

# Optimal Monetary and Fiscal Policy without Fiscal Backing

Masayuki Okada  
Bank of Japan

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# 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.)  $\times$  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).

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# 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?

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# 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)
<b>Consolidated (fiscal backing)</b>	Sargent and Wallace 1981 among others	Benigno and Woodford 2003 Schmitt-Grohe and Uribe 2004 among others
<b>Unconsolidated (No fiscal backing)</b>	Hall and Reis 2015 Del Negro and Sims 2015 Bassetto and Sargent 2020 Amador and Bianchi 2023	<b>This paper</b>

# Model

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# 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 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  $\rho^{j-1}$  in  $t + j$ .
- $\Phi$  is the firm's profit.



# Firms

- Standard set up of the adjustment cost model.

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

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

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

# Government

- Treasury's budget

Remittance from CB

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

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

- Central Bank trades reserves and government bonds.

Remittance to Treasury

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

$D$  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.  $\alpha$  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  $\rightarrow$  3 states).

# Equilibrium

- Market Clearing Conditions

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

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

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# 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

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

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

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

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Euler Equations

NKPC

Market Clearing

Consolidated  
Government

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

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## Solution

- Markov-perfect equilibrium.
- Shock: 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
$\beta$	0.995	Discount factor		Standard	
$\sigma$	2	Risk aversion		Standard	
$\nu$	3	Frisch Elasticity		Standard	
$\theta$	10	Elasticity of substitution		Standard	
$\varphi$	100	Price adjustment cost		Standard	
$\rho^T$	0.95	Duration of Treasury	Average maturity	5 years	5 years
$\chi_1$	0.0006	Utility from reserves	Steady-state reserves	15% of GDP	15% of GDP
$\chi_2$	0.0014	Utility from Treasury bond	Steady state bonds	40% of GDP	80% of GDP
$\gamma_1$	1.7	Curvature of utility from reserves	$\frac{\partial Q^c}{\partial d}$	-0.1	-0.05~-0.2
$\gamma_2$	1.5	Curvature of utility from Treasury	$\frac{\partial Q^T}{\partial b}$	-0.05	0~-0.1
$\alpha$	0.4	CB's asset holding	CB's Net worth	1	1
$H^*$	-0.0025	Lower bound on remittance	-	-0.25% of GDP	-

# Results

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# 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.

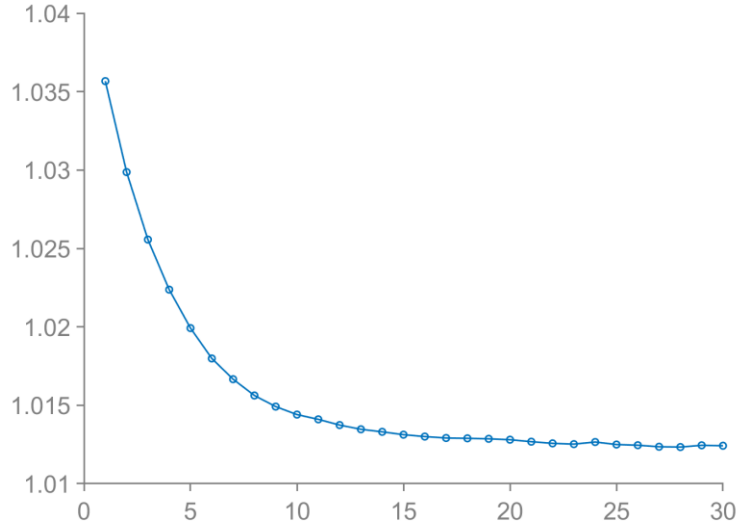
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## Simulation

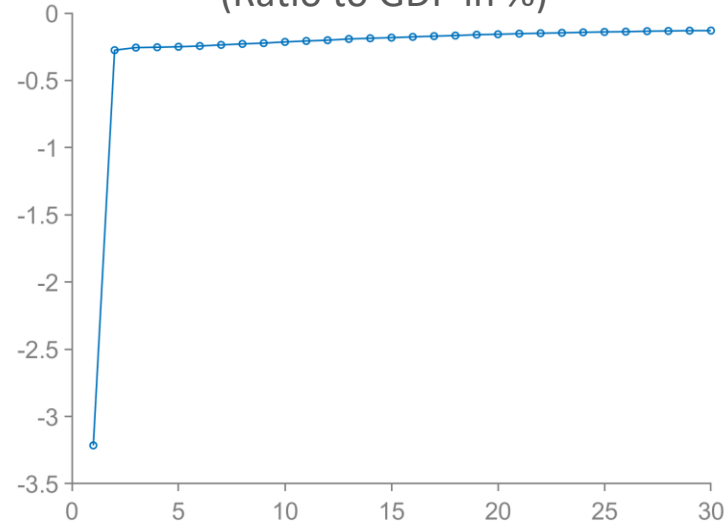
- Transition dynamics following a decline of productivity by 5%.
- The marginal cost increases and consumption drops.
- Optimal to raise nominal interest rate, leading to higher interest expenses.
- The initial state variables are large reserves (90<sup>th</sup> percentile of simulated reserves).
  - The economy moves even when the shock does not hit.

# Negative productivity shock with fiscal backing

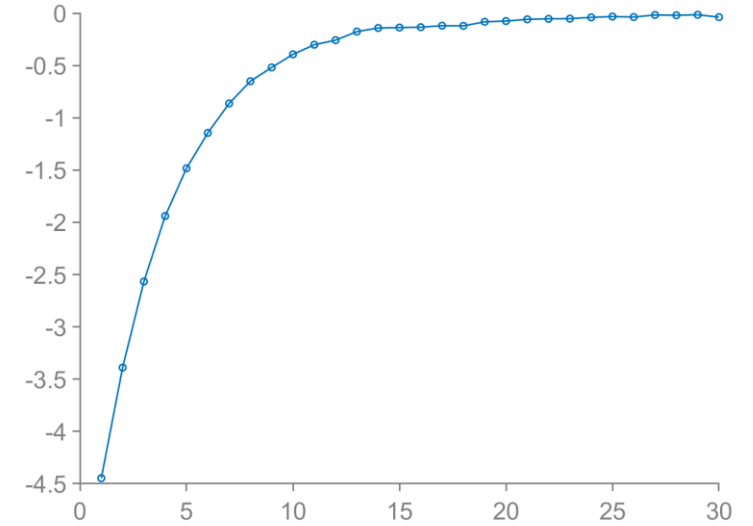
## Nominal interest on reserves, $\frac{1}{Q^c}$



