Federal Reserve Credibility and the Term Structure

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Society for Economic Measurement

Effect of monetary policy on term structure of interest rates

- Policymakers: Monetary policy transmission mechanism
- Bond Traders: Informed investment decisions

Large finance literature on latent-factor models

- No clear economic interpretation of factors

Motivation

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New and growing macro finance literature

- reduced form macro dynamics

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Newer macro-finance literature with structural macro models

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⇒ This paper: Explore implications of optimal monetary policy on the term structure in a structural macro model

This paper: Optimal monetary policy and term structure

Optimal monetary policy

- in a setting with forward looking agents

Current choices affected by future policies

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Current choices affected by future policies

Time-inconsistency problem

Kydland & Prescott (1977), Barro & Gordon (1983)

"economic planning is not a game against nature but, rather, a game against rational economic agents"

Optimal Monetary Policy Literature

Typically one of two cases

① Full Commitment

- Central bank is fully credible

② Discretion or No Commitment

- Central bank thinks it has no effect on agents expectations

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This paper: **Loose Commitment**

- Nests full commitment and discretion

Commitment

Discretion

This paper: Loose Commitment

The policymaker has access to a commitment technology ... BUT

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In each period:

with Prob. γ : Follow plan

with Prob. $1-\gamma$: Re-Optimize

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NOTE:
Re-Optimization $\neq$ Discretion

This Paper: Loose Commitment

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Limiting cases:

$\gamma=0 \rightarrow$ Discretion

$\gamma=1 \rightarrow$ Full-Commitment

Optimal Monetary policy and the term structure in simple model

- Flexible loose commitment framework
- Show how degree of credibility affects the term structure
- Show how re-optimization shocks affect term structure factors

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Medium scale regime-switching DSGE model

- Bayesian MCMC estimation
- Counterfactual: How would bond yields have behaved under different credibility scenarios?
- Historical effects of Re-optimization shocks

Preview of Results

- Probability of commitment (γ): 0.86
- Re-optimization shocks affect the “curvature” of the yield curve
- Yield data cannot be explained well by either commitment or discretion

Loose Commitment Literature (Theory)

- Roberds (1987), Schaumburg & Tambalotti (2007), Debortoli & Nunes (2010), Debortoli et. al (forthcoming)

Commitment Literature (Empirical)

- Ireland (1999), Givens (2012), Kirsanova et. al (2012), Coroneo et. al (2012), Debortoli & Lakdawala (2014)

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Monetary Policy & Term Structure in DSGE Models

- Rudebusch & Swanson (2012), Van Binsbergen et al (2010), Dew-Becker (2014)

Optimal monetary policy & term structure

- Palomino (2012)

Intuition: Simple Model

Central bank loss function

$$\min \frac{1}{2} E_0 \sum_{t=0}^{\infty} \beta^t [\kappa y_t^2 + \theta \pi_t^2]$$

s.t.

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

$$y_t = E_t y_{t+1} - \frac{1}{\sigma} (i_t - E_t \pi_{t+1})$$

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FOC:(Full Commitment)

$$\pi_t = -\frac{1}{\theta} [y_t - y_{t-1}]$$

i.i.d. cost-push shock

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Bond Pricing

Price of n-period zero coupon bond

$$P_{n,t} = E_t [M_{t+1} P_{n-1,t+1}]$$

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M_{t+1} : Stochastic Discount Factor

In the simple model: CRRA utility with risk aversion parameter σ

$$M_{t+1} = \beta \left(\frac{y_{t+1}}{y_t} \right)^{-\sigma} \frac{1}{\pi_{t+1}}$$

Let $z_t = [y_t, \pi_t]$, then

$$\log(M_{t+1}) = -\lambda_0 - \lambda'_1 z_{t+1} - \lambda'_2 z_t \quad (1)$$

Under loose commitment, solution to macro model

$$\begin{aligned} z_t &= F_{s_t} z_{t-1} + G v_t \\ v_t &\sim N(0, Q) \end{aligned}$$

