

# Forward Guidance and Heterogenous Beliefs

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# 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

- ▶ Strong impact on expected short term IR (Swansson-Williams, 2014)
  - ▶ But consumption, investment, activity, inflation did not react much.
- ▶ At odd, with incredibly strong macroeconomic impact in models.
  - ▶ “Forward guidance puzzle” (Del Negro, Giannoni & Patterson, 2015).
- ▶ How to explain that expectations about rates moved so much but agents reacted so little?
  - ▶ Extend the NK model: credit constraints (McKay et al., 2016), bounded rationality (Gabaix, 2016; Farhi-Werning, 2017), imperfect information (Angeletos 2016; Wiederholt 2015)...

# Our approach

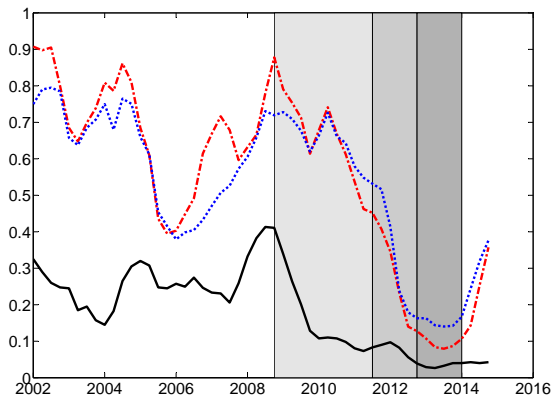
- ▶ The problem is the announcement (Woodford, 2012).
- ▶ *The FOMC has not been clear about the purpose of its forward guidance. Is it purely a transparency device, or is it a way to commit to a more accommodating future policy stance to add more accommodation today?* (C. I. Plosser, March 6, 2014)
- ▶ Announce to keep int. rates low can be interpreted differently
  - ▶ Signal about future state (“Delphic”);
  - ▶ Commitment to future accommodation (“Odyssean”);
  - ▶ (Terminology introduced by Campbell et al., 2012).

# Contributions

1. New facts from survey expectations:
  - ▶ Agreement on future interest 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;
    - ▶ agents view announcement on rates as accurate; but some believe in commitment (Odyssean) and some do not (Delphic).
  - ▶ Such heterogeneity mitigates effectiveness of FG (FG puzzle).
3. Optimal monetary policy:
  - ▶ Emphasize a trade-off at the ZLB:
    - ▶ improving expectations of believers in commitment (Odyssean) comes at the cost of inducing excess pessimism for non-believers (Delphic).
  - ▶ Potential detrimental impact of odyssean FG.

# Disagreement about future short-term interest rates

Historically low starting date-based FG



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

# 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
<b>2011Q4</b>			
Share of individuals	19%	29%	81%
Consumption	.32 (.28) [ <b>**</b> ,#]	-.20 (.19)	-.05 (.41)
Inflation	.19 (.22) [ <b>**</b> /#]	-.22 (.14)	-.12 (.55)
Nominal rates	-.41 (.46)	-.38 (.30)	-.42 (.44)
Shadow Taylor-rate	.35 (.25) [ <b>***</b> /###]	-.37 (.14)	-.16 (.37)
<b>2012Q1</b>			
Share of individuals	22%	23%	78%
Consumption	.79 (.33) [ <b>***</b> /###]	.13 (.24)	.19 (.24)
Inflation	.48 (.29) [ <b>***</b> /###]	-.26 (.29)	-.12 (.30)
Nominal rates	-.37 (.55)	-.04 (.08)	-.04 (.07)
Shadow Taylor-rate	.86 (.55) [ <b>**</b> /#]	-.17 (.31)	.05 (.35)
<b>2012Q4</b>			
Share of individuals	36%	24%	64%
Consumption	.20 (.19) [ <b>***</b> /###]	-.26 (.22)	-.21 (.26)
Inflation	.19 (.23) [ <b>***</b> /#]	-.32 (.32)	-.17 (.36)
Nominal rates	-.04 (.15)	.02 (.02)	-.02 (.06)
Shadow Taylor-rate	.23 (.30) [ <b>***</b> /###]	-.36 (.27)	-.27 (.26)
Corr(rev. inflation, rev. rates)			
<b>2009Q1-2011Q3</b>	.41 (.07)	.15 (.07)	.24 (.07)
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Define two groups of forecasters at DBFG dates using 2-year ahead forecasts:

