Optimal monetary and fiscal policy without fiscal backing for the central bank

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Introduction

- The Fed runs a large loss by paying interest on reserves after 2022.
  - Expenditure = Interest rate (5p.p.) * Reserve (15% of GDP)
  - Fed's loss / Treasury's tax revenue (2022 Q4 – 2024 Q3) = 2.5%
- The Fed transferred all profits to the Treasury before 2022.
- The Treasury does not offset the Fed's losses now.
- However, conventional macroeconomic models assume a consolidated government budget (Sargent and Wallace 1981).

Research Question

Do the **unconsolidated government budgets** change monetary-fiscal policy?

Treasury cannot provide the **optimal fiscal support** to the central bank.

What I do

Optimal monetary and fiscal Policy without commitment

- The government chooses policies to maximize the household utility subject to the equilibrium conditions.
    1. NK model with two interest-bearing liabilities, reserves and Government bonds.
    2. Constraint an optimal resource allocation from Treasury to the central bank.

What I find

1. Study the inflationary episode after 2022 and negative productivity shock.

   Question.

   How does the impulse responses change when the central bank lacks fiscal backing?

   Answer.

   The central bank without fiscal backing tolerates higher inflation.

   - Excess reserves as an initial condition is the key.
   - The central bank needs funds from the Treasury.

What I find

1. Study the inflationary episode after 2022 and negative productivity shock.

2. Quantitatively characterize the dynamic property of the optimal policy.

   Answer.

   Inflation is more volatile by 3% without the fiscal backing.

   Average inflation rate increases by 0.01%.

What I find

1. Study the inflationary episode after 2022 and negative productivity shock.

2. Quantitatively characterize the dynamic property of the optimal policy.

3. From a normative point, should the Treasury support the central bank?

   Answer.

   a. The welfare gain of fiscal backing is small (<0.01% of consumption) in the typical business cycle.

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

Model

Environment

- **Time.** Discrete, Infinite horizon.

- **Agents**

Household consumes, works, and trades reserves and government bonds. Appreciate reserves and bonds as a liquidity value.

Producers are the simple New-Keynesian style.

Treasury provides public expenditure. Finance by distortionary sales tax, government bonds, and remittance from the central bank.

Central bank provides reserves. Purchases government bonds to stabilize net worth.

- **Market.** Reserves and government bonds are traded. They differ in duration and liquidity value.

Household

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

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 **government bonds**. Duration is given by ρ.
- Φ is the firm's profit.

Firms

- Standard set up of the adjustment cost model.

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

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

Government

- Treasury's budget

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

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

- The central bank trades reserves and government bonds.

$$\overbrace{Q_t^C D_t}^{\text{Issue reserve}} + \overbrace{(1 + \rho Q_t^T) B_{t-1}^C}^{\text{Income \& capital gain}} = \overbrace{D_{t-1}}^{\text{Redemption}} + \overbrace{Q_t^T B_t^C}^{\text{Buy assets}} + \overbrace{P_t H_t}^{\text{Remittance to Government}}$$

D is reserves. B^C is government bonds held by the central bank.

- **Inequality constraint on the remittance**

$$H_t \geq H^*$$

Central Bank's Balance Sheet Policy

- Two goals of central bank's asset purchase policy

1. Stabilize net worth after increasing liabilities.
2. Stabilize asset markets

- The simplest policy to achieve two goals

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

B^C is government bonds held by the central bank. B^T is total supply of government bonds.

α is a parameter.

Equilibrium

- Market Clearing Condition

$$
\begin{aligned}
&(\text{Goods}) \quad && Y_t = C_t + G_t + \frac{\varphi}{2}\left(\pi_t - 1\right)^2 Y_t \\
&(\text{Government bonds}) \quad && B_t^H + B_t^C = B_t^T
\end{aligned}
$$

Optimal Policy (Discretion) - Unconsolidated Budgets

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

Choice

C_t, N_t, π_t, Sales Tax
Two liabilities
Prices of liabilities
Remittance

Euler Equations

NKPC

Market Clearing

Treasury: $Q_t^T B_t + P_t \tau_t Y_t + P_t H_t = (1 + \rho Q_t^T) B_{t-1} + P_t G_t.$

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

Remittance: $H_t \geq H^*$

Optimal Policy (Discretion) - Unconsolidated Budgets

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Choice

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Market Clearing

Treasury: $$Q_t^T B_t + P_t \tau_t Y_t + P_t H_t = (1 + \rho Q_t^T) B_{t-1} + P_t G_t.$$

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

Remittance: $$H_t \geq H^*$$

Optimal resource allocation through remittance
For CB, Reduce abundant reserves & Increase scarce reserves.
For Treasury, help tax smoothing.

Optimal Policy (Discretion) - Consolidated Budgets

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

Choice

C_t, N_t, π_t, Sales Tax
Two liabilities
Prices of liabilities
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.
- State variables … Shock, reserves, Treasury bond
- Shock… Cost-push, productivity, and government expenditure.
  - Include one shock and exclude the other two.
- **Globally** solve the model.
  - Occasionally binding constraints, $H_t \geq H^*$.

Calibration

Standard NK

Variable	Value	Description	Target	Model	Data
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
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^*	-0.005	Lower bound on remittance	-	-0.5% of GDP	-

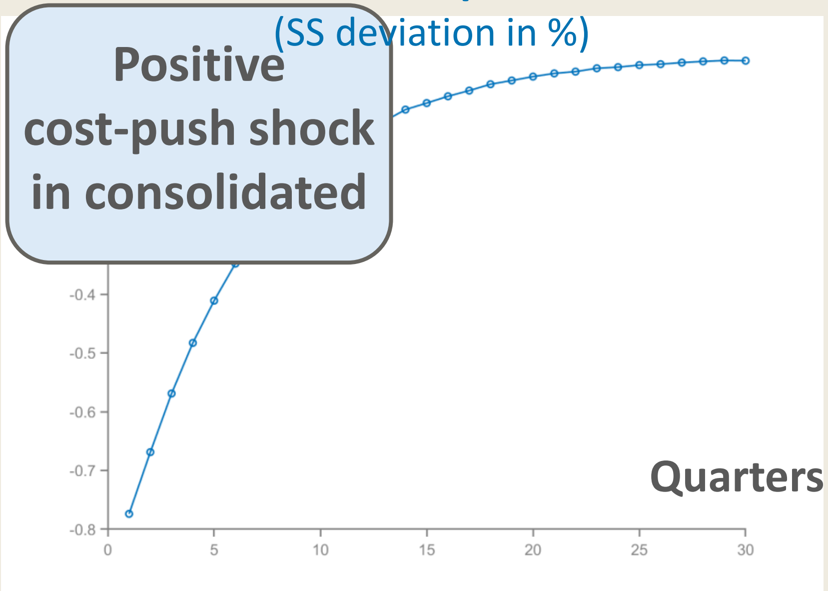
Results

Simulation

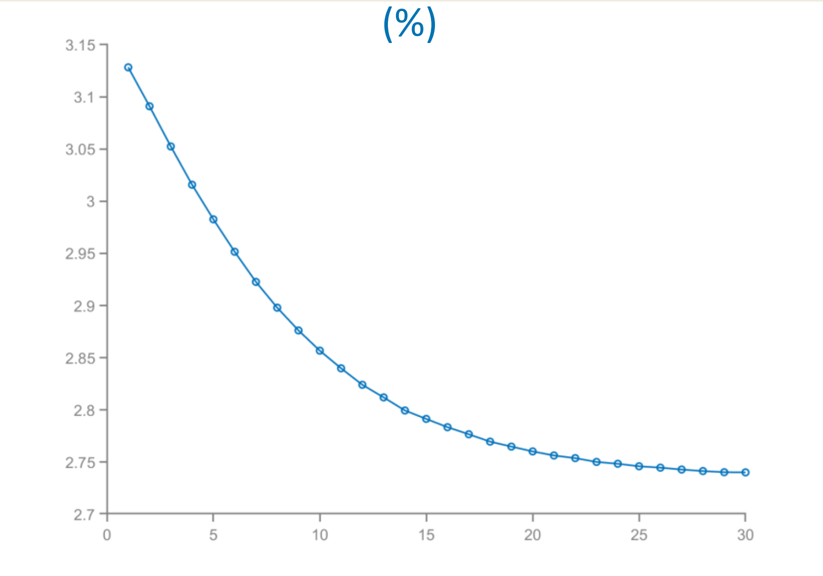
- The initial state variables are large reserves (90^{th} percentile of simulated reserves).
- The size of the shock is small (0.8% of the fall in output and 0.4% of the rise in inflation).
  - I do not finish solving the model with large shock.

