Monetary Commitment and the Level of Public Debt

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[1] The views expressed in this paper are those of the authors. No responsibility for them should be attributed to the Bank of Canada.

The benefits of inflation targeting

- Design of IT frameworks builds on insights from literature on monetary commitment
  - Inflation-output tradeoff shaped by inflation expectations
  - Credibility to affect expectations is positively valued
- Many features of IT frameworks serve as commitment devices
  - Accountability for mandated objectives
  - Transparency about decisions
  - ⇒ Increase cost of reneging on early promises
- Benefits of IT in terms of inflation widely discussed, little on the relation between IT and government debt

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Interactions and asymmetries

- IT central banks and treasuries interact
  - Government expenditure and taxes affect inflation
  - The policy rate affects the financing cost of the treasury
- Treasuries seem more vulnerable to time-consistency issues
  - Deviations from early promises can be justified with political turnover
  - Political nature of decisions hampers credibility of long-term fiscal plans

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Open questions

- IT ⇒ Debt
  - Effects of monetary commitment on debt accumulation
  - Does IT mitigate fiscal time-consistency issues
  - Welfare implications of IT if public debt taken into account
- Debt ⇒ IT
  - Could independence be questioned by treasuries?
  - The central bank and the government may disagree even if both benevolent
  - The mandate of instrument independent IT central banks finds legitimacy in the political arena

Simple monetary framework

- Baseline NK model where Pareto-efficiency is not implementable
  - Monopolistic competition and nominal price rigidities
  - Government spending is valued
  - Only distortionary taxes (linear in labor income) are available
  - Households save through nominal non-state-contingent bonds

▸ The model ▸ Competitive equilibrium ▸ Calibration

Timing, strategies and equilibrium

Sequence of events

- $t = 0$: MP announces targets $\{i_t^T(s^t, b_{-1}), \pi_t^T(s^t, b_{-1})\}_{t \geq 0}$
- $t \geq 0$:
  1. Shock occurs and observed by all agents
  2. Fiscal authority sets $G_r(s^r, b_{r-1})$ and $\tau_r(s^r, b_{r-1})$
  3. MP sets interest rate $1 + i_t \equiv (1 + i_t^T)(\pi_t/\pi_t^T)^{\phi_\pi}$

Strategies

$$\sigma_f^t = \{G_r(s^r, b_{r-1}), \tau_r(s^r, b_{r-1})\}_{r \geq t} \; \sigma_m^0 = \left\{i_t(s^t, b_{-1}, G_t, \tau_t)\right\}_{t \geq 0}$$

Equilibrium

1. For any σ_m^0, σ_f^{0*} max U_t at any history (s^t, b_{t-1}) given σ_f^{t+1*}
2. σ_m^{0*} max U_0 for any b_{-1}, given ϕ_π and σ_f^{0*}

Solution

IT as off-equilibrium threat

- Fiscal policy is time-consistent and taken into account by the central bank when choosing targets
- At equilibrium $\pi_t = \pi_t^T$ and $i_t = i_t^T$
  - ⇒ The central bank raises the nominal interest rate by $(\pi_t/\pi_t^T)^{\phi_\pi}$ only if fiscal policy deviates from equilibrium
- ϕ_π captures central bank's independence in defending the inflation target

Fiscal time-inconsistency and monetary commitment

Future governments impose two externalities on their predecessors

CCE

- Phillips curve: inflation bias
  - Current inflation worsens past inflation-output tradeoff
- Aggregate demand: interest rate manipulation revisited
  - Current AD expansion lowers past demand of bonds
  - Negative externality in flex-price literature: interest-rate manipulation
  - With sticky prices, it can be positive or negative depending on the monetary policy response
- Monetary policy response generates a link between interest rate manipulation and the inflation bias
  - $\Uparrow \Pi_t \Rightarrow \Uparrow i_t$

Generalized Euler Equation

Inflation targeting and steady-state debt

Debt | Welfare | Optimality condition

- Inflation has a budgetary cost if $b > 0$ and $\phi_\pi > 1/\beta$
- The optimal steady-state level of debt eliminates net gains from surprise inflation
  - Accumulate debt to the point where the budgetary cost of inflation equalizes its benefits
  - Larger ϕ_π increases the budgetary cost of inflation
  - Less need to accumulate debt to prevent future inflation
- Aggressive defense of the inflation target reduces steady-state debt and increases steady-state welfare