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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. Estimating Taylor rules from past revisions to project implied shadow rates from current expectations on inflation and consumption, optimists understand FG as future accommodation (Odyssean)  $\neq$  pessimists as no accommodation (Delphic)

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4. The correlation btw individual revisions of interest rate and inflation expectation flips sign for optimists (disagreement on policy rather than on fundamentals)

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# Theory

# A simple NK model with heterogenous beliefs on policy

## Overview

- ▶ 3 ingredients in an otherwise standard NK model of the ZLB
  - ▶ private agents uncertain about future fundamentals;
  - ▶ view CB's announcements on future rate as accurate;
  - ▶ different views on CB's commitment (cannot be observed at ZLB).
- ▶ Equilibrium where agents agree on future rates but (agree to) disagree on the policy implemented.
- ▶ Here particular case: the perceived precision of CB's signal is infinite.



# 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

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

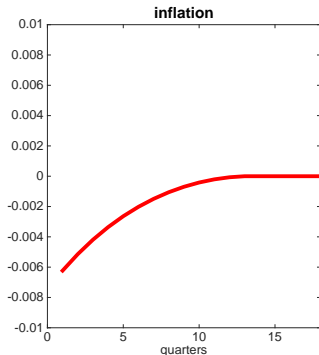
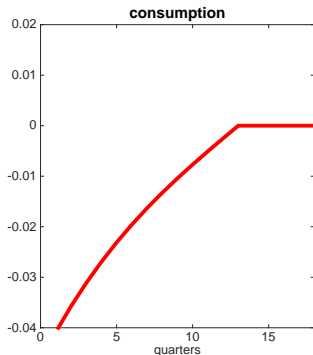
# A simple NK model with heterogenous beliefs on policy

## Information

- ▶ Shocks to the discount factor  $\Rightarrow$  ZLB for  $T^{ZLB}$  periods.
- ▶ CB announces that rates stay at zero for  $T^{CB}$ .
- ▶ Agents agree on  $T^{CB}$  periods of rates at ZLB (then back to normal).
- ▶ Private sector does not observe  $T^{ZLB}$  and disagrees on CB's type:
  - $1 - \alpha$  believe CB is of Odyssean type:  $E_{0,opt}[T^{ZLB}] < T^{CB}$
  - $\alpha$  believe CB is of Delphic type:  $E_{0,pess}[T^{ZLB}] = T^{CB}$
- ▶ Agreement on  $T^{CB}$  but disagreement on number of periods of extra accommodation  $T^{CB} - T^{ZLB}$ .

# Optimal policy

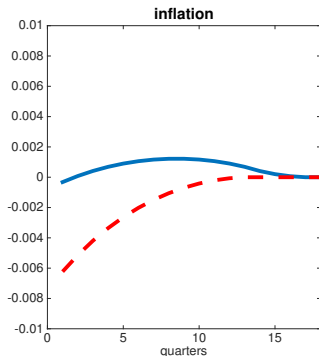
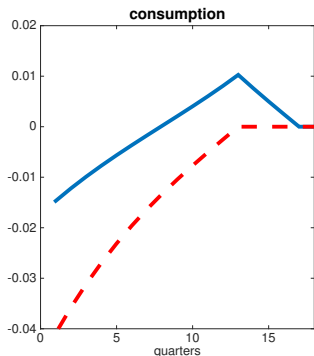
$\alpha = 1$ : every agent considers CB is Delphic



- ▶ The shock lasts for 12 quarters.
- ▶ Interest rate is at ZLB for 12 quarters.
- ▶ Optimal policy is Inflation Targeting (Delphic Forward Guidance).
- ▶ Agents *agree* on interest rate and *agree* on fundamentals.

