Optimal monetary and fiscal policy without fiscal backing

Masayuki Okada

NYU

Introduction

- The Fed runs a large loss by paying interest on reserves after 2022.
  - Expense = Interest rate (5p.p.) × Reserves (15% of GDP)
  - Fed's loss / Treasury's tax revenue = 2.5%
- Finance through (a) liability, (b)transfers from Treasury, (c) reduce assets/net worth.
  - The Fed transferred all profits to the Treasury before 2022.
  - Asymmetric transfers: The Treasury does not offset the Fed's losses now.
- 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 Central Bank)

does the optimal monetary-fiscal policy change?

What I do

Optimal monetary and fiscal policy without commitment

As in the literature,

- Standard NK model with government budgets.
- Government chooses policies to maximize utility s.t. equilibrium conditions.

New

1. 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	Sargent and Wallace 1981 among others	Benigno and Woodford 2003 Schmitt-Grohe and Uribe 2004 among others
Unconsolidated	Hall and Reis 2015 Del Negro and Sims 2015 Bassetto and Sargent 2020 Amador and Bianchi 2023	**This paper**

Literature

	Positive	Normative (Optimal Policy)
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What I find

Without fiscal backing,

1. Central Bank tolerates higher inflation in response to the cost-push shock.
    - Key: An initial condition with large reserves

What I find

Without fiscal backing,

1. Central Bank tolerates higher inflation in response to the cost-push shock.
   - Key: An initial condition with large reserves
2. The welfare loss is small (<0.01% of consumption) in the typical business cycle.

   Conditional on a large cost-push shock, the fiscal backing reduces the welfare cost by 20%

Model

Environment

- **Time.** Discrete, infinite horizon.
- **Assets.** Reserves and government 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 linear sales tax, government bonds, and remittance from Central Bank.

Central Bank issues reserves and buys government bonds.

Household

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

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 Central Bank.
- B_t is long-duration **government bonds** with exponentially declining coupon of ρ^j in $t + j$.
- Φ is the firm's profit.

Firms

- Standard set up of the adjustment cost model.

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

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

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 government bonds held by Central Bank.

- **Inequality constraint on the remittance**

$$H_t \geq H^*$$

Central Bank's Asset Purchase Policy

- Assume an exogenous asset purchase rule.

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

  - B^C is government bonds held by Central Bank.
  - B^T is total supply of government bonds.
  - α is a parameter.

- Reduces the size of the state space (4 states → 3 states).
- The goal of Central Bank's asset purchase policy is to stabilize the financial market.

Equilibrium

- Market Clearing Conditions

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

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

Government's problem under discretion

- The government simultaneously chooses both monetary and fiscal policy.
  - Policies: Two liabilities, their prices, tax on sales, and remittance.

- The government maximizes HH utility taking as given policy functions of HH and firms.
  - State variables: Shock, reserves, and government bonds.

- Define **the unconsolidated model** and **the consolidated model**.
  - In the unconsolidated model, the government faces a constraint on transfers.
  - In the consolidated model, there is no constraint on transfers. Two budgets are fully integrated.

Optimal Policy (Discretion) – Unconsolidated Model

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

States: Shock, reserves, and government bonds.

Choice

Allocation: Consumption, Labor supply.
Prices: Inflation rate, 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) – Consolidated Model

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

States: Shock, reserves, and government bonds.

Choice

- Allocation: Consumption, Labor supply.
- Prices: Inflation rate, 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

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

Calibration

	Variable	Value	Description	Target	Model	Data
Standard NK	β	0.995	Discount factor	-	-	-
	σ	2	Risk aversion	-	-	-
	ν	7	Frisch Elasticity	Frisch Elasticity	1/7	-
	θ	10	Elasticity of substitution	Mark up	7%	-
	φ	100	Price adjustment cost	Slope of NKPC	0.05	-
	ρ^T	0.94	Duration of Treasury	Average maturity	4 years	4 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 Treasury	40% of GDP	80% of GDP
$(Q^c d)^{1-\gamma_1}$	γ_1	1.7	Curvature of utility from reserves	$\frac{\partial Q^C}{\partial d}$	0.1	0.05~0.2
$(Q^T b)^{1-\gamma_2}$	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	-

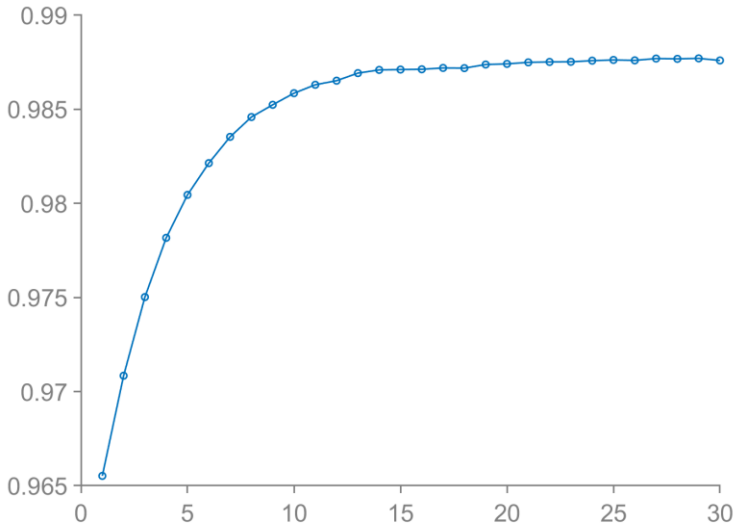
Results

Simulation

- 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.

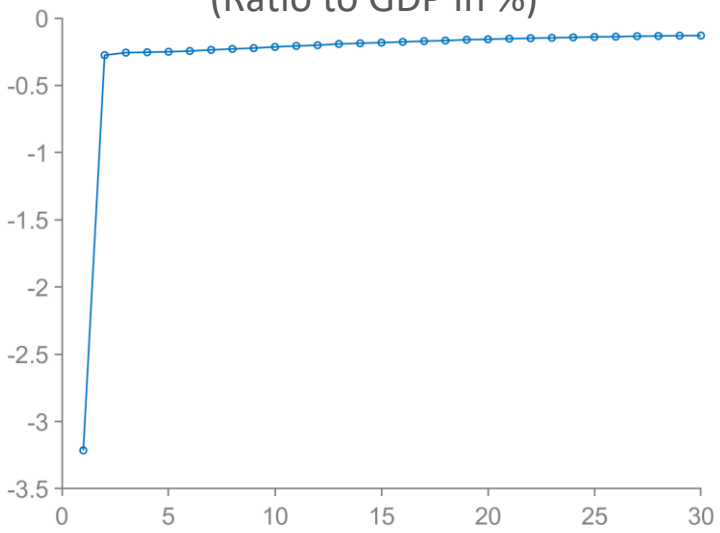
Negative productivity shock in consolidated model

Price of Reserves



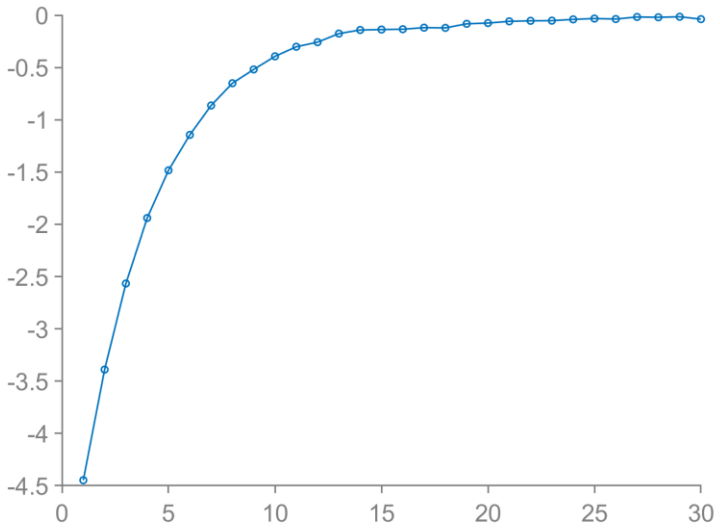
Remittance from CB to Treasury

(Ratio to GDP in %)



