Communicating Policy under Uncertainty

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Preliminary and incomplete

CEBRA Annual Meeting
Copenhagen, June 22-24, 2026

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What is the Role of Central Bank Communication?

"...monetary policy is 98 percent talk and only two percent action. The ability to shape market expectations of future policy through public statements is one of the most powerful tools the Fed has." – B. Bernanke, March 30, 2015

"Once policymakers reveal their economic forecast, they can become prisoners of their own words. Fed leaders would be well-served to skip opportunities to share their latest musings. ...forward-guidance – a tool rolled out to great fanfare in the financial crisis – has little role to play in normal times." – K. Warsh, April 25, 2025

- Forward guidance in the literature
  - Communicating private information of the central bank (Delphic)
  - Commitment to future policy (Odyssean)

How to model communications about the future? When are they optimal?

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What We Do

- Offer a **parsimonious model of forward guidance** = commitment to future policies
  - Built on the 3-equation New Keynesian framework
  - Commitment modeled as a cost of deviating to the central bank
- **Distinction from monetary literature = choice of extent of commitment**
  - Schaumburg-Tambalotti (2007), Debortoli-Nunes (2010): Fixed, exogenous probability of deviating
  - Sunakawa (2015): Fixed duration of punishment upon deviating, no eqm deviations
  - Partial default in fiscal policy: Clymo et al. (2023), Barthelemy-Mengus (2024). Exogenous degree of commitment.
- **What to communicate about?** i vs π vs x.
- For today, **two sets of analyses**
  - Analytical results with two-period setting.
  - Numerical analysis with infinite-horizon setting.

Model

Environment

- New-Keynesian setting
  - Natural rate shock r and cost push shock u follow AR(1)
  - Private sector dynamics is characterized by NKPC and NKIS
  - Central bank can have different patience (δ) from private sector (β)
  - CB promises interest rate $\bar{i}'$ & chooses the strength of commitment d' next period
- Central bank's recursive problem

$$\mathcal{L}(r, u, \bar{i}, d) = \min_{i, \bar{i}', d'} \left[\pi^2 + \theta x^2 + d(i - \bar{i})^2 + \delta \mathbb{E} \mathcal{L}(r', u', \bar{i}', d') \right]$$

$$\text{s.t.} \quad \pi = \beta \mathbb{E}(\pi') + \kappa x + u \qquad (NKPC)$$

$$x = \mathbb{E}(x') - \frac{1}{\sigma}(i - \mathbb{E}(\pi') - r) \qquad (NKIS)$$

- Choosing d for all periods before realization of the shocks can be thought of as institutional design, as opposed to the forward guidance in the above formulation

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- What this is not: NK textbook-style commitment with state dependence $\bar{i}(r, u, x^t, \pi^t)$. No downside to committing.

From discretion to textbook commitment via our model

1. Consider inflation promises rather than interest rate promises.
2. Make inflation promises state-contingent.
3. Make commitment perfect $d = \infty$.

$$\mathfrak{L}(\overline{\pi}, \omega) = \min_{\pi, \overline{\pi}(\omega'), x} \frac{1}{2}\left(\pi^2 + \theta x^2\right) + \beta \int \mathfrak{L}(\overline{\pi}(\omega'), \omega') dF(\omega' |) + \xi(\pi - \beta \int \pi(\omega') dF(\omega' | \omega) - \kappa x - u)$$
$$+ \frac{1}{2} d(\pi - \overline{\pi(\omega)})^2$$

$$[\pi] \quad d(\pi - \bar{\pi}) + \pi + \xi = 0$$

$$[x] \quad \theta x = \kappa \xi$$

$$[EC] \quad \mathfrak{L}_\pi = -d(\pi - \overline{\pi}) + \frac{d\pi}{d\overline{\pi}} \underbrace{(d(\pi - \bar{\pi}) + \pi + \xi)}_{=0} = -d(\pi - \overline{\pi}) \left(1 - \frac{d\pi(\omega')}{d\overline{\pi}(\omega')}\right) + \frac{d\pi}{d\overline{\pi}}(\pi + \xi)$$

$$[\overline{\pi}'] \quad \beta \mathfrak{L}'_\pi dF(\omega' | \omega) = \beta \xi \frac{d\pi(\omega')}{d\overline{\pi}(\omega')} dF(\omega' | \omega)$$