# Optimal policy

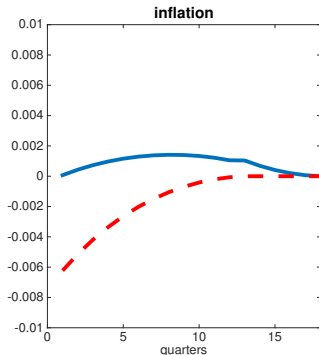
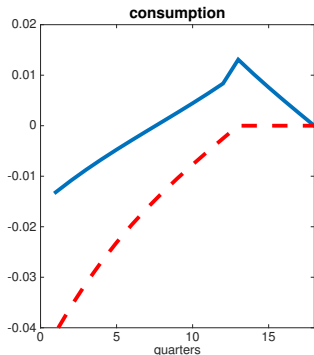
$\alpha = 0$ : every agent considers CB is Odyssean



- ▶ The shock lasts for 12 quarters.
- ▶ Interest rate is at ZLB for 12+5 quarters.
- ▶ Optimal policy is Odyssean FG.
- ▶ Agents *agree* on interest rate and *agree* on fundamentals.

# Optimal policy

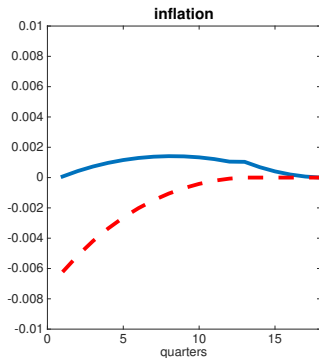
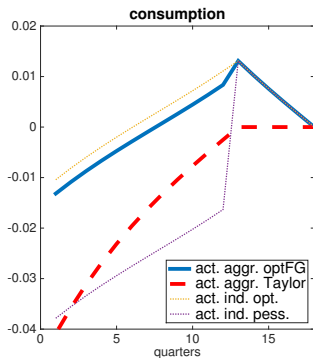
$\alpha = 0.1$ : 10% considers CB is Delphic



- ▶ The shock lasts for 12 quarters.
- ▶ Interest rate is at ZLB for 12+6 quarters.
- ▶ Optimal policy is more aggressive Odyssean FG
- ▶ Agents *agree* on interest rate and *disagree* on fundamentals.

# How the model works: actions

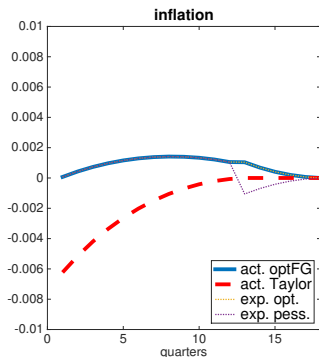
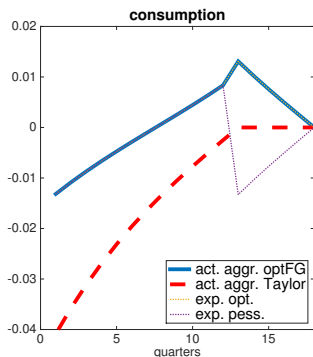
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- ▶ The shock lasts for 12 quarters.
- ▶ Interest rate is at ZLB for 12+6 quarters.
- ▶ Pessimists lower aggregate consumption (FG puzzle).

# How the model works: expectations at time 0

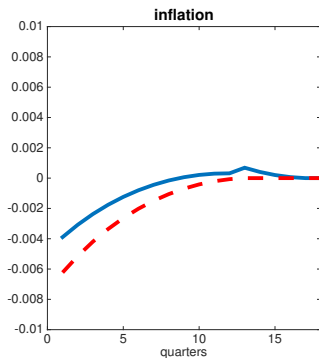
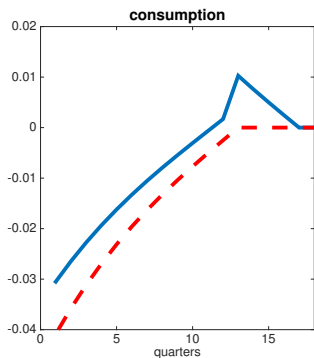
$\alpha = 0.1$ : 10% considers CB is Delphic