Positive cost-push shock in consolidated

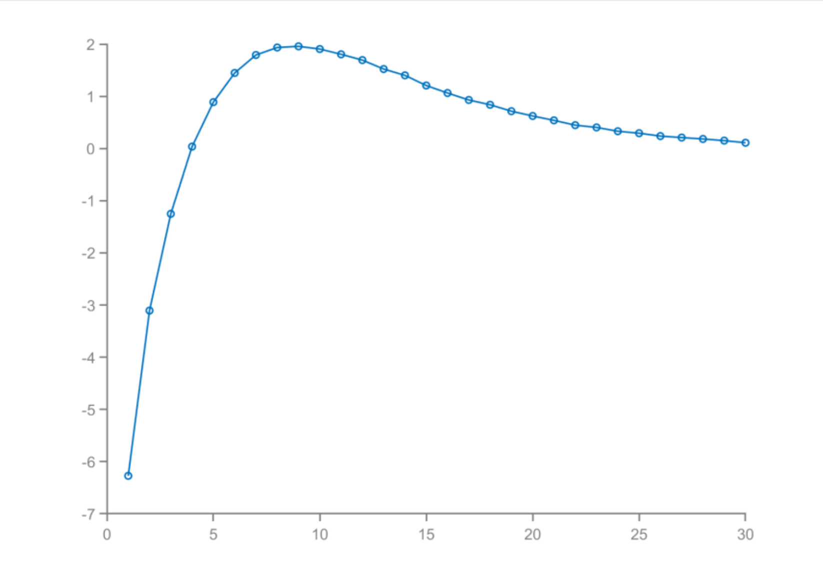
Consumption
(SS deviation in %)



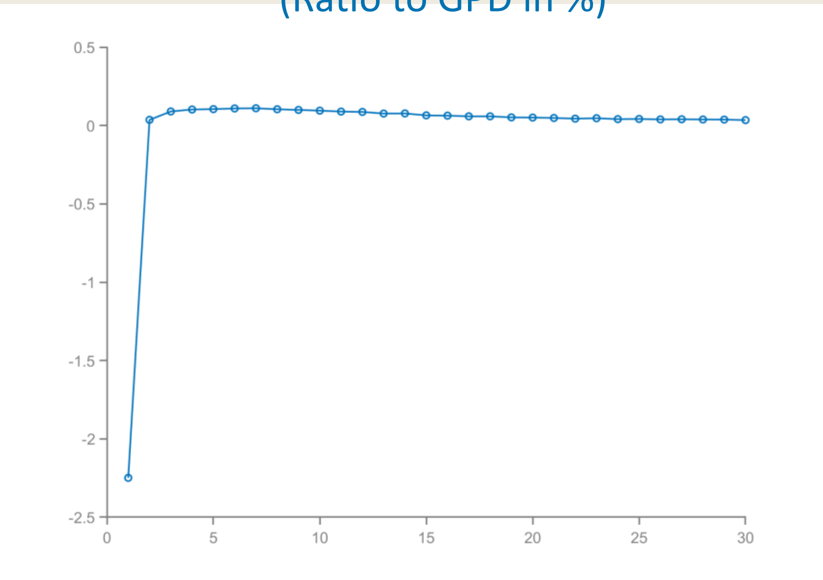
Inflation
(%)



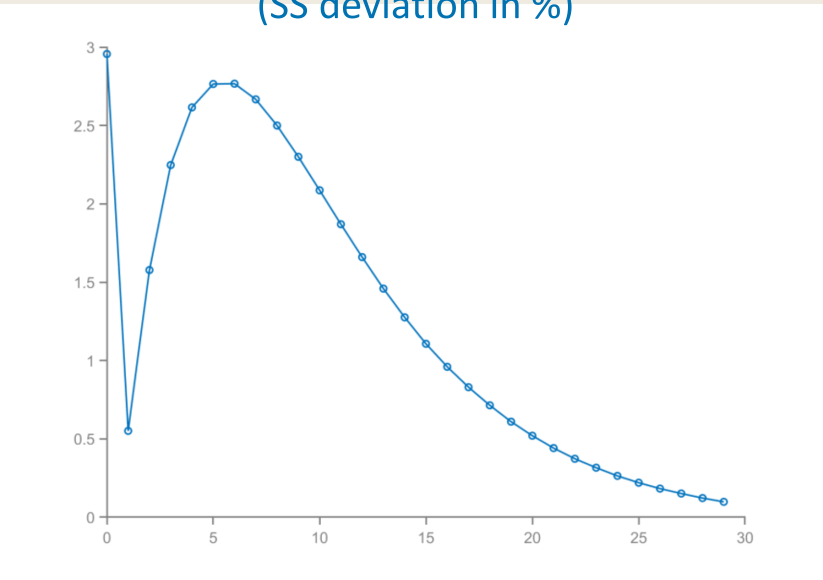
Tax rate



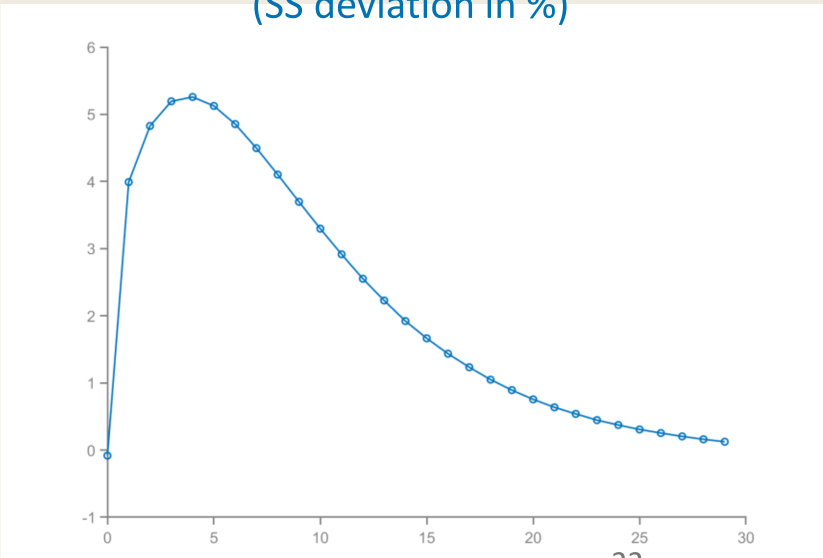
Remittance
(Ratio to GPD in %)



Reserves
(SS deviation in %)

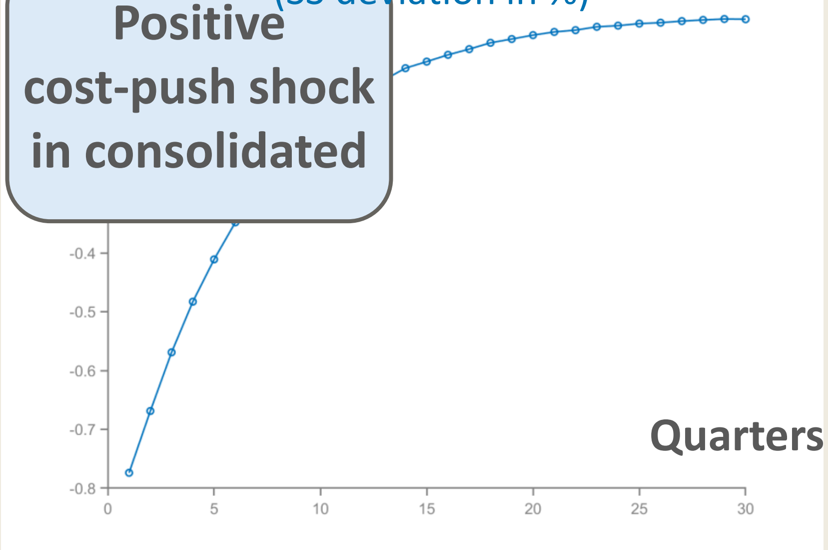


Treasury liability
(SS deviation in %)

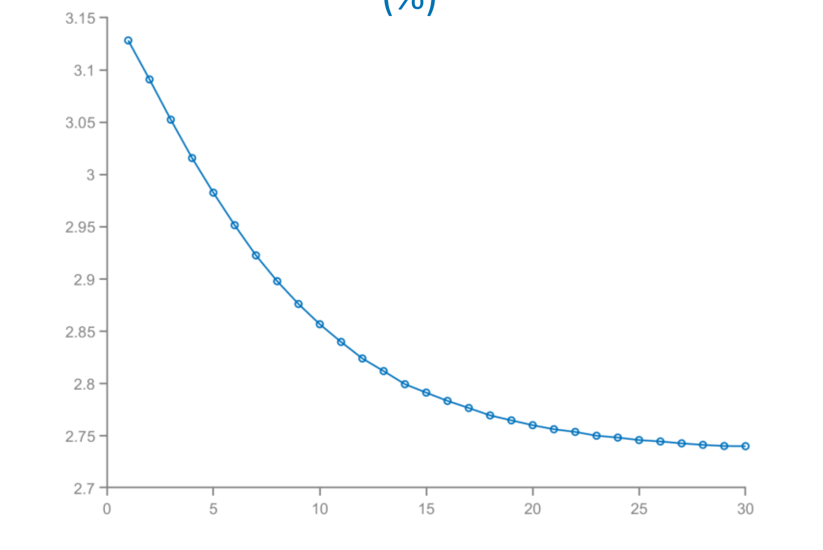


Positive cost-push shock in consolidated

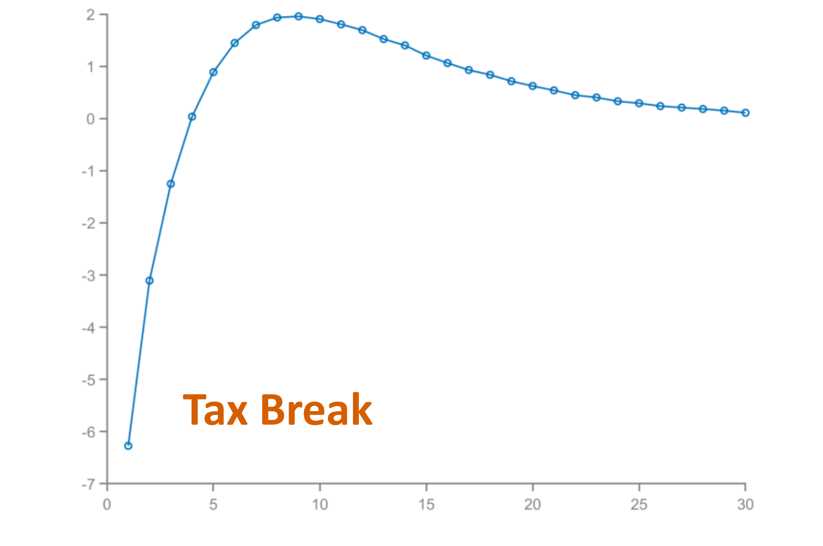
Consumption
(SS deviation in %)