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$$+ \frac{1}{2} d(\pi - \overline{\pi(\omega)})^2$$

Limit of $d \to \infty$ then $\overline{\pi} = \pi$ and $\frac{d\pi(\omega')}{d\overline{\pi}(\omega')} = 1$:

$$\begin{aligned}
[\pi] &\quad \pi + \xi = 0 \\
[x] &\quad \theta x = \kappa \xi \\
[EC] &\quad \mathfrak{L}_\pi = \pi + \xi \\
[\overline{\pi}'] &\quad \mathfrak{L}'_\pi = \xi \qquad \Rightarrow \qquad \pi' = \xi - \xi'
\end{aligned}$$

Textbook characterization of commitment.

Two-Period Illustrative Model

Two-Period Illustrative Model: Setting

- There are no pre-commitments in the first period: $d_1 = 0$
- Central bank chooses $\bar{i}_2$
- We investigate welfare with different values of d_2
- Expectations in the second period are exogenous: $\mathbb{E}(\pi_3) = \mathbb{E}(x_3) = 0$.
- Shocks (r_t and u_t) are i.i.d. and $\sigma = 1$

Period 2 problem given forward guidance

Solution for the second period problem for given $(r_2, u_2, \bar{i}_2, d_2)$:

$$x_2^* = \frac{d_2(r_2 - \bar{i}_2) - \kappa u_2}{\theta + d_2 + \kappa^2}$$

$$\pi_2^* = \frac{\kappa d_2(r_2 - \bar{i}_2) + (\theta + d_2)u_2}{\theta + d_2 + \kappa^2}$$

- Agents understand that the promise is partially reneged on.

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- Forward guidance as a natural rate shock: Inflation and output gap react to $r - \bar{i}_2$.
- Fwd guidance stabilizes output after cost-push shocks, amplifies demand shocks.

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$$i_2^* = \frac{d_2\bar{i}_2 + (\theta + \kappa^2)r_2 + \kappa u_2}{\theta + d_2 + \kappa^2}$$

- Interest rate: weighted avg of natural rate & forward guidance + cost-push term.

Period 2 problem given forward guidance

Solution for the second period problem for given $(r_2, u_2, \bar{i}_2, d_2)$:

$$\mathbb{E}[x_2^*] = -\frac{d_2 \bar{i}_2}{\theta + d_2 + \kappa^2}$$

$$\mathbb{E}[\pi_2^*] = -\frac{\kappa d_2 \bar{i}_2}{\theta + d_2 + \kappa^2} = \kappa \mathbb{E}[x_2^*] \qquad \text{expected NKPC}$$

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Cost-push response and the role of d_2

Note $\bar{i}_2 = \bar{i}_2(u_1)$ is independent of u_2, so treat it as constant. Let $\Omega \equiv \theta + d_2 + \kappa^2$.

Inflation:

$$\frac{\partial \pi_2^*}{\partial u_2} = \frac{\theta + d_2}{\Omega} \in (0,1), \qquad \frac{\partial}{\partial d_2}\left(\frac{\theta + d_2}{\Omega}\right) = \frac{\kappa^2}{\Omega^2} > 0.$$

$\Rightarrow$ amplified in d_2; loading $\to 1$ as $d_2 \to \infty$.

Output gap:

$$\frac{\partial x_2^*}{\partial u_2} = -\frac{\kappa}{\Omega} < 0, \qquad \frac{\partial}{\partial d_2}\left(\frac{\kappa}{\Omega}\right) = -\frac{\kappa}{\Omega^2} < 0.$$

$\Rightarrow$ dampened in d_2; response $\to 0$ as $d_2 \to \infty$.

Interpretation: larger d_2 = more commitment:

- output stabilized against cost-push shocks,
- inflation absorbs the full shock.

