Fiscal and Monetary Policy with Heterogeneous Agents

Replication of Auclert, Rognlie, and Straub (2024)

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Labor market, inequalities and macroeconomics

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Research Question and Objectives

Research Question:

- How does household heterogeneity (in income risk, wealth, and discount factors) change the transmission of fiscal and monetary policy compared with Representative-Agent (RA) and Two-Agent (TA) models?

Objectives:

1. Build a **canonical HANK model** with sticky wages and flexible prices[1] that avoids counterfactual profit fluctuations.
2. Quantify how **deficit-financed fiscal policy** affects output when households differ in their saving behavior and face incomplete markets.

[1] Sticky wages (generate the NKPC) and flexible prices keep markups and profits constant: With no dividends or profit income, the redistribution through profits is avoided.

Methodological Approach

Model ingredients:

- Incomplete markets: households face idiosyncratic labor income risk.
- Discount-factor heterogeneity (patient vs. impatient households).
- No labor supply choice: earnings move only with aggregate wage and shocks.
- Households follow a buffer-stock saving rule: they save to insure against income risk and spend down excess wealth.
- Sequence-Space Jacobians are used to solve for impulse responses using MIT shocks with household behavior summarized by iMPCs and the aggregate dynamics summarized by the "intertemporal Keynesian cross":

$$dY = M(dY - dT) + dG \tag{1}$$

Main Results

- **Fiscal Amplification:** Deficit-financed shocks generate significantly larger multipliers than in standard models (RA/TA). Spending creates labor income, which fuels further consumption by high-MPC households (driven by equation1).
- **Distributional Dynamics ("Trickling Up"):** Fiscal stimulus creates persistent inequality. High-MPC agents spend the transfers immediately, while patient, wealthy agents eventually accumulate the newly issued government debt.
- **Forward-Looking Boost (Why HA $>$ TA Initially)**: HA households anticipate future income from the coming boom and raise today's consumption more than TA households.

Main Results: Monetary Policy

1. **Benchmark Result ($B = 0$): Monetary Equivalence**
   - **Result:** Output response to dr is identical in RA, TA, and HA models (Proposition 2).
   - Stronger income-consumption feedback in HA is offset by the lower interest-rate sensitivity of high-MPC agents.

2. **With Government Debt ($B > 0$): Fiscal Interaction**
   - Equivalence breaks down; fiscal rules determine the outcome.
   - Lower rates reduce debt service $\rightarrow$ Fiscal space allows tax cuts $\rightarrow$ Amplifies demand.

3. **Decomposition (Direct vs. Indirect)**
   - **Indirect effects dominate** direct substitution.
   - **Labor Income:** Large initial jump due to high MPCs; persistent.
   - **Capital Gains:** Smaller, persistent wealth effect from higher asset prices.

Main Results: Monetary Policy

4. Mechanisms Affecting Transmission

- **Debt Maturity:** Longer maturity → Interest rates affect debt service less → Smaller fiscal reaction → Weaker transmission.
- **Fisher Channel (Nominal Assets):** Rate cuts → Inflation ↑ → Erodes real value of nominal debt.
  - Wealth shifts from creditors to **high-MPC debtors** → Amplification.
- **Cyclical Income Risk:** If recessions increase income risk (countercyclical risk), precautionary savings rise → Amplifies downturns.
- **Forward Guidance:** HA models naturally dampen the "Forward Guidance Puzzle" because constrained agents have shorter planning horizons.

Model: Households

Households face uninsurable idiosyncratic labor productivity risk e_{it} and discount factor risk β_{it}. They maximize expected utility:

$$\max_{\{c_{it}\}} \mathbb{E}_0 \sum_{t=0}^{\infty} \left(\prod_{s \leq t-1} \beta_{is} \right) \{\log(c_{it}) - v(n_{it})\} \tag{2}$$

Eq 2 Details

Subject to:

$$c_{it} + a_{it} \leq (1 + r_t^p) a_{it-1} + (1 - \tau_t) w_t e_{it} N_t \tag{3}$$

$$a_{it} \geq 0 \tag{4}$$

Eq 3-4 Details

Labor supply is determined by union rationing, such that every household works the aggregate hours ($n_{it} = N_t$).

