Optimal Monetary and Fiscal Policy without Fiscal Backing

Masayuki Okada

Bank of Japan

Introduction

- The Fed is required to transfer all profits to the Treasury.
- The Treasury makes no transfer to offset the Fed's loss.
  - Expense = Interest rate (5 p.p.) × Reserves (15% of GDP)
  - Fed’s net loss / Treasury's tax revenue = 2%. (2022-2024)
- Asymmetric resource allocation between monetary and fiscal authorities.
  - U.S, Canada, ECB, and Australia.
- Conventional macroeconomic models assume a consolidated government budget (Sargent and Wallace 1981).

Research Question

If the government budgets are **unconsolidated**,

(= If Treasury does not provide the **optimal fiscal support** to the central bank)

does the optimal monetary-fiscal policy change?

What I do

Optimal monetary and fiscal policy without commitment

As in the literature,

- Government chooses policies to maximize utility s.t. equilibrium conditions.
- NK model with the budgets of Treasury and central bank.

New

1. Two types of liabilities: Reserves as a novel ingredient. Bonds as in the literature.
2. Constraint on transfers from Treasury to central bank.

Literature

	Positive	Normative (Optimal Policy)
Consolidated (fiscal backing)	Sargent and Wallace 1981 among others	Benigno and Woodford 2003 Schmitt-Grohe and Uribe 2004 among others
Unconsolidated (No fiscal backing)	Hall and Reis 2015 Del Negro and Sims 2015 Bassetto and Sargent 2020 Amador and Bianchi 2023	**This paper**

Model

Environment

- **Time.** Discrete, infinite horizon.
- **Assets.** Reserves and bonds (Differ in duration and liquidity value).
- **Agents**

Household consumes and works. Trades reserves and bonds. Get a convenience yield.

Producers are NK model, facing cost-push and productivity shock.

Treasury finances public expenditure by a sales tax, bonds, and remittance from central bank.

Central bank issues reserves for their liquidity value and buys bonds.

Household

$$\max_{C_t, N_t(j), B_t, D_t} E_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{1}{1-\sigma} C_t^{1-\sigma} - \frac{1}{1+\nu} N_t^{1+\nu} + \frac{\chi_1}{1-\gamma_1} \left(Q_t^C \frac{D_t}{P_t} \right)^{1-\gamma_1} + \frac{\chi_2}{1-\gamma_2} \left(Q_t^T \frac{B_t}{P_t} \right)^{1-\gamma_2} \right]$$

s.t.

$$P_t C_t + Q_t^C D_t + Q_t^T B_t = D_{t-1} + (1 + \rho Q_t^T) B_{t-1} + P_t w_t \int_0^1 N_t(j) dj + P_t \Phi_t,$$

- D_t is **reserves** directly held by the household and issued by the central bank.
- B_t is long-duration **bonds** with exponentially declining coupon of ρ^{j-1} in $t + j$.
- Φ is the firm's profit.

Firms

- Standard set up of the adjustment cost model.

$$\max_{p_t(i)} \quad E_0 \sum_{t=0}^{\infty} \beta^t \Lambda_t \left(\underbrace{(1-\tau_t)}_{\text{Sales tax}} p_t(i) y_t(i) - \underbrace{\mu_t^w}_{\substack{\text{Exogenous} \\ \text{Cost-push shock}}} w_t N_t(i) - P_t \frac{\varphi}{2} \left(\frac{p_t(i)}{p_{t-1}(i)} - 1 \right)^2 Y_t \right)$$

$$\text{Production function} \quad y_t(i) = \underbrace{A_t}_{\substack{\text{Exogenous} \\ \text{Productivity}}} N_t(i)$$

$$\text{Demand curve for product} \quad y_t(i) = \left(\frac{p_t(i)}{P_t} \right)^{-\theta} Y_t$$

Government

- Treasury's budget

Remittance from CB

$$Q_t^T B_t^T + P_t \tau_t A_t N_t + \overbrace{P_t H_t} = (1 + \rho Q_t^T) B_{t-1}^T + P_t G_t$$

B^T is the total supply of government bonds. The government expenditure, G_t, is exogenous.

- Central Bank trades reserves and government bonds.

Remittance to Treasury

$$Q_t^C D_t + (1 + \rho Q_t^T) B_{t-1}^C = D_{t-1} + Q_t^T B_t^C + \overbrace{P_t H_t}$$

D is reserves. B^C is bonds held by Central Bank.

- **Inequality constraint on the remittance**

$$H_t \geq H^*$$

Central Bank's Asset Purchase Policy

$$B_t^C = \alpha B_t^T$$

- B^C is government bonds held by central bank, B^T is total supply of bonds.α is a parameter.

- If asset purchase is fully flexible, fiscal backing does not matter.
- In my view, asset side is not for making profits. For example, asset purchase policy is to stabilize the financial market.
  - In practice, Fed is making net losses.
- Under this rule, Liability / assets ratio is stable over the business cycle.
- Reduces the size of the state space (4 states → 3 states).

Equilibrium

- Market Clearing Conditions

$$\text{(Goods)} \quad A_t N_t = C_t + G_t + \frac{\varphi}{2}\left(\pi_t - 1\right)^2 A_t N_t$$

$$\text{(Government bonds)} \quad B_t + B_t^C = B_t^T$$

Government's problem under discretion

- The government simultaneously chooses both monetary and fiscal policy.
  - Policies: Two liabilities, their prices, tax on sales, and remittance.
- **No Strategic Interaction** between monetary and fiscal authority.
- The government maximizes HH utility taking as given policy functions of HH and firms.
  - State variables: Shock, reserves, and bonds.

Optimal Policy (Discretion) – No Fiscal Backing

$$V_t(s_t) = \max_{a_t} \quad \frac{1}{1-\sigma}C_t^{1-\sigma} - \frac{1}{1+\nu}N_t^{1+\nu} + \frac{\chi_1}{1-\gamma_1}\left(Q_t^C\frac{D_t}{P_t}\right)^{1-\gamma_1} + \frac{\chi_2}{1-\gamma_2}\left((1-\alpha)Q_t^T\frac{B_t}{P_t}\right)^{1-\gamma_2} + \beta E_t V_{t+1}(s_{t+1})$$

States (s_t): Shock, reserves, and government bonds.

Choice
Allocation: Consumption, Labor supply.
Prices: Inflation, price of liabilities.
Policies: Sales tax, two liabilities, and remittance.

Euler Equations

NKPC

Market Clearing

Treasury

$$Q_t^T B_t^T + P_t\tau_t A_t N_t + P_t H_t = (1+\rho Q_t^T)B_{t-1}^T + P_t G_t$$

CB

$$Q_t^C D_t + (1+\rho Q_t^T)B_{t-1}^C = D_{t-1} + Q_t^T B_t^C + P_t H_t$$

Remittance $H_t \geq H^*$

Optimal Policy (Discretion) – Fiscal Backing

$$V_t(s_t) = \max_{a_t} \quad \frac{1}{1-\sigma}C_t^{1-\sigma} - \frac{1}{1+\nu}N_t^{1+\nu} + \frac{\chi_1}{1-\gamma_1}\left(Q_t^C\frac{D_t}{P_t}\right)^{1-\gamma_1} + \frac{\chi_2}{1-\gamma_2}\left((1-\alpha)Q_t^T\frac{B_t}{P_t}\right)^{1-\gamma_2} + \beta E_t V_{t+1}(s_{t+1})$$

States (s_t): Shock, reserves, and government bonds.

Choice

Allocation: Consumption, Labor supply.

Prices: Inflation, price of liabilities.

Policies: Sales tax, two liabilities, and remittance.

Euler Equations

NKPC

Market Clearing

Consolidated Government

$$Q_t^C D_t + Q_t^T(1-\alpha)B_t + \tau_t P_t Y_t = D_{t-1} + (1+\rho Q_t^T)(1-\alpha)B_{t-1} + P_t G_t.$$

Solution

- Markov-perfect equilibrium.
- Shock: Cost-push, productivity, or government expenditure.
  - Include one shock, and exclude the other two.
- **Globally** solve the model.
  - Occasionally binding constraint: $H_t \geq H^*$.