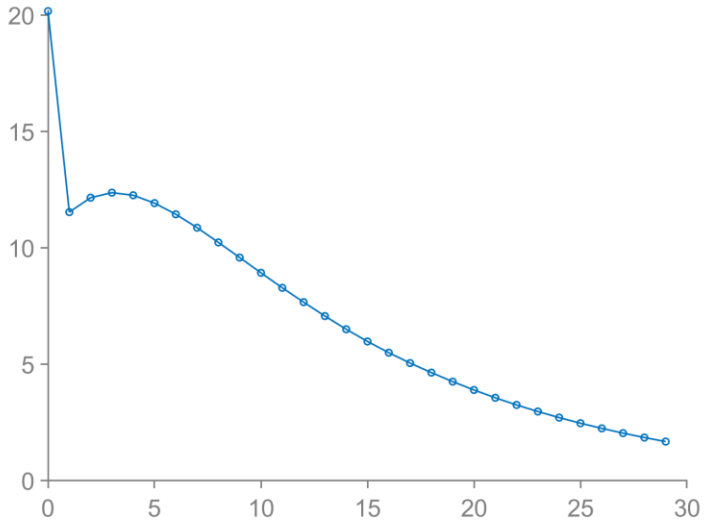
Consumption

(SS deviation in %)



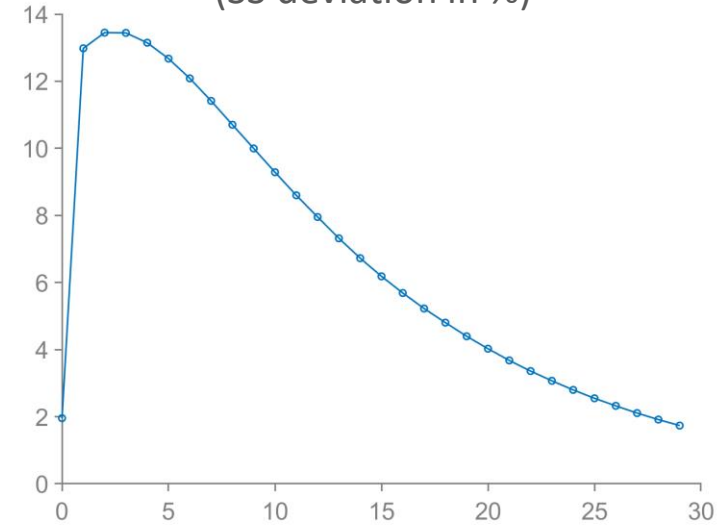
Reserves

(SS deviation in %)



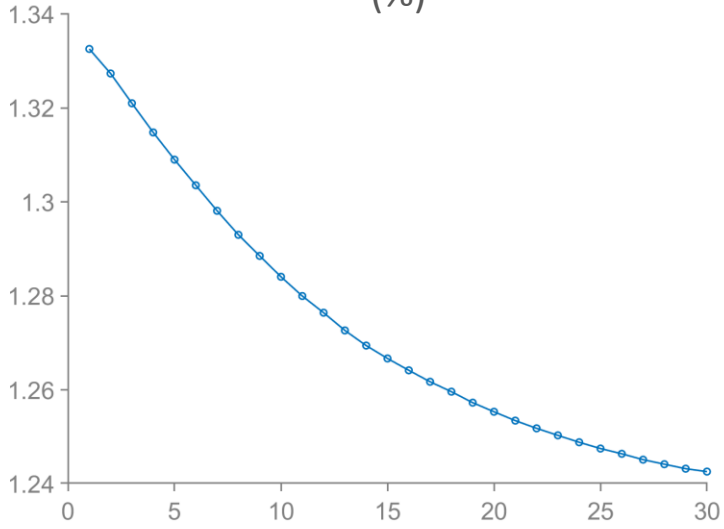
Government bonds

(SS deviation in %)



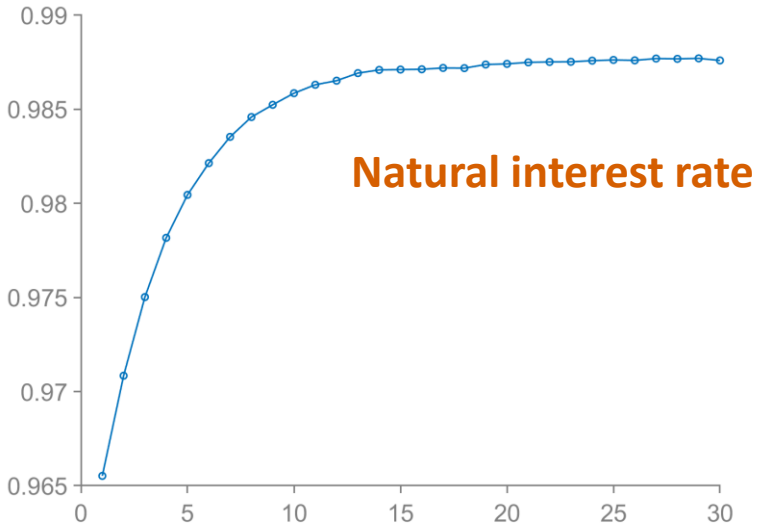
Inflation

(%)



Negative productivity shock in consolidated model

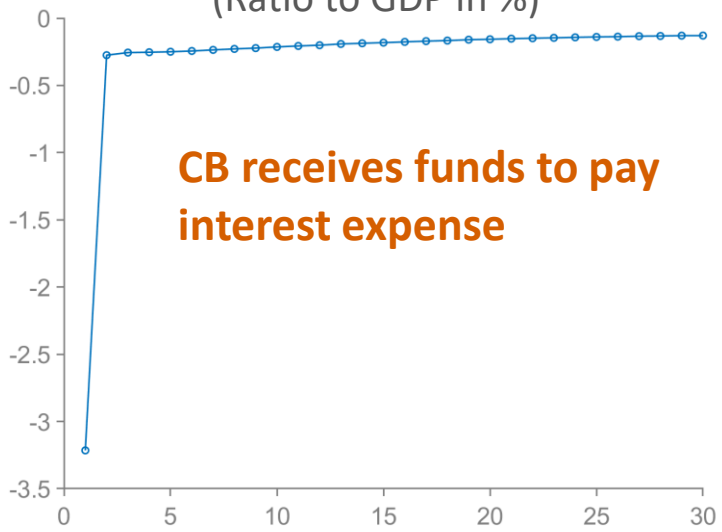
Price of Reserves



Natural interest rate ↑

Remittance from CB to Treasury

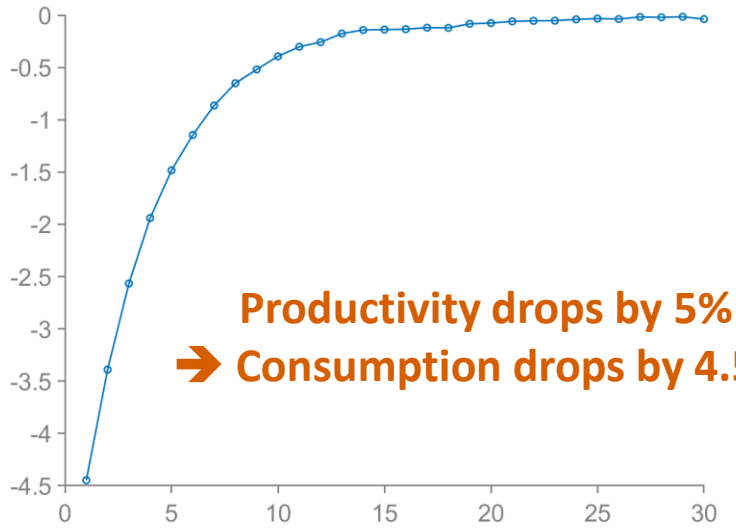
(Ratio to GDP in %)