Model: Firms and Government

Firms (Sticky Wages, Flexible Prices):

- Production: $Y_t = N_t$
- Prices are a constant markup over wages ($P_t = \mu W_t$), ensuring constant real wages $w_t = 1/\mu$ and avoiding profit spikes.
- **Wage Phillips Curve:**

$$\pi_t^w = \kappa \left(v'(N_t) - \frac{1 - \tau_t}{\mu C_t} \right) + \bar{\beta} \pi_{t+1}^w \tag{5}$$

Eq 5 Details

Government Budget Constraint:

$$G_t + (1 + r_{t-1}) B_{t-1} = B_t + \tau_t Y_t \tag{6}$$

Eq 6 Details

Fiscal rule: Taxes adjust slowly to stabilize debt following a shock.

Model

No-Arbitrage Condition for Assets

$$1 + r_t = \frac{p_{t+1} + d_{t+1}}{p_t} \tag{7}$$

Asset Market Clearing

$$A_t = p_t + B_t \tag{8}$$

Mutual Fund Return Identity

$$(1 + r_0^p)A = p_0 + d_0 + (1 + r)B \tag{9}$$

Goods Market Clearing

$$C_t + G_t = Y_t \tag{10}$$

Calibration: Key Parameters

The model is calibrated to match U.S. macro aggregates and micro moments.

Variable	Value	Variable	Value
r	2%	μ	1.11
A	500%	(β^L, β^H)	(0.91, 1.00)
B	100%	ω	49%
M_{00}	0.2	q	1%
G	20%	T	22%

Table: *Source:* Auclert, Rognlie, and Straub (2024), Table 1.

The parameters jointly shape savings behavior, MPCs, and the wealth distribution.

Defining the Steady State

Calibration Trilemma: The steady state is chosen to simultaneously match three key empirical targets:

1. High Wealth ($\approx$ 500% of GDP)
2. High MPC ($\approx$ 0.20 quarterly)
3. Wealth distribution matching the 2019 US Survey of Consumer Finances

Mechanism:

- A two-state discount factor process creates **patient** (high-β) households who accumulate most wealth and **impatient** (low-β) households who have high MPCs.
- Generational turnover (q) prevents patient households from accumulating infinite wealth and ensures a stationary distribution.

Computing the Steady State

Heterogeneous-Agent (HA) Model

- Solve households' dynamic program (backward iteration) until consumption–saving decisions stabilize.
- Simulate transitions across income and wealth states to obtain the stationary distribution.
- Aggregate across households and impose market clearing.

Representative-Agent (RA) Model

- Use the steady-state Euler equation: $\beta = 1/(1 + r)$.

Two-Agent (TA) Model

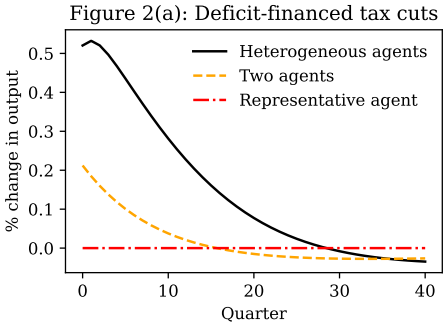
- Choose the hand-to-mouth share to match MPC $= 0.20$.
- Solve simple closed-form consumption conditions for the unconstrained group as constrained households consume their post-tax labor income.

Simulation: Deficit-Financed Tax Cut

- A deficit-financed tax cut of 1% of GDP.
- The shock decays over time ($\rho = 0.9$).
- Government debt (B_t) absorbs the initial shortfall.