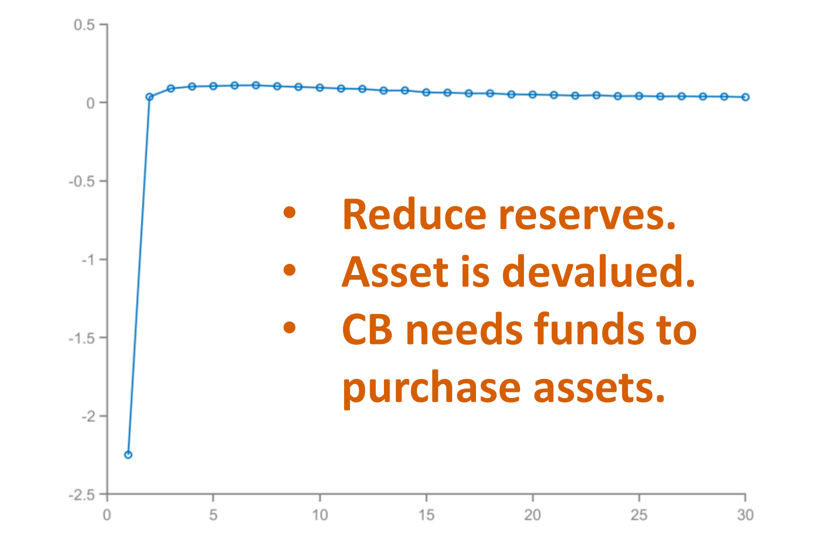
Inflation
(%)



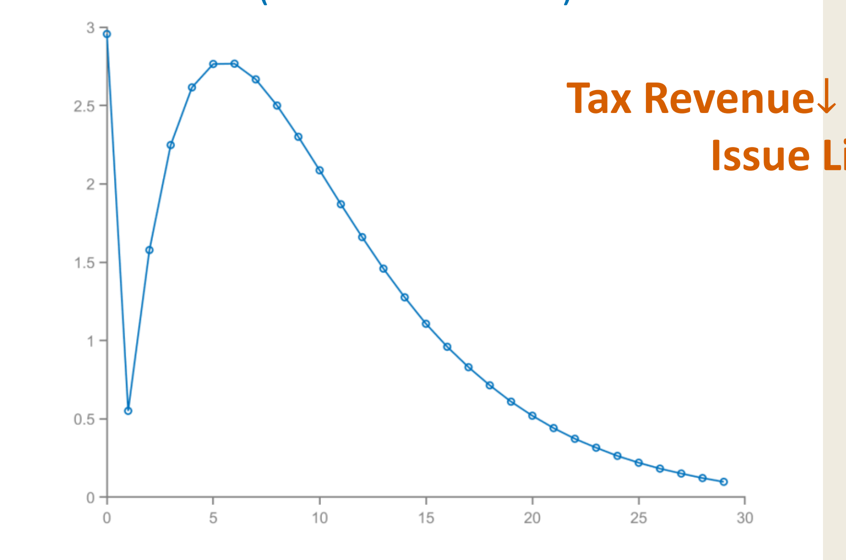
Tax rate



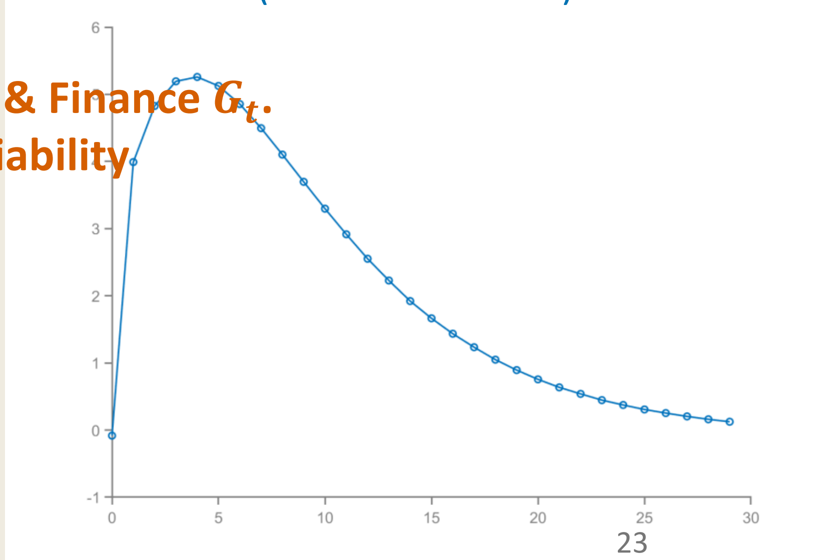
Remittance
(Ratio to GPD in %)



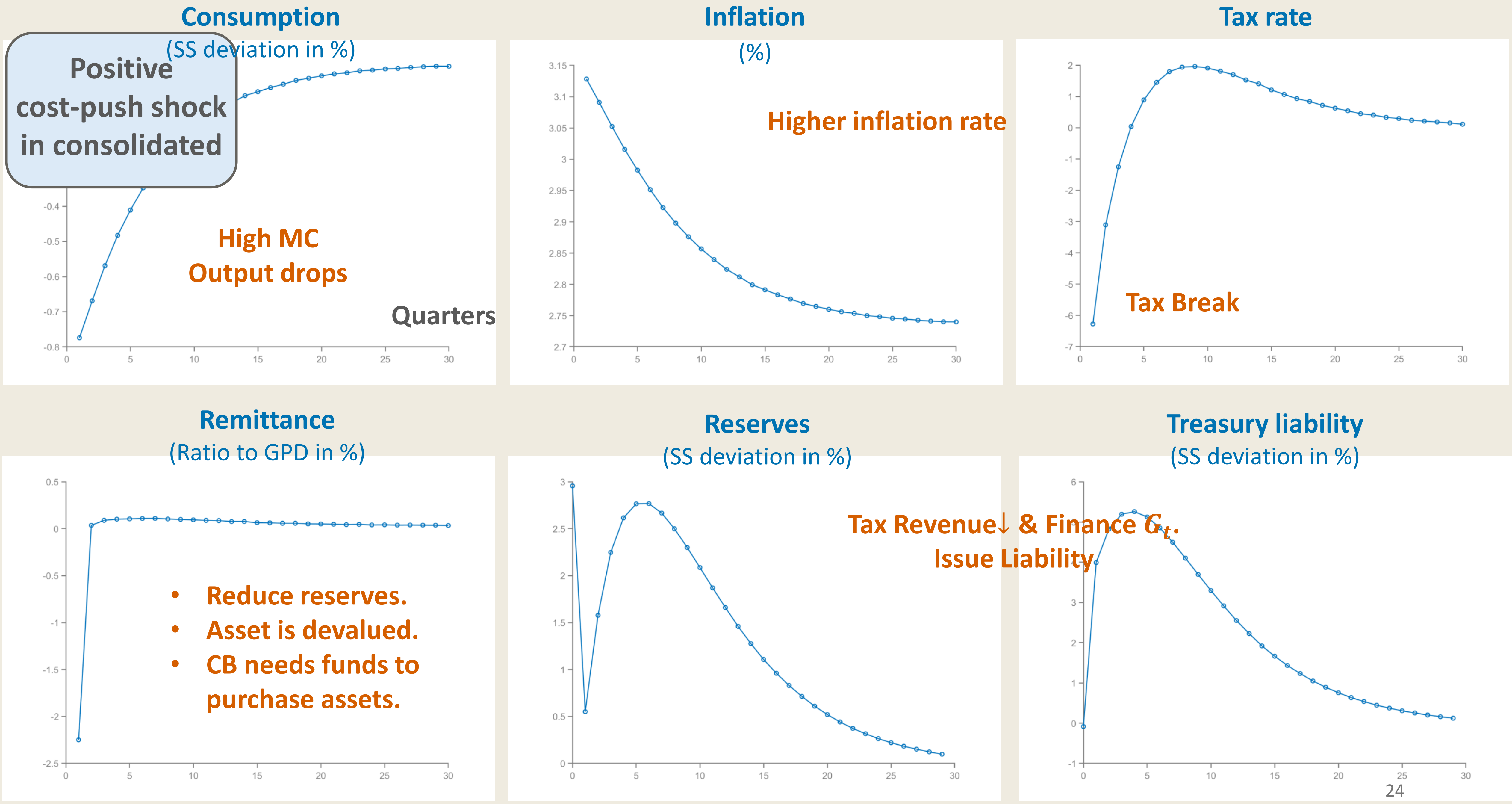
Reserves
(SS deviation in %)