CB receives funds to pay interest expense

Consumption

(SS deviation in %)

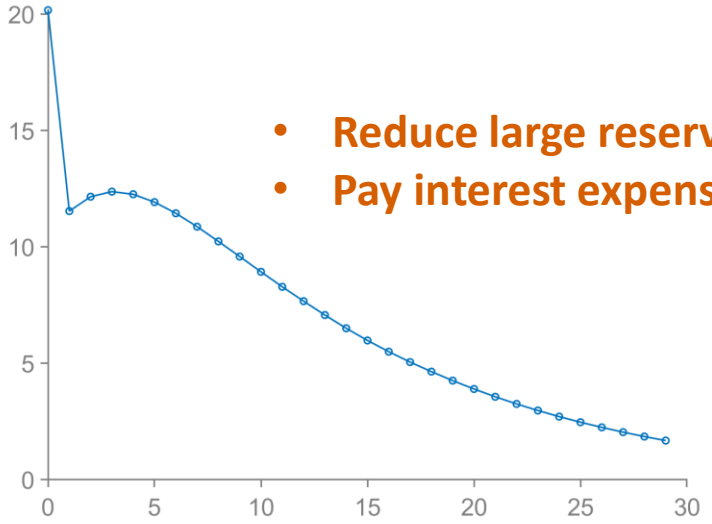


Productivity drops by 5%

➔ Consumption drops by 4.5%

Reserves

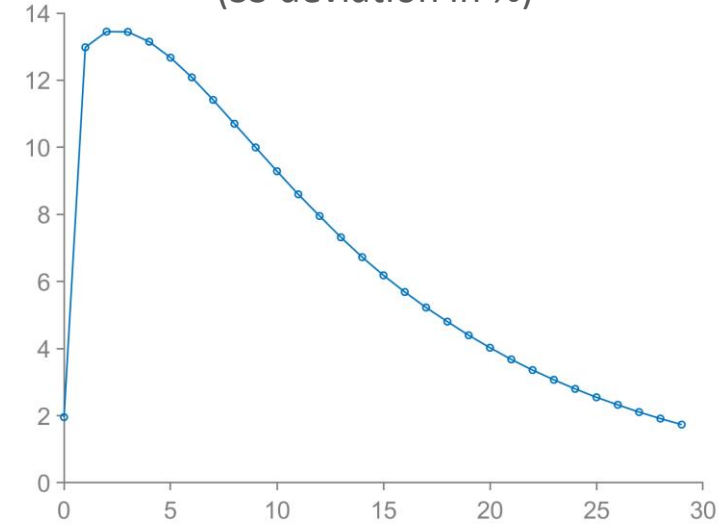
(SS deviation in %)



- **Reduce large reserves**
- **Pay interest expense**

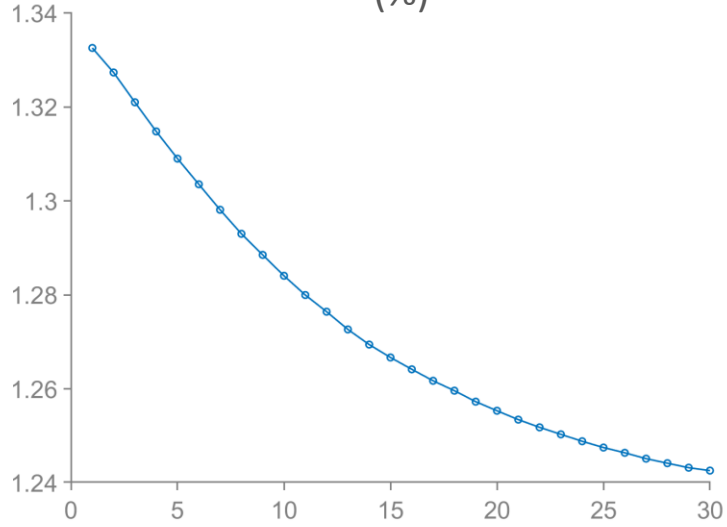
Government bonds

(SS deviation in %)



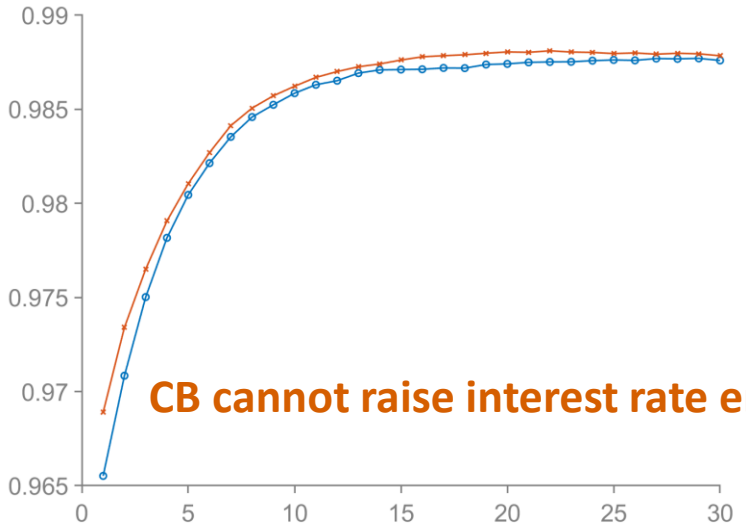
Inflation

(%)



Consolidated (blue) and unconsolidated (red)