- ▶ 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

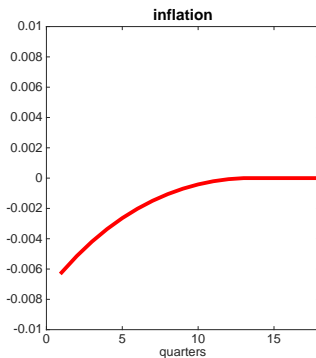
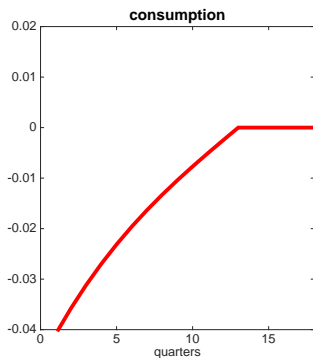


- ▶ The shock lasts for 12 quarters.
- ▶ Interest rate is at ZLB for 12+5 quarters.



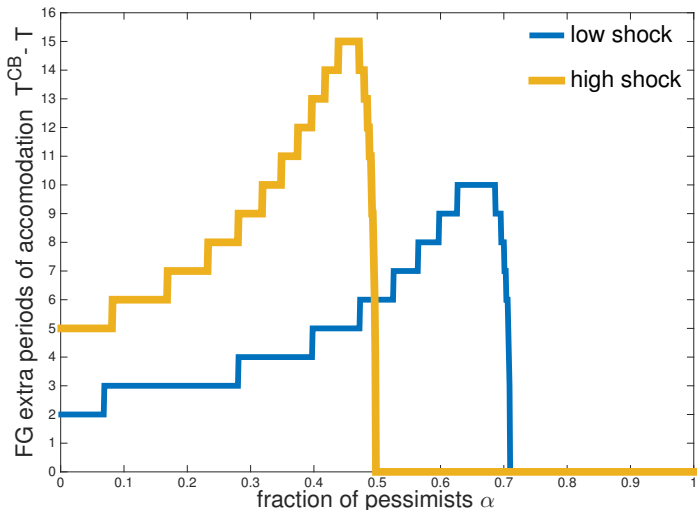
# Optimal policy

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



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

# Optimal Policy with Disagreement



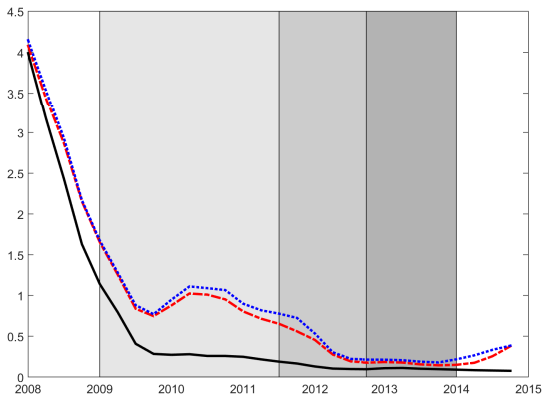
- Trade-off: further accommodation makes delphic more pessimistic.

# 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

## Sizeable drop of expected IR during FG period

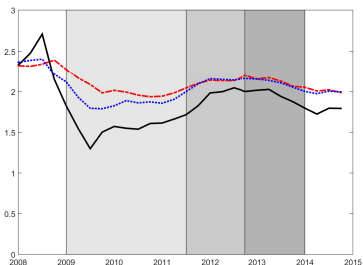


**Figure:** Average of 1-quarter (black line), 1-year (red line), and 2-year (blue line) ahead individual mean point forecasts for 3-month TBill rate in US SPF.

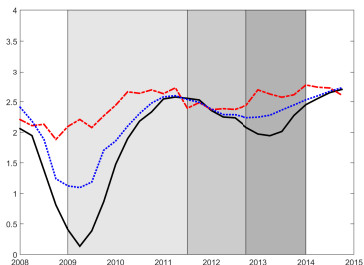
# Average of individuals' inflation / consumption forecasts

No noticeable move during FG period (drop in consumption)

## Inflation



## Consumption



**Figure:** Average of 1-quarter (black line), 1-year (red line), and 2-year (blue line) ahead individual mean point forecasts for real consumption growth and CPI inflation in US SPF.