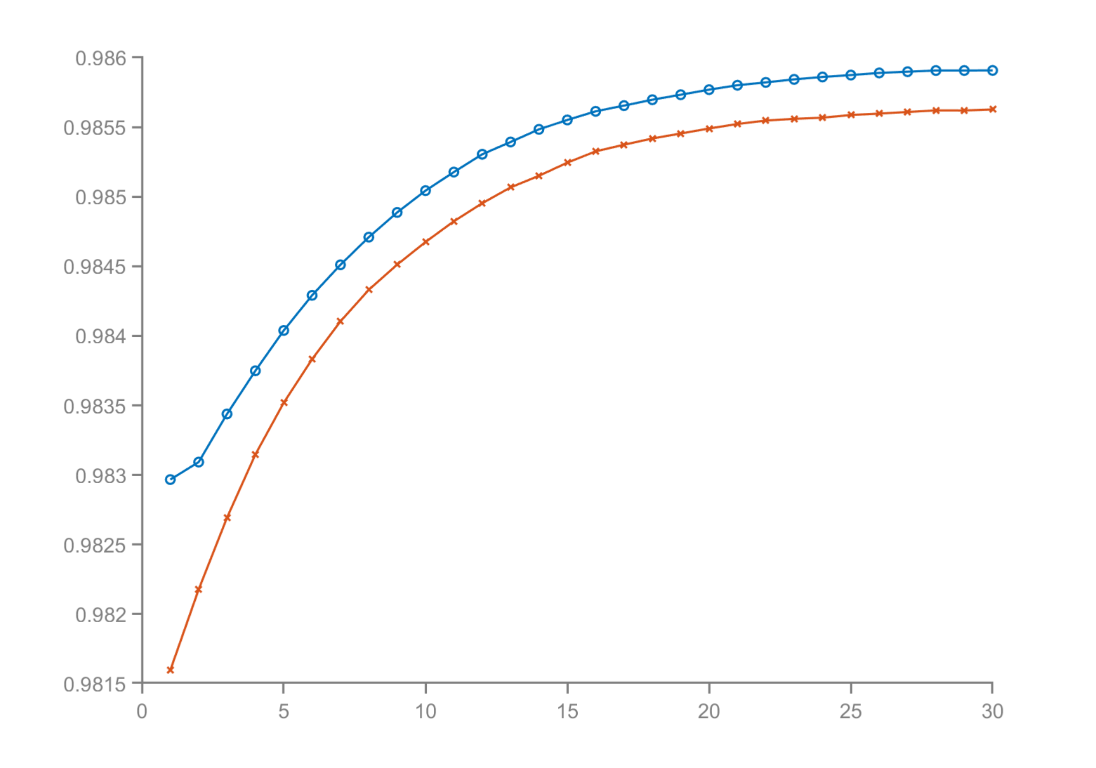
Treasury liability
(SS deviation in %)



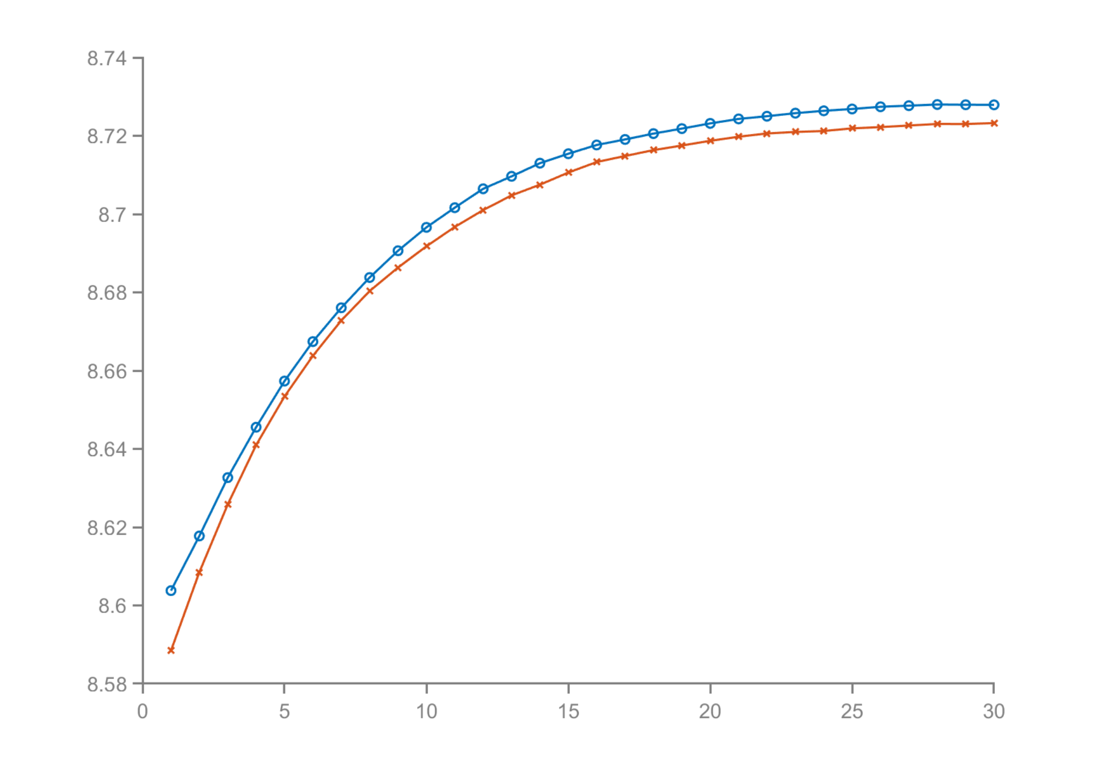
Tax Revenue↓ & Finance G_t.
Issue Liability


Consumption
(SS deviation in %)
Positive
cost-push shock
in consolidated
High MC
Output drops
Quarters
Inflation
(%)
Higher inflation rate
Tax rate
Tax Break
Remittance
(Ratio to GPD in %)
• Reduce reserves.
• Asset is devalued.
• CB needs funds to purchase assets.
Reserves
(SS deviation in %)
Tax Revenue↓ & Finance G_t.
Issue Liability
Treasury liability
(SS deviation in %)

