Credit Frictions and Optimal Monetary Policy

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[1] The views expressed in this paper are those of the author and do not necessarily reflect the position of the Federal Reserve Bank of New York or the Federal Reserve System.

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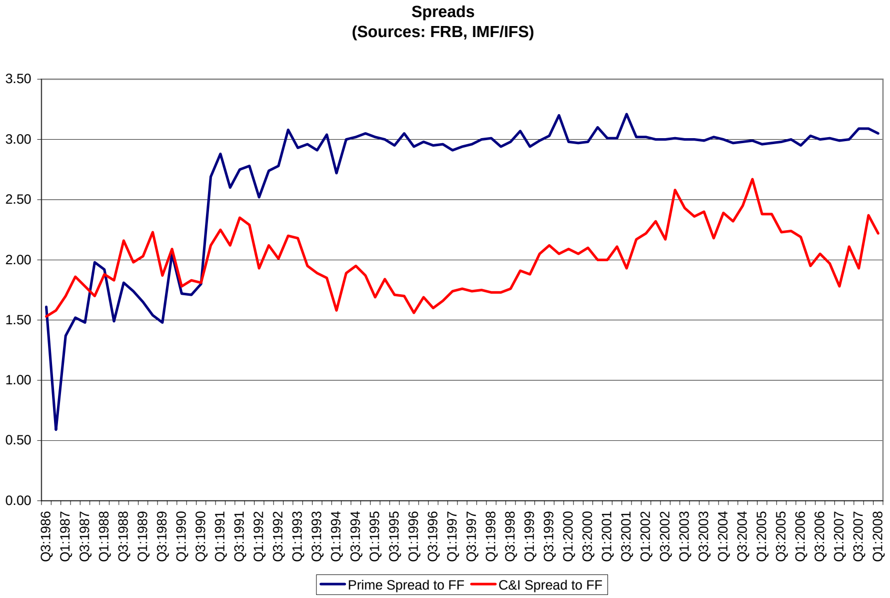
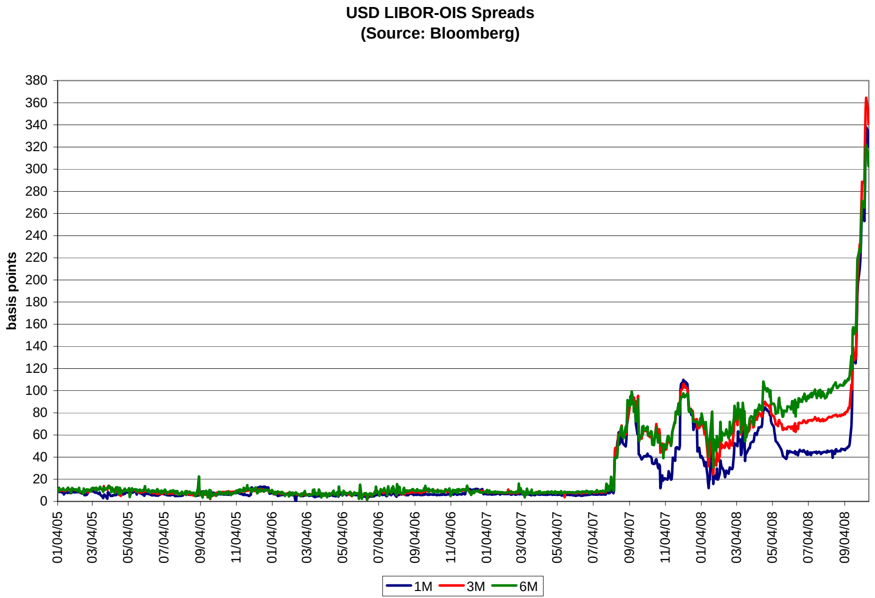
- But in actual economies (even financially sophisticated)
  - different interest rates
  - rates do not move perfectly together

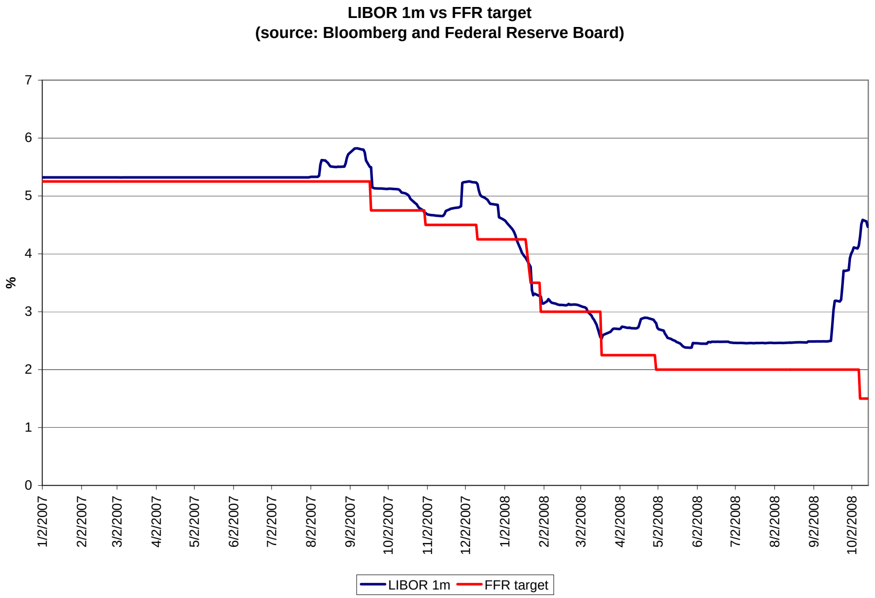
Spreads change over time



Spreads volatility



Policy and lending rates



Questions

- How much is monetary policy analysis changed by recognizing existence of spreads between different interest rates?

- How should policy respond to "financial shocks" that disrupt financial intermediation, dramatically widening spreads?

Systematic response to spreads?