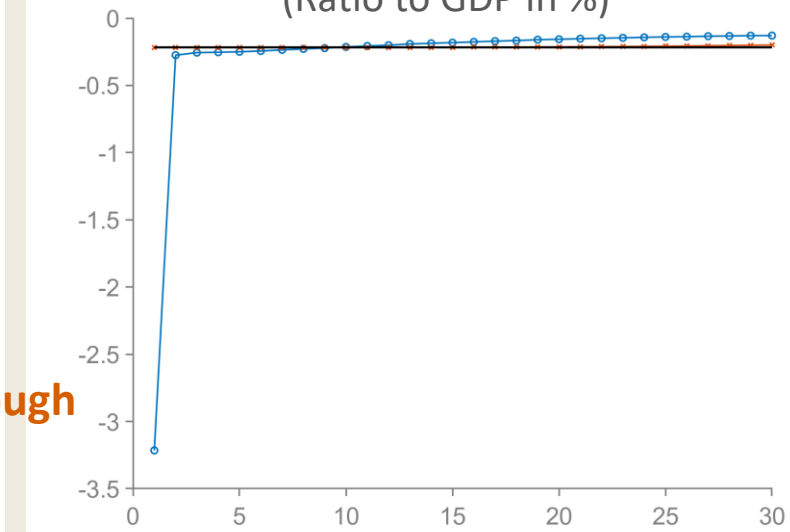
Price of Reserves



CB cannot raise interest rate enough

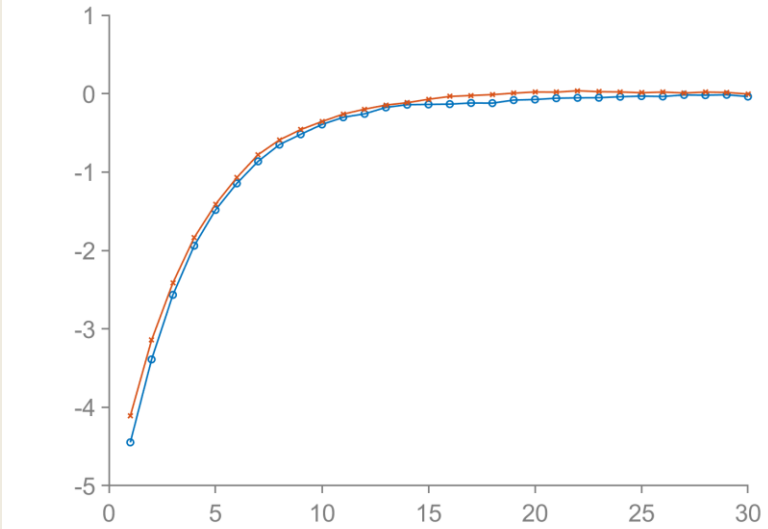
Remittance from CB to Treasury

(Ratio to GDP in %)



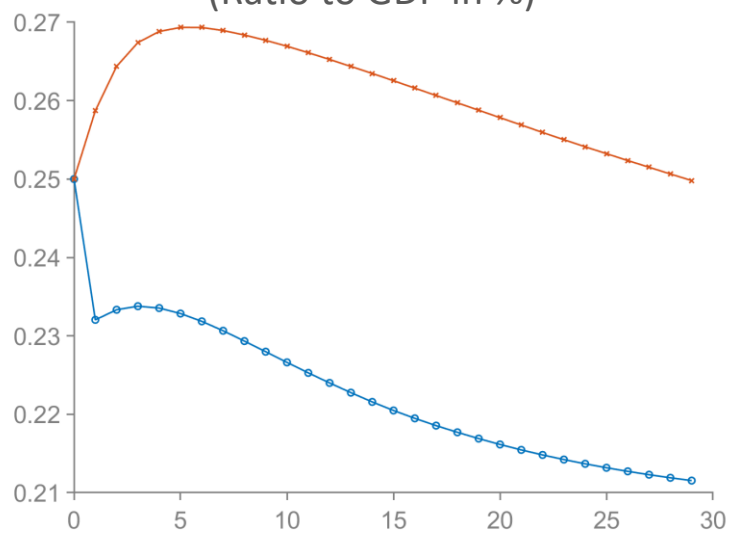
Consumption

(SS deviation in %)



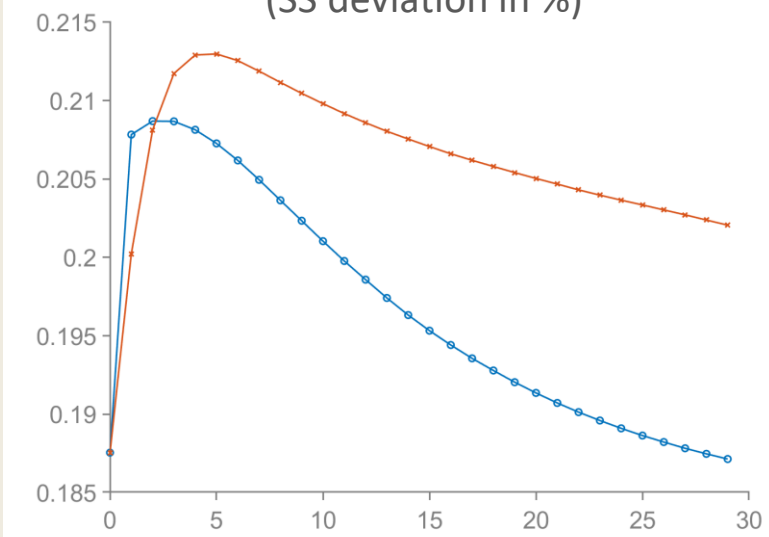
Reserves

(Ratio to GDP in %)



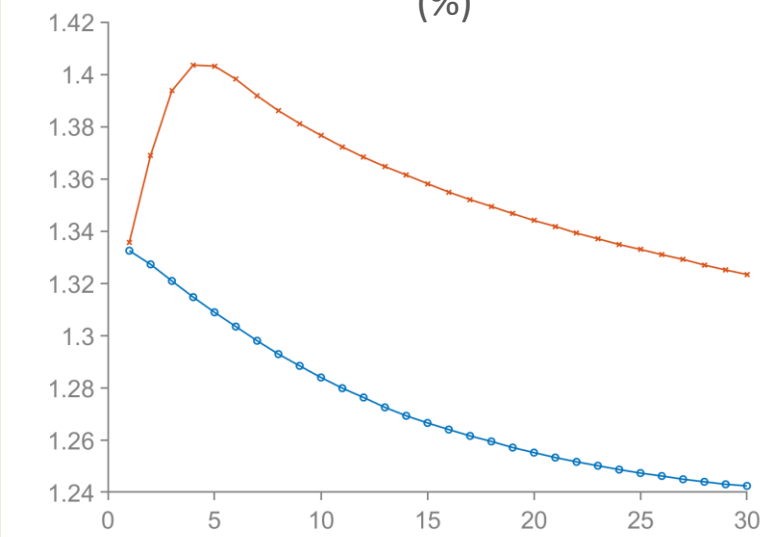
Government bonds

(SS deviation in %)