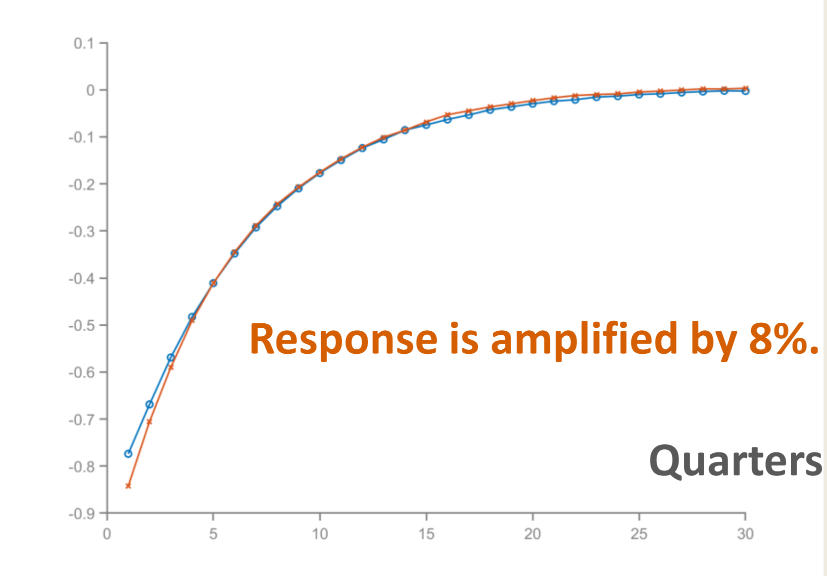
Price of reserves



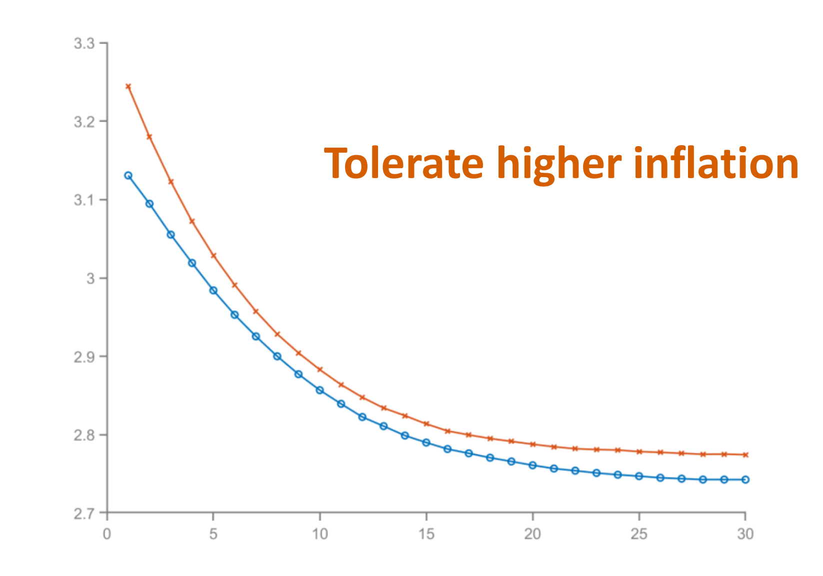
Price of government bods



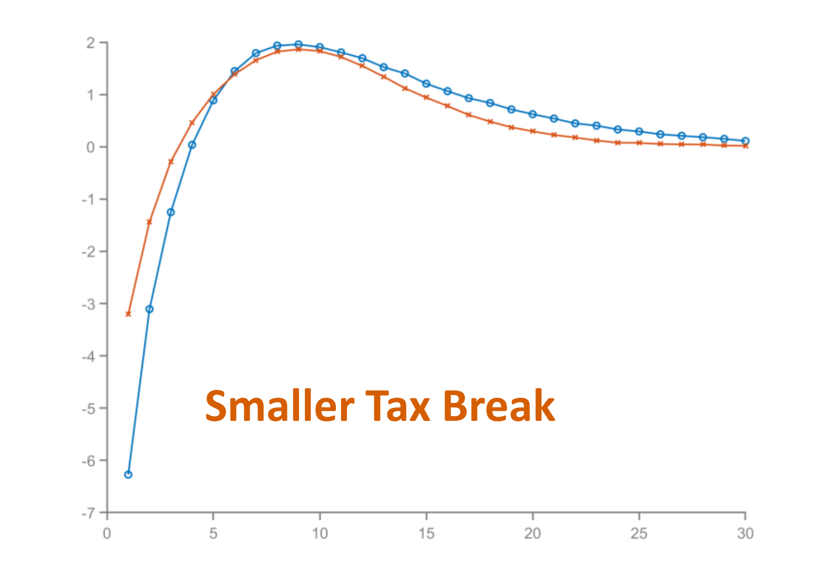
Consumption



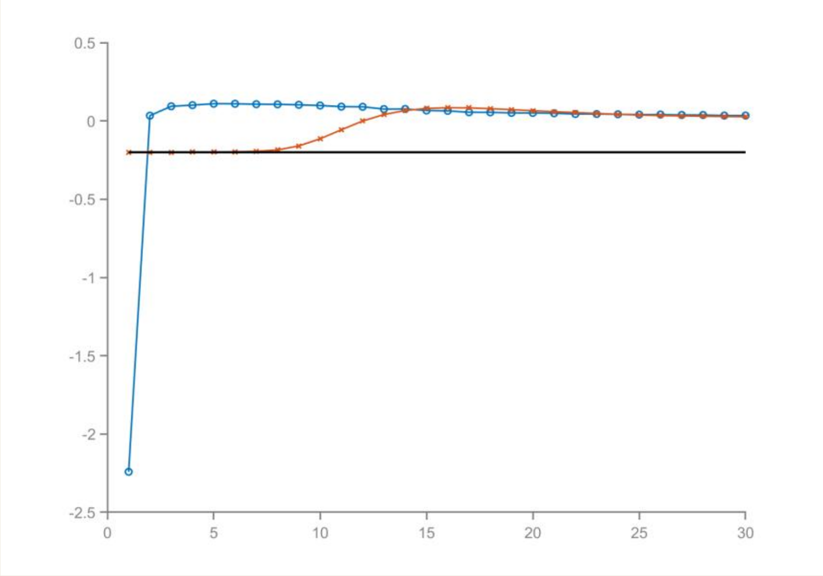
Inflation



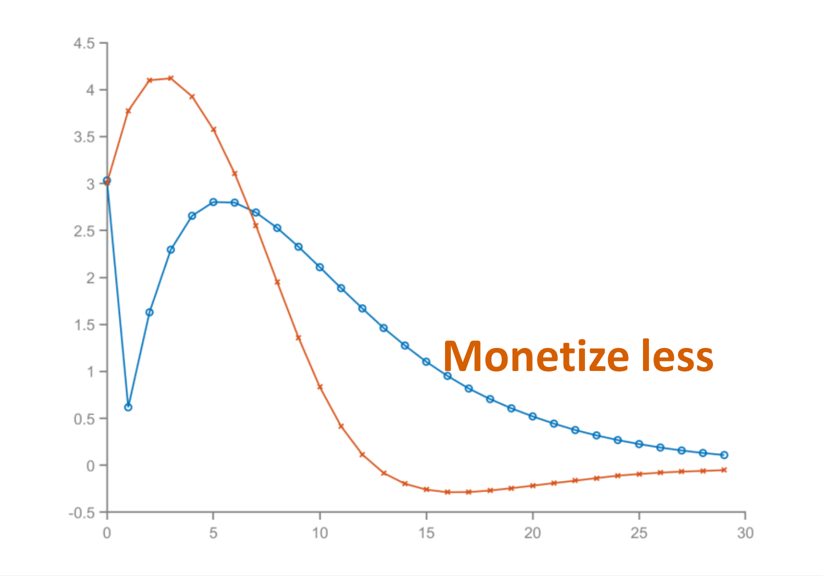
Tax rate



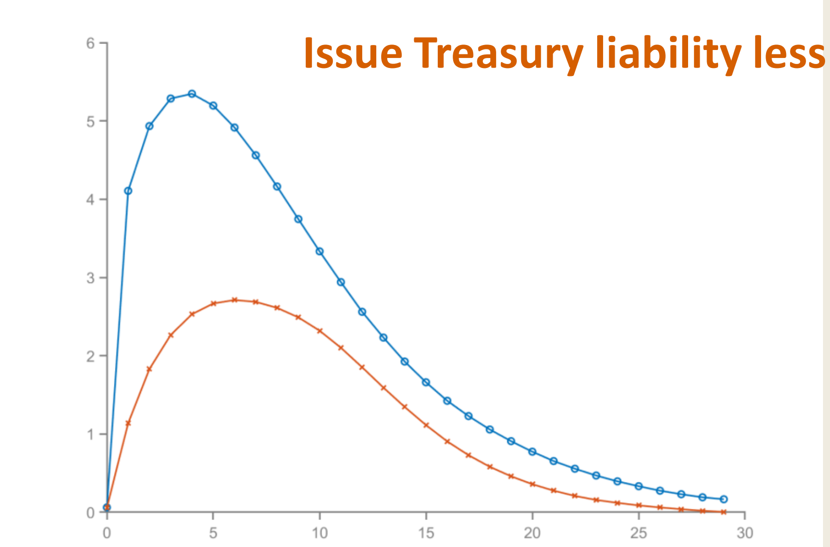
Remittance



Reserves



Treasury liability

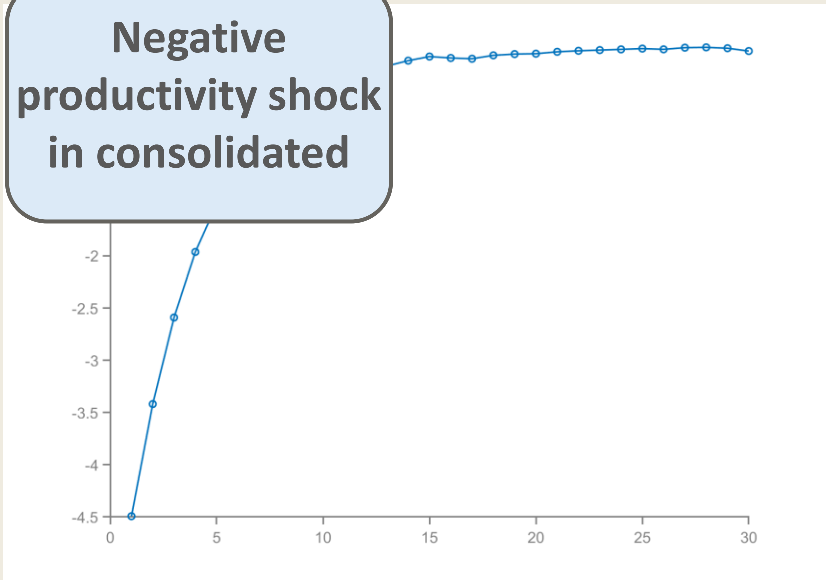


Primary Policy Tool and Central Bank's Role

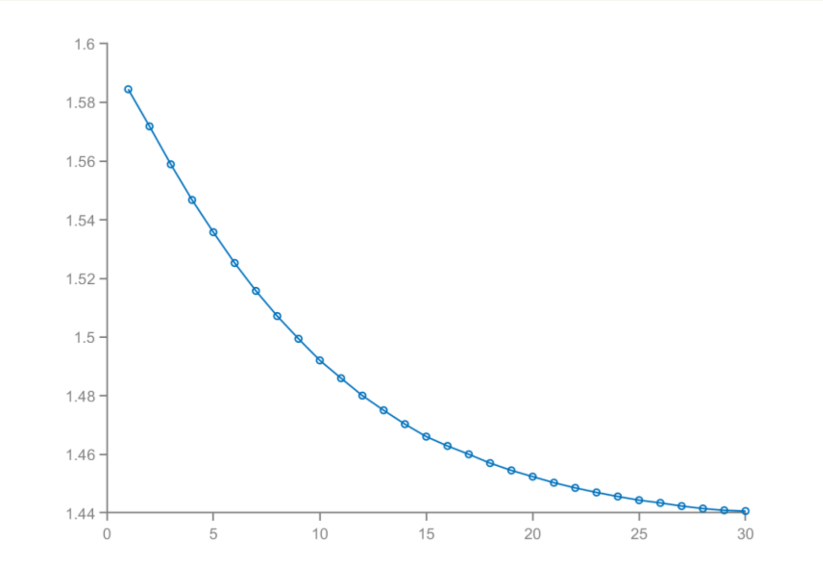
- After cost-push shock, the primary policy tool is tax break.
- **The central bank's role to issue reserves helps tax break**.
  - The key parameter is Frisch elasticity and $(Q^C b^C)^{1-\gamma}$.
- After productivity shock, **the central bank's role is to raise nominal interest rate enough**.
- When the household cannot absorb large reserves, the unconsolidated model gives difference.
  - The key parameter is risk aversion and $(Q^C b^C)^{1-\gamma}$.