Output smoothing drives optimal forward guidance

- Policy promise given commitment $d_2 \geq 0$
- Trade-off between reputational cost vs. "relaxed" NKPC constraint.

$$\bar{i}_2 = \frac{\beta\kappa\Omega}{(\theta+\kappa^2)\delta(d_2(\kappa^2+\theta)+\Omega^2)+\theta\beta^2\kappa^2 d_2}\theta u_1$$

$$\Omega \equiv d_2+\theta+\kappa^2$$

- Policy promise has the same sign as cost-push shock u_1
  - Engineer deflation next period to lower inflation today.
- Loading is increasing in the weight on the output gap θ
- Loading is decreasing in the degree of commitment d_2 and patience δ

Generalization to $\bar{i}_1, d_1 \neq 0$:

- Linear and decreasing in $\bar{i}_1$.

Optimal commitment: The case for the myopic central banker?

$$\left.\frac{\partial \mathcal{L}_1}{\partial d_2}\right|_{d_2=0} = \underbrace{-\frac{\kappa^2\beta^2\theta^2}{\delta(\theta+\kappa^2)^4}u_1^2}_{\text{social welfare}} + \underbrace{\delta\left(\sigma_r^2 + \frac{\kappa^2\sigma_u^2}{(\theta+\kappa^2)^2}\right)}_{\text{expected reputation cost}}$$

Obvious points:

- If $\theta > 0$, social loss is strictly lower with forward guidance and commitment.
- Central Banker always uses commitment in period 1 if myopic ($\delta = 0$). Fully myopic uses fwd guidance to achieve $\pi_1 = x_1 = 0$.

Less obvious points:

- CB values commitment in period 1 only if period-1 cost-push shock (u_1) is large.
- If commitment is chosen after observing (r_1, u_1), it is used only when u_1^2 is large.

Surprising result

- Patient central bank never chooses commitment unless it knows u_1.
- Break this result: Make u_1 more volatile than u_2

Infinite-Horizon Numerical Model

Infinite-Horizon Model: Additional Assumptions

- For today, we assume:
  - Fixed $d = \bar{d}$ (institutional design)
  - $\delta = \beta$ (no present bias for central bank)

- Shocks follow AR(1) processes.

- Paper: Inflation promises as partly state-contingent promises.

$$\mathcal{L}(\bar{i}, u, r^*) = \min_{\pi, x, i, \bar{i}'} \pi^2 + \theta x^2 + d(i - \bar{i})^2 + \beta \mathbb{E}[\mathcal{L}(\bar{i}', u', r^{*\prime})]$$

$$\text{s.t.} \quad i = \sigma(\mathbb{E}[x'] - x) + \mathbb{E}[\pi'] + r^* \quad \text{(Euler)}$$

$$x = \frac{\pi - \beta \mathbb{E}[\pi'] - u}{\kappa} \quad \text{(Phillips curve)}$$

First-Order & Envelope Conditions

$$
\begin{aligned}
[\pi]: &\quad \lambda_{pc} = 2\kappa\pi \\
[x]: &\quad \lambda_{pc} = -2\theta x - \sigma\lambda_{ee} \\
[i]: &\quad \lambda_{ee} = -2d(i - \bar{i}) \\
[\bar{i}']: &\quad \beta\mathbb{E}[L'_{\bar{i}}] = \lambda_{ee}\left(\sigma\frac{d\mathbb{E}[x']}{d\bar{i}'} + \frac{d\mathbb{E}[\pi']}{d\bar{i}'}\right) - \frac{\beta\lambda_{pc}}{\kappa}\frac{d\mathbb{E}[\pi']}{d\bar{i}'} \\
[\bar{i}]: &\quad L_{\bar{i}} = -2d(i - \bar{i})
\end{aligned}
$$

Key simplification. Guess & verify linearity of policy rules.

$\Rightarrow$ derivatives $\frac{d\mathbb{E}[\pi']}{d\bar{i}'}$, $\frac{d\mathbb{E}[x']}{\bar{i}'}$ are *constant*.

$\Rightarrow$ The model decouples block-recursively:

1. Coefficients on $\bar{i}$: $(\iota_i, \bar{\iota}_i, \psi_i, \xi_i)$ solved *first* (nonlinear).
2. Coefficients on u and r^* then solved by *linear* systems.