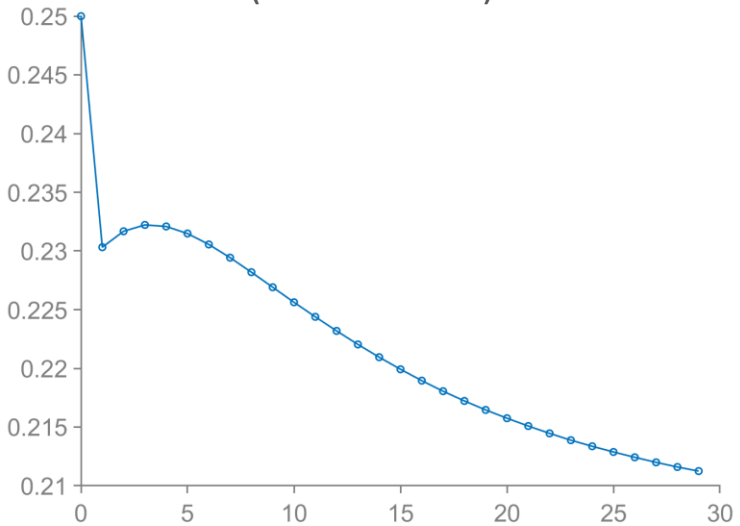
## Remittance from CB to Treasury (Ratio to GDP in %)



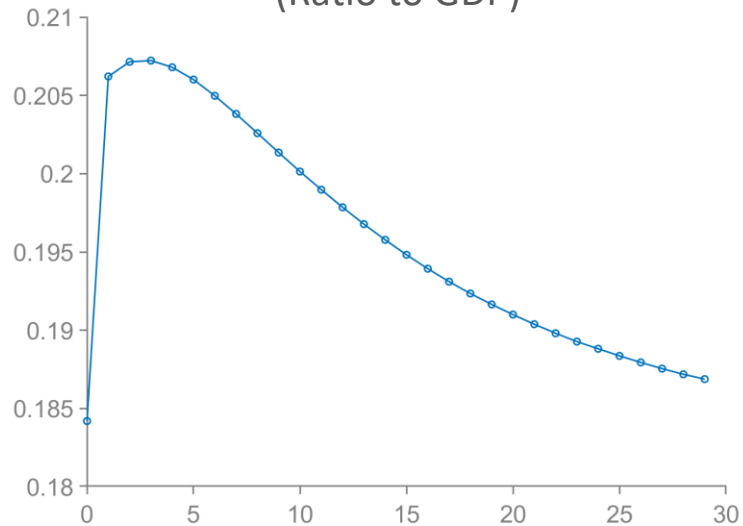
## Consumption (SS deviation in %)



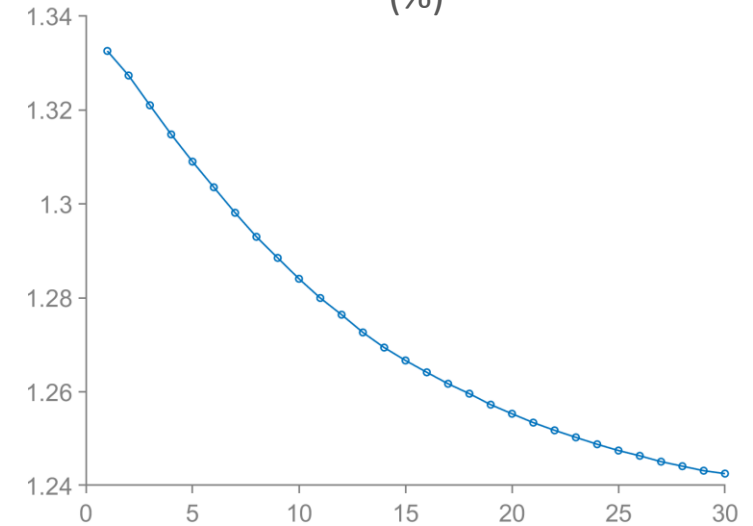
## Reserves (Ratio to GDP)



## Government bonds (Ratio to GDP)

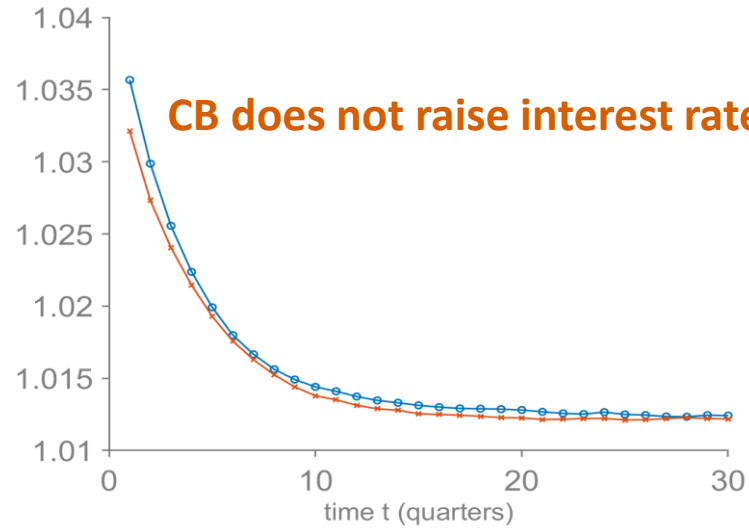


## Inflation (%)

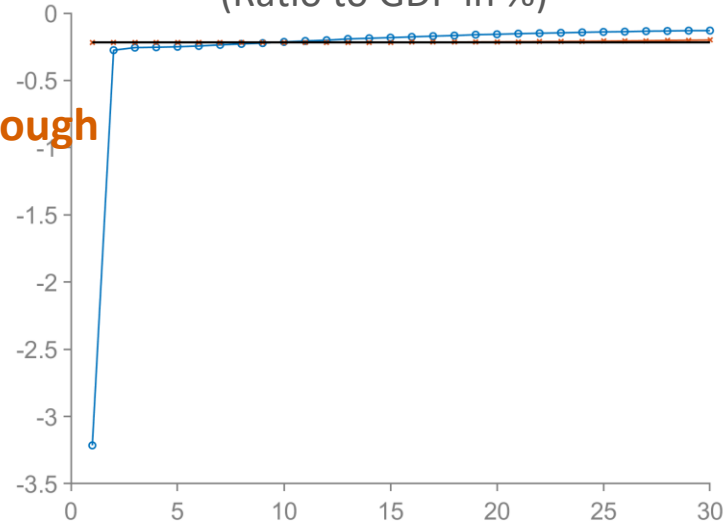


# Fiscal Backing (blue) and No Fiscal Backing (red)

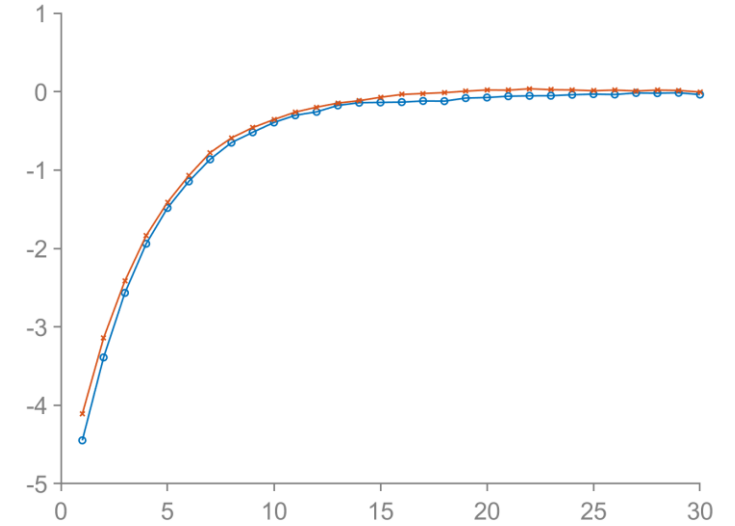
## Nominal interest on reserves, $\frac{1}{Q^c}$