Calibration

Standard

$\chi_1(Q^c d)^{1-\gamma_1}$

$\chi_2(Q^T b)^{1-\gamma_2}$

Variable	Value	Description	Target	Model	Data
β	0.995	Discount factor		Standard	
σ	2	Risk aversion		Standard	
ν	3	Frisch Elasticity		Standard	
θ	10	Elasticity of substitution		Standard	
φ	100	Price adjustment cost		Standard	
ρ^T	0.95	Duration of Treasury	Average maturity	5 years	5 years
χ_1	0.0006	Utility from reserves	Steady-state reserves	15% of GDP	15% of GDP
χ_2	0.0014	Utility from Treasury bond	Steady state bonds	40% of GDP	80% of GDP
γ_1	1.7	Curvature of utility from reserves	$\frac{\partial Q^C}{\partial d}$	-0.1	-0.05~-0.2
γ_2	1.5	Curvature of utility from Treasury	$\frac{\partial Q^T}{\partial b}$	-0.05	0~-0.1
α	0.4	CB's asset holding	CB's Net worth	1	1
H^*	-0.0025	Lower bound on remittance	-	-0.25% of GDP	-

Results

First Finding

Without fiscal backing,

Monetary Policy

- The government tolerates **higher inflation** after an inflationary shock.
- **Optimally chooses not to raise** the interest rate as much as the case with fiscal backing.

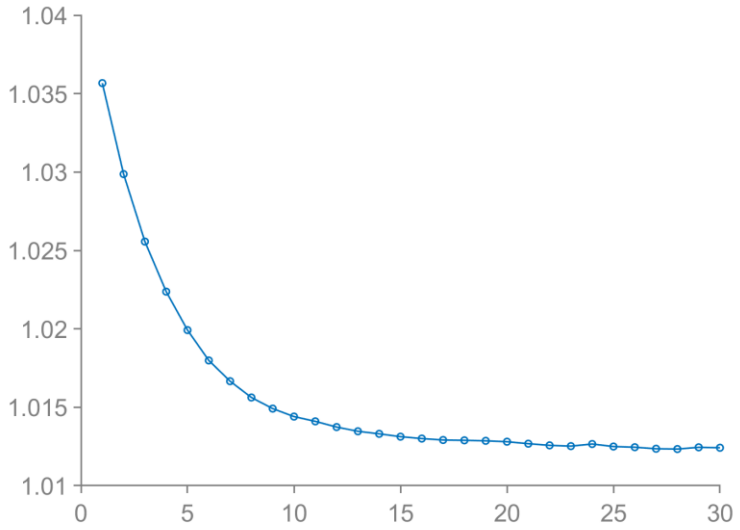
Simulation

- Transition dynamics following a decline of productivity by 5%.
- The marginal cost increases and consumption drops.
- Optimal to raise nominal interest rate, leading to higher interest expenses.

- The initial state variables are large reserves (90^{th} percentile of simulated reserves).
  - The economy moves even when the shock does not hit.

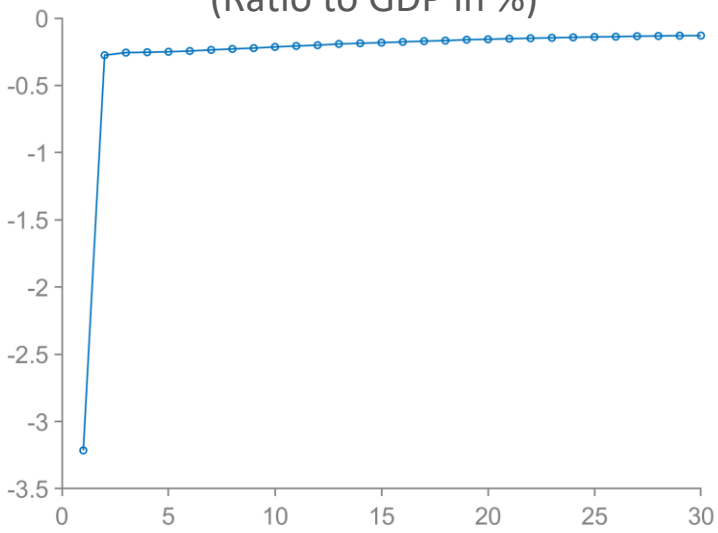
Negative productivity shock with fiscal backing

Nominal interest on reserves, $\frac{1}{Q^c}$



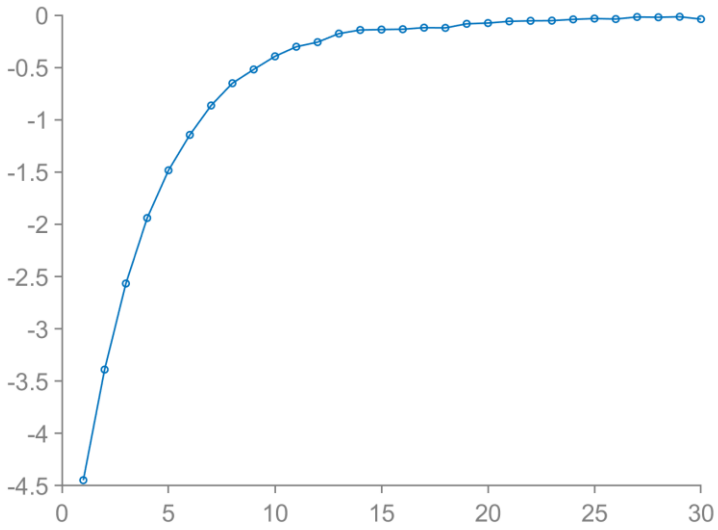
Remittance from CB to Treasury

(Ratio to GDP in %)



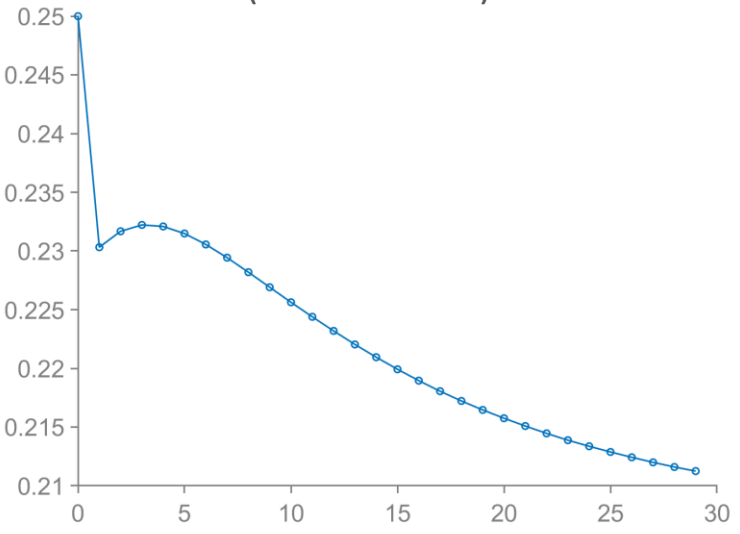
Consumption

(SS deviation in %)



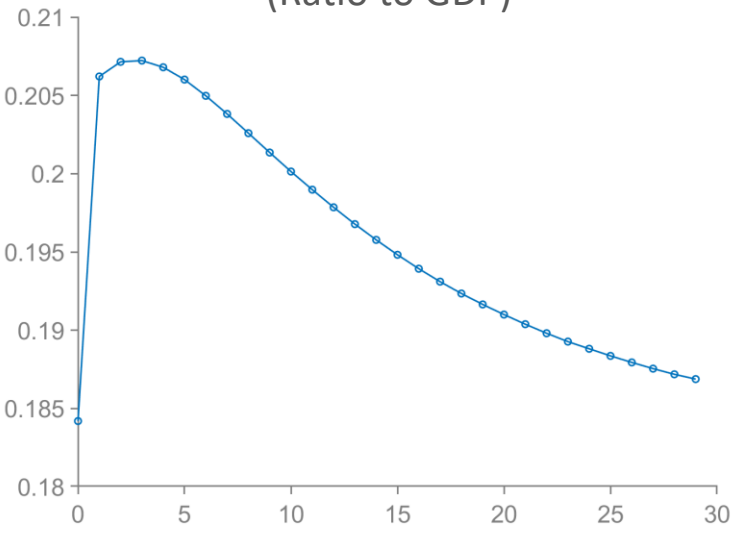
Reserves

(Ratio to GDP)