The same deficit-financed tax cut hits all three models (RA, TA, HA). A tax cut today is offset by higher taxes in the future ($dG = 0$, higher B_t).
Reaction of the output depends on households' ability to borrow, save, and redistribute the tax cut across agents.

Figure 2(a): Role of Heterogeneity

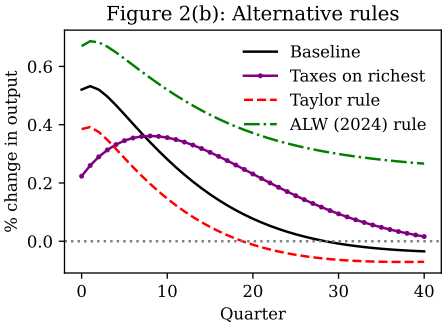


Findings:

- **RA Model:** A representative agent saves the entire tax cut to pay future taxes. Ricardian equivalence: $dC_t = 0$, $dY_t = 0$.
- **TA Model:** Hand-to-mouth agents spend the tax cut, while Ricardian agents save to repay future taxes. Once taxes rise, output falls back.
- **HA Model:** Poor households spend the tax cut; rich households buy the new debt. [a]

[a] Mechanism: redistribution between high-MPC and low-MPC agents and buffer-stock behavior ("excess savings").

Figure 2(b): Alternative Scenarios



Sensitivities:

- **Taxes on Richest:** Lower impact multiplier (rich have low MPCs), but more persistent (rich don't cut consumption to pay future taxes).
- **Taylor Rule:** Inflation triggers rate hikes, dampening the boom (crowding out).
- **Self-Financing (ALW):** Output boom generates enough revenue to pay for the tax cut without raising rates.

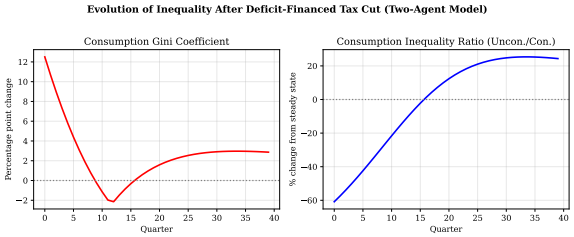
Inequality Dynamics After a Deficit-Financed Tax Cut

This part evaluates how a deficit-financed tax cut affects between-group inequality in the Two-Agent model with:

- **Hand-to-mouth households** (consume all income, hold no assets),
- **Unconstrained households** (smooth consumption, hold all assets).

Using the IRFs of group-specific consumption and aggregate assets, we reconstruct the path of inequality measures and plot their deviation from steady state.

Inequality IRFs: Gini & Consumption Ratio



see Full Dynamics

- A large initial drop in inequality: constrained households receive a strong temporary income boost and consume immediately.
- Around quarter 10–15, inequality reverses as the temporary income effect fades.
- In the medium run, inequality rises above steady state as unconstrained households accumulate the newly issued government debt.

What We Expect in the Full HA Model vs. Our TA Results

Distributional Dynamics in a Full HA Model:
The expected path is as follows: High-MPC HH increase consumption sharply after tax cuts in short run, while wealth inequality barely responds on impact because low-wealth HH hold few assets. In the medium run, as government debt expands, patient high-wealth HH absorb the new assets, resulting in a persistent rise in top wealth shares and wealth Gini. ("trickling up" of wealth)

Contrast with the Two-Agent Model Used in Our Simulation:

- Wealth inequality is mechanically fixed: H2M hold zero assets and RA households hold 100%. The wealth Gini cannot move by construction.

Appendix

Appendix: Utility Specification

Equation (1) Breakdown:

- **Preferences:** Households have log utility over consumption ($\log(c_{it})$) and separable disutility of labor.
- **Heterogeneity (β_{it}):** Households stochastically switch between patient and impatient states, which allows the model to reconcile high aggregate wealth with high marginal propensities to consume.
  - **Calibration Role:** This heterogeneity decouples aggregate wealth from the average MPC, enabling the model to simultaneously target:
    1. **High Aggregate Wealth:** Driven by the long-term accumulation of patient agents (β^H).
    2. **High MPCs:** Driven by the hand-to-mouth behavior of impatient agents (β^L).