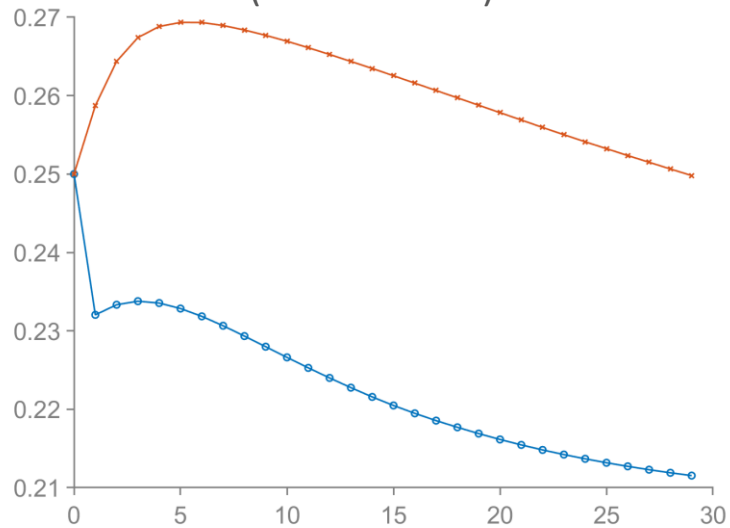
## Remittance from CB to Treasury (Ratio to GDP in %)



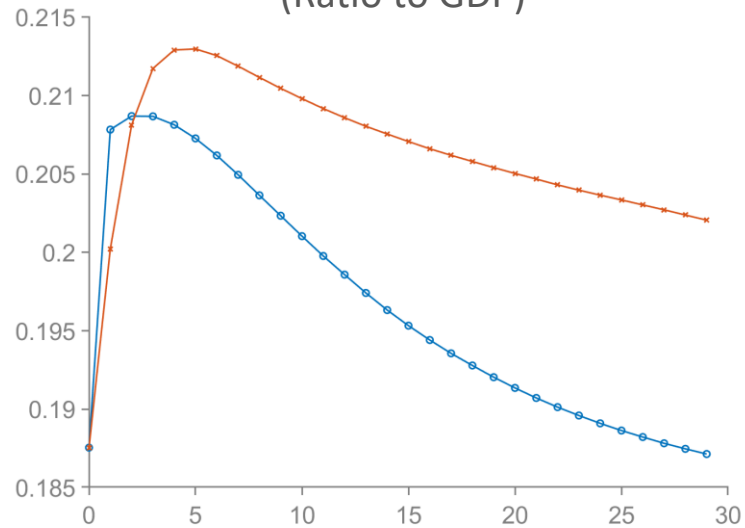
## Consumption (SS deviation in %)



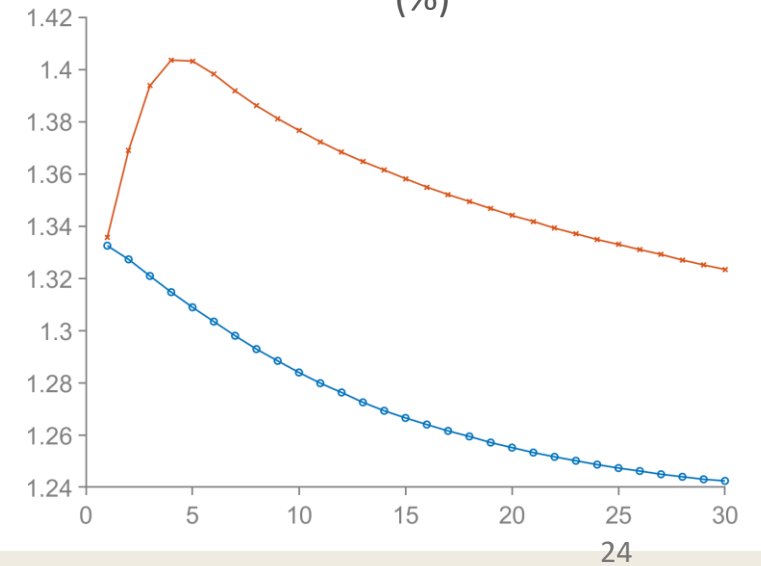
## Reserves (Ratio to GDP)



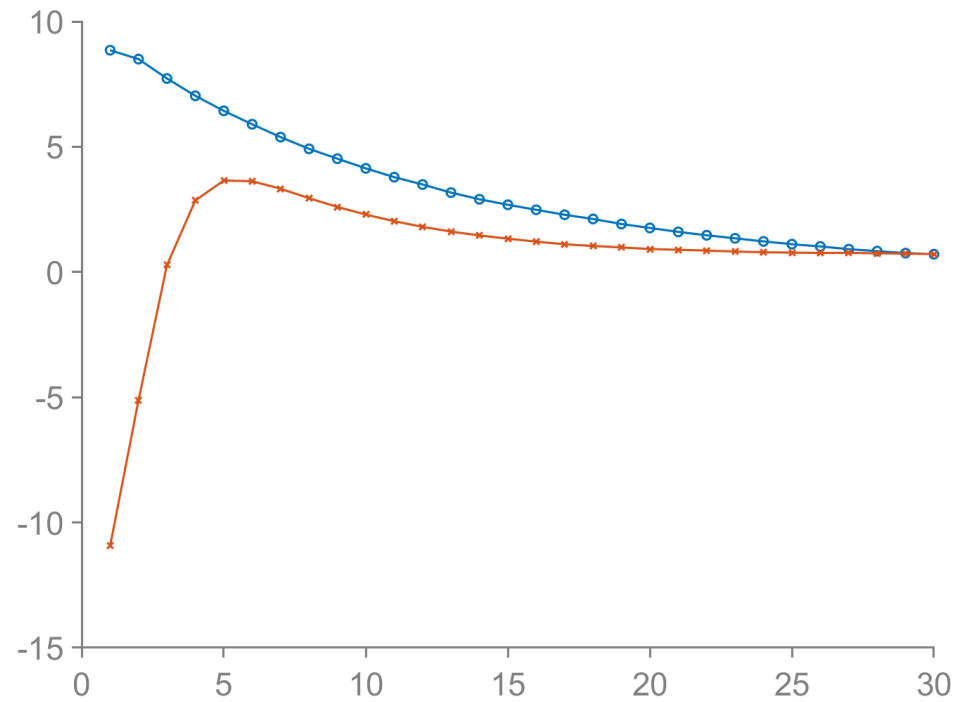
## Government bonds (Ratio to GDP)