Negative productivity shock in consolidated

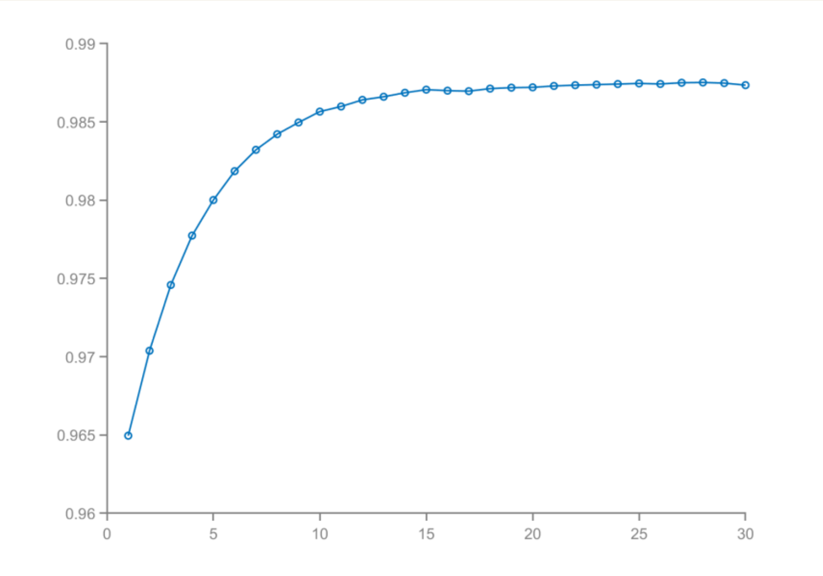
Consumption



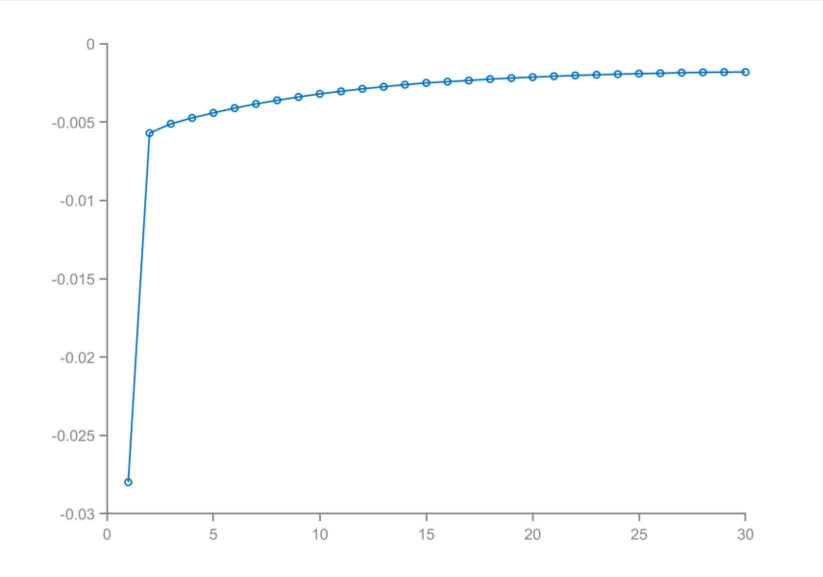
Inflation



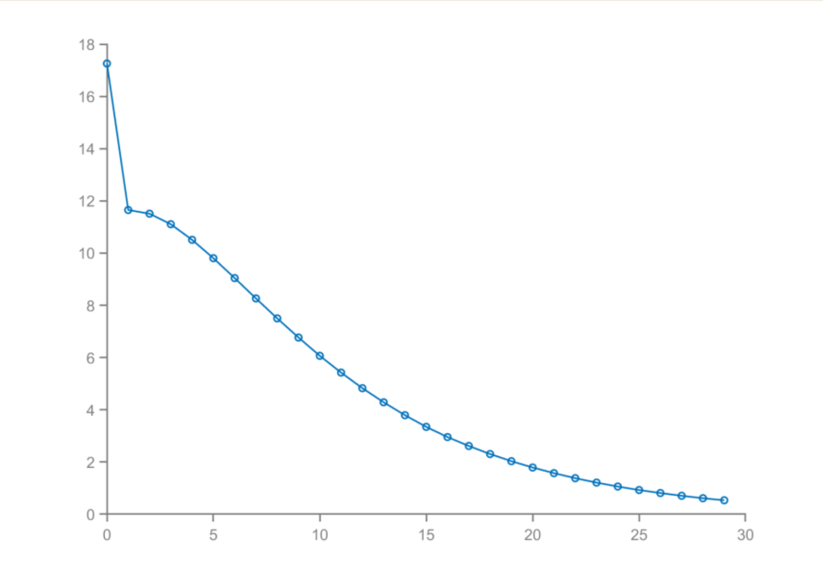
Price of Reserves



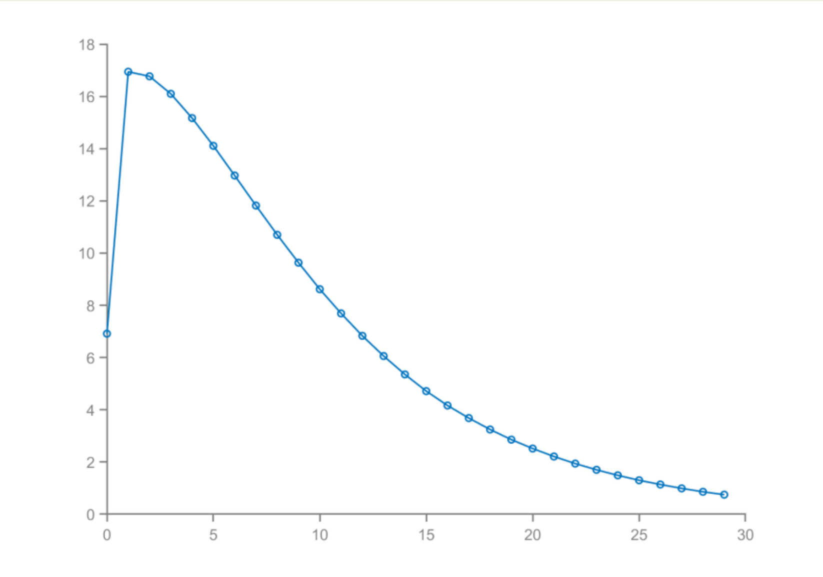
Remittance



Reserves

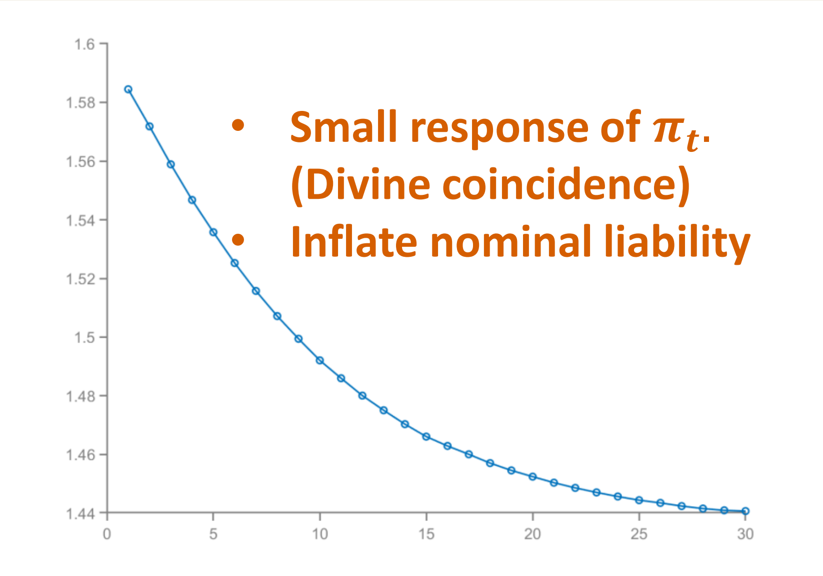


Treasury liability

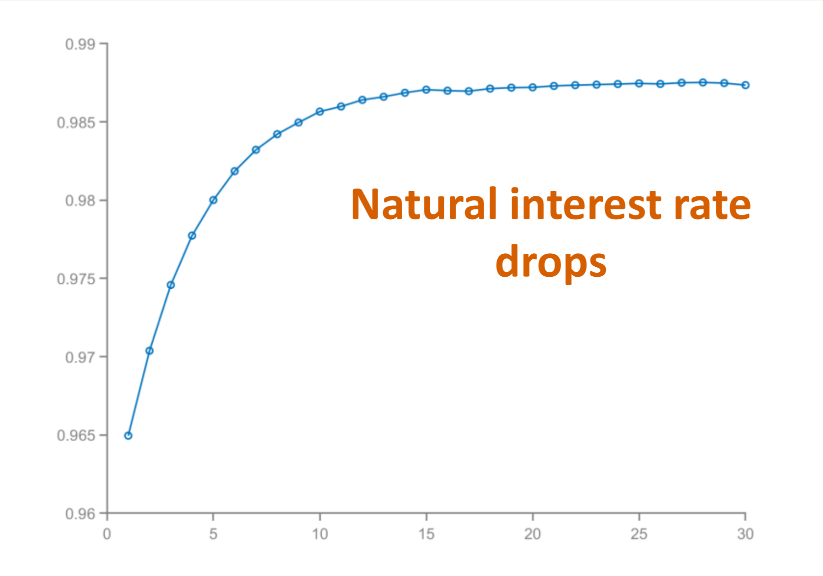


Consumption