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Feasibility of IT

Welfare gains from changing ϕ_π taking the transition into account

Welfare

- Optimal level of ϕ_π balances off the long run benefits of low debt and the short run gains of deficit financed fiscal expansions
- Assume fall in ϕ_π
  - Steady-state costs: debt increases in the long-run
  - Short-run benefits: economic boom while increasing debt
- Optimal to weaken the inflation response if debt is too high or if MP is not accommodative enough during fiscal consolidations

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Conclusion

- Monetary policy affects debt accumulation
- More aggressive defense of the inflation target reduces debt
- Monetary policy has first-order effects on welfare
- If monetary policy is not chosen wisely, central bank's independence may be questioned

Private sector

- HOUSEHOLDS
  - Representative household consumes infinitely many varieties of market goods, public goods and leisure
  - Income is spent on market goods or saved through nominal non-state contingent bonds
  - Labor income is taxed linearly

Households

- FIRMS
  - Infinitely many firms, each producing a differentiated variety
  - Firms rent labor services from households
  - Quadratic adjustment costs to prices

Firms

Game

Households

- Objective

$$U_0 = E_0 \sum_{t=0}^{\infty} \beta^t \left[(1-\chi) \ln C_t + \chi \ln G_t - \frac{N_t^{1+\varphi}}{1+\varphi} \right] \tag{1}$$

$$C_t = \left[\int_0^1 C_t(j)^{\frac{\eta-1}{\eta}} \, dj \right]^{\frac{\eta}{\eta-1}} \tag{2}$$

$$G_t = \left[\int_0^1 G_t(j)^{\frac{\eta-1}{\eta}} \, dj \right]^{\frac{\eta}{\eta-1}} \tag{3}$$

- Budget constraints

$$\int_0^1 P_t(j) C_t(j) \, dj + \frac{B_t}{1+i_t} = W_t N_t (1-\tau_t) + B_{t-1} \tag{4}$$

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Firms

- Technology

$$Y_t(j) = z_t N_t(j) \tag{5}$$

- Demand

$$Y_t(j) = \left(\frac{P_t(j)}{P_t}\right)^{-\eta} Y_t^d \tag{6}$$

- Profits

$$E_t \left\{ \sum_{s=0}^{\infty} Q_{t,t+s} \left[P_{t+s}(j) Y_{t+s}(j) - W_{t+s} N_{t+s}(j) - \right.\right.$$
$$\left.\left. -P_{t+s} \frac{\gamma}{2} \left(\frac{P_{t+s}(j)}{P_{t+s-1}(j)} - 1 \right)^2 \right] \right\} \tag{7}$$

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Competitive equilibrium

- Exogenous events: $s^t \equiv (z_0, ..., z_t)$
- Policies: $p_t \equiv (i_t, G_t, \tau_t)$
- Decisions and prices: $x_t(s^t, b_{t-1}) \equiv (C_t, N_t, b_t, mc_t, \pi_t)$
- $\mathcal{A}_t = \{x_r(s^r, b_{t-1}), p_r\}_{r \geq t}$ is a CCE if it satisfies

$$z_t N_t - C_t - G_t - \frac{\gamma}{2}(\pi_t - 1)^2 = 0, \quad \frac{1}{C_t(1+i_t)} - \beta E_t \frac{1}{C_{t+1}\pi_{t+1}} = 0,$$

$$\frac{N_t^{\varphi} C_t}{1-\chi} - w_t(1-\tau_t) = 0, \quad \frac{b_t}{1+i_t} + \tau_t mc_t z_t N_t = \frac{b_{t-1}}{\pi_t} + G_t,$$

$$\beta E_t \frac{C_t \pi_{t+1}(\pi_{t+1} - 1)}{C_{t+1}} + \frac{\eta}{\gamma} z_t N_t \left(mc_t - \frac{\eta - 1}{\eta} \right) - \pi_t(\pi_t - 1) = 0,$$

$$\lim_{T \to \infty} E_t \left\{ \beta^{T+1} \frac{b_{t+T}}{C_{t+T+1}\pi_{t+T+1}} \right\} = 0.$$