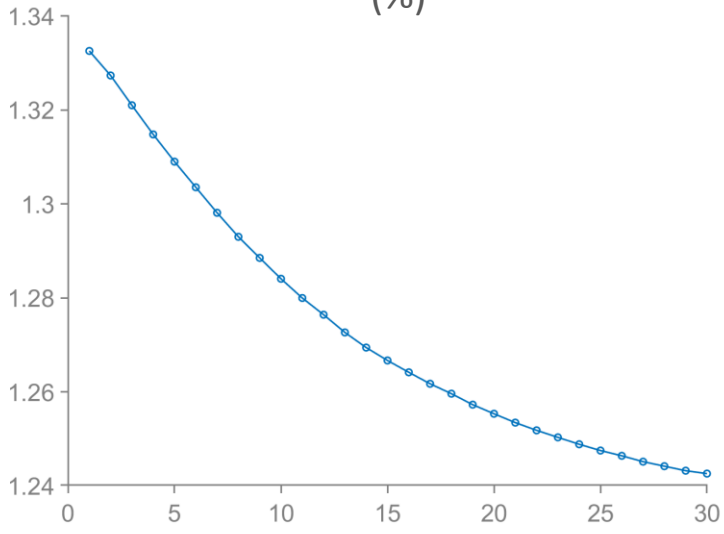
Government bonds

(Ratio to GDP)



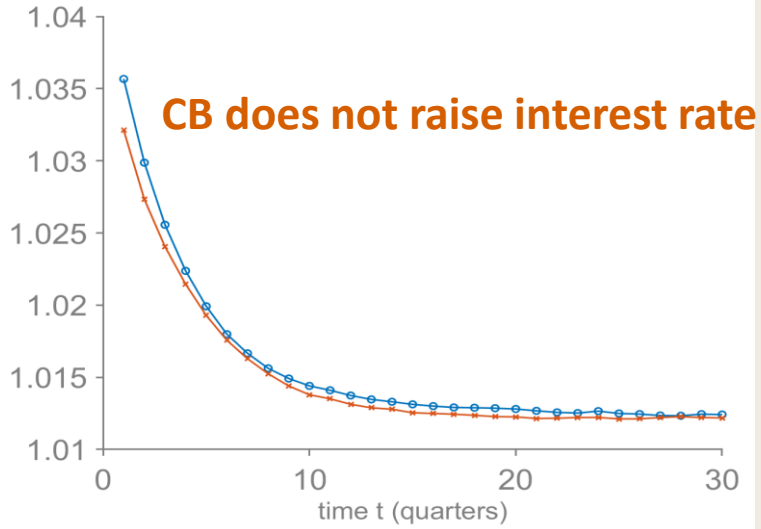
Inflation

(%)



Fiscal Backing (blue) and No Fiscal Backing (red)

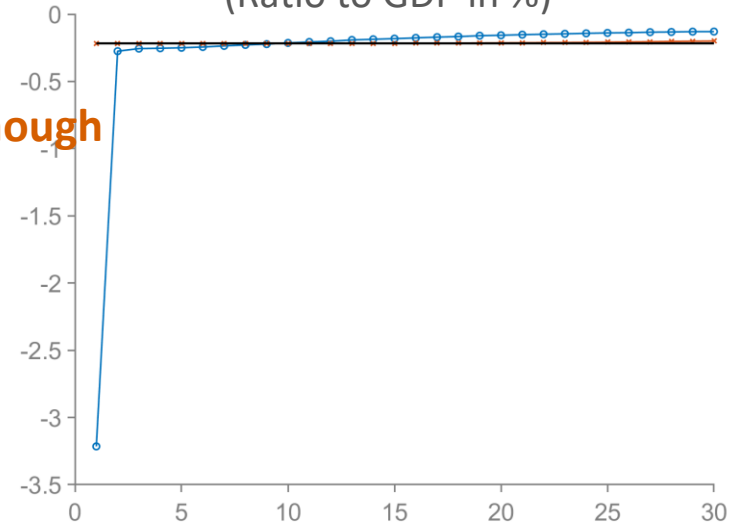
Nominal interest on reserves, $\frac{1}{Q^c}$



CB does not raise interest rate enough

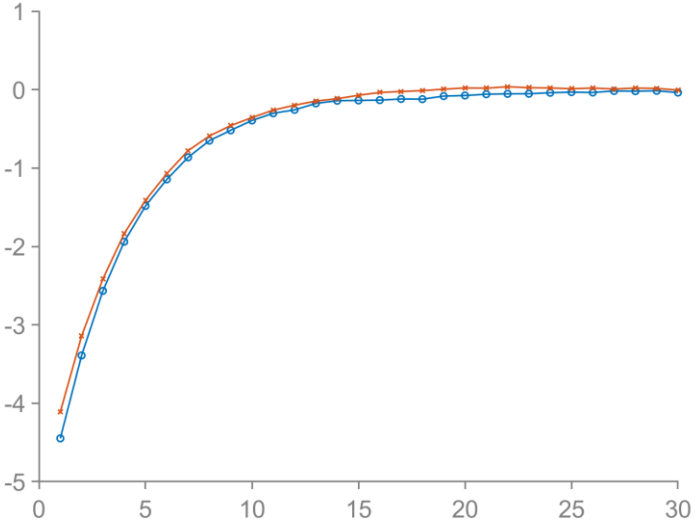
Remittance from CB to Treasury

(Ratio to GDP in %)



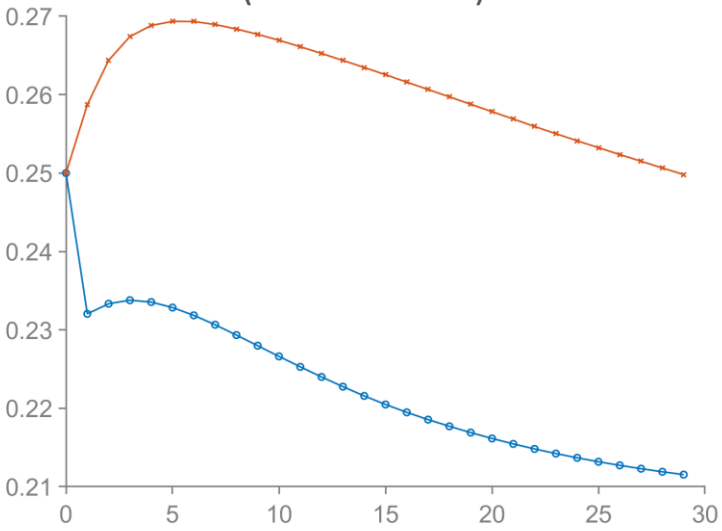
Consumption

(SS deviation in %)



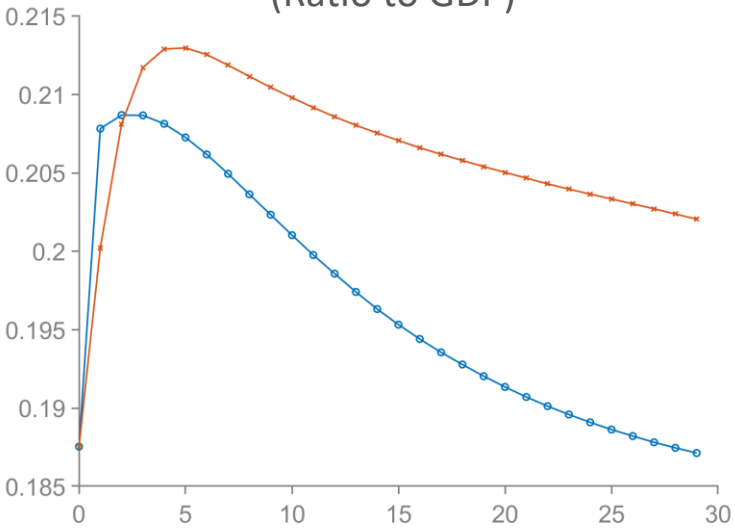
Reserves

(Ratio to GDP)



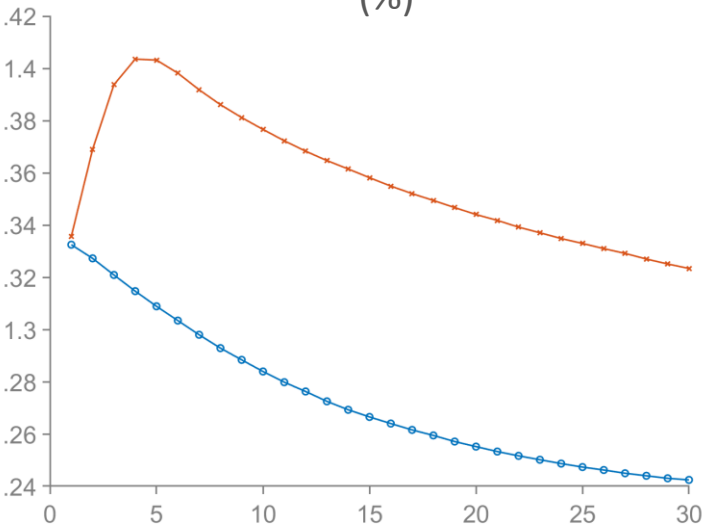
Government bonds

(Ratio to GDP)