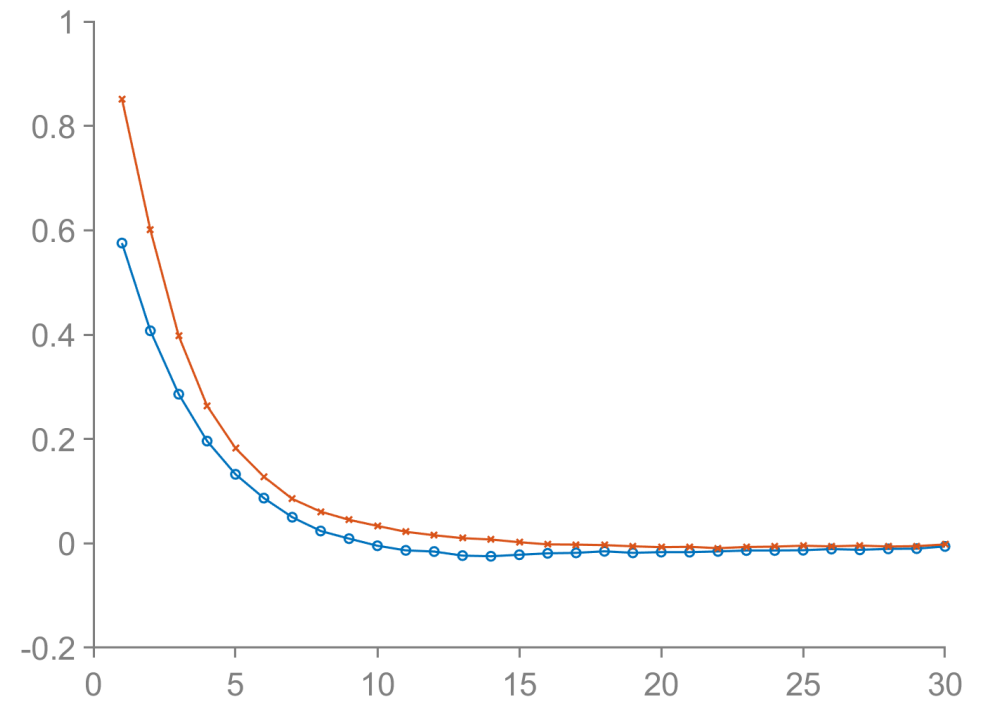
## Inflation (%)



**Tax rate on sales  
SS deviation**



**Labor supply  
SS deviation**



# Intuition

## Finding

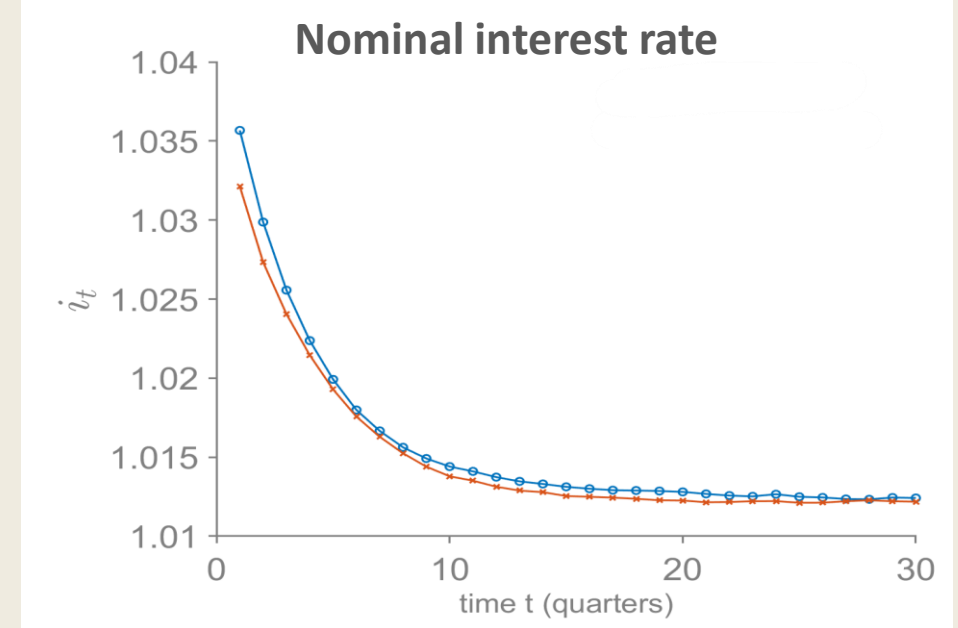
- *Optimally* choose the lower interest rate.

## Intuition

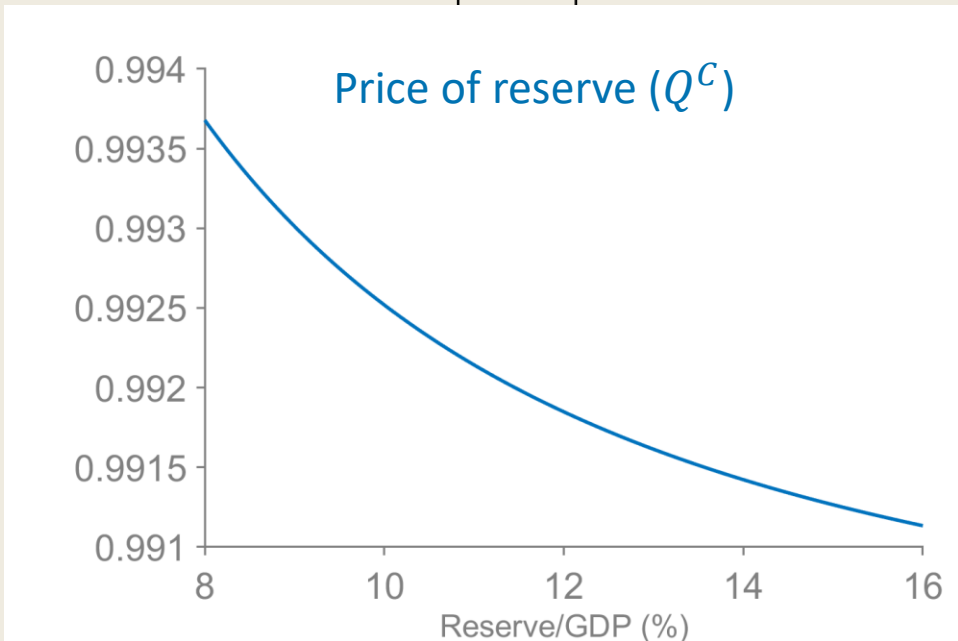
- Suppose interest rate is high without fiscal backing.
- No fiscal backing to reduce reserves. → Larger reserves.
- **Downward**-slope demand curve → Higher interest rate.