Game | Time-inconsistency issues

Solution: Primal approach

Back

- ϕ_π is restricted so that σ_f, σ_m and equations defining CEE yield a locally unique solution
- Any competitive equilibrium can be implemented by choosing σ_f and σ_m jointly. For any ϕ_π, σ_m can be chosen to implement any CCE consistent with fiscal optimality
- We can solve policy problems by primal approach: (i) find the optimal allocation; (ii) construct strategies implementing the desired allocation

Solution: Markov-perfect fiscal policy

Back

$$U_t(s^t, b_{t-1}) = E_t \sum_{r=t}^{\infty} \beta^r \left[(1-\chi) \ln C_r + \chi \ln G_r - \frac{N_r^{1+\varphi}}{1+\varphi} \right]$$

- $\bar{\sigma}_f$ is Markov-perfect if any of its continuations $\bar{\sigma}_f^t$ maximizes U_t given σ_m and continuation $\bar{\sigma}_f^{t+1}$
- We compute $\bar{\sigma}^f$ by using primal approach
  - Find $\bar{\mathcal{A}}_t$ maximizing U_t given b_{t-1}, σ_m and $\bar{\mathcal{A}}_{t+1}$
  - Take $G_r(s^r, b_{r-1}), \tau_r(s^r, b_{r-1})$ from $\bar{\mathcal{A}}_r$, $r \geq t$ and form $\bar{\sigma}_f^t$

Solution: Monetary policy

Back

- We compute $\bar{\sigma}_0^m$ by using primal approach
  - Find $\bar{\mathcal{A}}_0$ maximizing U_0 given b_{-1}, and the optimality condition of the fiscal authority
  - Choose $i_t^T = i_t$, $\pi_t^T = \pi_t$ from continuations $\bar{\mathcal{A}}_t$

Forward looking constraints

$$k_t \equiv -E_t \underbrace{\left\{\frac{\beta}{C_{t+1}\pi_{t+1}}\right\}}_{\text{Aggregate demand}} ; \quad f_t \equiv E_t \underbrace{\left\{\frac{\beta C_t \pi_{t+1}(\pi_{t+1}-1)}{C_{t+1}}\right\}}_{\text{Inflation-output tradeoff}}$$

- Current allocation is affected by
  - MP via interest rate through the Euler equation
  - Future MP and FP via expected inflation and consumption through the Euler equation and the Phillips curve
- $\uparrow k_t \implies \uparrow C_t$ given MP instrument

  $\implies$ boost aggregate demand
- $\uparrow f_t \implies \uparrow \pi_t$ given output

  $\implies$ worsen inflation-output tradeoff
- FP affects k_t and f_t through debt accumulation

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Generalized Euler equation

- Utility value of boosting AD through debt accumulation: λ_b. Positive or negative?
- Optimality w.r.t. debt at the steady state
- $\frac{\partial f_t}{\partial b_t} > 0$
  - $\uparrow b$ boost AD and worsen inflation-output tradeoff
  - $\lambda_b > 0 \implies$ expanding AD has positive value
- $\frac{\partial f_t}{\partial b_t} < 0$
  - $\uparrow b$ boost AD and improve inflation-output tradeoff
  - $\lambda_b < 0 \implies$ expanding AD has negative value

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Parameterization

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Table: Benchmark calibration

Description	Parameter	Value
Weight of G in utility	χ	0.15
Weight of C in utility	$1-\chi$	0.85
Elast. subst. goods	η	11
Price stickiness	γ	20
Serial corr. tech.	ρ_z	0
Discount factor	β	0.99
Frisch elasticity	φ^{-1}	1

Steady-state debt

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- General

$$b = \frac{\gamma\pi^2}{\eta(\beta\phi_\pi - 1)} \Bigg[\left(1 - \frac{\chi}{G\lambda^s}\right) \eta(\pi - 1) + (2\pi - 1) \\ -\beta\phi_\pi \left(\frac{\frac{\partial \Pi}{\partial b_t} C(2\pi - 1) - \frac{\partial \mathcal{C}}{\partial b_t}\pi(\pi - 1)}{\frac{\partial \Pi}{\partial b_t} C + \frac{\partial \mathcal{C}}{\partial b_t}\pi} \right) \Bigg] \tag{8}$$

- Open-loop

$$b = -\frac{\gamma\pi^2}{\eta} \left[\left(1 - \frac{\chi}{G\lambda^s}\right) \eta(\pi - 1) + (2\pi - 1) \right] \tag{9}$$