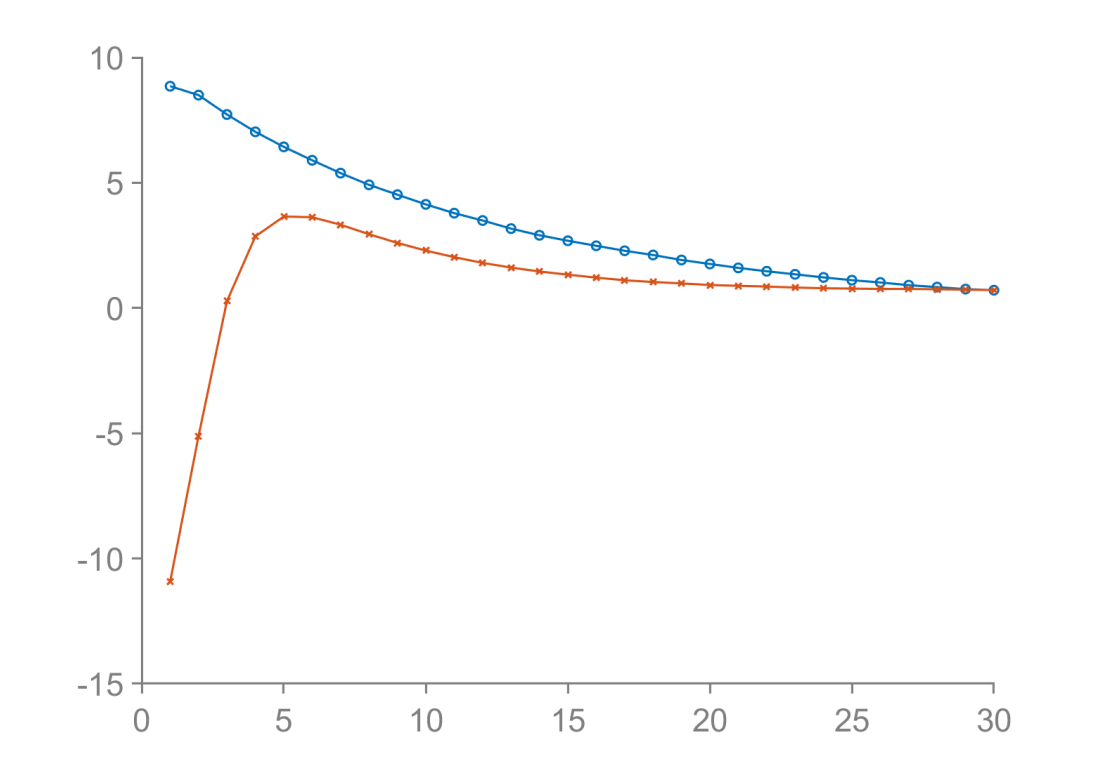


Inflation

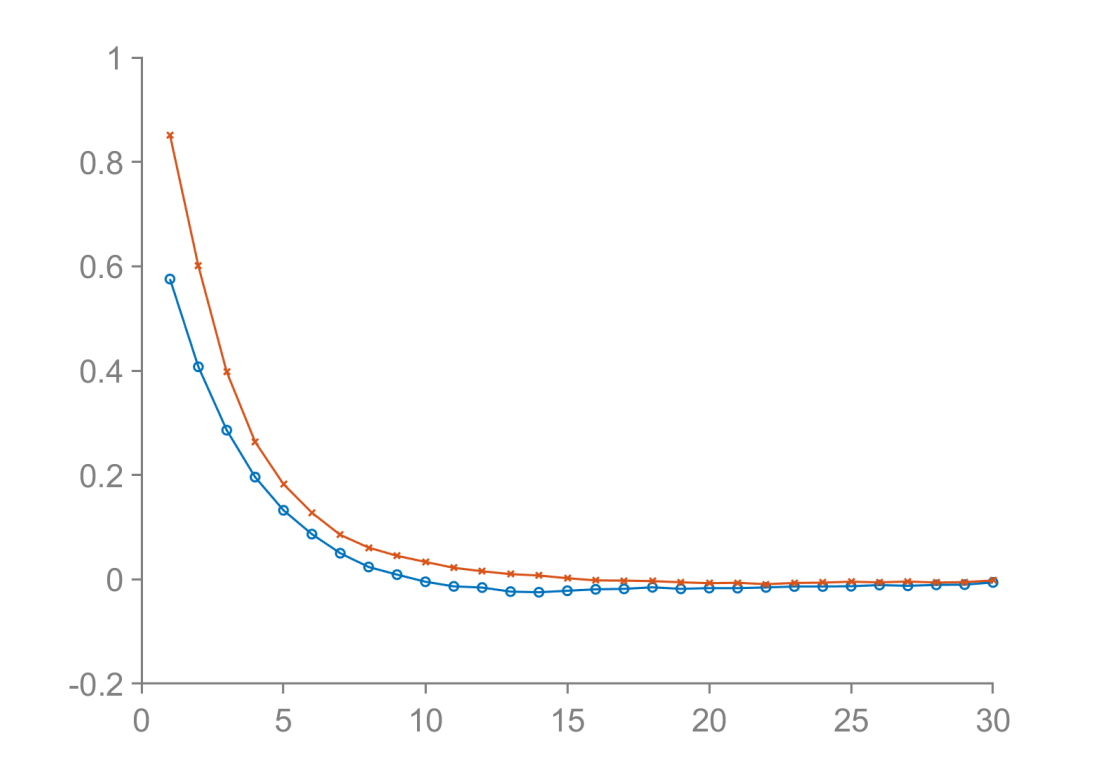
(%)



Tax rate on sales
SS deviation



Labor supply
SS deviation



Intuition

Finding

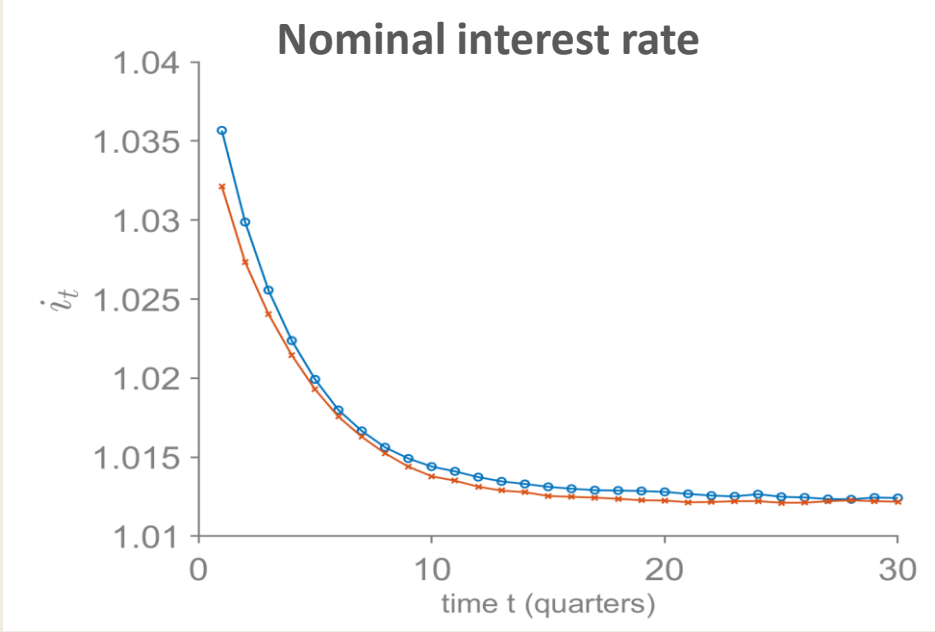
- ***Optimally*** choose the lower interest rate.