Existence of a Stable Root

Proposition

Let $d, \theta > 0$ *with* $\beta \in (0, 1)$, *and let* $\tilde{P}(\bar{\iota}_i) \equiv d(A(\bar{\iota})B(\bar{\iota}) + \beta) - A(\bar{\iota})\beta\bar{\iota}_i(dC(\bar{\iota} - A(\bar{\iota}))$, *a quartic polynomial in* $\bar{\iota}_i$ *with*

$$A(\bar{\iota}_i) = \frac{\theta+\kappa^2-\beta\theta\bar{\iota}_i}{\kappa\sigma} \quad B(\bar{\iota}_i) = \frac{\sigma+\kappa-\sigma\beta\bar{\iota}_i}{\kappa} \quad C(\bar{\iota}_i) = \frac{\sigma}{\kappa}(1-\beta\bar{\iota}_i)(\bar{\iota}_i - 1) + \bar{\iota}_i$$

(i) $\tilde{P}$ *has at least one real root.*

(ii) *For* $d > 0$ *sufficiently small, there is a root with* $|\bar{\iota}_i| < 1$ *and* $\bar{\iota}_i < 0$.

Coefficients on u: Linear System

With (ι_i, ψ_i, ξ_i) known, the $\boldsymbol{u}$-coefficients $(\bar{\iota}_u, \xi_u, \psi_u, \iota_u)$ solve

$$\mathbf{A}_u \mathbf{x}_u = \mathbf{b}_u$$

$$\begin{pmatrix} \beta p(\iota_i - 1) & 0 & -\beta\psi_i & -p(\sigma\xi_i + \psi_i - \beta\rho_u) \\ 0 & 1 & \kappa/\theta & -\sigma p/\theta \\ -\beta\psi_i & -\kappa & 1 - \beta\rho_u & 0 \\ -(\sigma\xi_i + \psi_i) & \sigma(1 - \rho_u) & -\rho_u & 1 \end{pmatrix} \begin{pmatrix} \bar{\iota}_u \\ \xi_u \\ \psi_u \\ \iota_u \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 1 \\ 0 \end{pmatrix}$$

Rows: FOC$[\hat{i}']$, FOC$[x]$, Phillips, Euler.

Analogously for r^*: same matrix with $\rho_u \to \rho_r$, RHS $= (0, 0, 0, 1)^\top$ (since r^* enters Euler, not PC).

Optimal commitment: Key forces

- Given optimal behavior, changing commitment affects the Central Bank's value function in steady state in two ways
  1. Higher weight on $\mathbb{E}[(i - \bar{i}_-)^2]$
  2. Changing constraints via expectations $\mathbb{E}[\pi'], \mathbb{E}[x']$
- Numerically, Central Bank prefers $d = 0$ in steady state (but not for all shocks).
- Social planner doesn't value CB's reputational cost: Optimal d is interior.

Optimality of zero commitment d for CB

Notation: Stack choice variables π, x, i and $\bar{i}$ (or $\bar{\pi}$), into $\mathbf{z}$ with $\mathbf{e}_1'\mathbf{z} = z_1$ the forward guidance. Forward guidance refers to policy $z_p = \mathbf{e}_p'\mathbf{z}$.
Period loss, constraints: $\ell(\mathbf{z}), \mathbf{f}(\mathbf{z}, \mathbb{E}[\mathbf{z}], \xi) = 0$ with Lagrange multipliers $\boldsymbol{\lambda}$.
Value function: $\mathcal{L}(z_1, \xi) = \ell(\mathbf{z}^*(z_1, \xi)) + d(\mathbf{e}_p'\mathbf{z} - z_{1,-})^2 + \beta\mathbb{E}[\mathcal{L}'] + \boldsymbol{\lambda} \odot \mathbf{f}(\mathbf{z}, \mathbb{E}[\mathbf{z}^{*\prime}], \xi)$.