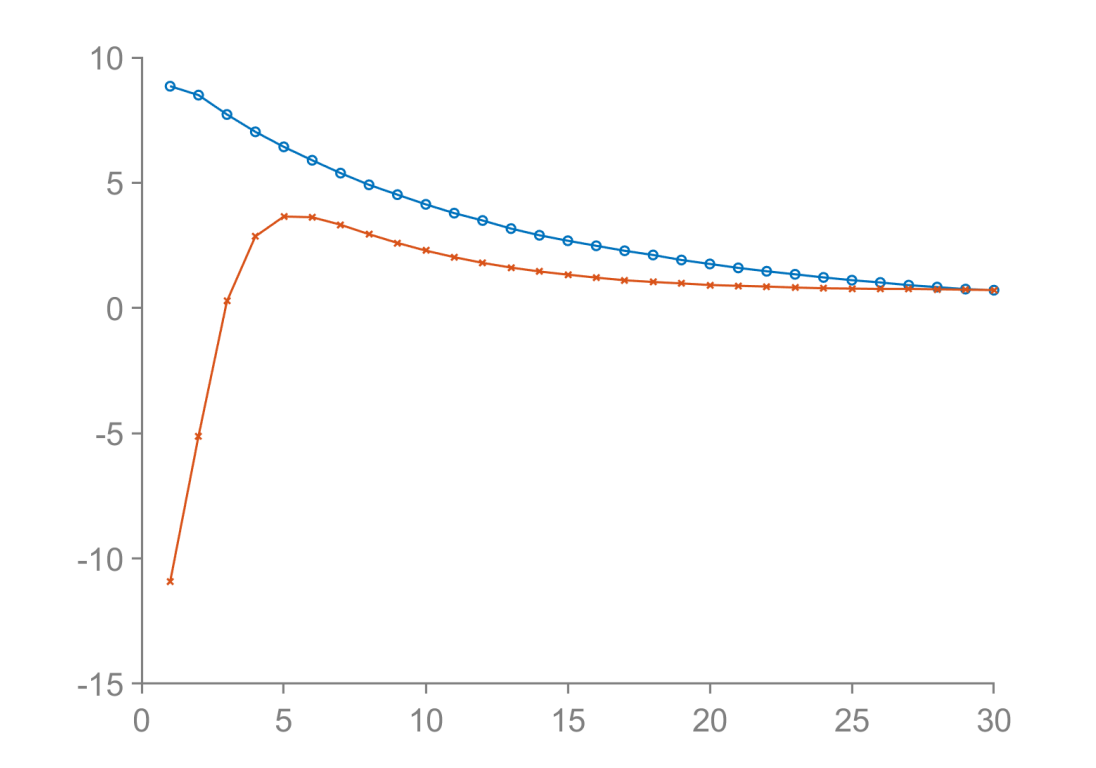


Inflation

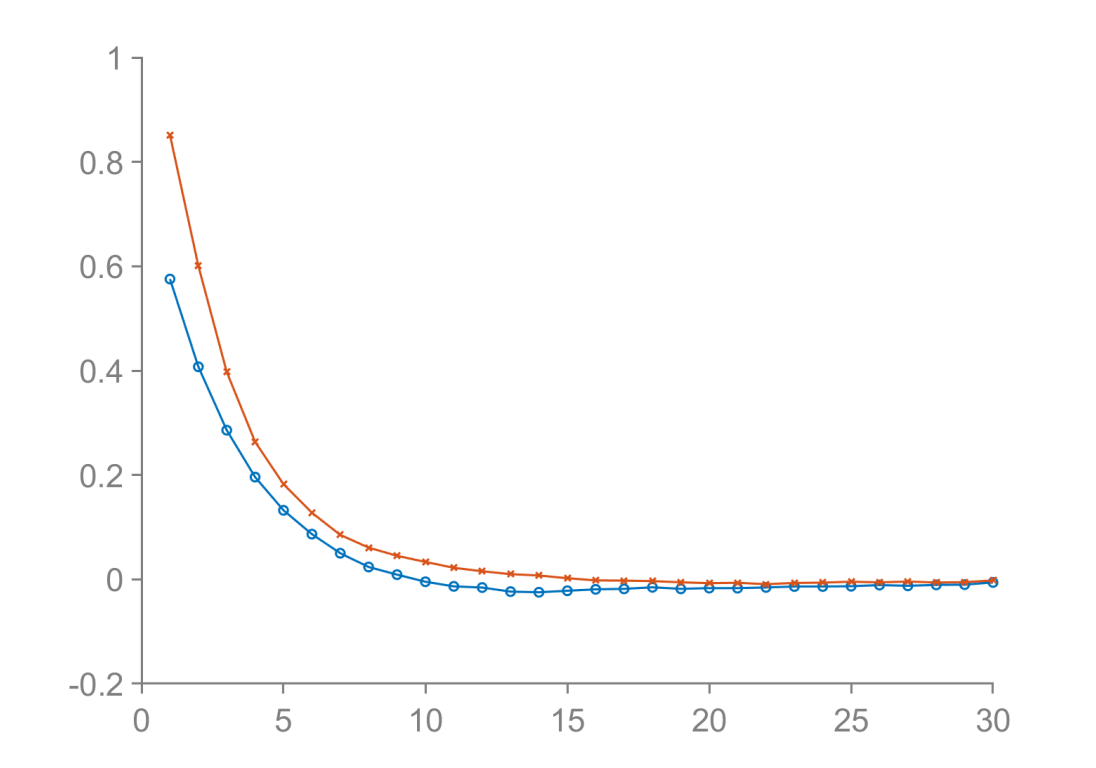
(%)



Tax rate on sales
SS deviation



Labor supply
SS deviation



- The lack of fiscal backing implies

	Negative productivity shock	Positive cost-push shock
Constraint	**Monetary policy**	
Efficient policy tool	**Track natural interest rate**	

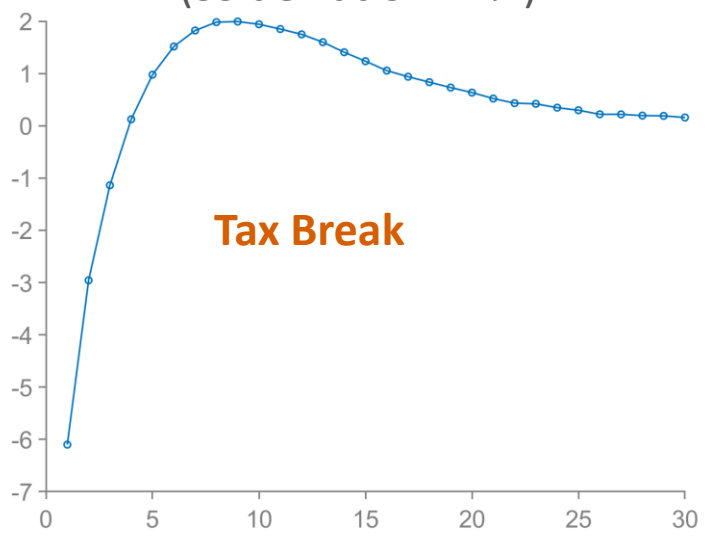
- The lack of fiscal backing implies

	Negative productivity shock	Positive cost-push shock
Constraint	**Monetary policy**	**Fiscal policy**
Efficient policy tool	**Track natural interest rate**	**Tax on sales (MC=MP)**

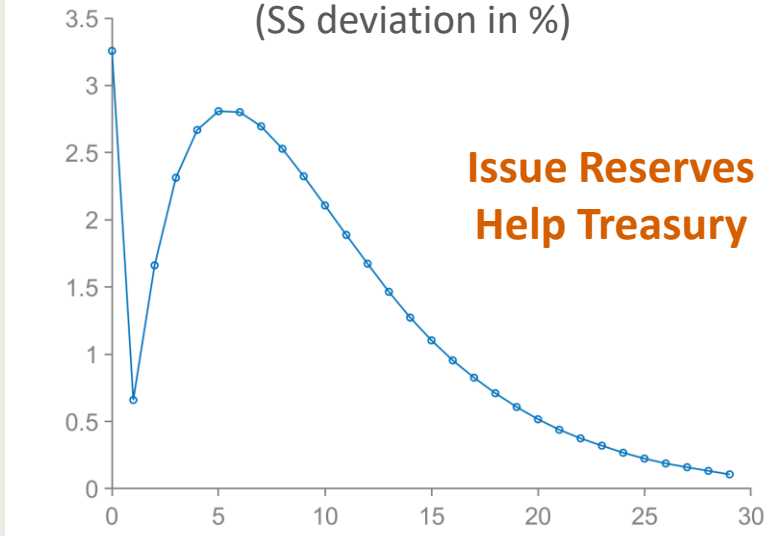
$$\pi_t = \kappa(y_t + \tau_t + u_t) + \beta E_t \pi_{t+1}$$