Intuition

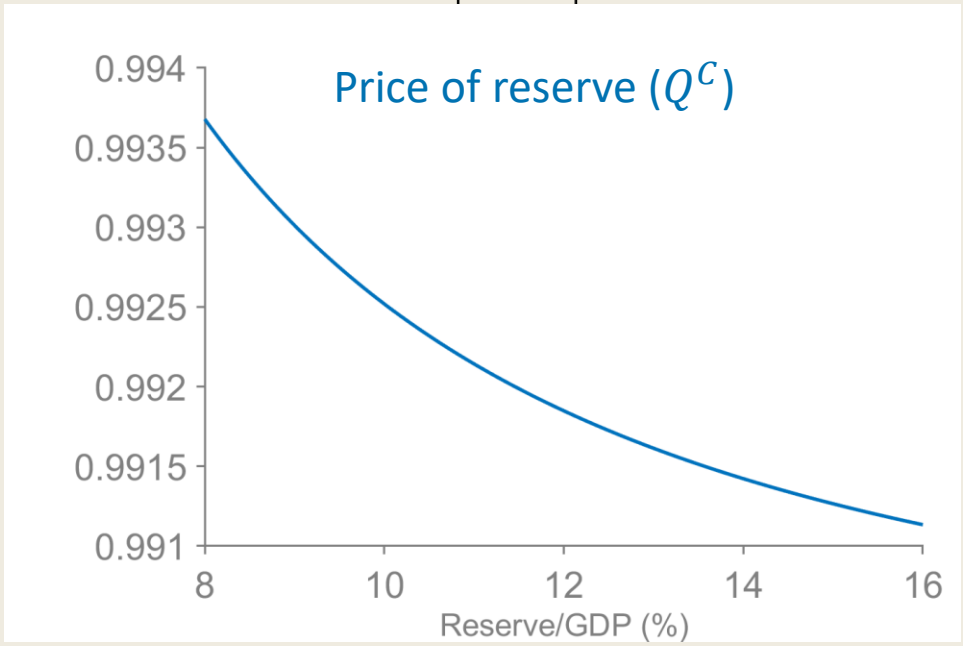
- Suppose interest rate is high without fiscal backing.
- No fiscal backing to reduce reserves. → Larger reserves.
- **Downward**-slope demand curve → Higher interest rate.

Key parameter

- The **slope** of demand curve is a key object.
  - Flat demand curve → Raise interest rate.

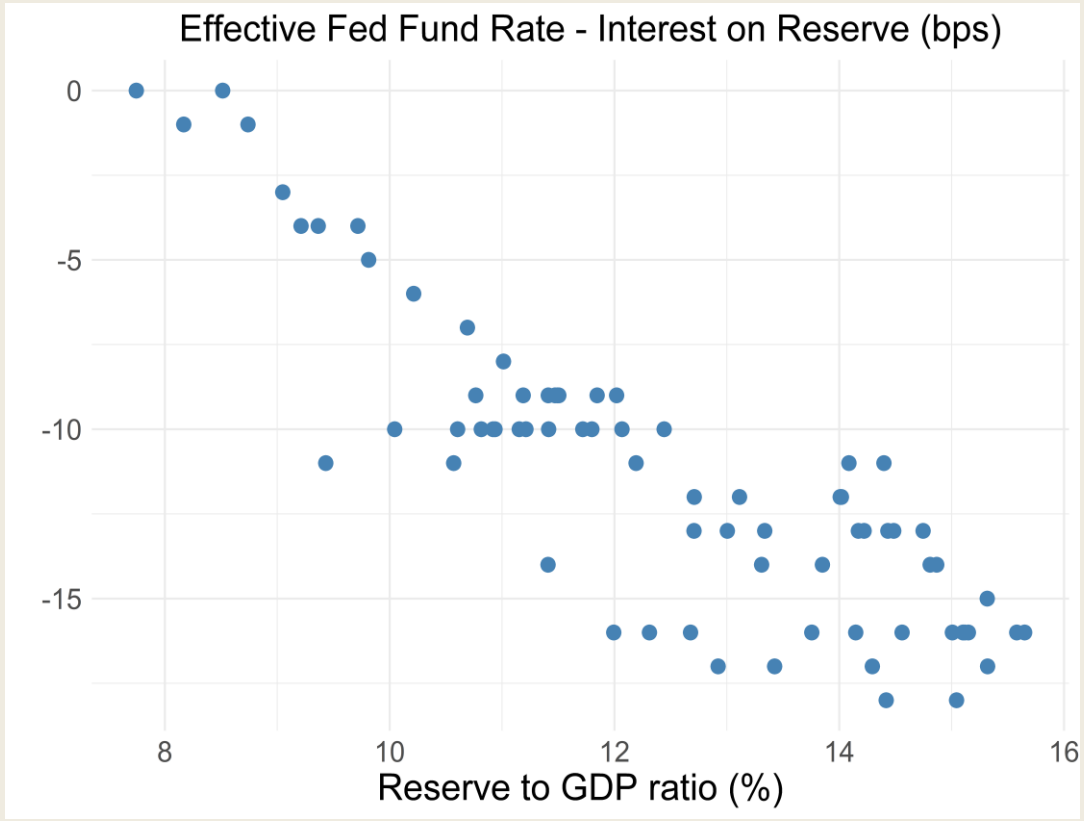


Euler $C_t^{-\sigma} Q_t^C = \beta E_t \left[\frac{C_{t+1}^{-\sigma}}{\pi_{t+1}} \right] + \chi_1 (Q_t^C d_t)^{-\gamma_1} Q_t^C$



- Horizontal: the **quantity** of reserves: Reserve/GDP.
- Vertical: the **price** of reserves: EFF – IOR (bps)
- 1% increase in Reserve/GDP → Price drops by 0.5~2bps.

(Vissing-Jorgensen 2024).



(Data: 2013-2019)

Why is the central bank's losses costly?

High interest rates

→Excess reserves (Quantity)

→Destabilize interest rates (Price)

This research focuses on

○ Fight against inflation with large reserves

× Losses due to FXI or ETF

Common Argument & Model Implications

- BOJ:

"Although the process of **raising interest** rates may **temporarily** result in **losses** due to higher interest expenses, these are likely to be **offset in the long run** as maturing long-term bonds are replaced with new issuances at higher yields."

Q. Is the temporary loss costless?

A. No. Excess reserves prevent central bank to track the natural rate.

Fiscal Policy

Second Finding

Without fiscal backing,

Fiscal Policy

- Tax rate is more volatile over the business cycle.
- The central bank is limited to helping the Treasury finance government spending.

Procedure

- Feed the exogenous path of **public expenditure (G_t)** that follows AR(1) with a shock.
- Simulate the economy in both regimes for 1000 periods.
- Compute the variance of tax rate on sales.

Intuition when there is fiscal backing.

- Positive shock to public expenditure (G_t).
- The government wants to smooth tax distortion (τ_t) over time.
- The Treasury can issue bonds (B_t). The central bank can issue reserves (D_t).
- The Treasury receives funds from the central bank (H_t) and finance G_t.

Treasury

$$Q_t^T B_t^T + P_t \tau_t A_t N_t + P_t H_t = (1 + \rho Q_t^T) B_{t-1}^T + P_t G_t$$

CB

$$Q_t^C D_t = D_{t-1} + P_t H_t$$

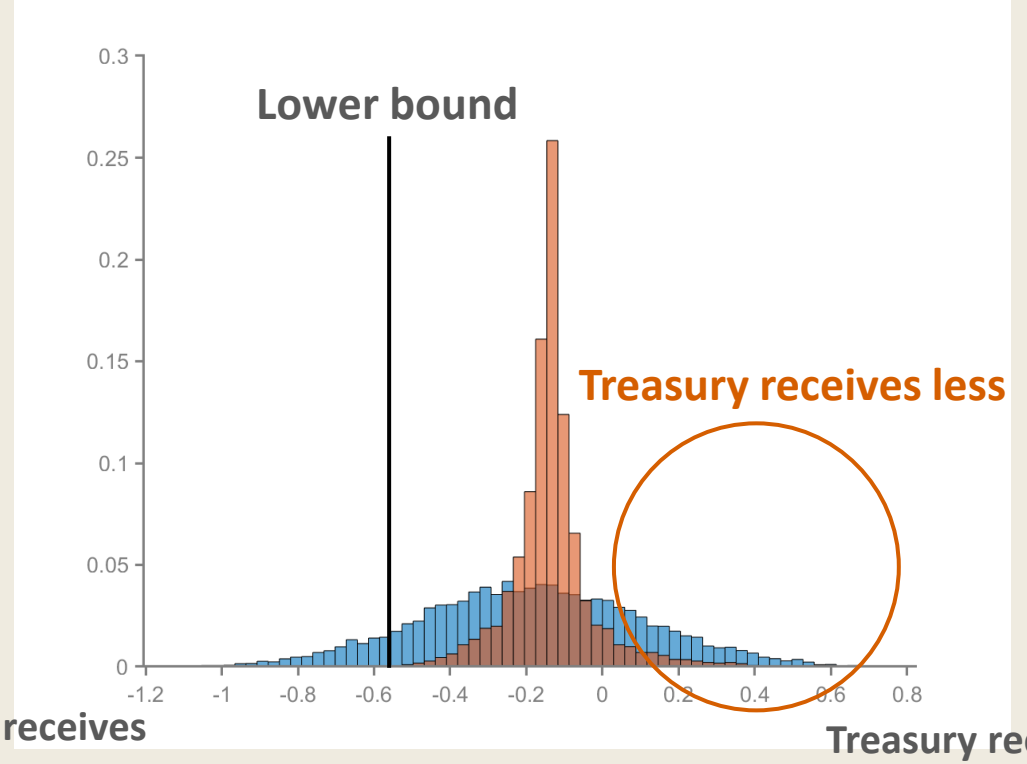
- Show standard deviation.