## Key parameter

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



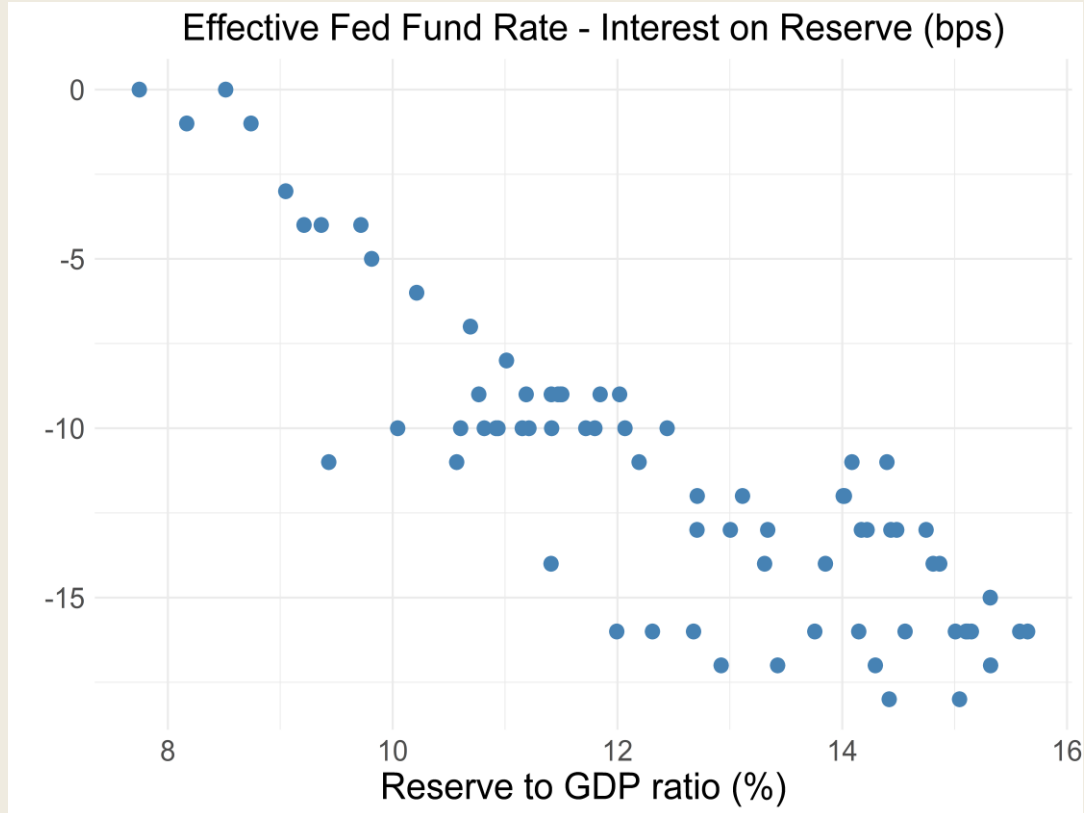
$$\text{Euler} \quad C_t^{-\sigma} Q_t^C = \beta E_t \left[ \frac{C_{t+1}^{-\sigma}}{\pi_{t+1}} \right] + \chi_1 (Q_t^C d_t)^{-\gamma_1} Q_t^C$$





- 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

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# 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

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# 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.

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## 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 ( $\tau_t$ ) 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

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

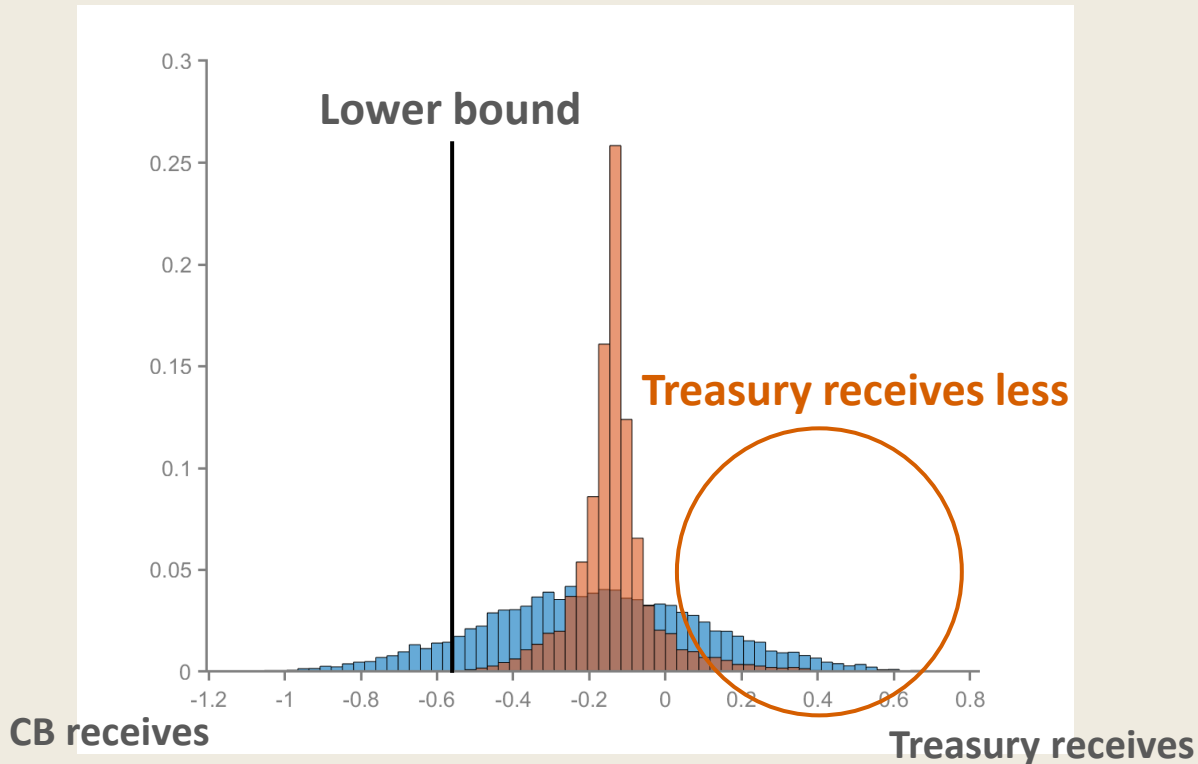
- Show standard deviation.