Optimality: $\mathbf{z}^*$ satisfies the FOC $[\mathbf{z}]$:

$$[\mathbf{z}]\ \nabla_z \ell(\mathbf{z}^*) + 2d\,(\mathbf{e}_p'\mathbf{z} - z_{1,-}) \odot \mathbf{e}_p + \beta\mathbb{E}\left[\frac{\partial}{\partial z_1'}\mathcal{L}'\right]\mathbf{e}_1$$
$$+ \boldsymbol{\lambda} \odot (\nabla_z \mathbf{f}(\mathbf{z}, \mathbb{E}[\mathbf{z}^{*\prime}], \xi) + \nabla_{\mathbb{E}}(\boldsymbol{\lambda}\mathbf{f}(\mathbf{z}, \mathbb{E}[\mathbf{z}^{*\prime}], \xi))\nabla_z \mathbb{E}[\mathbf{z}^{*\prime}] = \mathbf{0}$$
$$[d]\ \frac{d\mathcal{L}}{d\,d} = \nabla\mathcal{L}\frac{\partial \mathbf{z}}{\partial d} + (\mathbf{e}_p'\mathbf{z} - z_{1,-})^2 + \nabla_{\mathbb{E}}(\boldsymbol{\lambda} \odot \mathbf{f}(\mathbf{z}, \mathbb{E}[\mathbf{z}^{*\prime}], \xi))\nabla_d \mathbb{E}[\mathbf{z}^{*\prime}] + \frac{d}{d\,d}\beta\mathbb{E}[\mathcal{L}']$$

Effects of higher d: Envelope theorem: no indirect effects – except through constraints. Direct effect: $(\mathbf{e}_p z - z_{1,-})^2 > 0$.

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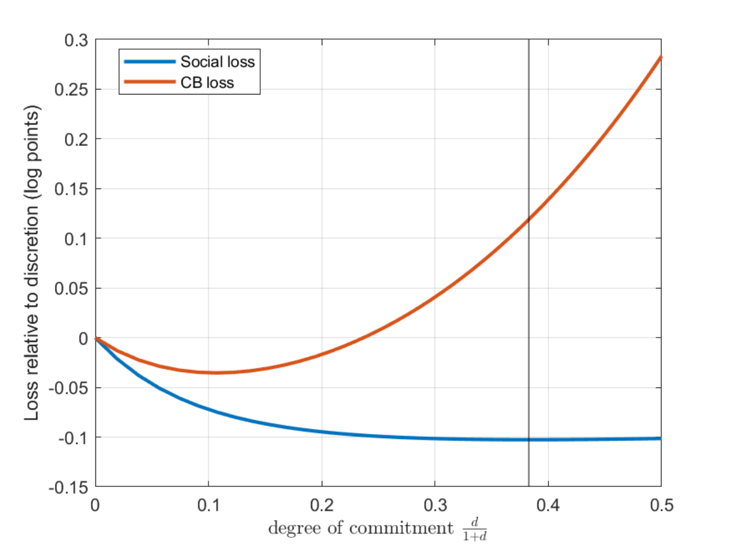
Results

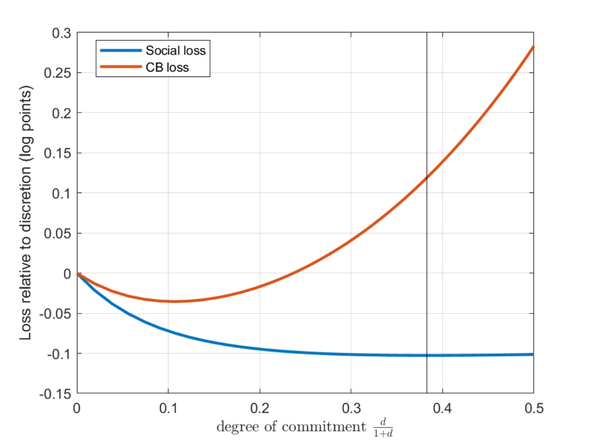
Social Welfare and CB Welfare by degree of commitment



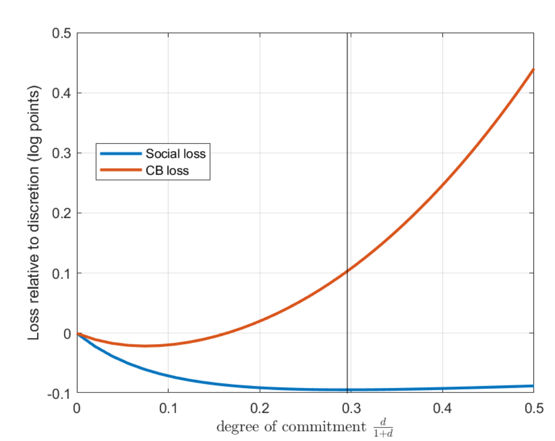
- Gali-style calibration.
- Very persistent cost-push shocks: $\rho_u = 0.9$