Positive cost shock (9%↑) in consolidated model

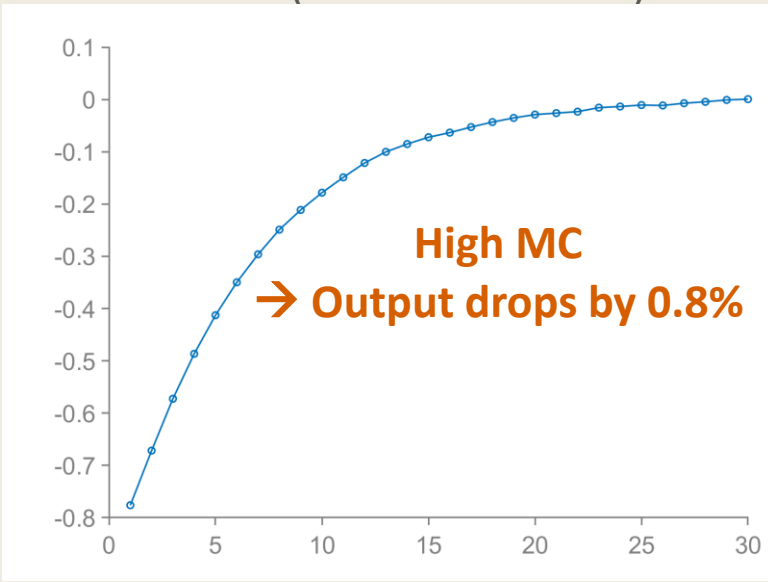
Sales tax
(SS deviation in %)



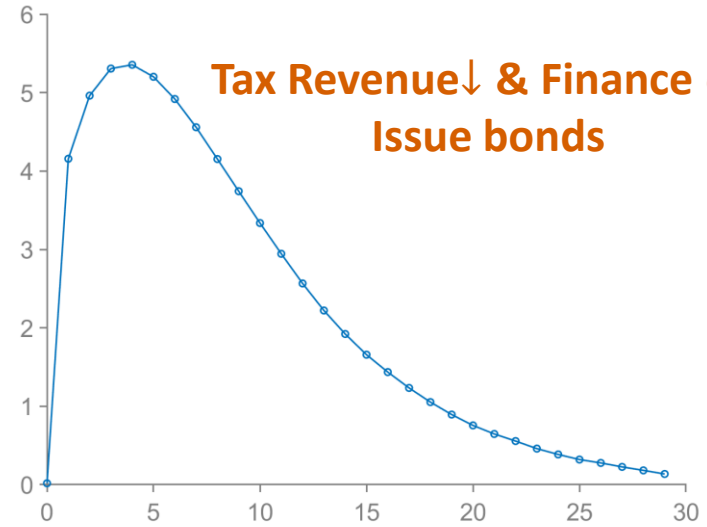
Reserves
(SS deviation in %)



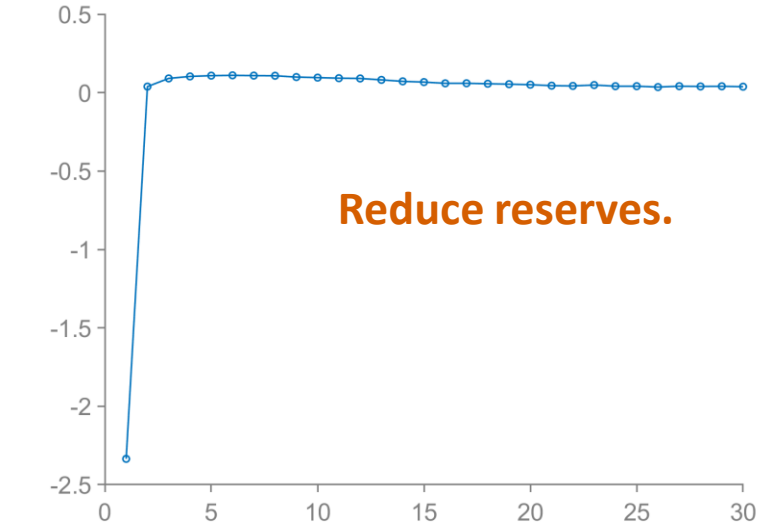
Consumption
(SS deviation in %)



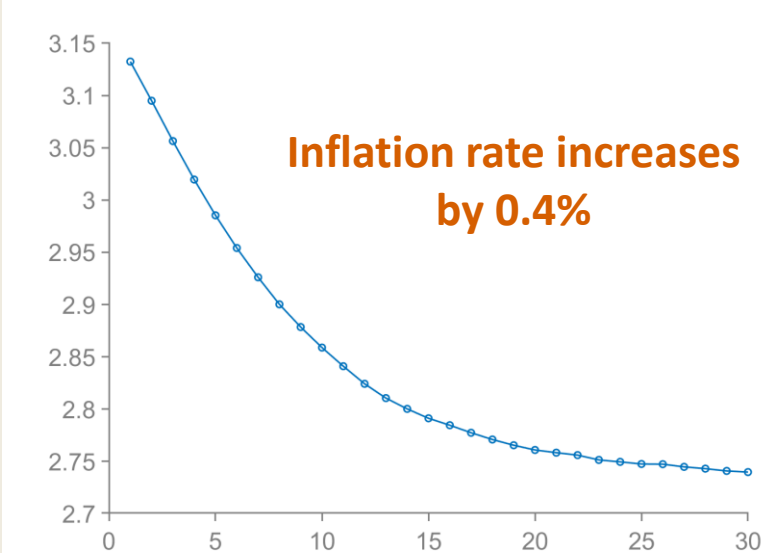
Government bonds
(SS deviation in %)



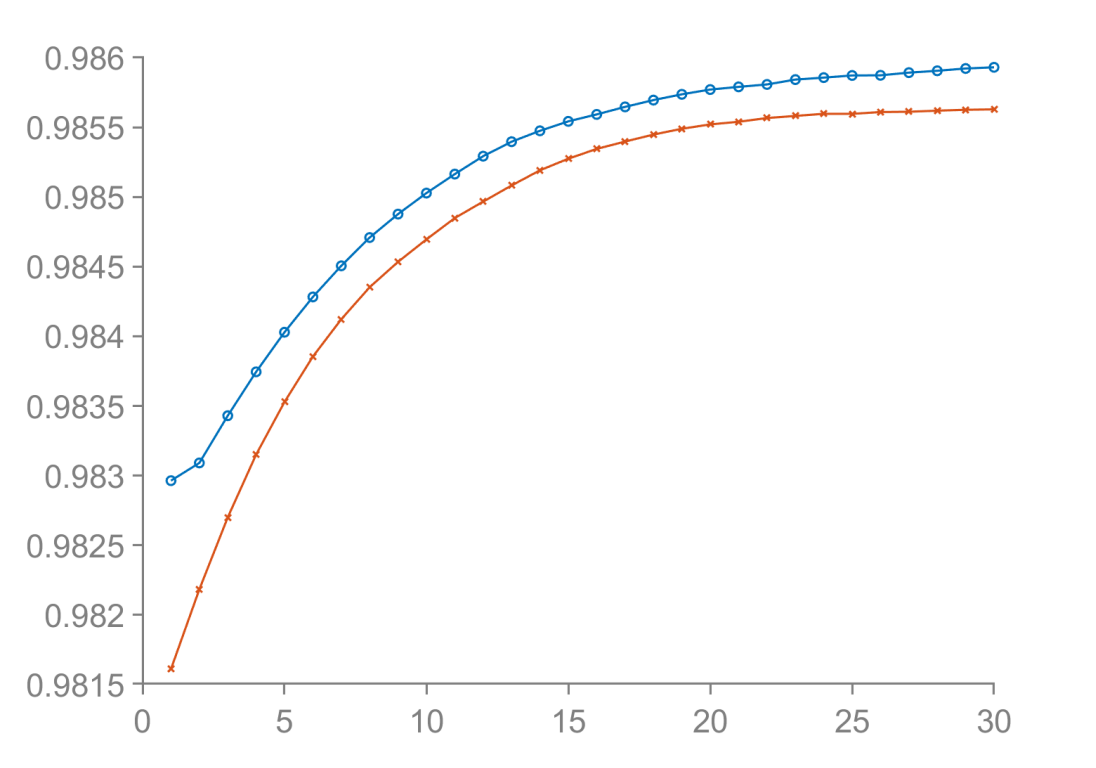
Remittance from CB to Treasury
(Ratio to GDP in %)