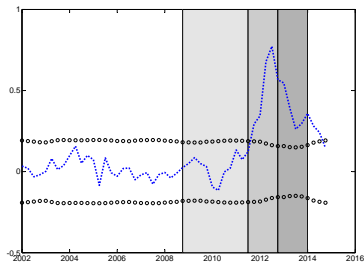
# Excess disagreement on future infl. / cons.

Starting date-based FG

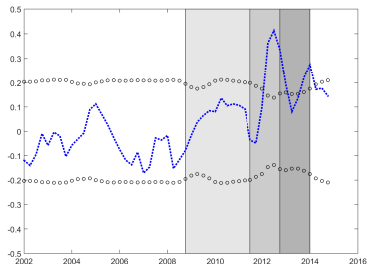
- ▶ Estimate link btw disagreements pre-crisis

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

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

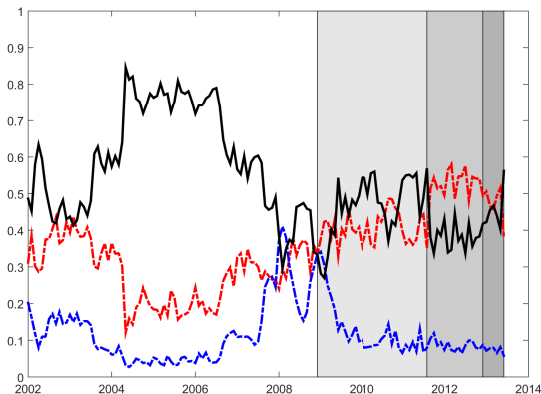


$\hat{\epsilon}(x = \text{CONS}, h = 2y)$



# Comparable evidence in HHs survey (Michigan)

- ▶ The share of HHs expecting constant IR over next 12M reached a historical high  $>50\%$



**Figure:** Fraction of HH in the Michigan survey expecting IR will increase (black), stay constant (red) or decrease (blue) over the next 12 months.



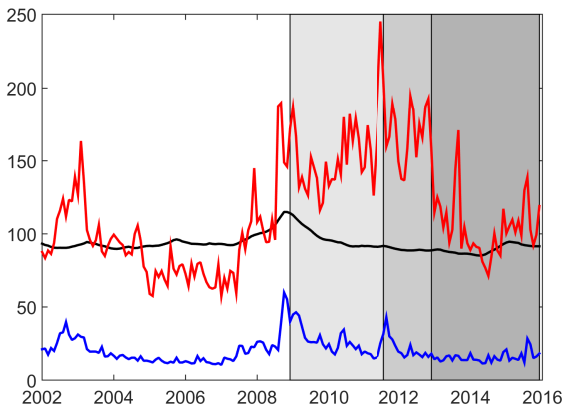
# Comparable evidence in HHs survey (Michigan)

- ▶ **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

# Further evidence

No clear impact on uncertainty



The chart displays the evolution of 3 different measures of uncertainty: the CBOE financial market volatility index (VIX, blue line), the macroeconomic uncertainty measure developed by Jurado et al. (2015) (JLN, dark line), the economic policy uncertainty measure developed by Bloom et al. (2016) (EPU, red line).

# 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:

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

- ▶ 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

## 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
- ▶ agents believe the central bank set rates optimally, but does not observe commitment ability
- ▶ beliefs (length of the trap; commitment) are consistent with the current allocation
- ▶ markets clear

# 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?

ECB experience

ECB introductory statement of July 4, 2013:

*The Governing Council expects the key ECB interest rates to remain at present or lower levels for an extended period of time. This expectation is based on the overall subdued outlook for inflation extending into the medium term, given the broad-based weakness in the real economy and subdued monetary dynamics.*

# Communication on expanded APP

Current statement

ECB, introductory statement of April, 15 2015

*Purchases are intended to run until the end of September 2016 and, in any case, until we see a sustained adjustment in the path of inflation that is consistent with our aim of achieving inflation rates below, but close to, 2% over the medium term.*

*When carrying out its assessment, the Governing Council will follow its monetary policy strategy and concentrate on trends in inflation, looking through unexpected outcomes in measured inflation in either direction if judged to be transient and to have no implication for the medium-term outlook for price stability.*