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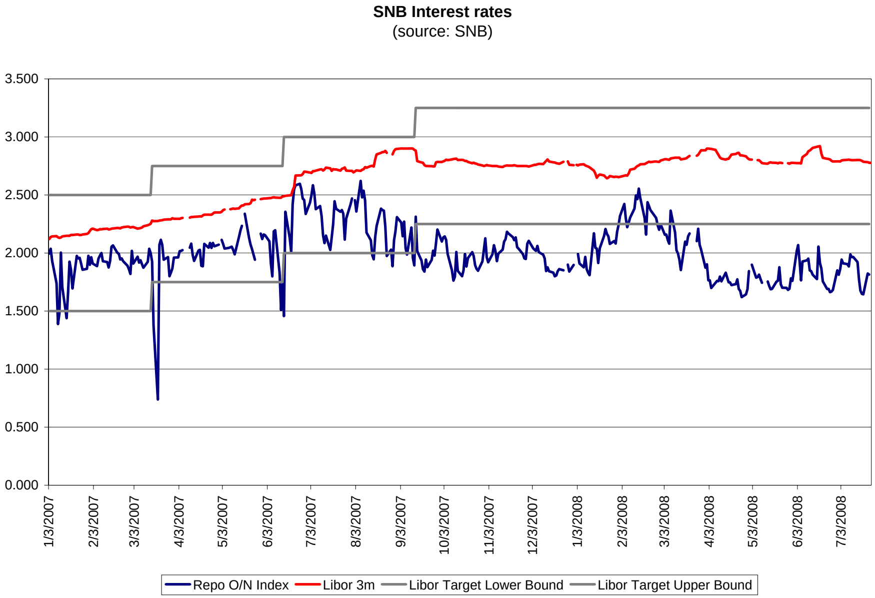

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- **Question**: Is a systematic response of that kind desirable?

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- Each household has type $\tau_t(i) \in \{b, s\}$, determining preferences

$$E_0 \sum_{t=1}^{\infty} \beta^t \left[u^{\tau_t(i)}\left(c_t(i); \xi_t\right) - \int_0^1 v\left(h_t(j; i); \xi_t\right) dj \right]$$

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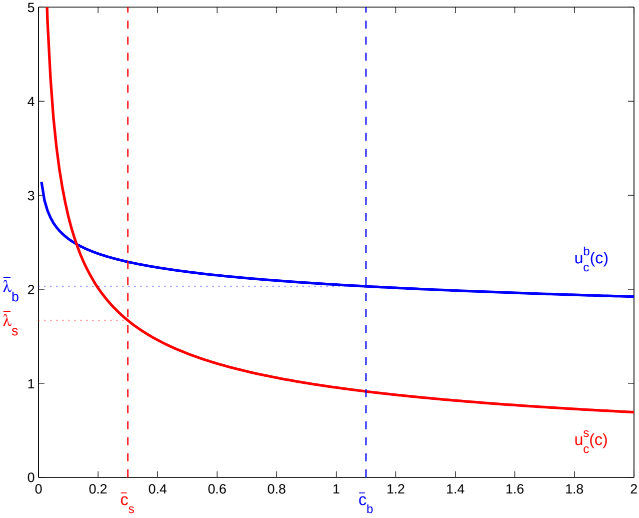
  - each period type remains same with probability $\delta < 1$
  - when draw new type, always probability π_τ of becoming type τ

Model: Marginal utilities of two types



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- MUI and expenditure same each period for households of a given type

Model: Aggregate demand

- Euler equation for each type $\tau \in \{b, s\}$:

$$\lambda_t^\tau = \beta E_t \left\{ \frac{1 + i_t^\tau}{\Pi_{t+1}} \left[\delta \lambda_{t+1}^\tau + (1 - \delta) \lambda_{t+1} \right] \right\}$$

where

$$\lambda_t \equiv \pi_b \lambda_t^b + \pi_s \lambda_t^s$$

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- Aggregate demand relation:

$$Y_t = \sum_\tau c^\tau \left(\lambda_t^\tau ; \xi_t \right) + G_t + \Xi_t$$

  where Ξ_t denotes resources used in intermediation

Model: Log-linear IS

- Intertemporal IS relation:

$$\begin{aligned}\hat{Y}_t &= E_{t+1}\hat{Y}_{t+1} - \bar{\sigma}\left[\hat{\imath}_t^{avg} - \pi_{t+1}\right] - E_t\Delta g_{t+1} \\ &\quad - E_t\Delta\hat{\Xi}_{t+1} - \bar{\sigma}s_\Omega\hat{\Omega}_t + \bar{\sigma}\left(s_\Omega + \psi_\Omega\right)E_t\hat{\Omega}_{t+1}\end{aligned}$$

where

$$\begin{aligned}\hat{\imath}_t^{avg} &\equiv \pi_b\hat{\imath}_t^b + \pi_s\hat{\imath}_t^d \\ \hat{\Omega}_t &\equiv \hat{\lambda}_t^b - \hat{\lambda}_t^s \\ g_t &\equiv \text{composite exogenous disturbance to expenditure} \\ \bar{\sigma} &\equiv \pi_b s_b\sigma_b + \pi_s s_s\sigma_s > 0 \\ s_\Omega &\equiv \pi_b\pi_s\frac{s_b\sigma_b - s_s\sigma_s}{\bar{\sigma}}\end{aligned}$$

Model: Marginal utility gap and spreads

- Determination of the marginal utility gap:

$$\hat{\Omega}_t = \hat{\omega}_t + \hat{\delta} E_t \hat{\Omega}_{t+1}$$

where

$$\begin{aligned} \hat{\omega}_t &\equiv \hat{\imath}_t^b - \hat{\imath}_t^d \\ \hat{\delta} &< 1 \end{aligned}$$

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$$d_t = b_t + \Xi_t\left(b_t\right)$$

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$$\omega_t\left(b_t\right) = \Xi_{bt}\left(b_t\right)$$

- More generally,

$$1 + \omega_t\left(b_t\right) = \mu_t^b\left(b_t\right)\left(1 + \Xi_{bt}\left(b_t\right)\right)$$

where μ_t^b is markup in banking sector

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- Rate that matters for the IS relation:

$$\hat{\imath}_t^{avg} = \hat{\imath}_t^d + \pi_b \hat{\omega}_t$$

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  - Dixit-Stiglitz monopolistic competition
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- Only difference: labor supply depends on both MUI: λ_t^b and λ_t^s