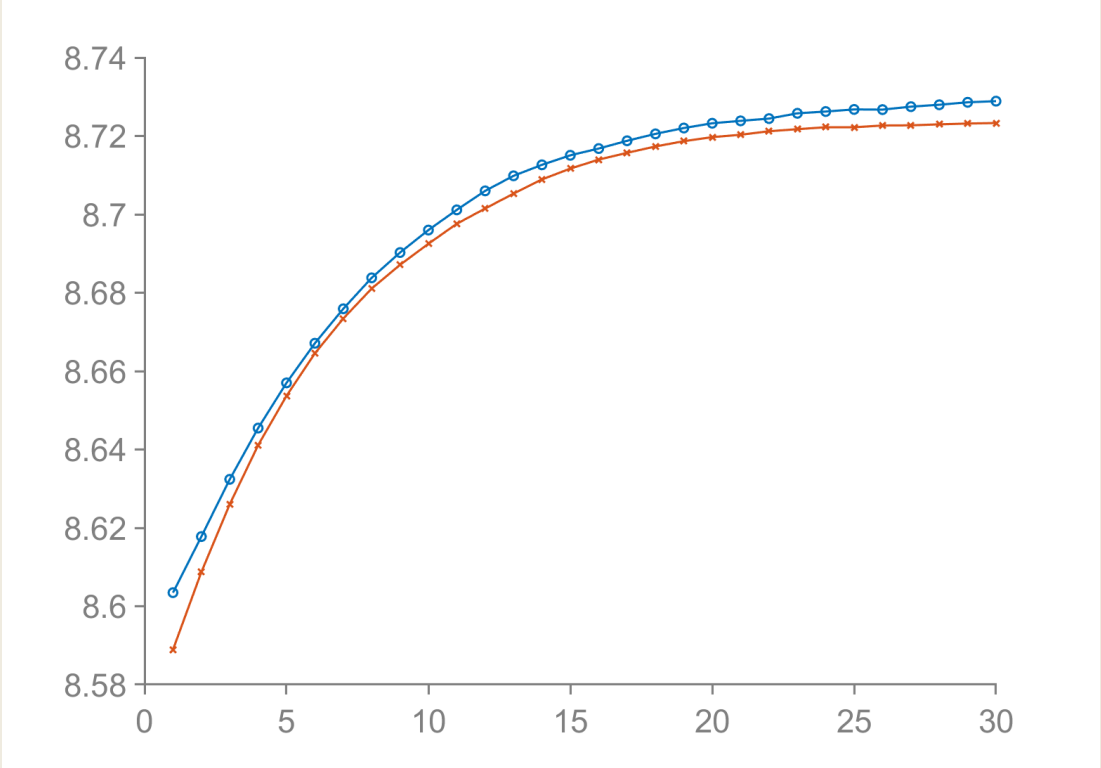
Inflation
(%)



Price of reserves

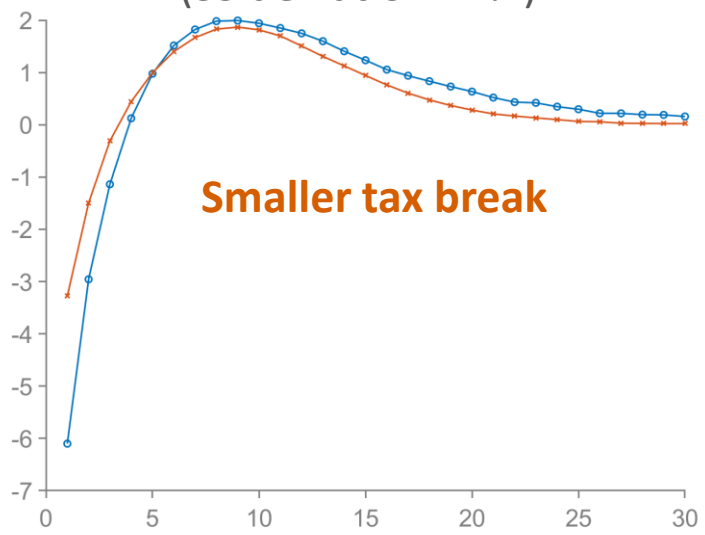


Price of government bods

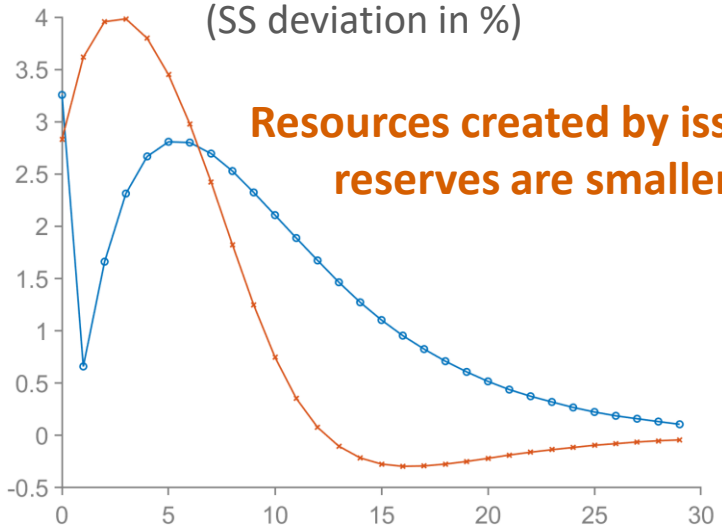


Positive cost shock (9%↑) in consolidated model

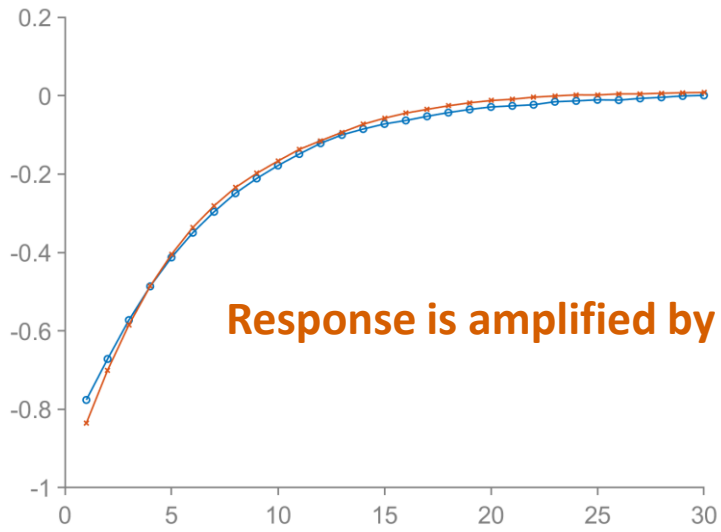
Sales tax
(SS deviation in %)



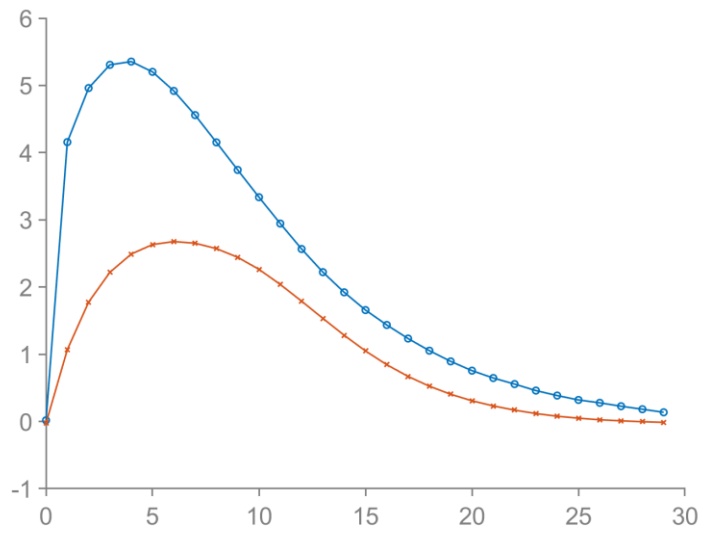
Reserves
(SS deviation in %)