	Fiscal backing	No fiscal backing
Tax rate on sales (percent)	**0.57**	**0.60**
Reserve (ratio to GDP in %)	**4.1**	**1.1**
Bonds (ratio to GDP in %)	**4.1**	**6.3**

Intuition: Retained Earnings

- Central bank reduces remittances.
- Remittance to reduce reserves is not available.

Histogram for remittance in **With** and **Without**



Treasury

$$Q_t^T B_t^T + P_t \tau_t A_t N_t + P_t H_t = (1 + \rho Q_t^T) B_{t-1}^T + P_t G_t$$

Tax rate needs to adjust ← Less support

Policy Implications & Takeaway

Policy in practice

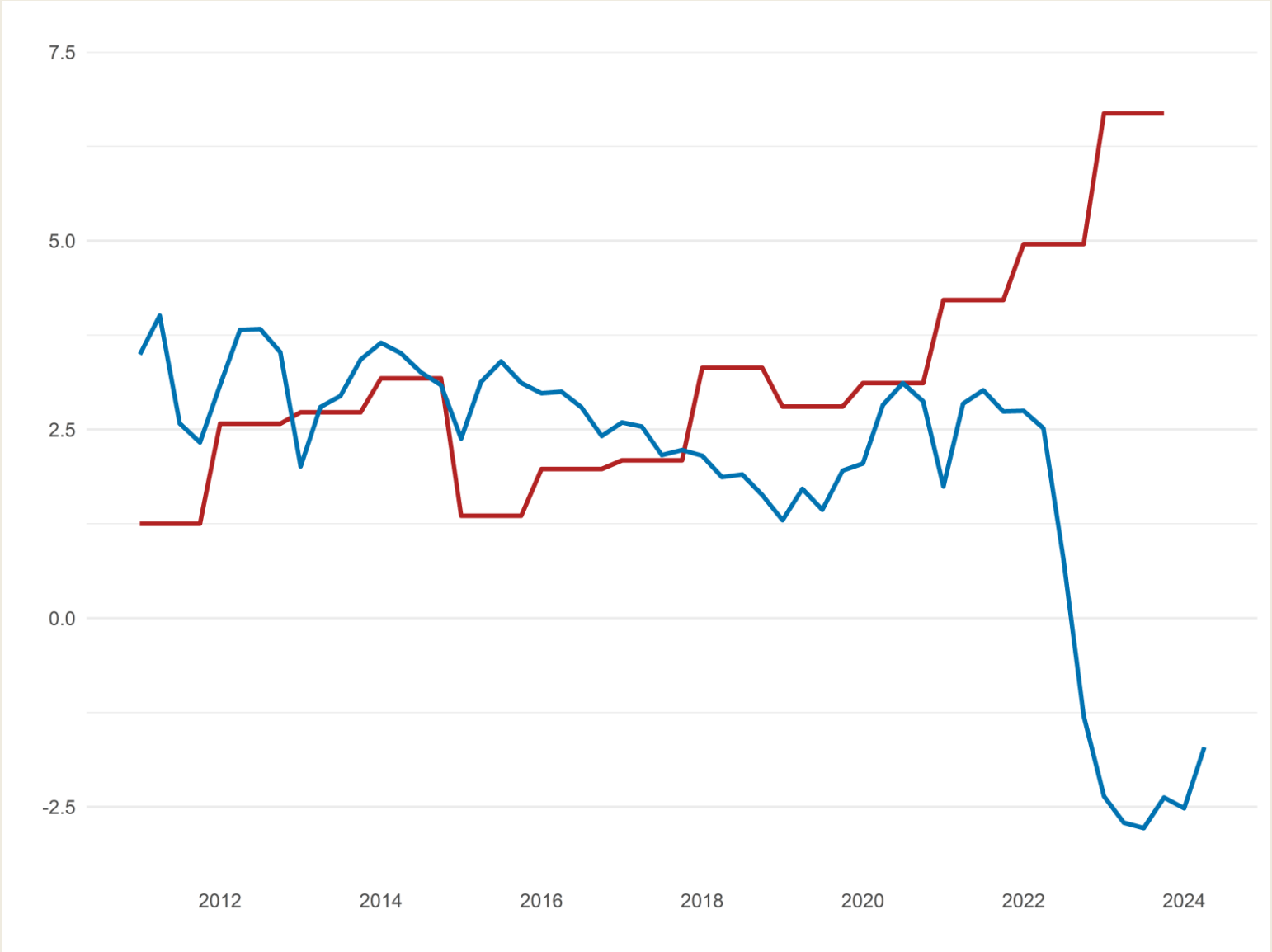
- The central bank's remittance finances public expenditure.
  - Fed's transfer / Government expenditure = 2% (2010-2022).
- The central banks retain their earnings.
  - Bank of Japan **retains 5% of profits** and transfers the rest to the Treasury.
  - Bank of England retains profits if its net worth is below a threshold.

Takeaway

- When Treasury's budget is tightened, the central bank should support Treasury.
- The lack of ***fiscal*** backing constraints optimal ***fiscal*** policy: volatile tax rate.

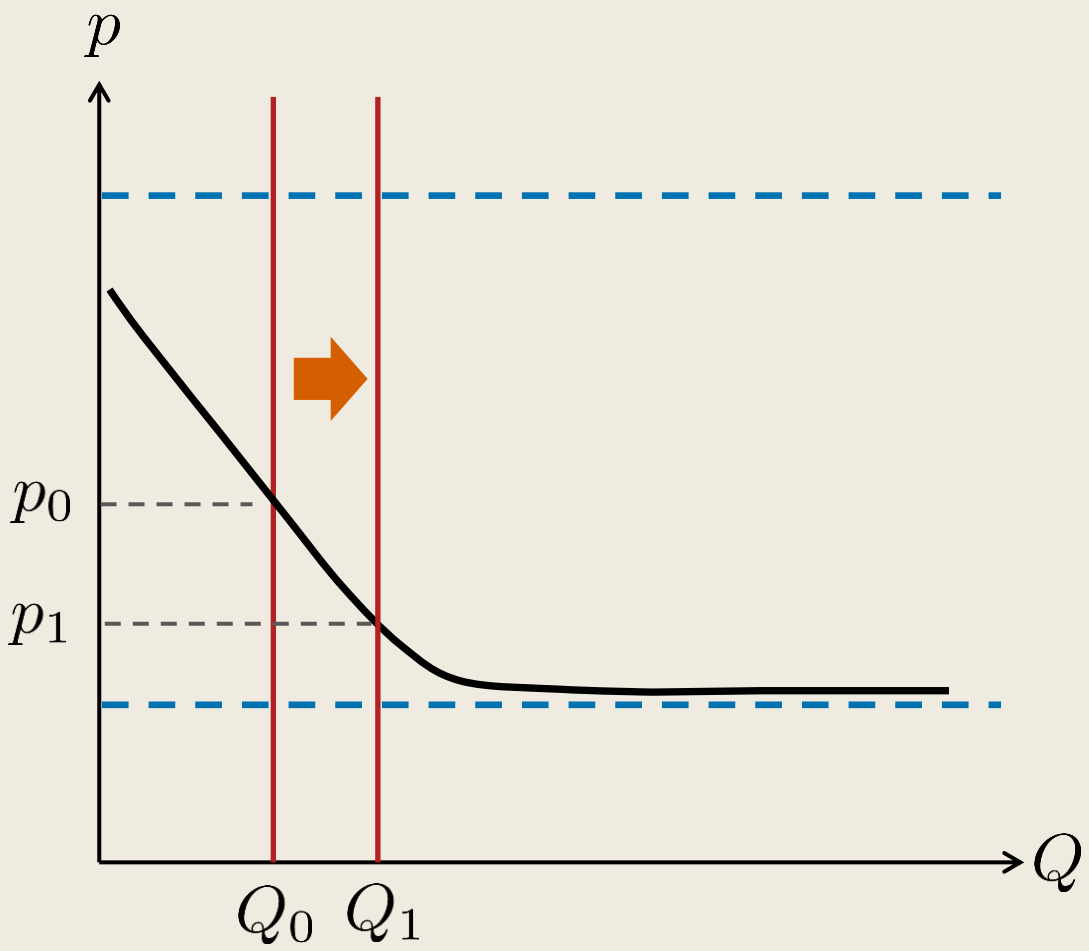
Central bank's profits / Government expenditure (%)