Model: AS relation

- Log-linear AS generalizes NK Phillips curve:

$$\pi_t = \beta E_t \pi_{t+1} + \kappa \left(\hat{Y}_t - \hat{Y}_t^n \right) + u_t + \xi \left(s_\Omega + \pi_b - \gamma_b \right) \hat{\Omega}_t - \xi \bar{\sigma}^{-1} \hat{\Xi}_t$$

  where

  - $\hat{Y}_t^n$, u_t, κ, ξ defined exactly as in basic NK
  - $\bar{\sigma}$ is average of elasticity of two types
  - $\gamma_b \equiv \pi_b \left(\bar{\lambda}^b / \bar{\bar{\lambda}} \right)^{1/\nu}$, with $\bar{\bar{\lambda}}$ an average of MUI of two types

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  - $\hat{\Xi}_t$ terms vanish
  - $\hat{\omega}_t$ exogenous $\Rightarrow$ $\hat{\Omega}_t$ exogenous
- Usual 3-equation model suffices to determine paths of $\left\{ \hat{Y}_t, \pi_t, \hat{\imath}_t^{avg} \right\}$
  - AS relation
  - IS relation
  - MP relation (written in terms of $\hat{\imath}_t^{avg}$, given exogenous spread)

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- Responses to **financial shocks** equivalent to responses to 3 shocks in simultaneous:
  - monetary policy shock
  - "cost-push" shock
  - shift in natural rate of interest

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  - Need to include law of motion for private debt b_t
- Resort to numerical solution of calibrated examples
  - see how much difference the credit frictions make

Calibration

- Preferences heterogeneity:
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- Assume $\sigma_b / \sigma_s = 5$
  - implies credit contracts in response to monetary policy tightening (consistent with VAR evidence)

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- Financial frictions:
  - Resource costs: $\Xi_t(b) = \tilde{\Xi}_t b_t^{\eta}$
  - Exogenous markup: μ_t^b (no steady state markup: $\bar{\mu}^b = 1$)

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  - steady-state credit spread $\bar{\omega} = 2.0$ percent per annum (median spread between FRB C&I loan rate and FF rate)
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- Calibrate η
  - 1% increase in credit raises spread by 0.10% (per annum) (relative VAR responses of credit, spread)
  - requires $\eta = 6.06$

Numerical results: Taylor rule

- Monetary policy rule:

$$\hat{\imath}_t^d = \phi_\pi \pi_t + \phi_y \hat{Y}_t + \varepsilon_t^m$$

with $\phi_\pi = 2$ and $\phi_y = 0.75/4$

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- Compare 3 model specifications:

  - FF model: model with heterogeneity and credit frictions
  - No FF model: same heterogeneity, but $\omega_t = \Xi_t = 0, \forall t$
  - RepHH model: representative household w/ intertemporal elasticity $\bar{\sigma}$

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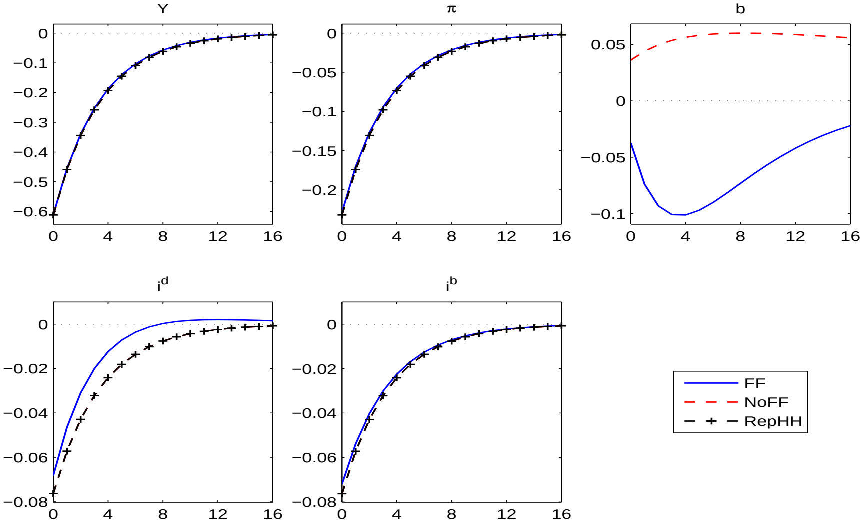
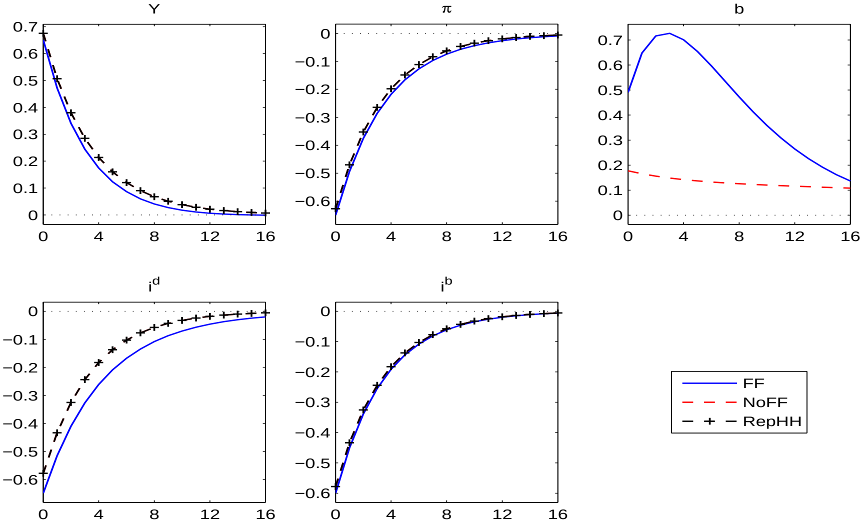