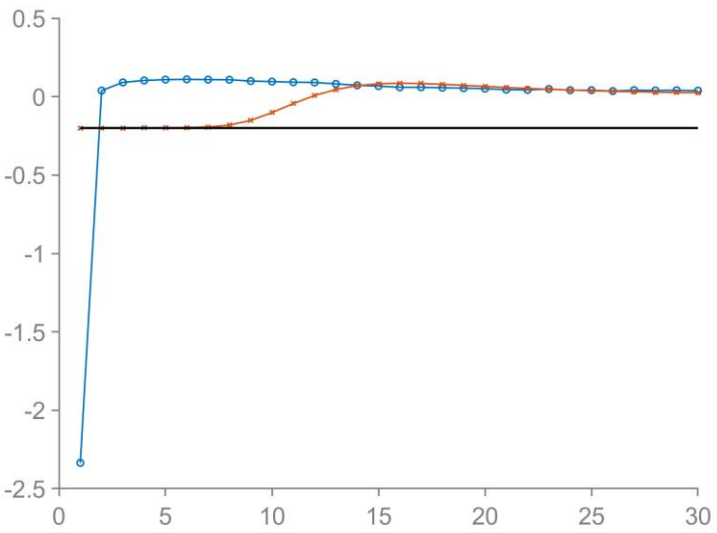
Consumption
(SS deviation in %)



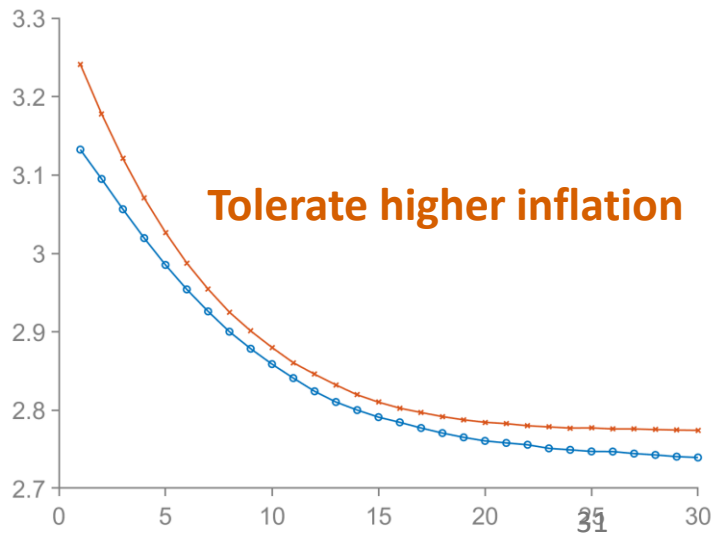
Government bonds
(SS deviation in %)



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



Inflation
(%)



- The lack of fiscal backing implies

	Negative productivity shock	Positive cost-push shock
Constraint	**Monetary policy**	**Fiscal policy**
Efficient policy tool	**Track natural interest rate**	**Tax Break on sales (MP = MC)**
CB's budget or Treasury's budget	**High interest expenses in CB's budget**	**Low tax revenues in Treasury's budget**

Dynamic Properties of the Optimal Policy

Does the fiscal backing affect dynamic properties of the optimal policy?

- I simulate the economy in the consolidated and unconsolidated model.
- Compute the variance of consumption, inflation, and tax rate.

- Show the change in volatility in the unconsolidated model compared to the consolidated model.

	Cost-push shocks	Government expenditure shock
Consumption	**+3%**	**+0.6%**
Tax	**-10%**	**+2%**
Inflation	**+3%**	**+2%**

The lack of fiscal backing constrains the size of tax break

The lack of fiscal backing limits tax smoothing

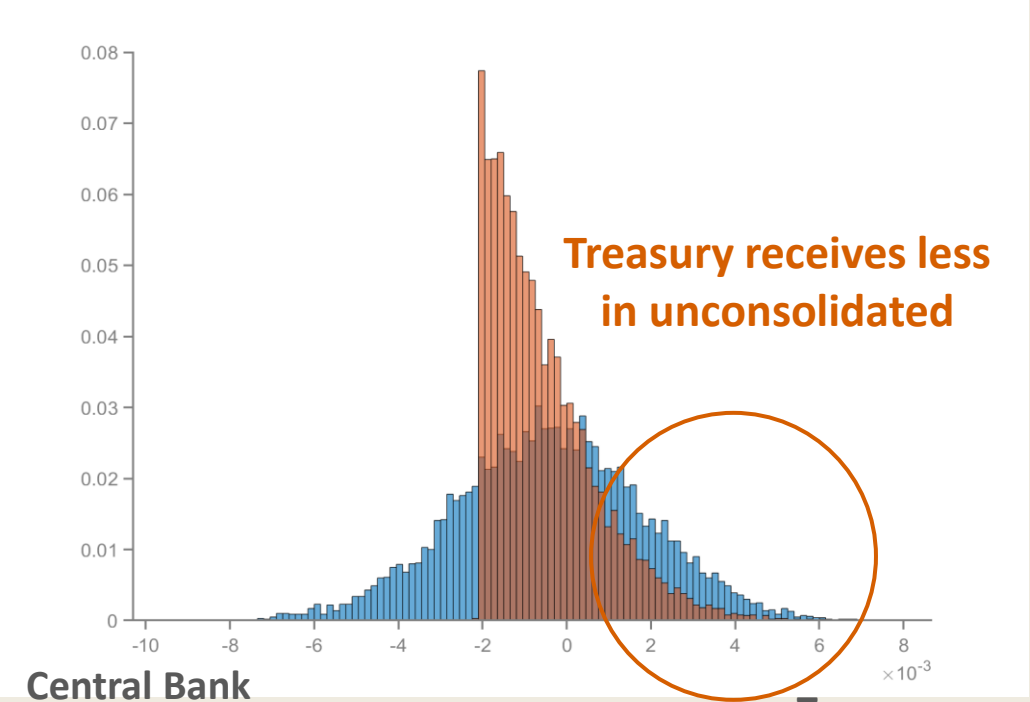
Retained Earnings by Central Banks

- Bank of Japan **retains 5% of profits** and transfers the rest to the Treasury.
- Bundesbank uses its financial buffers to cushion burdens.
- No reason to retain earnings if Central Bank and Treasury are consolidated.

Why do Central Banks transfer less?

Model implications

- A lower bound on remittance makes the upper tail thinner.
- Central Bank knows large reserves cannot be reduced through remittance.
- Less reserves and transfers. **Forward looking decision-making.**



- Simulated the economy with cost-push shock.
- Histogram for remittance in consolidated and unconsolidated.

The welfare gain of fiscal backing

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

- 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%.

The welfare gain of fiscal backing < 0.01% in consumption equivalence.

- I compute the welfare gain of increasing the lower bound on remittance, H^*.
- Simulate the economy for 1000 periods. Consumption equivalence compared to the case of $H^* = -\infty$.

(Intuition)

- Fiscal backing affects the variance but less the mean.