Return to Model

Appendix: Constraints & Income

Equations (2) and (3) Breakdown:

- **Budget Constraint:**

$$c_{it} + a_{it} \leq \underbrace{(1 + r_t^p)a_{it-1}}_{\text{Savings Return}} + \underbrace{(1 - \tau_t)w_t e_{it} N_t}_{\text{Net Labor Income}}$$

- **Taxation:** Labor income is taxed at rate τ_t.
- **Union Labor:** As a result of $n_{it} = N_t$, the household problem simplifies to a standard consumption-savings choice with additive income risk.
- **Borrowing Constraint:** $a_{it} \geq 0$ implies households cannot borrow, enforcing "buffer-stock" behavior consistent with micro data (Deaton 1991).

Return to Model

Appendix: Wage Phillips Curve

$$\pi_t^w = \kappa \left(v'(N_t) - \frac{1-\tau_t}{\mu C_t} \right) + \bar{\beta}\, \pi_{t+1}^w$$

- $v'(N_t)$ reflects the marginal disutility of working an additional hour and $\frac{1-\tau_t}{\mu C_t}$ is the marginal benefit of that extra hour, expressed in consumption units.
  When the benefit of working exceeds its cost, unions want higher wages $\rightarrow$ upward pressure on wage inflation.
- κ measures how costly it is for unions to change wages (nominal rigidity), so a higher κ means stronger wage adjustment when labor-market conditions shift.
- $\bar{\beta}\, \pi_{t+1}^w$ captures the forward-looking behavior of unions.
- Since wages cannot jump freely, employment becomes the adjustment channel; wage stickiness creates real rigidity and shapes the transmission of shocks.
- The prices are constant mark-up over the wages at all times, thus wage inflation equals price inflation at all times.

Appendix: Government Budget Constraint

$$G_t + (1 + r_{t-1})B_{t-1} \;=\; B_t + \tau_t Y_t$$

- The government either finances its obligations through taxes or by rolling over debt. A deficit corresponds to issuing more debt: $B_t > (1 + r_{t-1})B_{t-1} - \tau_t Y_t$
- In the fiscal shock studied in the paper, taxes adjust slowly. Therefore, a tax cut today must be matched by an increase in debt issuance, which connects to the "deficit-financed" nature.
- Since government bonds are held primarily by patient, high-wealth households, changes in debt change the wealth distribution, which is the central mechanism for the inequality IRFs.
- The path of government debt affects bond returns and interacts with households' saving behavior, influencing aggregate demand through the intertemporal Keynesian cross.

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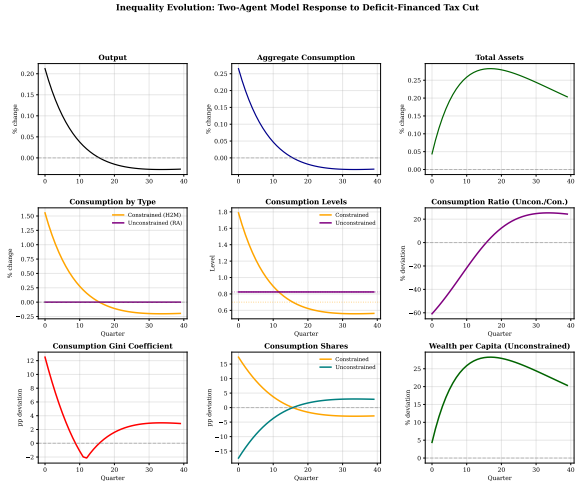
Appendix: Macro Responses and Inequality Evolution



Back to Inequality Dynamics