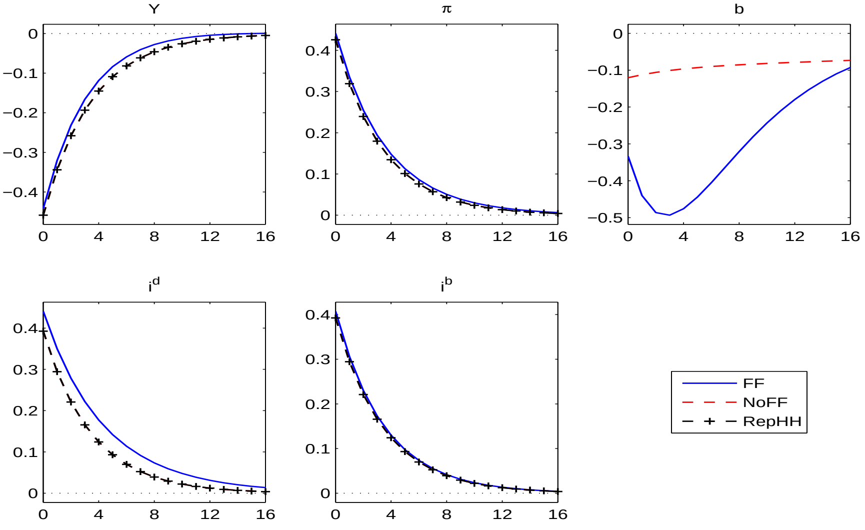
Responses to monetary policy shock

Numerical results: Taylor rule



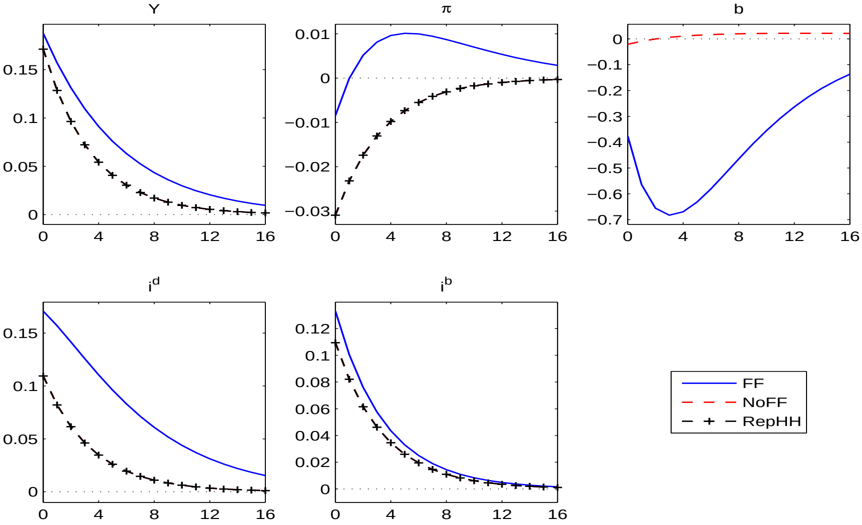
Responses to technology shock

Numerical results: Taylor rule



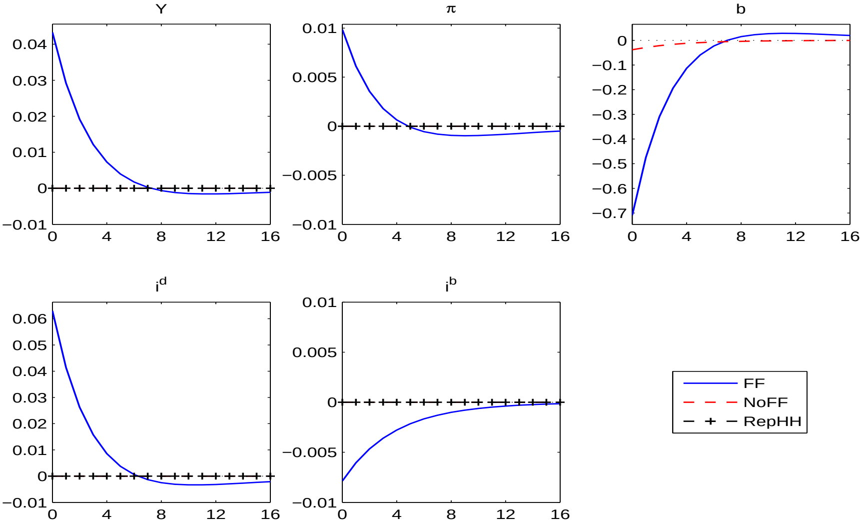
Responses to wage markup shock

Numerical results: Taylor rule

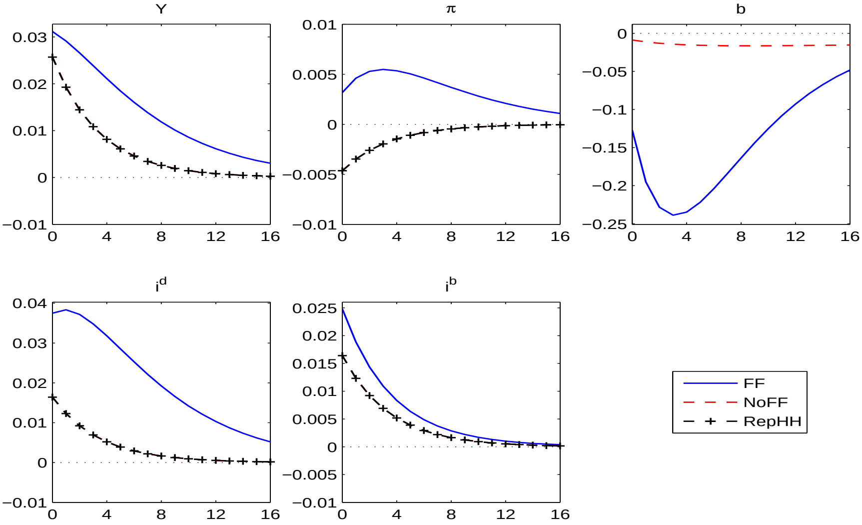


Responses to shock to government purchases

Numerical results: Taylor rule



Responses to shock to government debt



Responses to shock to demand of savers

Optimal policy

Natural objective for stabilization policy: average expected utility

$$E_0 \sum_{t=0}^{\infty} \beta U\left(Y_t, \lambda_t^b, \lambda_t^s, \Delta_t; \xi_t\right)$$

where

$$\begin{aligned} U\left(Y_t, \lambda_t^b, \lambda_t^s, \Delta_t; \xi_t\right) \equiv \; & \pi_b u^b\left(c^b\left(\lambda_t^b; \xi_t\right); \xi_t\right) + \pi_s u^s\left(c^s\left(\lambda_t^s; \xi_t\right); \xi_t\right) \\ & -\frac{1}{1+\nu}\left(\frac{\tilde{\lambda}_t}{\tilde{\Lambda}_t}\right)^{-\frac{1+\nu}{\nu}} \bar{H}_t^{-\nu}\left(\frac{Y_t}{A_t}\right)^{1+\omega_y} \Delta_t \end{aligned}$$

and

- $\tilde{\lambda}_t / \tilde{\Lambda}_t$ is decreasing function of $\lambda_t^b / \lambda_t^s$
- total disutility of producing is increasing function of MU gap

