interest rate is at ZLB for 12+6 quarters.
- ▶ Optimal policy is more aggressive Odyssean FG
 - ▶ Bodenstein et al. (2012)

How the model works: actions

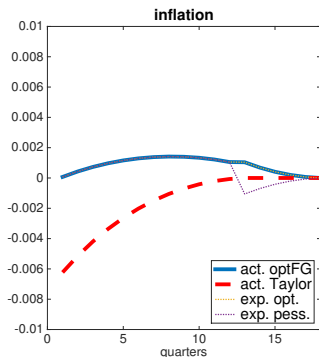
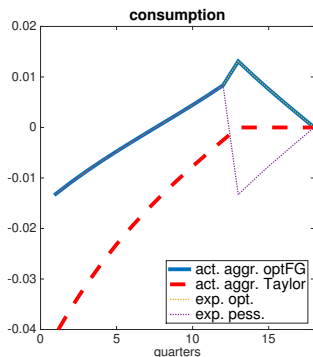
$\alpha = 0.1$: 10% considers CB is Delphic



- ▶ The shock lasts for 12 quarters.
- ▶ Interest rate is at ZLB for 12+6 quarters.
- ▶ Pessimists lower aggregate consumption (FG puzzle).

How the model works: expectations at time 0

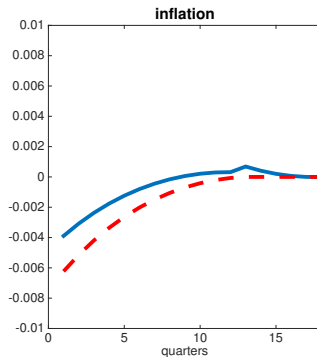
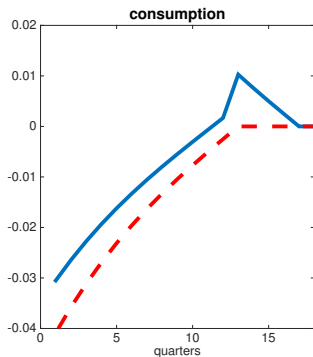
$\alpha = 0.1$: 10% considers CB is Delphic



- ▶ The shock lasts for 12 quarters.
- ▶ Agents *agree* on interest rate at ZLB for 12+6 quarters.
- ▶ Agents *disagree* on inflation and consumption at the end of the trap.

Optimal policy

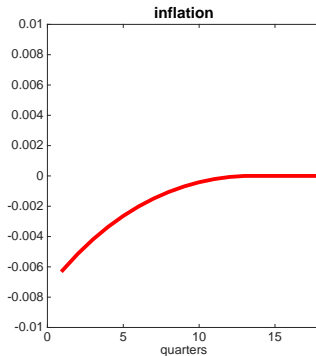
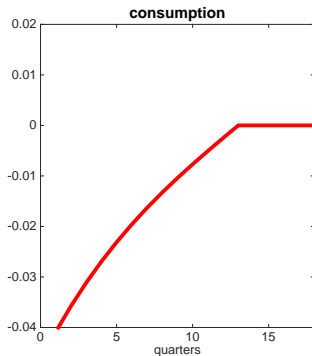
$\alpha = 0.3$: 30% considers CB is Delphic



- ▶ The shock lasts for 12 quarters.
- ▶ Interest rate is at ZLB for 12+5 quarters.