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

# Intuition: Retained Earnings

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

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



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

Treasury
Tax rate needs to adjust
←
Less support
↑



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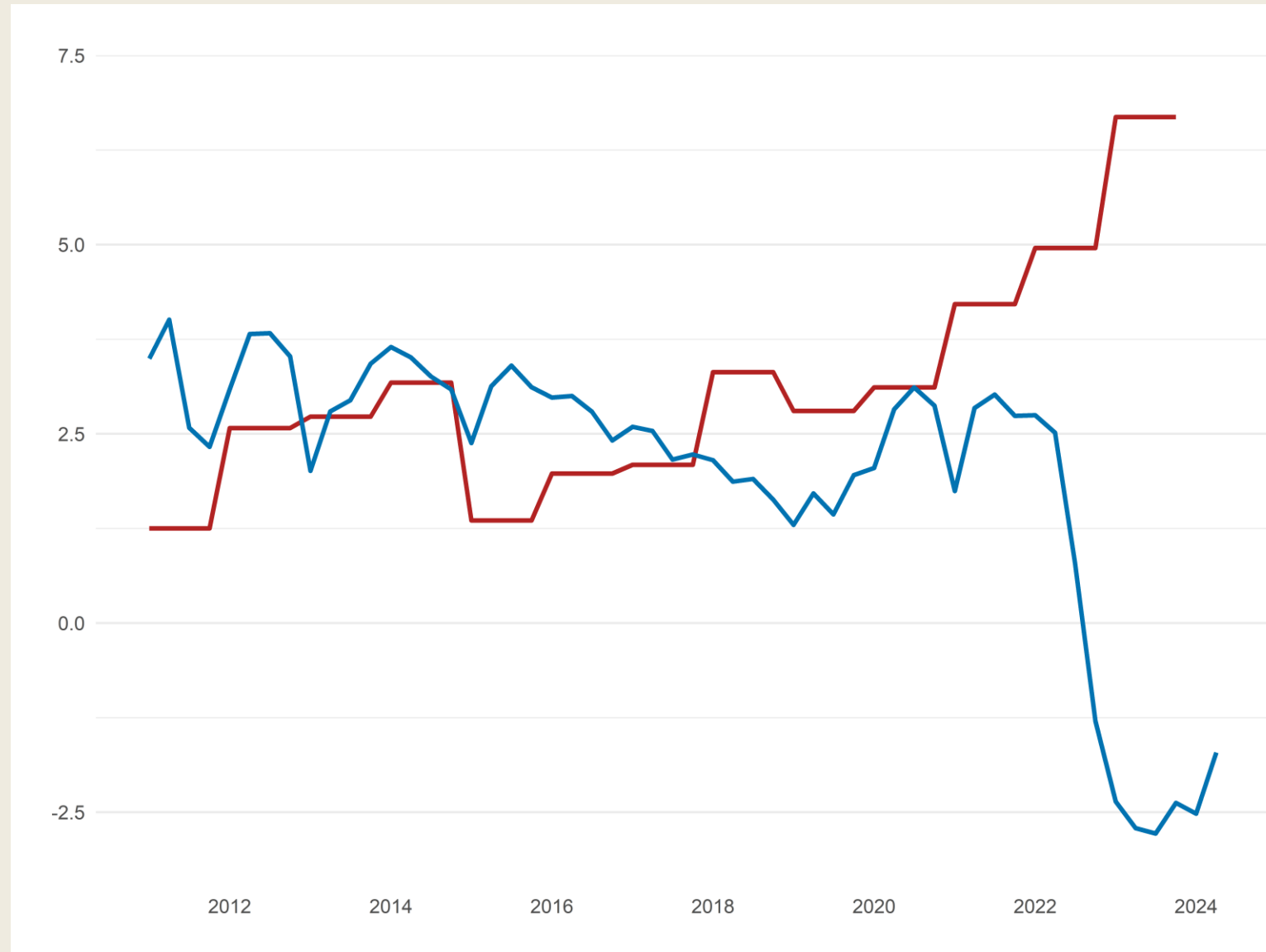
# Policy Implications & Takeaway

## Policy in practice

- 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.

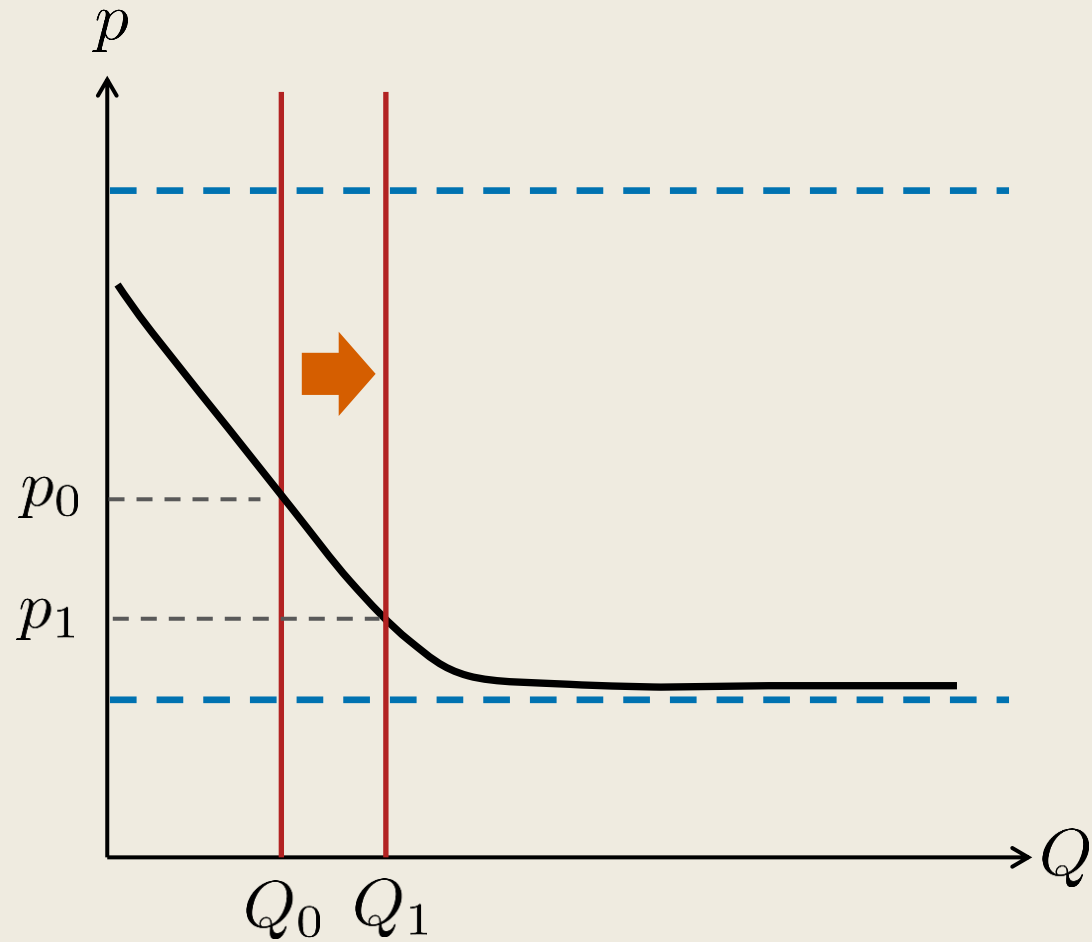
# Central bank's profits / Government expenditure (%)