Optimal policy: LQ approximation

- Compute a quadratic approximation to welfare measure in the case of small fluctuations around optimal steady state

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- Results especially simple in special case:
  - No steady-state distortion to level of output (P = MC, W/P = MRS)(Rotemberg-Woodford, 1997)
  - No steady-state credit frictions: $\bar{\omega} = \bar{\Xi} = \bar{\Xi}_b = 0$
    - Allow for shocks to the size of credit frictions

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- Approximate objective for the special case:
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  - New weights: $\lambda_\Omega, \lambda_\Xi > 0$

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  - New weights: $\lambda_\Omega, \lambda_\Xi > 0$

- LQ problem: minimize loss function subject to log-linear constraints
  - AS relation
  - IS relation
  - law of motion for $\hat{b}_t$
  - relation between $\hat{\Omega}_t$ and expected credit spreads

Optimal policy: LQ approximation

- Consider special case:
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- Result:
  - optimal policy characterized by same target criterion as in basic NK model

$$\pi_t + \frac{\lambda_y}{\kappa}(x_t - x_{t-1}) = 0$$

"flexible inflation targeting"

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- Result:
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$$\pi_t + \frac{\lambda_y}{\kappa}(x_t - x_{t-1}) = 0$$

"flexible inflation targeting"

  - **but**, state-contingent path of policy rate required to implement target criterion not the same

Implementing optimal policy: Interest rate rule

- Instrument rule to implement the above target criterion:
  - Given
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    - observed current expectations of future inflation and output
  - solve AS and IS relations for target i_t^d
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    $\Rightarrow$ ensures determinacy of REE
  - in this example, also implies "E-stability" of REE
    $\Rightarrow$ convergence of least-squares learning dynamics to REE

- Implementable rule:

$$\hat{\imath}_t^d = \hat{r}_t^n + \phi_u u_t + (1 + \beta\phi_u) E_t \pi_{t+1} + \bar{\sigma}^{-1} E_t x_{t+1} - \phi_y x_{t-1} - (\pi_b + \delta^{-1} s_\Omega) \hat{\omega}_t + ((\delta^{-1} - 1) + \phi_u \xi) s_\Omega \hat{\Omega}_t$$

where

$$\phi_u \equiv \frac{\kappa \bar{\sigma}^{-1}}{\lambda_y + \kappa^2}$$

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- This is a forward-looking Taylor rule, w/ adjustments proportional to
  - the credit spread
  - the marginal-utility gap

Implementing optimal policy: Interest rate rule

- Note that if
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    ... except in case of very persistent fluctuations in credit spread
- In this scenario
  - it is really only i_t^b that matters much to economy
  - simple intuition for spread adjustment is reasonably accurate

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  - effectively an instrument rule in terms of $\hat{\imath}_t^{avg}$, rather than $\hat{\imath}_t^d$ or $\hat{\imath}_t^b$

Numerical results: Optimal policy

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- Numerical results suggest
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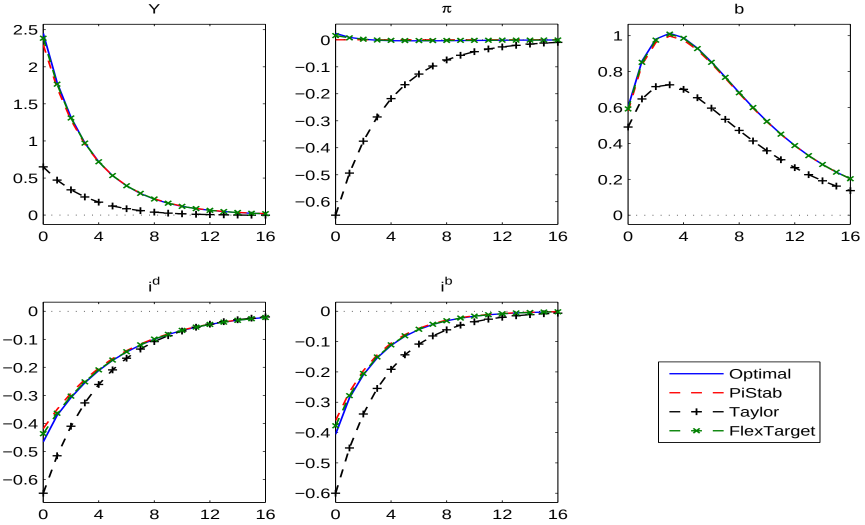
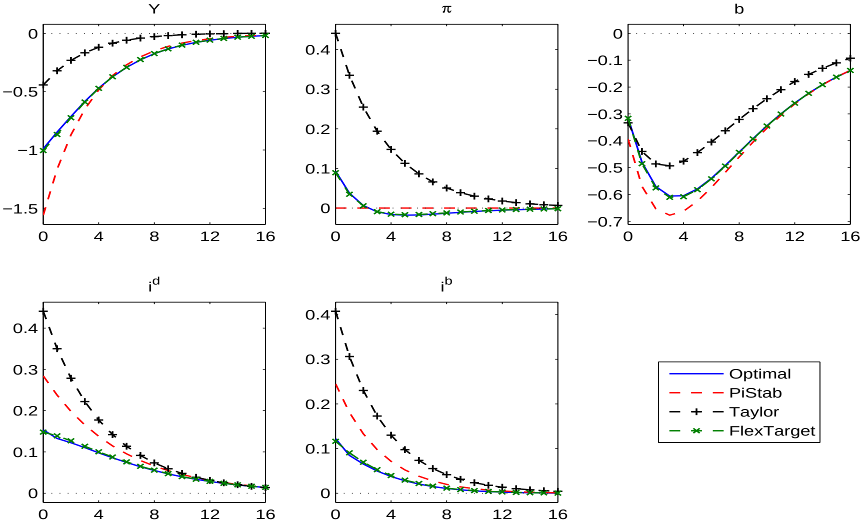
Numerical results: Optimal policy