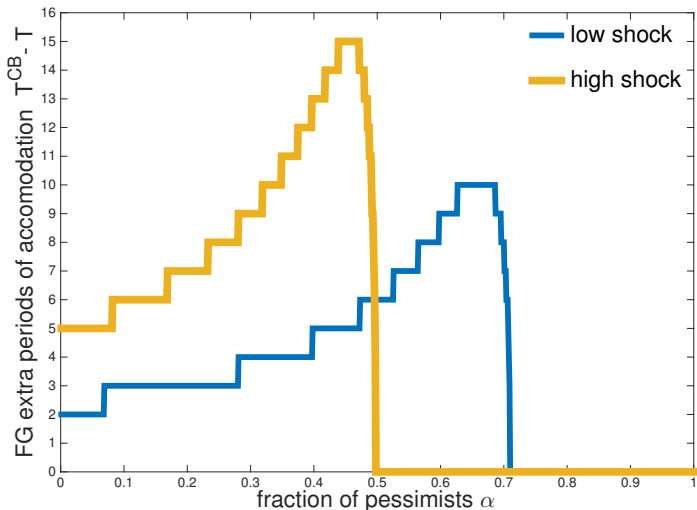
Optimal policy

$\alpha = 0.1$: 50% considers CB is Delphic



- ▶ The shock lasts for 12 quarters.
- ▶ Interest rate is at ZLB for 12+0 quarters.

Optimal Policy with Disagreement



- Trade-off: further accommodation makes delphic more pessimistic.

Conclusion

1. Evidence specific to FG period:

- ▶ Agents agreed on interest rate / disagreed on macro var.
- ▶ Two interpretations of same policy coexisted.

2. We build a std NK model with heterogenous beliefs where:

- ▶ Agents agree on interest rate but disagree on policy;
- ▶ FG is less effective than pure odyssean FG;
- ▶ Odyssean FG is not always optimal.

3. Policy implications:

- ▶ Underline limits of looking at (expected) int. rates to assess FG effectiveness.
- ▶ Emphasize credibility of CB's commitment is key when conducting FG (communication? QE?).

Appendix

FG very effective on IR

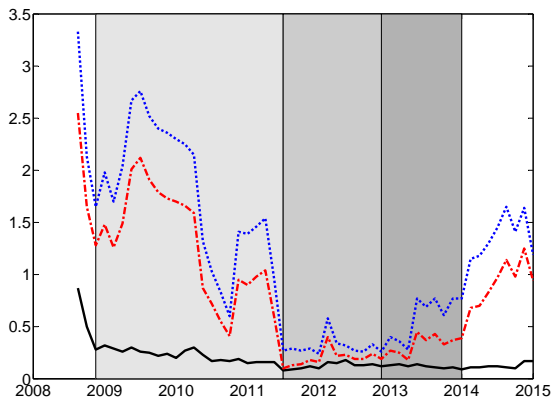
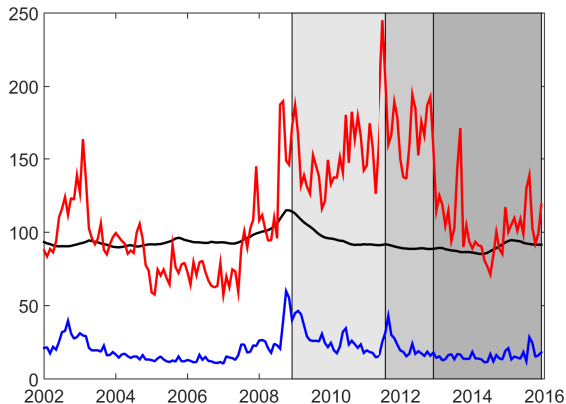


Figure: Expected federal fund rates 1Q (black), 1.5Y (red) and 2Y (blue) ahead. (from OIS, 5-day average after FOMC dates)

Further evidence

No clear impact on uncertainty



FG and change in uncertainty measures: **VIX**, JLN (Jurado-Ludvigson-Ng), **EPU** (Baker-Bloom-Davis).

Can agents agree on future rates but disagree on fundamentals?

Intuition

- ▶ Yes: agree on futures rates but disagree on policy
- ▶ Simple policy rule:

$$r = \phi\Omega + \delta.$$

- ▶ Future interest rate expected by individual i :

$$E_t^i(r) = \phi E_t^i(\Omega) + E_t^i(\delta).$$

- ▶ Heterogeneity in deviations $E_t^i(\delta)$ offsets heterogeneity in fundamentals $E_t^i(\Omega)$.
 - ▶ Optimistic on fundamentals $E_t^j(\Omega) > 0$ sees accommodative deviations $E_t^j(\delta) < 0$.
 - ▶ Pessimistic on fundamentals $E_t^i(\Omega) < 0$ sees restrictive deviations $E_t^i(\delta) > 0$.