● US and Japan

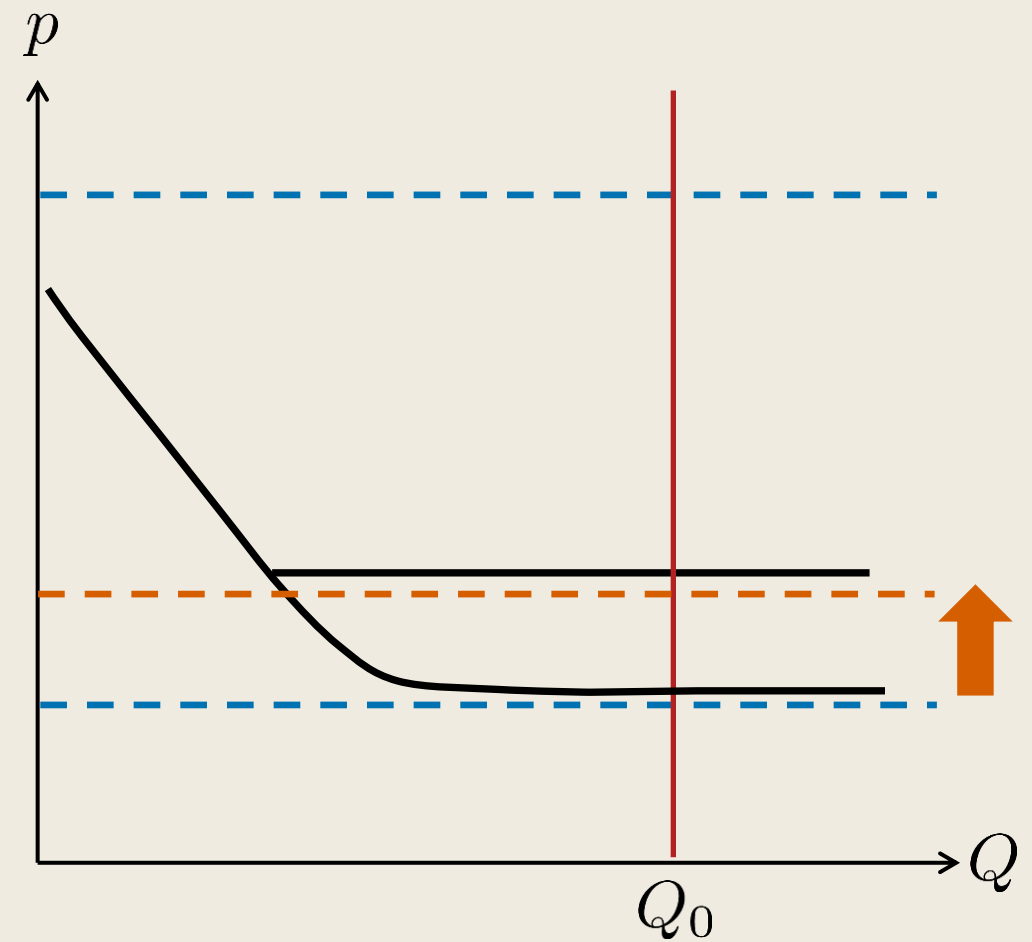


# Monetary Policy Operation (Pool 1968)

## Open Market Operation



## Floor System



# Additional Findings

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# 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

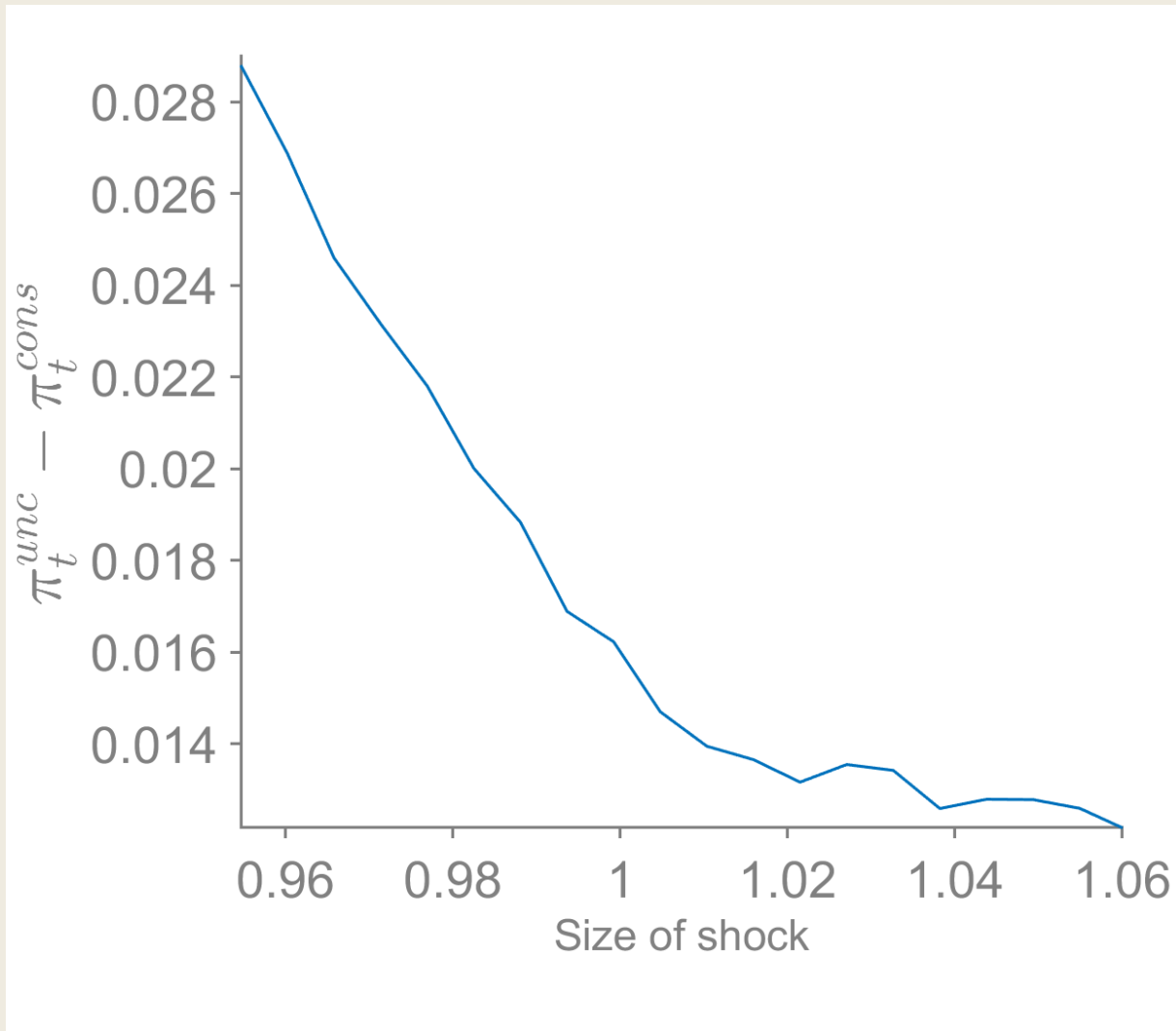
→ The inequality constraint on transfers does not bind;  $H_t \geq H^*$ .