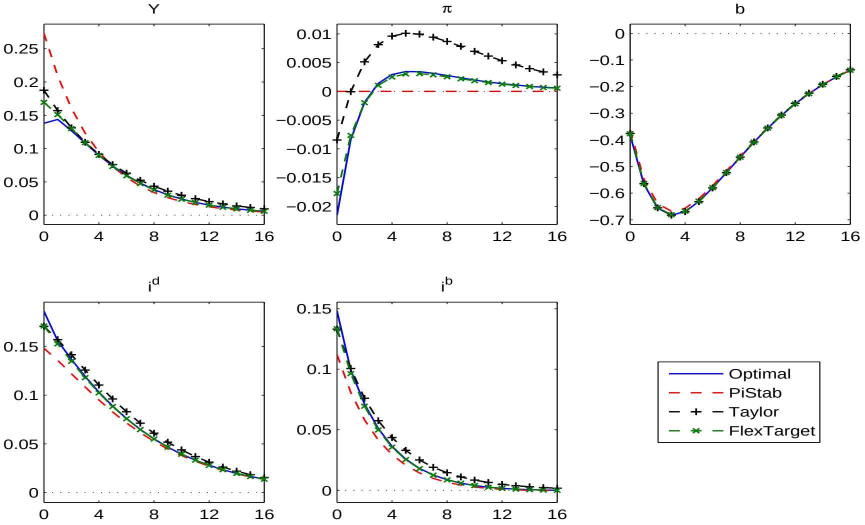
Responses to technology shock

Numerical results: Optimal policy



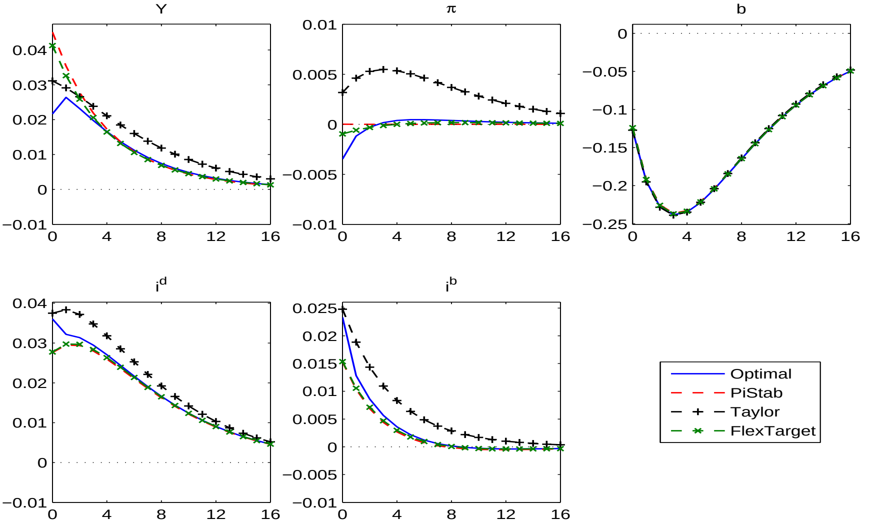
Responses to wage markup shock

Numerical results: Optimal policy



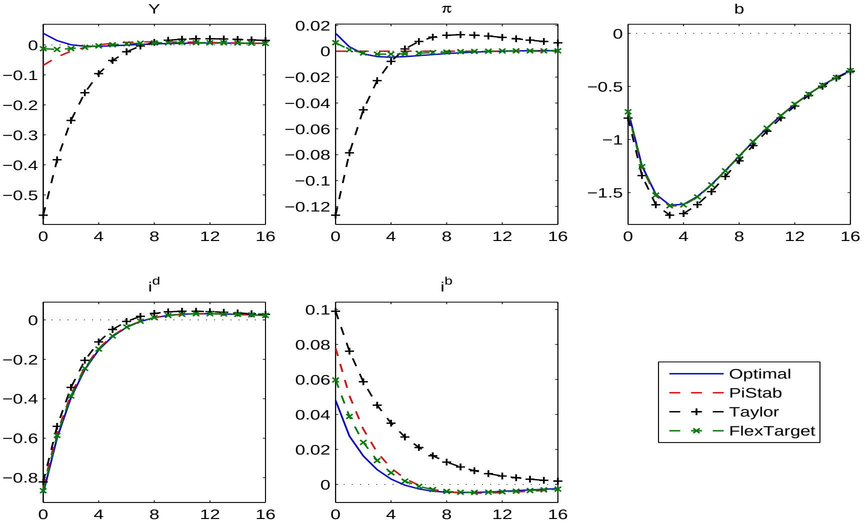
Responses to shock to government purchases

Numerical results: Optimal policy



Responses to shock to demand of savers

Numerical results: Optimal policy



Responses to financial shock

Spread-adjusted Taylor rule

- Rule of thumb suggested by various authors:
  (McCulley and Toloui, 2008; Taylor, 2008)
  - adjust intercept of Taylor rule in proportion to changes in spreads

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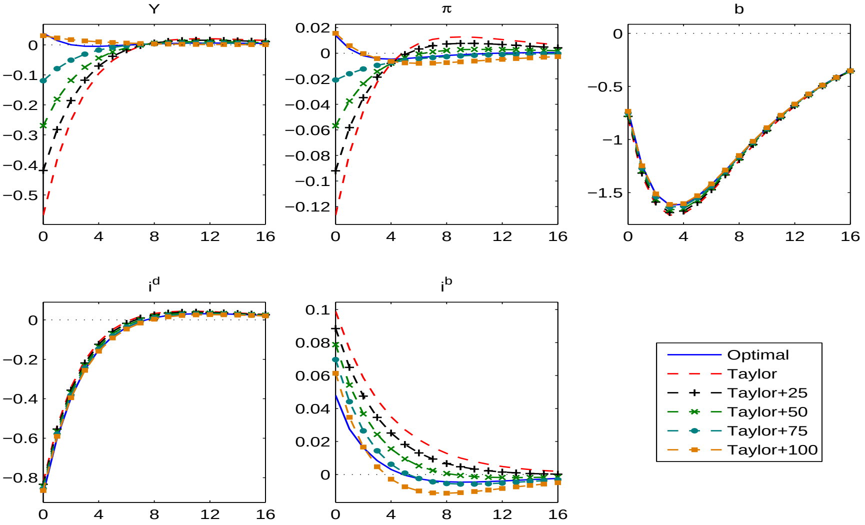