A simple NK model with heterogenous beliefs on policy

Households' family

- ▶ Continuum of agents $i \in [0, 1]$ maximizing family's welfare:

$$U_0 = \int_0^1 \sum_{t=0}^{\infty} (\beta e^{\xi_t})^t \left(\frac{C_{i,t}^{1-\gamma} - 1}{1-\gamma} - \frac{L_{i,t}^{1+\psi}}{1+\psi} \right) di.$$

- ▶ Preference shocks:

$$\xi_t = 0 \text{ (normal times); } \xi_t < 0 \text{ (crisis times).}$$

- ▶ Individual budget constraint:

$$P_t C_{i,t} + B_{i,t} = R_{t-1} B_{i,t-1} + W_t L_{i,t} + D_t + Z_{i,t}.$$

- ▶ Intra-household transfers (equate wealth of members):

$$\int_0^1 Z_{i,t} di = 0.$$

A simple NK model with heterogenous beliefs on policy

Firms

- ▶ Final good production:

$$Y_t = \left(\int Y_{j,t}^{\frac{\theta-1}{\theta}} dj \right)^{\frac{\theta}{\theta-1}}.$$

- ▶ Intermediate goods production:

$$Y_{j,t} = L_{j,t}.$$

- ▶ Intermediate goods producers subject to Calvo pricing (proba $1 - \chi$).

A simple NK model with heterogenous beliefs on policy

Information

- ▶ Sequence of shocks $\{\xi_t\}_{t \geq 0}$ such that ZLB binds up to T^{ZLB} .
- ▶ CB knows T^{ZLB} .
- ▶ Private agents:
 - ▶ observe current shock ξ_0 ,
 - ▶ observe the current allocation,
 - ▶ don't know future shocks hence length of the trap T^{ZLB} ,
 - ▶ uncertain about commitment ability of central bank $\{\Delta_t\}_{t \geq 0}$.

How FG was communicated?

Fed experience: weak coordination of opinions

Federal Reserve press release of January 28, 2009:

*The Federal Open Market Committee decided today to keep its target range for the federal fund rate at 0 to 1/4 percent. **The Committee continues to anticipate that economic conditions are likely to warrant exceptionally low levels of the federal funds rate for some time.** [...] The Committee anticipates that a gradual recovery in economic activity will begin later this year, but the downside risks to that outlook are significant.*

How FG was communicated?

Fed experience: strong coordination but different interpretation

Federal Reserve press release of August 9, 2011:

To promote the ongoing economic recovery and to help ensure that inflation, over time, is at levels consistent with its mandate, the Committee decided today to keep the target range for the federal funds rate at 0 to 1/4 percent. The Committee currently anticipates that economic conditions – including low rates of resource utilization and a subdued outlook for inflation over the medium run – are likely to warrant exceptionally low levels for the federal funds rate at least through mid-2013.... The Committee will regularly review the size and composition of its securities holdings and is prepare to adjust those holdings as appropriate.

How FG was communicated?

Fed experience: strong coordination with mostly odyssean interpretation

Federal Reserve press release of September 13, 2012:

To support continued progress toward maximum employment and price stability, the Committee expects that a highly accommodative stance of monetary policy will remain appropriate for a considerable time after the economic recovery strengthens. In particular, the Committee also decided today to keep the target range for the federal funds rate at 0 to 1/4 percent and currently anticipates that exceptionally low levels for the federal funds rate are likely to be warranted at least through mid-2015.

How FG was communicated?

Fed experience: strong coordination with mostly odyssean interpretation

Federal Reserve press release of December 12, 2012:

To support continued progress toward maximum employment and price stability, the Committee expects that a highly accommodative stance of monetary policy will remain appropriate for a considerable time after the asset purchase program ends and the economic recovery strengthens. In particular, the Committee also decided today to keep the target range for the federal funds rate at 0 to 1/4 percent and currently anticipates that exceptionally low levels for the federal funds rate will be appropriate at least as long as the unemployment rate remains above 6-1/2 percent, inflation between one and two years ahead is projected to be no more than a half percent point above the Committee's 2 percent longer-run goal, and longer-term inflation expectations continue to be well anchored.