- Taylor with $\pi^* = 1$

$$b = \frac{\gamma}{\eta(\beta\phi_\pi - 1)} \left(1 - \beta\phi_\pi \frac{\frac{\partial \Pi}{\partial b_t} C}{\frac{\partial \Pi}{\partial b_t} C + \frac{\partial \mathcal{C}}{\partial b_t}} \right) \tag{10}$$

Steady-state results

◂ Back

Table: Steady state

	Open-loop	Taylor $\phi_\pi = 1.5$ $\pi^* = 1$	Closed-loop $\phi_\pi = 1.5$
Variable	Value		
C	0.7486	0.7227	0.7222
G	0.1366	0.1227	0.1300
N	0.8853	0.8454	0.8522
$b/(4Y)$	-62.13%	112.77%	81.59%
τ	0.1423	0.2093	0.2036
π	0.9973	1	1.0021

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Debt and ϕ_π

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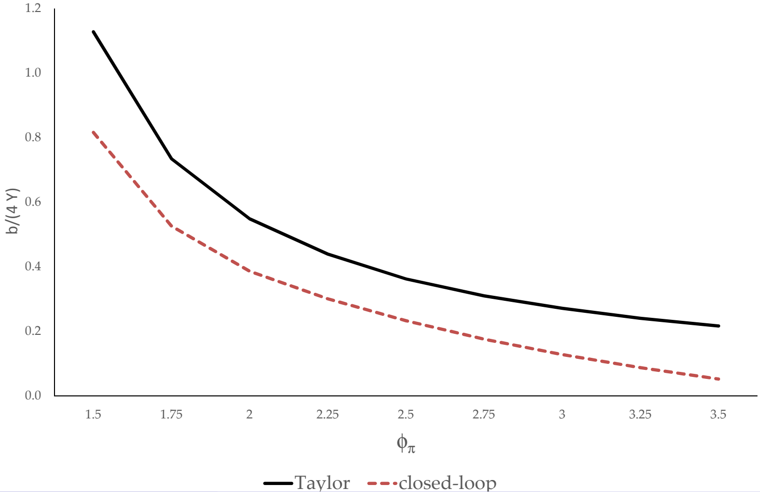
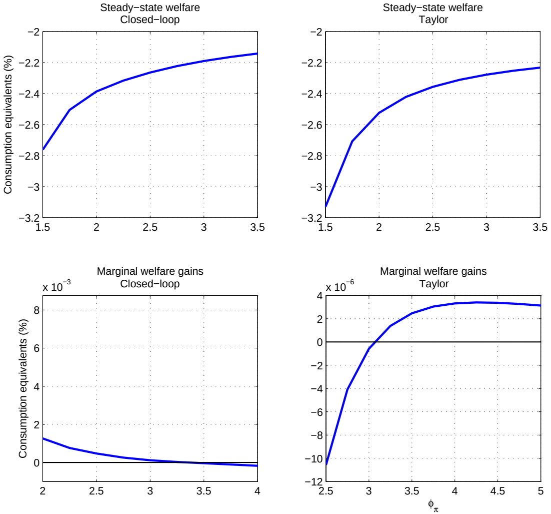


Welfare and ϕ_π

◂ Debt ◂ Optimal ϕ_π



Optimality w.r.t. inflation at the steady state

- First-order condition

$$\underbrace{-\frac{\lambda^s b}{\pi^2}(\beta\phi_\pi - 1)}_{\text{budget cost}} - \underbrace{\lambda^f \gamma(\pi - 1)}_{\text{resource cost}} - \underbrace{\lambda^p(2\pi - 1)}_{\text{output gain}} \underbrace{-\beta\phi_\pi \frac{\lambda^b}{C\pi^2}}_{\text{AD effect}} = 0$$

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- $\uparrow \pi \implies \uparrow$ debt refinancing cost
  - λ^s value of relaxing the government budget constraint
  - Positive debt gives the treasury an incentive to deflate

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- $\uparrow \pi \implies \downarrow AD \implies \uparrow B$
  - λ^b value of boosting aggregate demand
  - $\lambda_b > 0$ if $\uparrow B \implies \uparrow \Pi_{t+1}$: utility falls, additional cost of inflation
- Under the optimal rule λ_b is positive; it is negative under a Taylor rule
- Optimal rule makes inflation more costly for the fiscal policy maker

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