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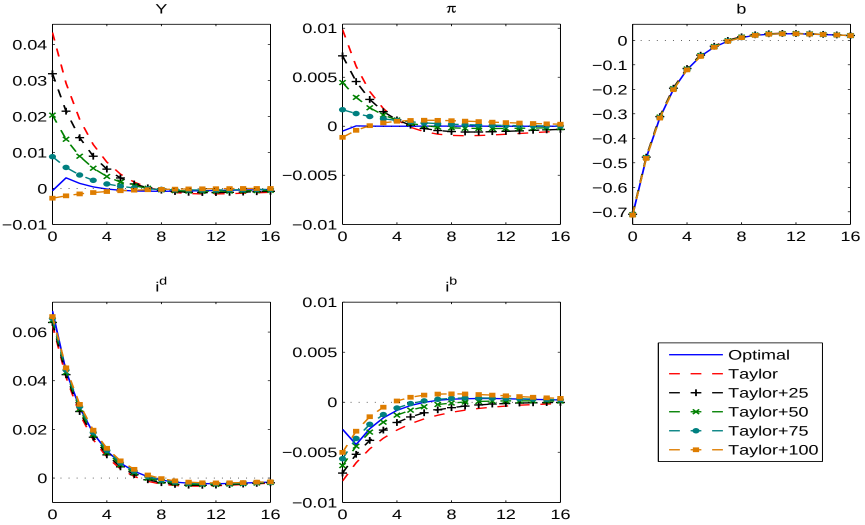
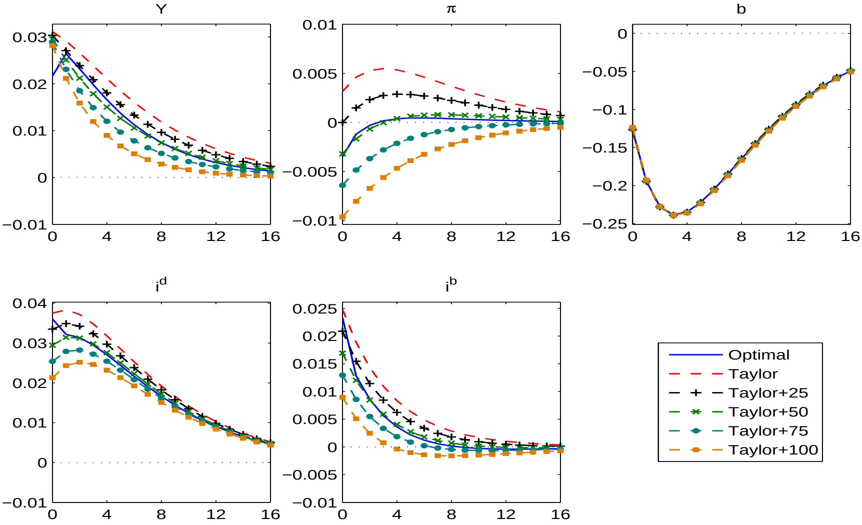


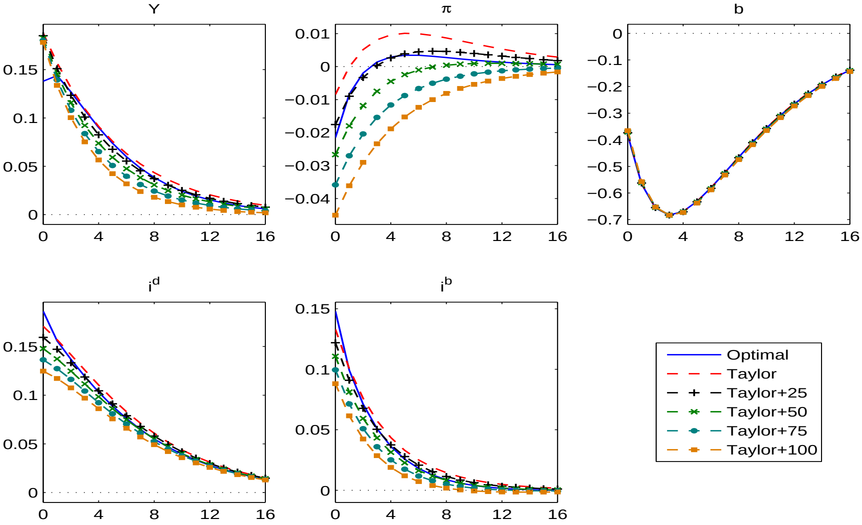
Responses to a shock to government debt

Numerical results: Spread-adjusted Taylor rule



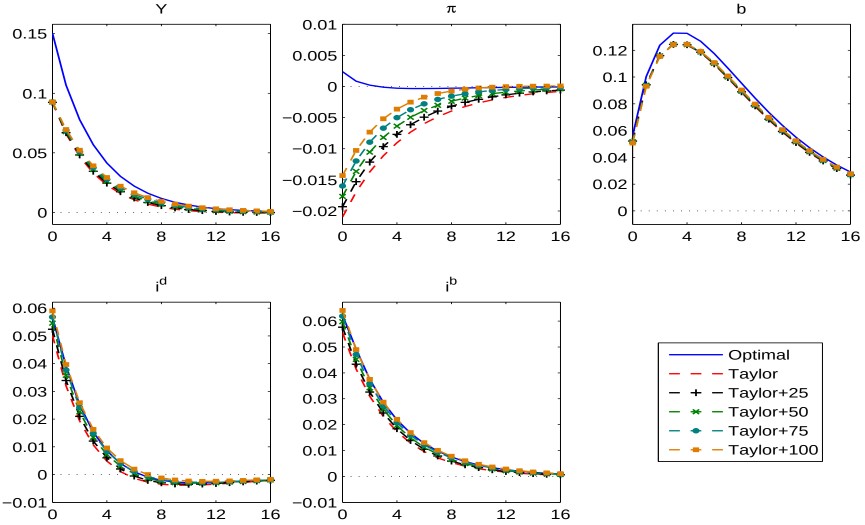
Responses to a shock to the demand of savers