- **US** and **Japan**

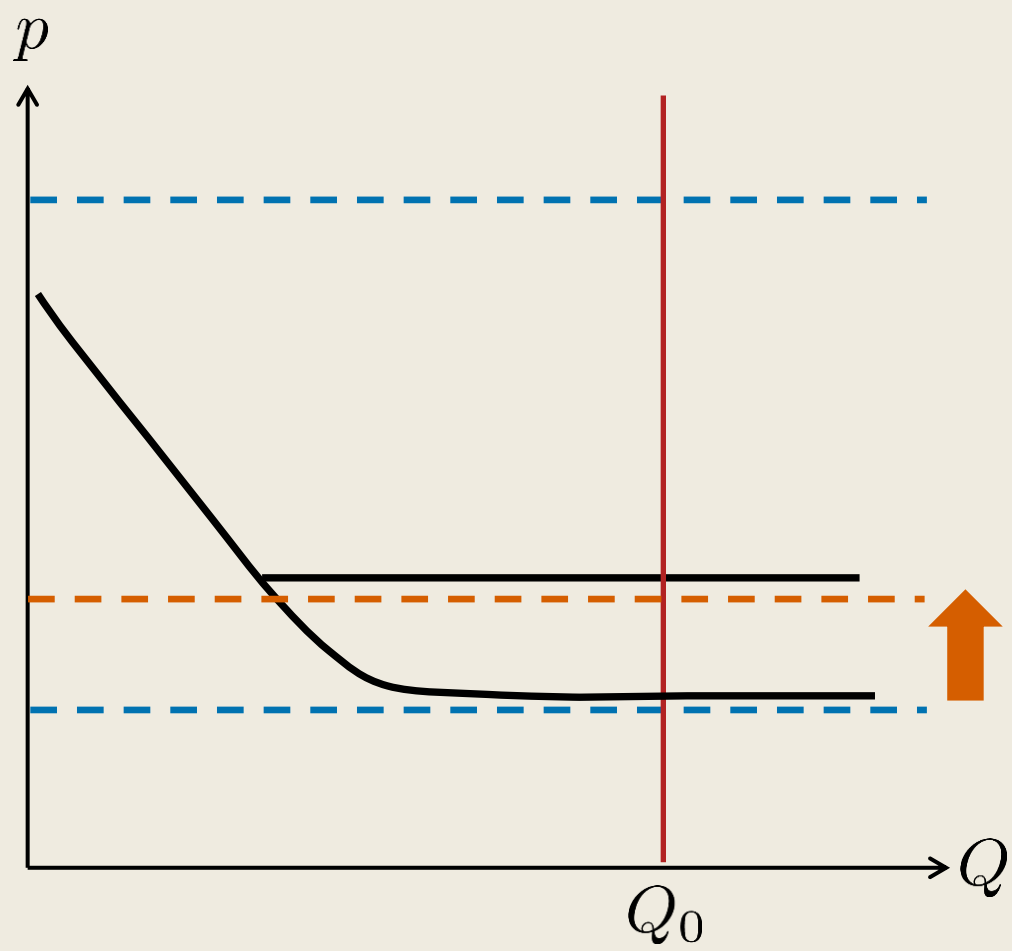


Monetary Policy Operation (Pool 1968)

Open Market Operation



Floor System



Additional Findings

Additional Findings

1. **Non-linearity of the model**

- The higher inflation due to lack of fiscal backing is exacerbated by (i) larger shocks and (ii) higher initial reserves.

2. **Welfare analysis**

- After a 10% increase in the wage mark-up, the welfare loss is 20% lower in the unconsolidated than the consolidated.

Non-linearity of the model

1. If the inflationary shock is small
2. The central bank holds small reserves

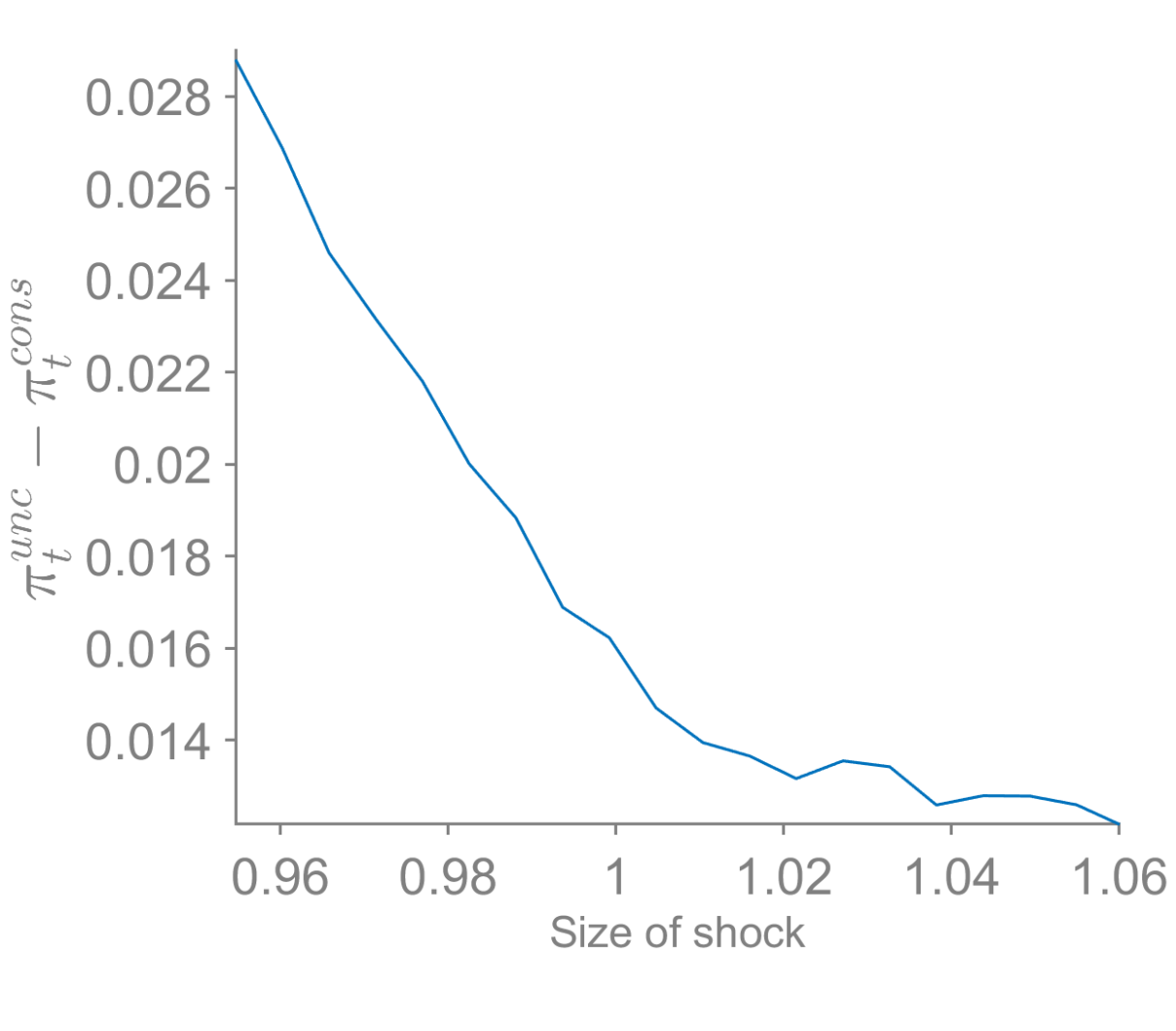
→The inequality constraint on transfers does not bind; $H_t \geq H^*$.