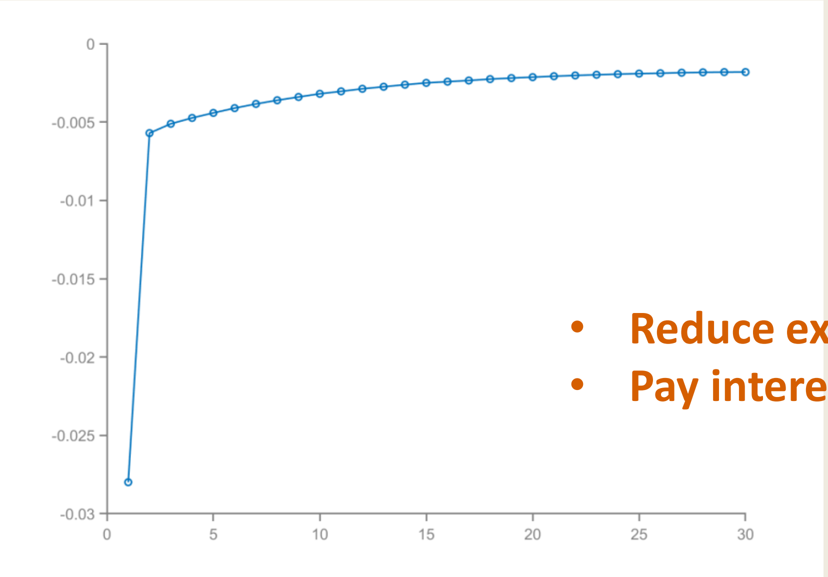
Inflation



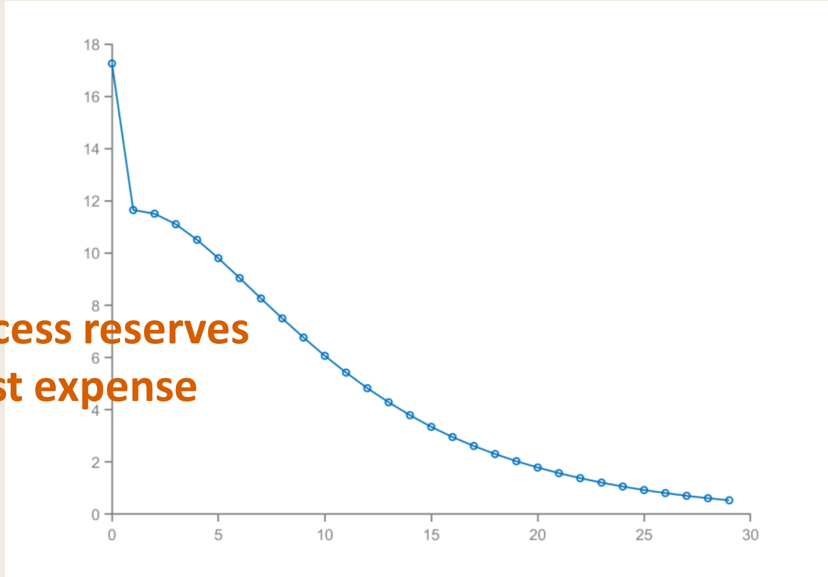
Price of Reserves



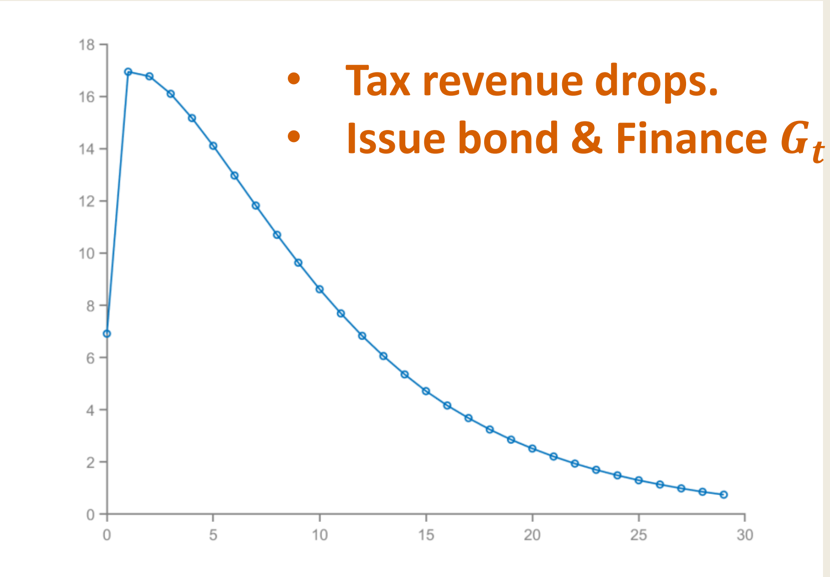
Remittance



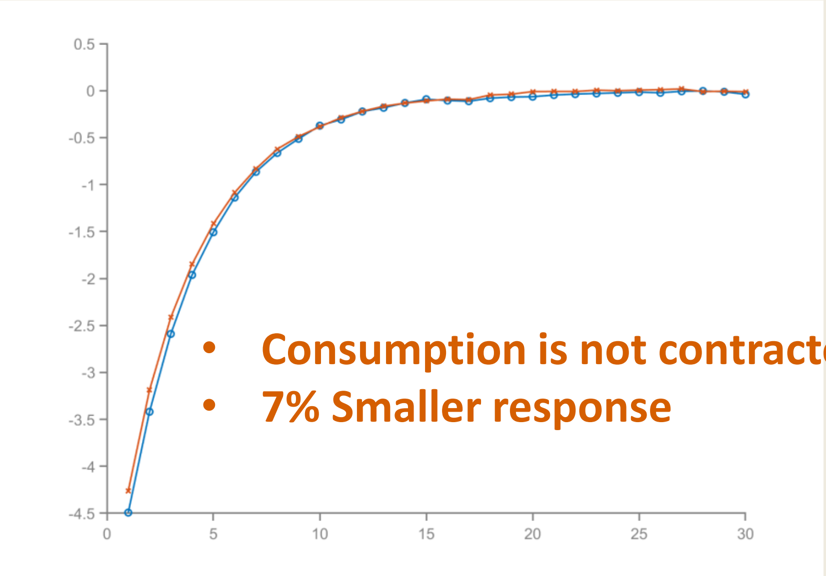
Reserves



Treasury liability

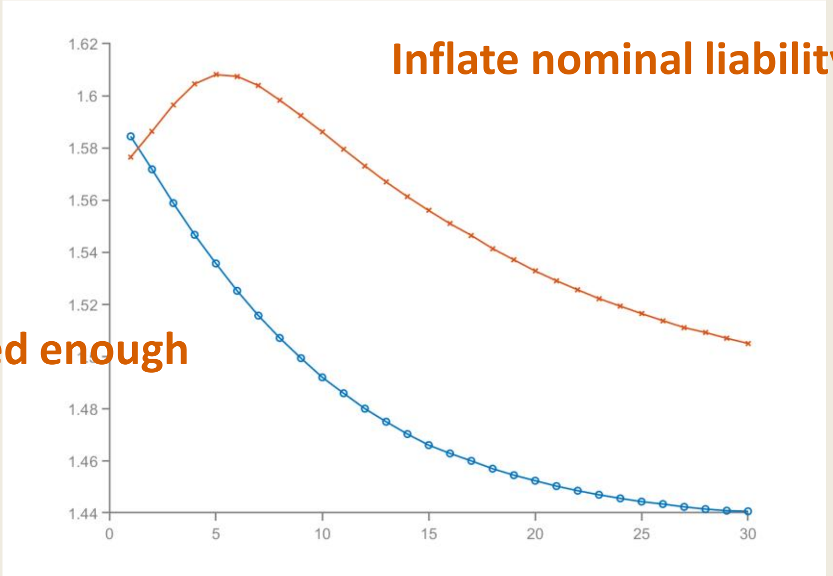


Consumption



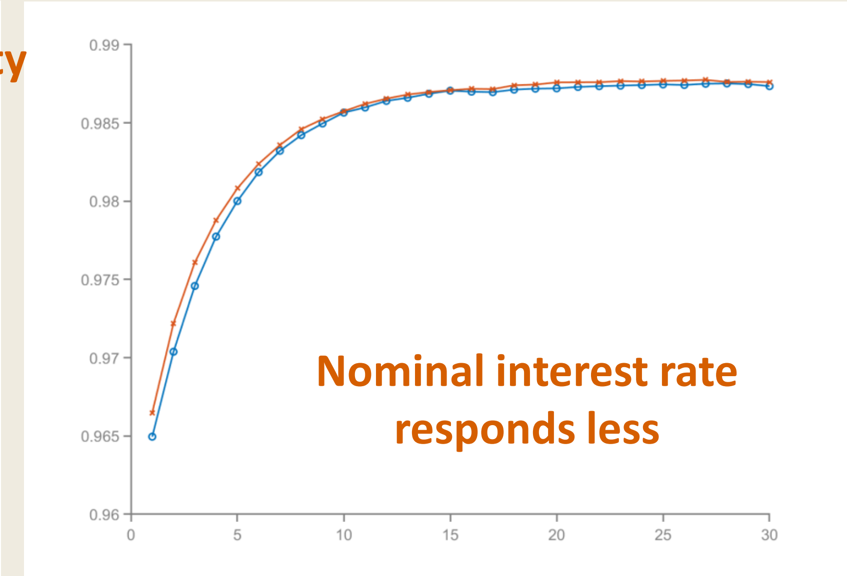
- Consumption is not contracted enough
- 7% Smaller response