Numerical results: Spread-adjusted Taylor rule

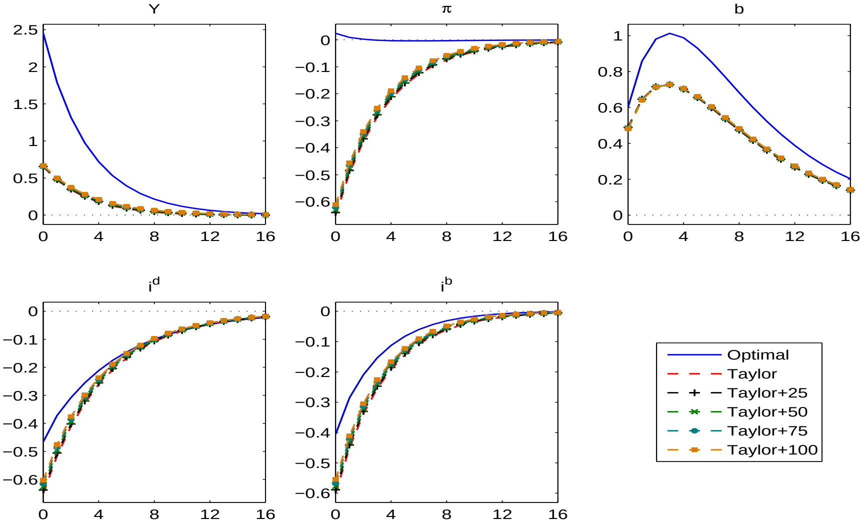


Responses to a shock to government purchases

Numerical results: Spread-adjusted Taylor rule



Responses to a shock to the demand of borrowers



Responses to a technology shock

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- We consider this family of rules, allowing also for $\phi_b < 0$

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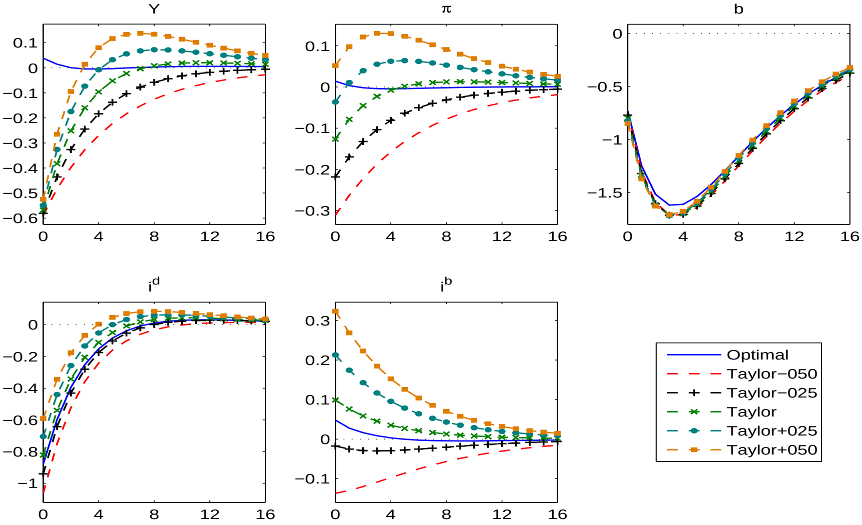

Responses to financial shock

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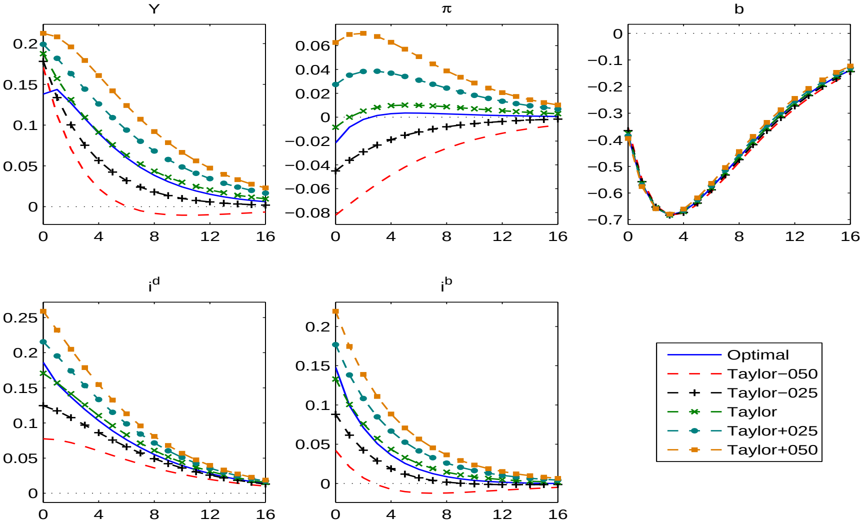

Responses to a shock to government purchases

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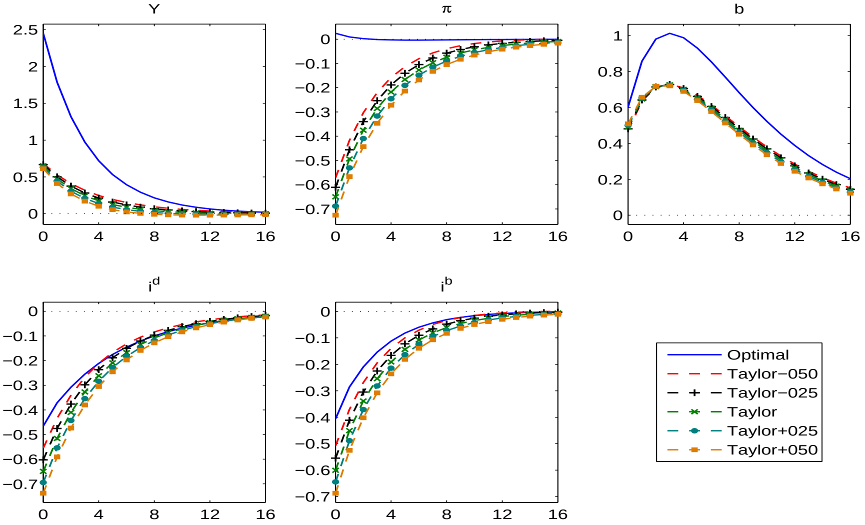

Responses to a technology shock

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  - More generally, a generalization of basic NK model
    - that retains many qualitative features of that model of the transmission mechanism
  - Quantitatively, basic NK model remains a good approximation
    - especially if little endogeneity of credit spreads

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- Guideline for policy:
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  - Take account of credit frictions only in model used to determine policy action required to fulfill target criterion