Social Welfare and CB Welfare by degree of commitment

Small dmd shocks



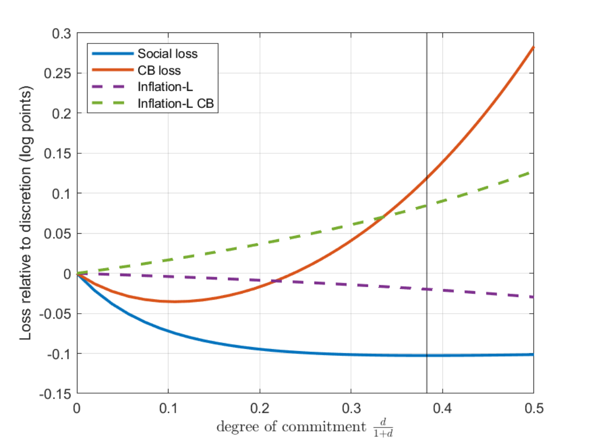
Large dmd shocks



$\Rightarrow$ More volatile demand shocks: Commitment is less desirable.

Social Welfare and CB Welfare by degree of commitment

Small dmd shocks



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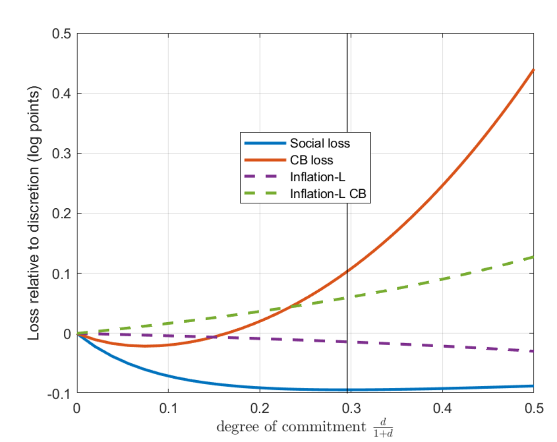

Social Welfare and CB Welfare by degree of commitment

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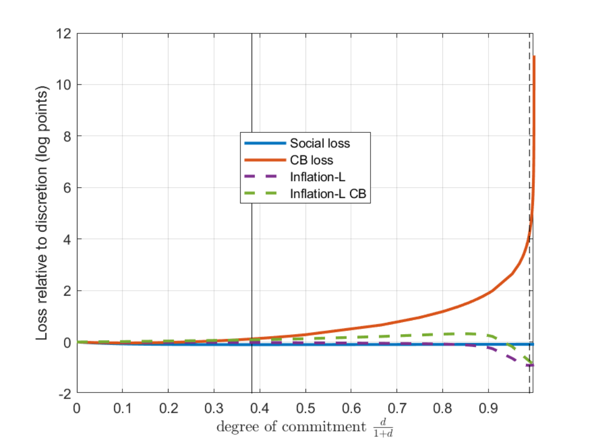

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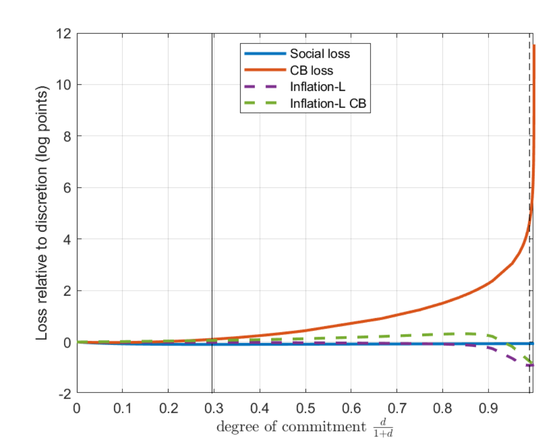
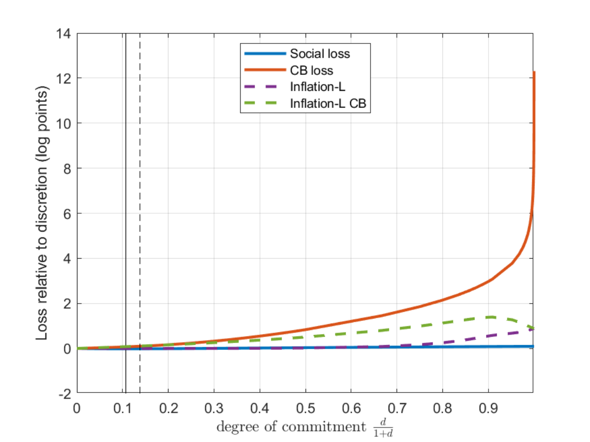