Inflation



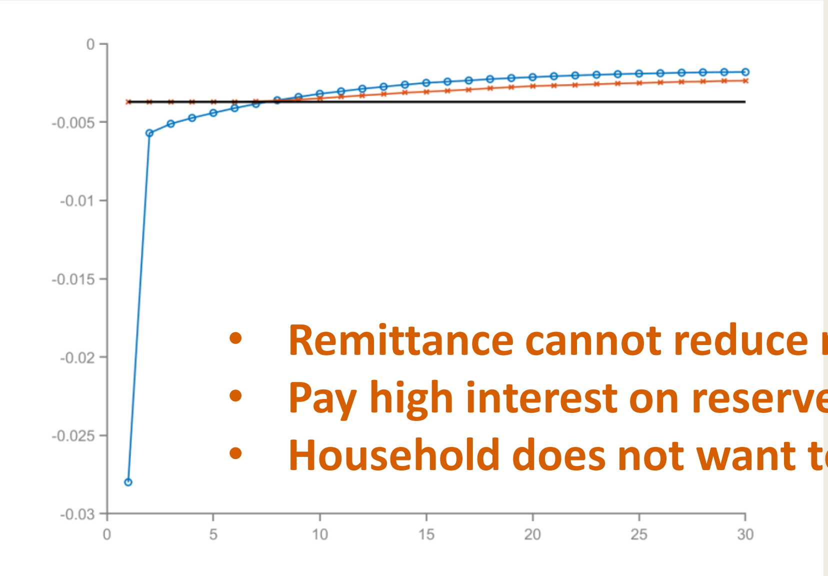
Inflate nominal liability

Price of Reserves



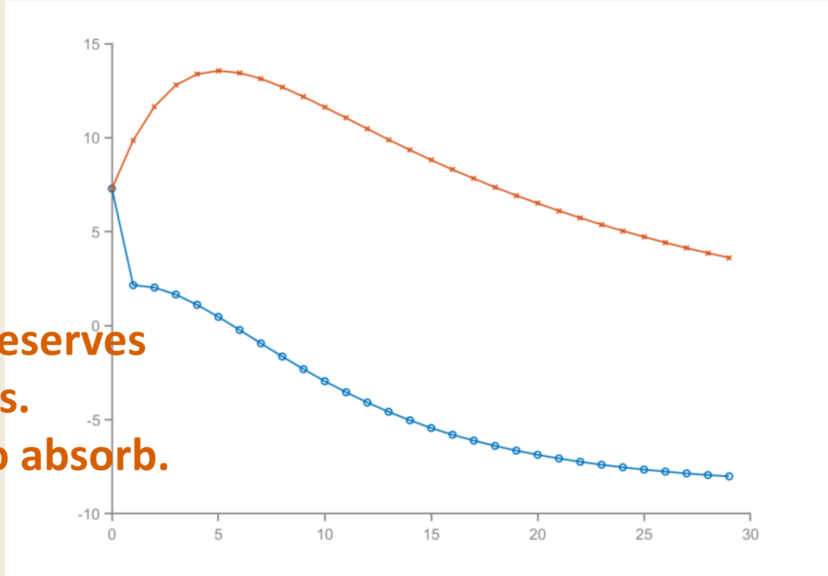
Nominal interest rate responds less

Remittance

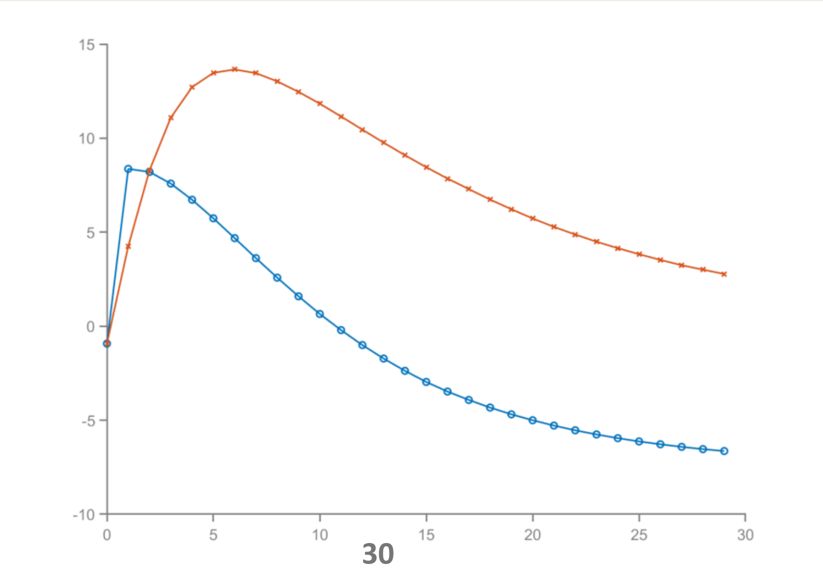


- Remittance cannot reduce reserves
- Pay high interest on reserves.
- Household does not want to absorb.

Reserves



Treasury liability



Dynamic Property of the Optimal Policy

Does the fiscal backing affect dynamic property 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	Government expenditure
Consumption	**+3%**	**+1%**
Tax	**-10%**	**+3%**
Inflation	**+1%**	**+2%**

Fiscal backing allows tax break

- How each variable's volatility changes as fiscal backing for the central bank decreases (i.e., $H^* \uparrow$).

	Cost-push	Government expenditure
Consumption	**+3%**	**+1%**
Tax	**-10%**	**+3%**
Inflation	**+1%**	**+2%**

	Fiscal backing allows tax break	Fiscal backing allows tax smoothing

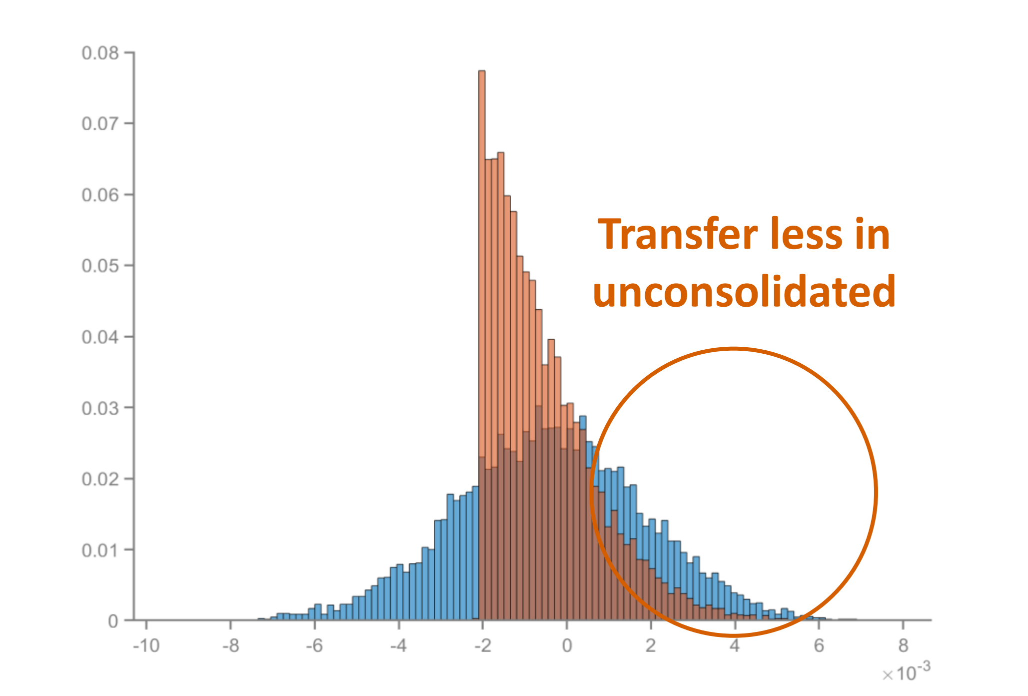
Retained Earnings by the central bank

- 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 the central bank and Treasury are consolidated.

Why do the central banks transfer less?

Model implications

- A lower bound on remittance makes the upper tail thinner.
- The central bank knows excess reserves cannot be reduced through remittance.
- Issue fewer reserves and transfers less. **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 < 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.