The lack of fiscal backing does not make a difference.

Simulation

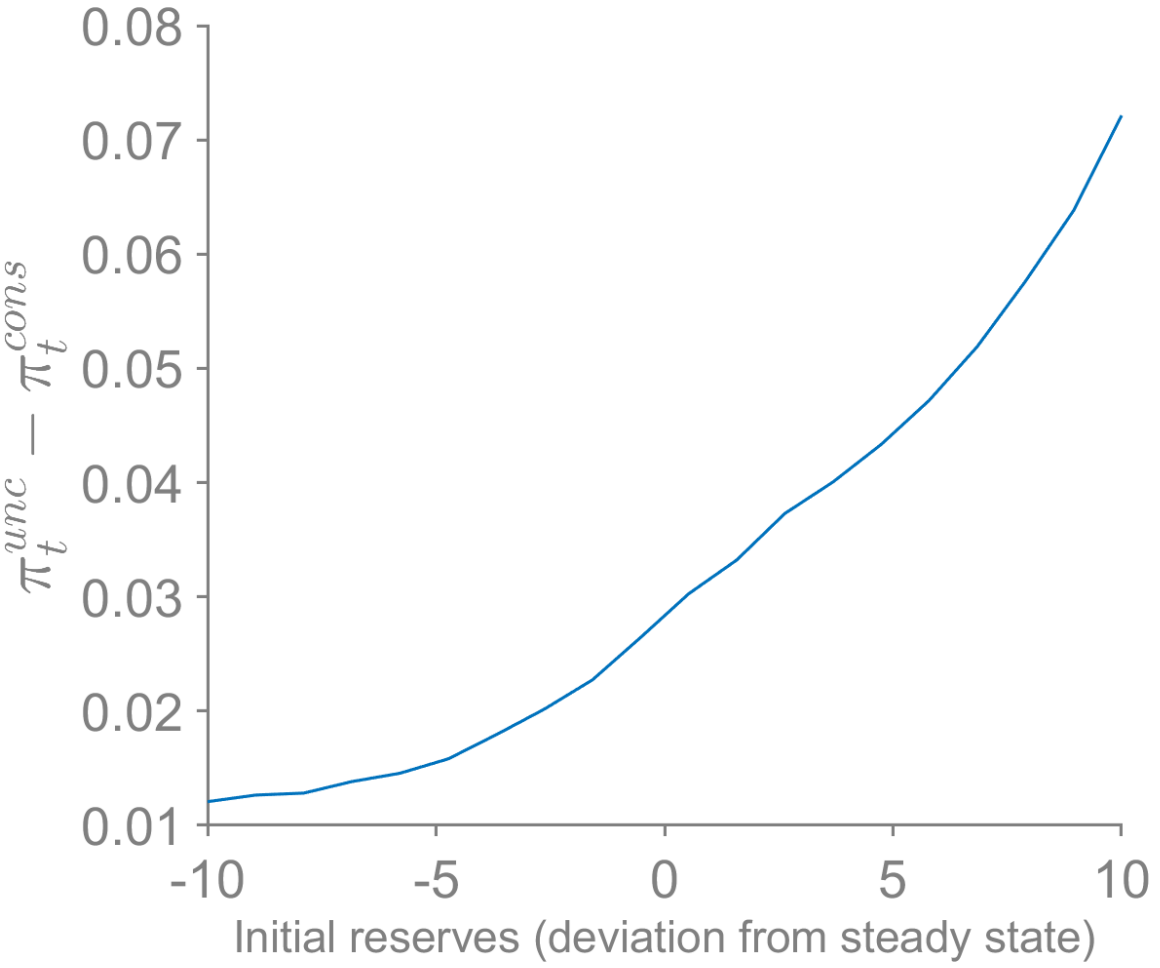
- Compute the response of inflation rate for both regimes (i) following the different size of shock (ii) different size of initial condition for reserves.

The size of a shock.



- The horizontal is A_t at t=1.
- The vertical is the difference in inflation between two regimes.
- When productivity drops by 4%, the inflation rate is higher by 0.028%.

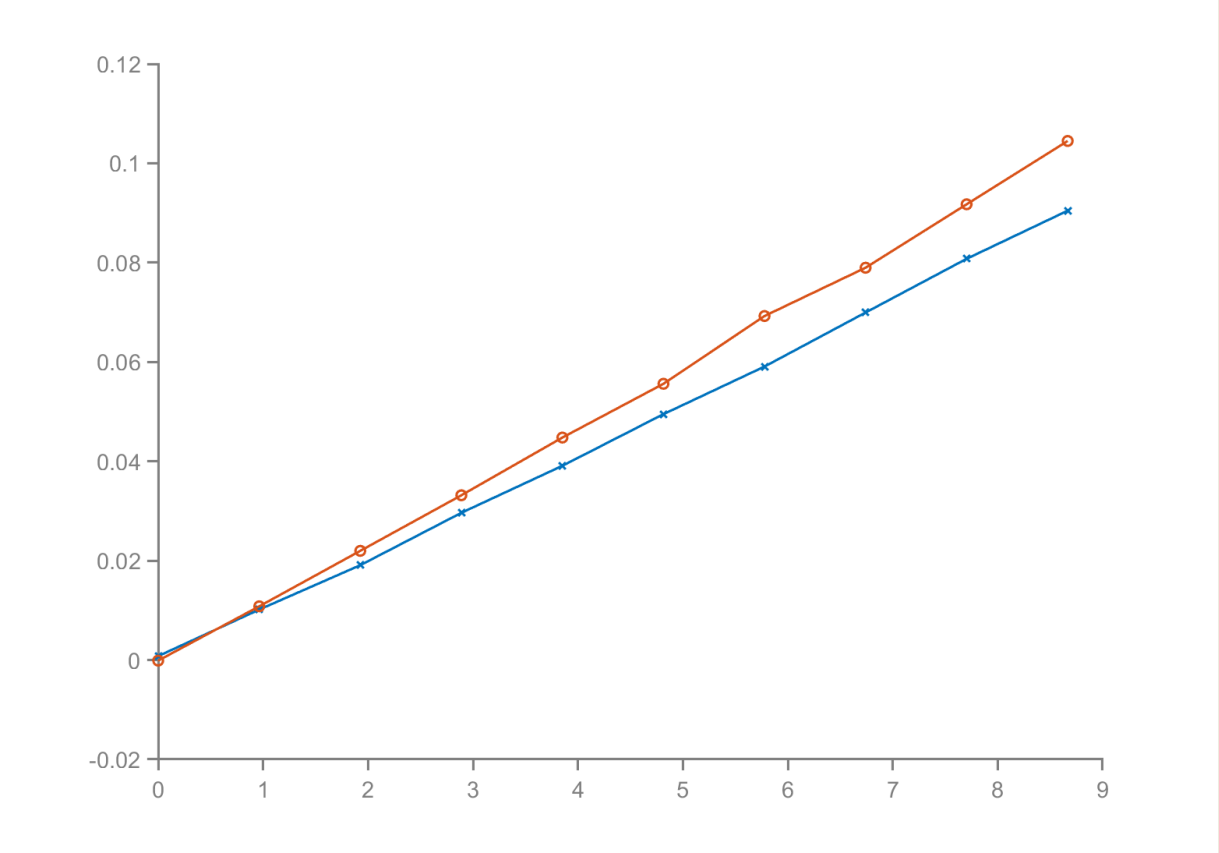
The initial condition for reserves



- The horizontal is the initial condition for reserves.
- The vertical is the difference in inflation between two regimes following the decline of productivity by 5%.
- When the central bank holds 10% higher reserves, the difference in inflation is 0.07%.

The welfare gain of fiscal backing increases with the size of shock.

Welfare cost in consumption equivalence (%).



Increase in wage mark-up in %.

- Compute the welfare loss of cost-push shock compared to the steady-state.
- Show the welfare loss (horizontal) on the size of shock (vertical) for consolidated and unconsolidated.
- Fiscal backing can reduce the welfare loss by 20%.

Conclusions

Monetary Policy

- The government tolerates **higher inflation** after an inflationary shock.

Fiscal Policy

- Tax rate is **more volatile** over the business cycle.

- These are exacerbated by (i) larger shocks and (ii) higher initial reserves.

Appendix