$\Rightarrow$ Social planner prefers forward guidance about inflation

Social Welfare and CB Welfare by degree of commitment

now low persistence

Small dmd shocks



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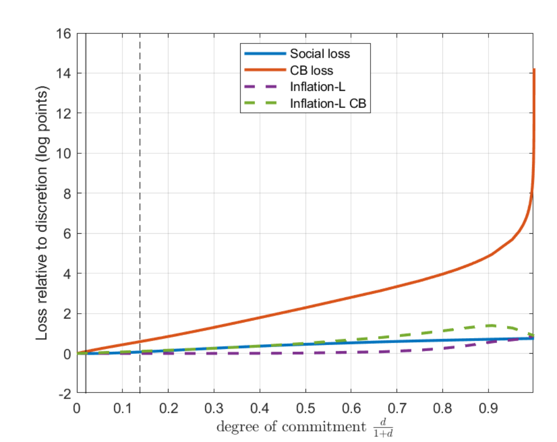
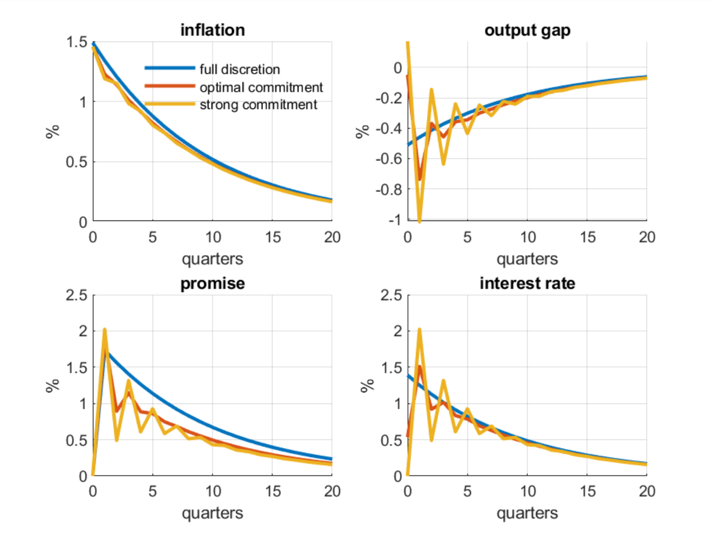