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Bond Price:

$$\begin{aligned}P_{n,t} &= \exp\{-A_n - B'_n z_t\} \\A_n &= A_{n-1} + \lambda_0 - \frac{1}{2}(\lambda_1 + B_{n-1})' G Q G' (\lambda_1 + B_{n-1}) \\B_n &= \bar{F}' B_{n-1} + (\lambda_2 + \bar{F}' \lambda_1)\end{aligned}$$

where

$$\bar{F} = \gamma F_{(s_t=1)} + (1 - \gamma) F_{(s_t=0)}$$

Model implied yield curve

Effect of re-optimization (after i.i.d. cost-push shock)

Response of term structure factors to re-optimization shock (after i.i.d. cost-push shock)

Medium-Scale DSGE Model

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- Embed optimal policy under loose commitment
- Regime-switching estimation using macro and yield data
- Explore implications for term structure

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Smets & Wouters (2007)AER:

- Nominal rigidities, markup shocks, capital adjustment costs
- 7 observable variables, 7 shocks

Optimal Policy under Loose Commitment: Central Bank

Quadratic loss function

$$E_0 \sum_{t=0}^{\infty} \beta^t x_t' W x_t$$

Specific Loss function for Baseline Results

$$\pi_t^2 + w_y \tilde{y}_t^2 + w_r (i_t - i_{t-1})^2$$

Optimal Policy under Loose Commitment: Central Bank

The central bank's problem is:

$$x'_{-1} V x_{-1} + d = \min_{\{x_t\}_{t=0}^{\infty}} E_0 \sum_{t=0}^{\infty} (\beta \gamma)^t [x'_t W x_t + \beta (1 - \gamma) (x'_t V x_t + d)]$$

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$$\text{s.t.} \quad A_{-1} x_{t-1} + A_0 x_t + \gamma A_1 E_t x_{t+1} + (1 - \gamma) A_1 E_t x_{t+1}^r + B v_t = 0$$

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Solution to planner's problem

$$z_t = F_{s_t} z_{t-1} + G v_t$$

where $z_t \equiv [x_t, \lambda_t]$, λ_t denote Lagrange multipliers.

Data 1984:Q1 - 2008:Q3

Macro Data: 7 observables (Same as Smets & Wouters)

- 1 Real GDP
- 2 Real Consumption
- 3 Real Investment
- 4 Real Wages
- 5 Hours
- 6 GDP Deflator
- 7 ~~Fed Funds Rate~~ 3 month T-bill

Yield Data: Zero-coupon Treasury rates (Gurkaynak et al)

- 1 6 month
- 2 1 year
- 3 3 year
- 4 6 year
- 5 10 year

Model setup for estimation

$$\begin{aligned}x_t^{obs} &= A + Hz_t + w_t \\z_t &= F_{s_t} z_{t-1} + Gv_t\end{aligned}$$

$$\begin{aligned}w_t &\sim N(0, R) \\v_t &\sim N(0, Q)\end{aligned}$$

$$s_t = \begin{cases} 1 & \text{if no reoptimization} \\ 0 & \text{if reoptimization} \end{cases}$$

Transition matrix of s_t

$$P = \begin{bmatrix} \gamma & 1 - \gamma \\ \gamma & 1 - \gamma \end{bmatrix}$$

Model Fit

Model implied steady state yields

	6 month	1 year	3 year	6 year	10 year
Data (Average)	4.95	5.41	5.93	6.41	6.81
Loose Commitment	4.68	4.73	5.44	6.04	6.60
Full Commitment	5.12	5.21	5.72	5.86	6.08
Discretion	3.23	2.98	3.26	3.67	4.28

Prob of Commitment: $\gamma = .86$ (Posterior mean)

Figure: Smoothed Probability of Re-optimization

Re-optimization effect on yields

Re-optimization effect on “factors”

Counterfactual

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- Estimated DSGE model to explore how credibility affects term structure
- Re-optimization shocks affect the “curvature” of the yield curve
- Yield data cannot be explained well by either commitment or discretion

Thank you!