The lack of fiscal backing does not make a difference.

## Simulation

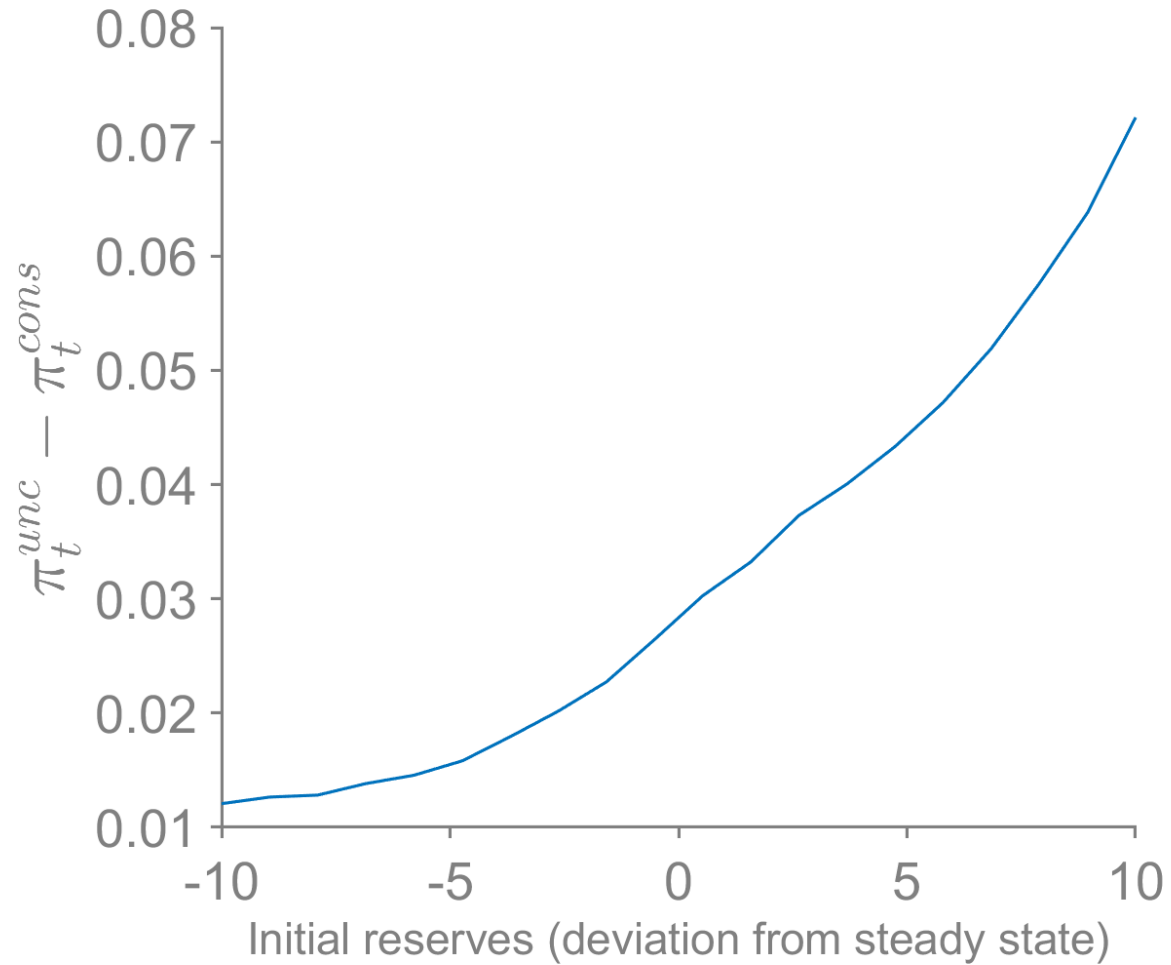
- Compute the response of inflation rate for both regimes (i) following the different size of shock (ii) different size of initial condition for reserves.

# 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

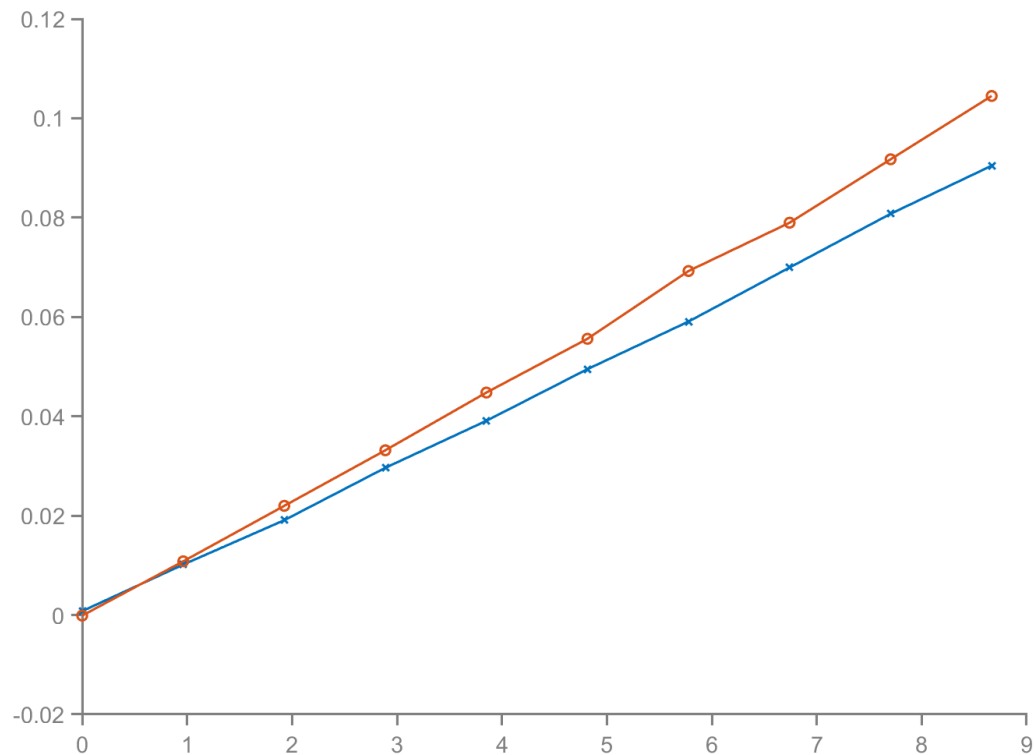


- The horizontal is the initial condition for reserves.
- The vertical is the difference in inflation between two regimes following the decline of productivity by 5%.
- When the central bank holds 10% higher reserves, the difference in inflation is 0.07%.



# 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%.

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# 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