IRFs Across Degrees of Commitment: Cost-push shock



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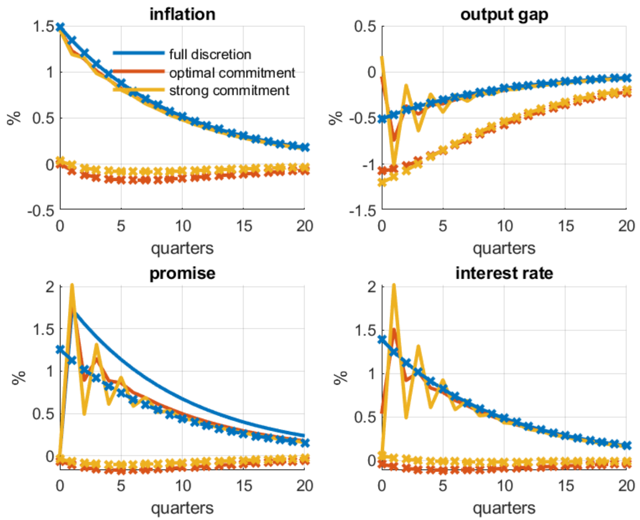
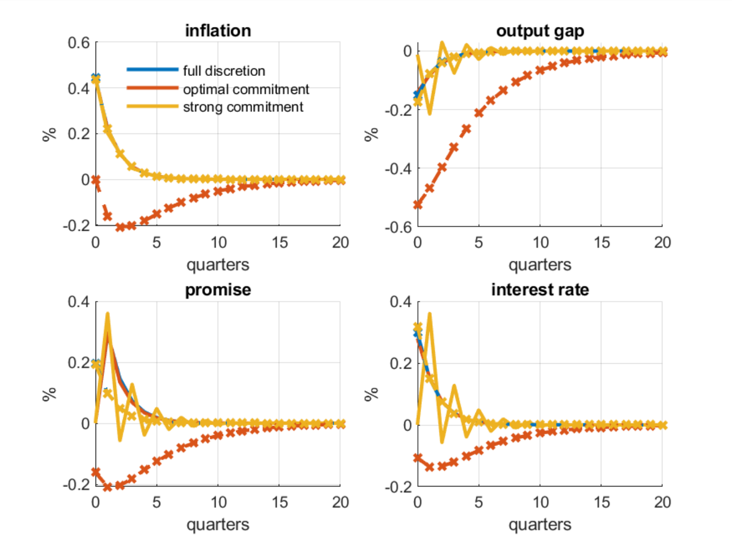


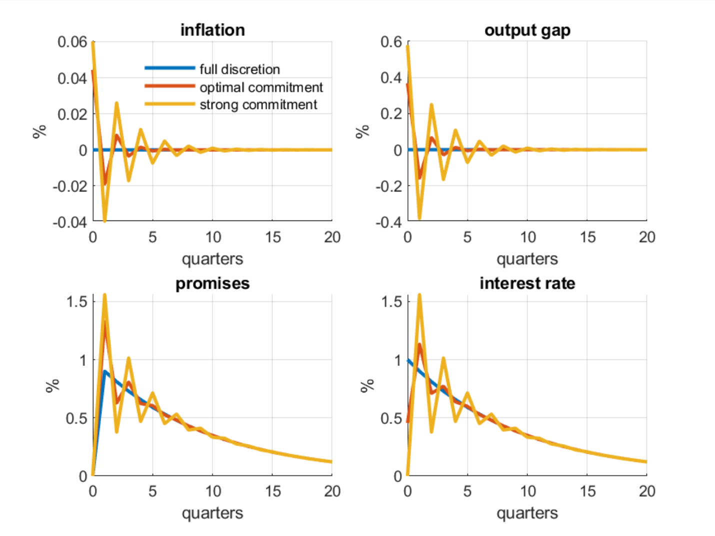
- Solid lines: Interest rate promises.
- Dashed lines: Inflation promises.

IRFs Across Degrees of Commitment: Cost-push shock



- Solid lines: Interest rate promises.
- Dashed lines: Inflation promises.
- Now: Low persistence: $\rho_u = 0.5$ rather than 0.9.

IRFs Across Degrees of Commitment: Natural rate shock



Summary

- We provide a tractable framework to analyze forward guidance as "defaultable commitment"
- Unlike existing literature, the extent of commitment to future policy is also a choice
- 2-period model: Optimal forward guidance is time-varying
  - Commitment to is more beneficial when the current of cost push shock is large
  - Implies endogenous, time-varying policy uncertainty
- Infinite-horizon model: Inflation communication $\succ$ interest rate communication
  - Commitment to interest rates is more desirable when (a) demand shock are small and (b) cost-push shocks are persistent.

Summary

- We provide a tractable framework to analyze forward guidance as "defaultable commitment"
- Unlike existing literature, the extent of commitment to future policy is also a choice
- 2-period model: Optimal forward guidance is time-varying
  - Commitment to is more beneficial when the current of cost push shock is large
  - Implies endogenous, time-varying policy uncertainty
- Infinite-horizon model: Inflation communication $\succ$ interest rate communication
  - Commitment to interest rates is more desirable when (a) demand shock are small and (b) cost-push shocks are persistent.
- Next steps: Calibrate simple model, solve with time-varying commitment, fixed cost of deviating.